Putting It All Together: Software Planning, Estimation and Risk Assessment for a Successful Project

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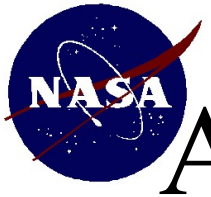

Approach to Putting "it" Together

Three phased approach

1. Characterize the project
   - COCOMO II
   - ISO 9001 Development Processes
   - IV&V Criteria
2. Tune the Risk Strategy
3. Planning and Implementation

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Phase 1: Characterize the Project

Use Common and Specific Tools

- COCOMO Cost Estimation
- Software Control Level Matrix (tailored version of DERA Size matrix)
- NASA Independent Verification and Validation Criteria

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Phase 1: Characterize the Project
Development Framework - COCOMO II

Factors derived from COCOMO II

- Cost of development
- Schedule
- Personnel requirements
- Size of project
- Software Reuse

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Phase 1: Characterize the Project Development Framework - Control Level

Characterization Factors from Control Level

- Organizational Complexity
  - Customers (internal – multiple industries)
  - Development site(s) (single – multiple sites)
- Technical Complexity
  - Degree of Innovation
  - Use of tools
  - Interdependencies of Deliverables
- Consequence of Failure
  - Safety Implications
  - Business Implications

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Phase 1: Characterize the Project

Determine Need for IV&V or Independent Assessment

Factors From Independent Verification & Validation

- The need for IV&V is based on possible effect and extent of failure of the software to perform as intended.

Factors Used to Calculate:

- Resources (manpower) expended
- Investment (money) expended
- Effect of failure on personnel and equipment

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Phase 1: Characterize the Project

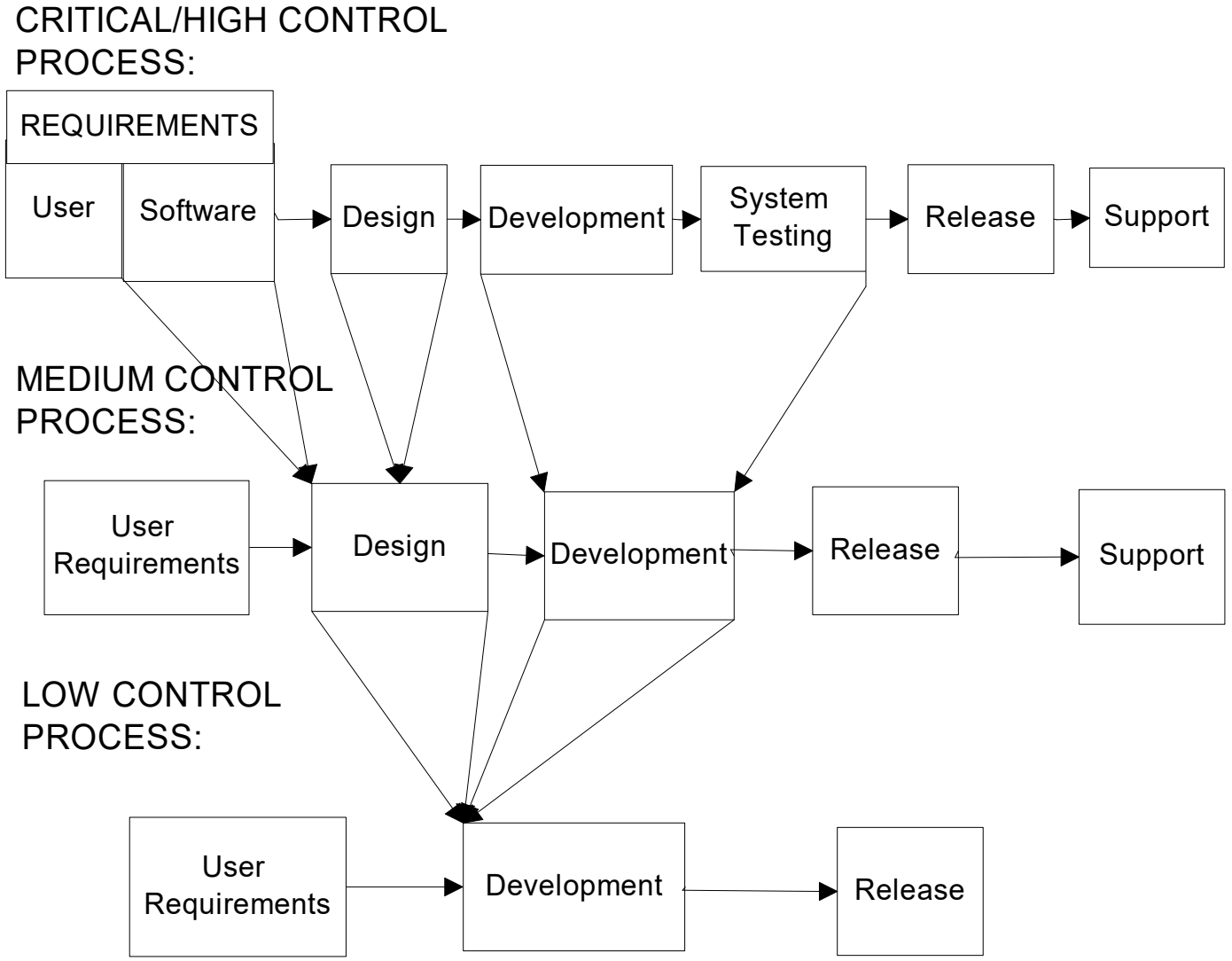
Tailor Development Processes

Software Control Levels

Critical/High Control Level

Medium Control Level

Low Control Level



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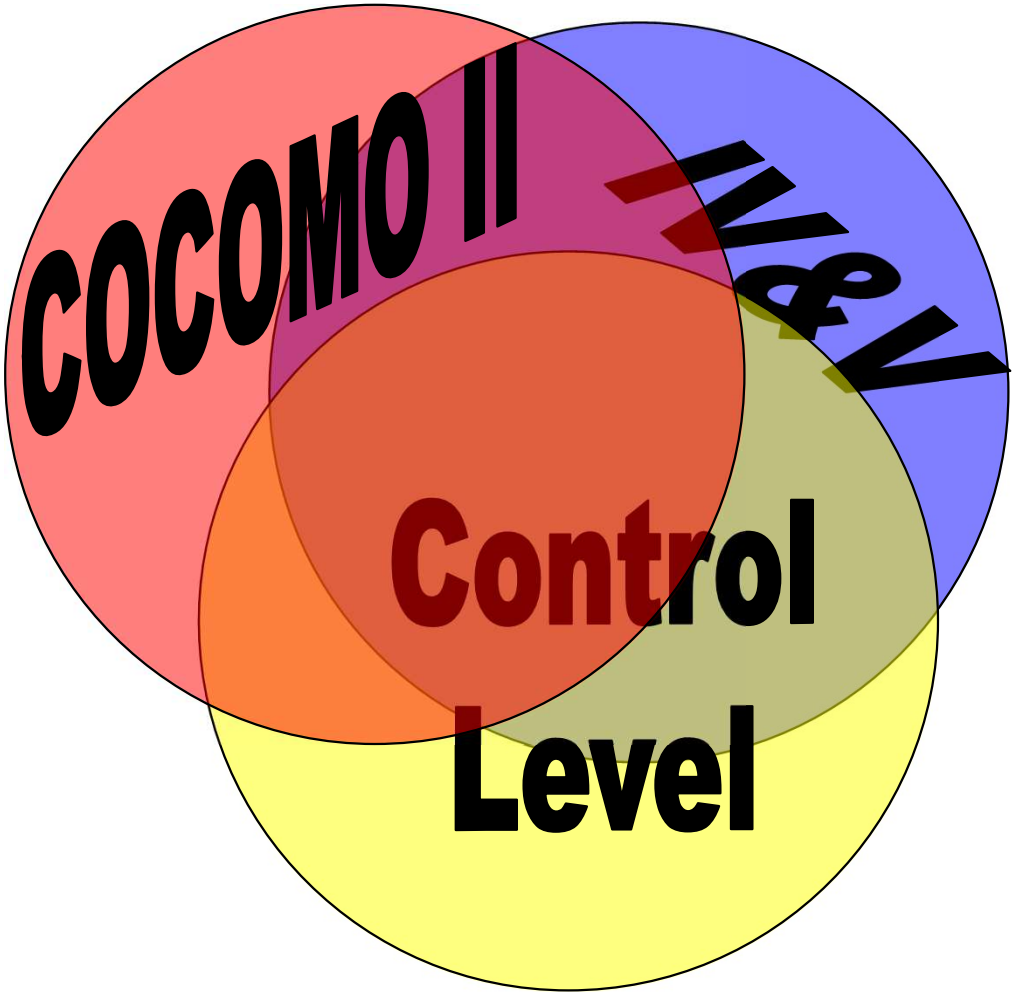
Phase 1: Characterize the Project

Build on Common Areas



- COCOMO II factors address majority of the development planning issues
- Control Level factors overlap COCOMO II and address additional organizational and performance issues
- Incorporating other areas of interest, (i.e. IV&V, Software Assurance), build on COCOMO II and Control level questions

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Phase 1: Characterize the Project

Outcomes

- What the project will cost (personnel, money)
- How long the project will take
- What controls are required; what documents need to be generated
- What activities need to be performed
- An initial set of risk mitigations based on the project's parameters

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Phase 1: Characterize the Project

Identify Initial Activities Set Based on Control Level

Development Phase/Activity	Low Pact	Medium Pact	High Pact	Critical Pact
Requirements Phase				
Authorization to proceed	X	X	X	X
Identify design/coding standards	X	X	X	X
Maintain Softw are Development Folder		X	X	X
Softw are Assurance review s Management Plan		X	X	X
Implement Problem report and corrective action system		X	X	X
Management Plan approval	X	X	X	X
Documented requirements	X	X	X	X
Peer review of requirements		X	X	X
Conduct formal inspection of requirements				X
Softw are Assurance review s requirements			X	X
Requirements approval	X	X	X	X
Peer review of plans			X	X
Implement Formal configuration management			X	X
Conduct Product Assurance Audits			X	X
Conduct Formal Review s			X	X
Document approval of requirements and formal review			X	X
Customer approval of certification procedures				X
Conduct analyses of criticality and safety				X
Plan and schedule IV&V activities				X
Identify method for verification of safety critical functions and requirements				X

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Phase 2: Tune Risk Strategy Terminology

- Risks - combination of likelihood (probability of occurrence) and impact (how much damage it will do if it occurs).
- PACT - risk mitigation, implementation of a PACT will have some effectiveness in reducing one or more risks
  - **P**reventive measures
  - **A**nalyses
  - process **C**ontrols
  - **T**ests

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Phase 2: Tune Risk Strategy
Terminology

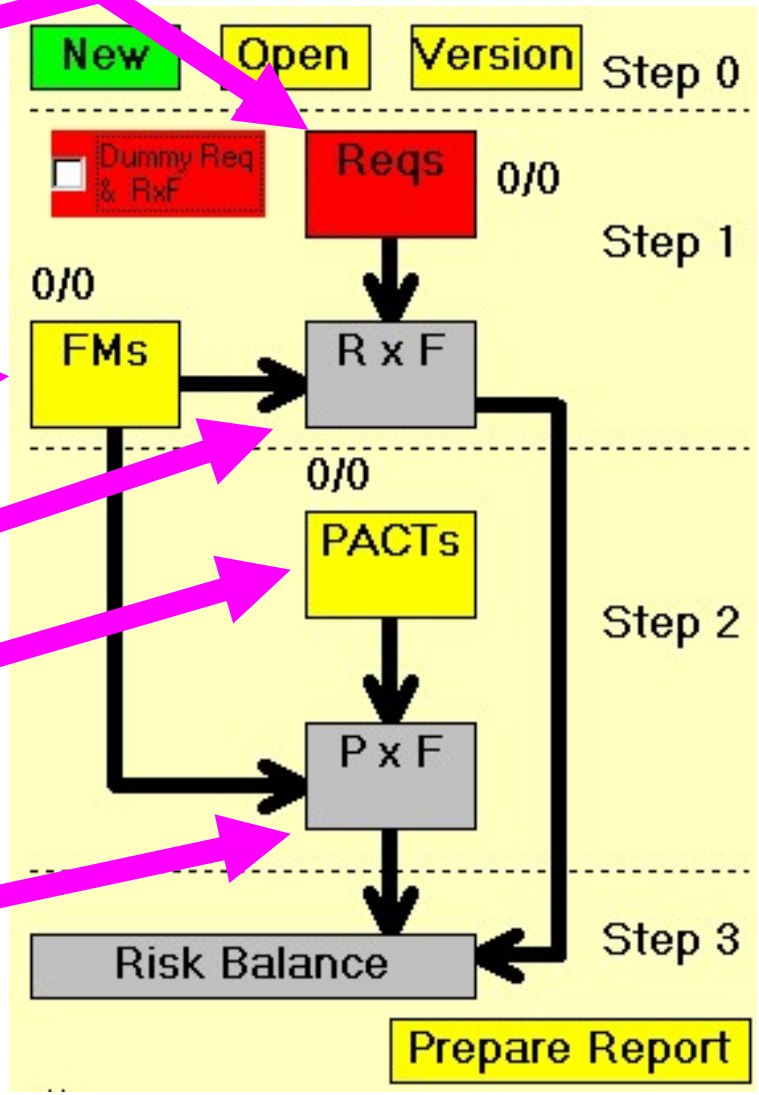
Requirements: what you want
- weight (relative importance)

Risks ("**Failure Modes**" in DDP-speak): what can happen to inhibit requirements
- a-priori likelihood

Impact: Requirement x FailureMode

Mitigations ("**PACTs**" in DDP-speak): what can get in the way
- costs (time, schedule)

Effect: PACT x FailureMode



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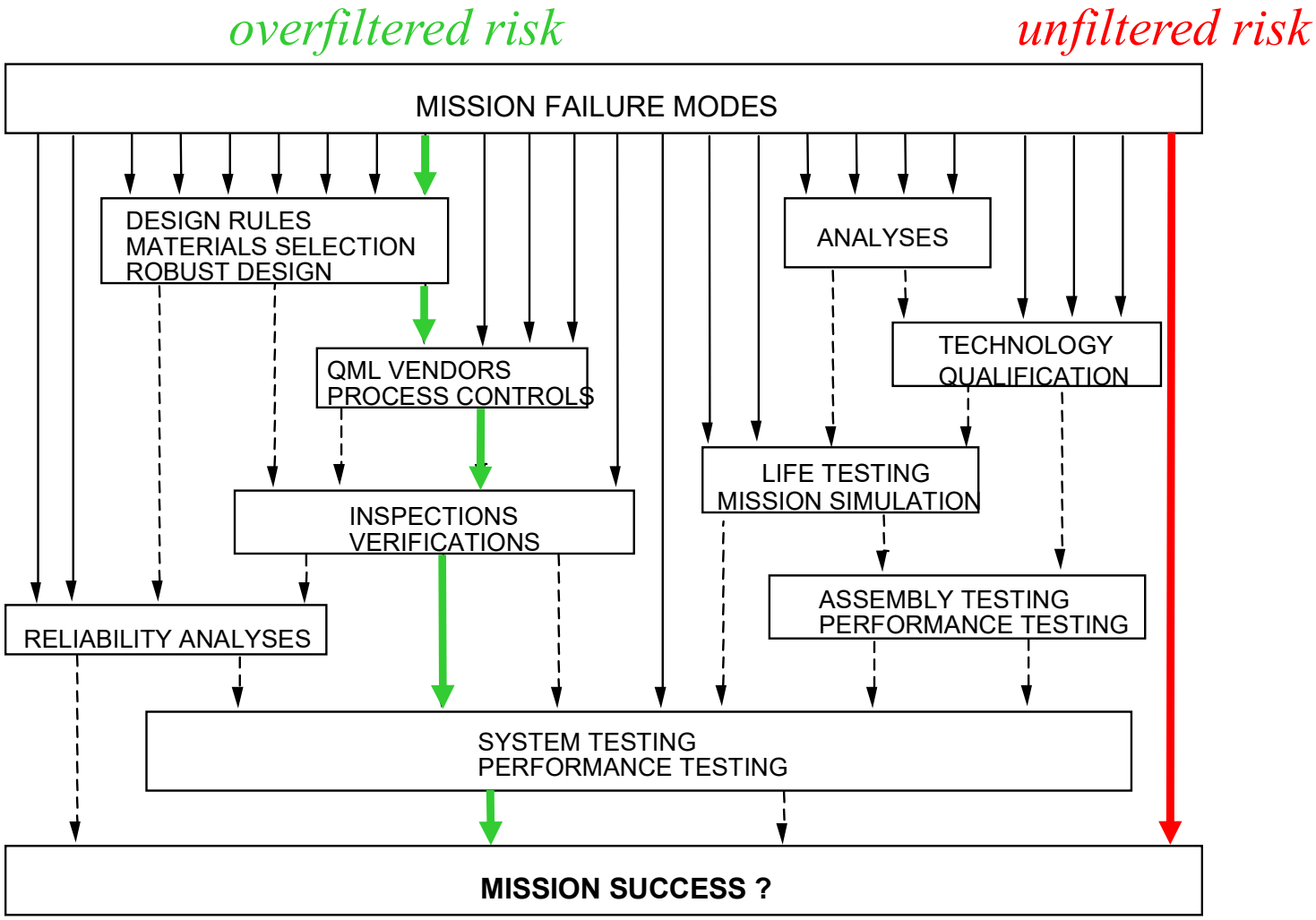
Steve Cornford's flow-down image: *assurance activities "filter out" risk*



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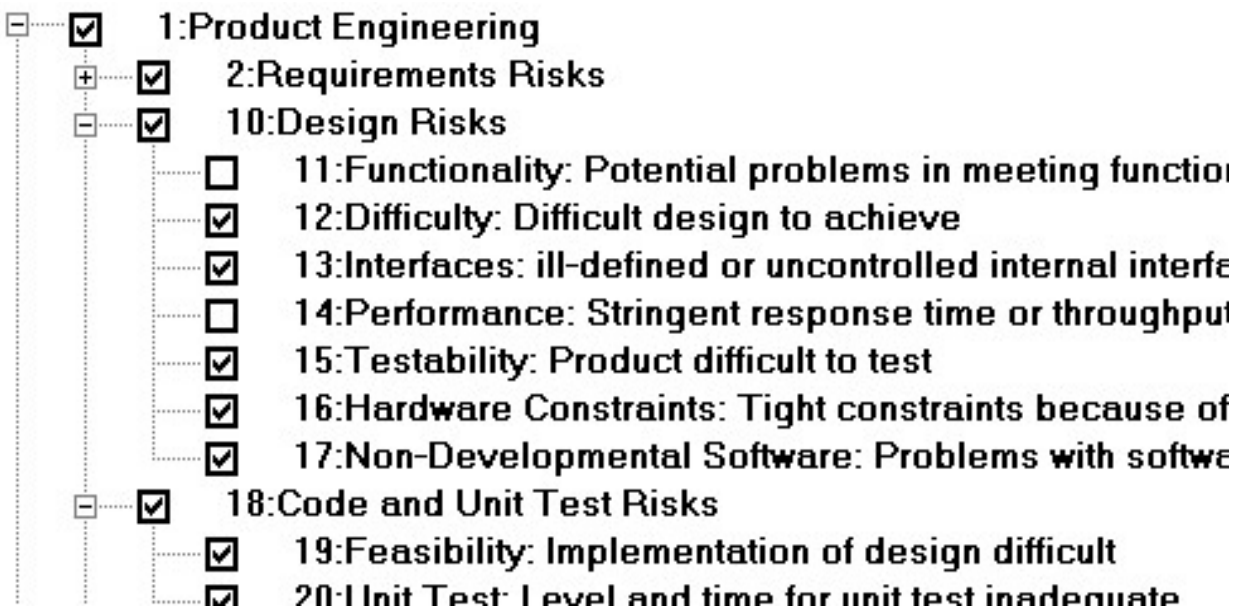
Phase 2: Tune Risk Strategy
Identify and Prioritize Specific Risks

Identify project specific risks

- Start with Software Engineering Institue's Software Risk Taxonomy as the base set of software development risks
- Remove inapplicable risks
- add project specific risks



Prioritize risks based on requirements

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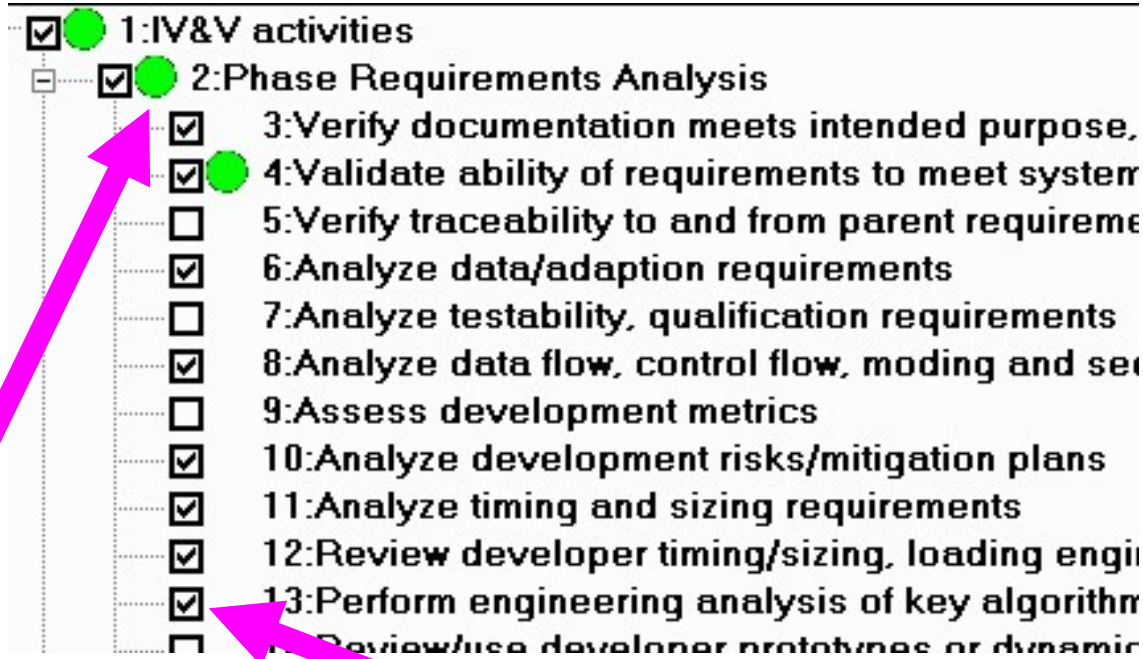
Phase 2: Tune Risk Strategy

Identify Risk Mitigations

Use as the initial set of mitigations those identified based on the characteristics of the project

Select the mitigations based on available resources and impact to the risks



Circles used to indicate focus of attention – a mitigation within the tree

Checked boxes indicate selected mitigations

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Phase 2: Tune Risk Strategy

Estimate Risk Mitigation Effectiveness

Effects (PACT x FM)

proportion of FM mitigated by PACT

		FMs	[-]Product Engineering					
		FMs	[-]Requirements Risks					
		FMs	Stabilit	Compl	Clarity:	Validity	Feasib	Pre
PACTs	PACTs	FoM\R	0.5	0.5	0.5	0.5	0.5	0.5
	Authori	7.95	0.1	0.1	0.1	0.1	0.1	0.3
	Identify	2.3						
	[illegible]	0						
	Softwa	2.65						
	Implem	1.85	0.9	0.3	0.9	0.9	0.3	0.3
	Manag	0.15						
	Docum	1.65	0.3	0.9	0.9	0.1	0.3	0.3
	Peer	2.8	0.9	0.9	0.9	0.9	0.9	0.9

- Each mitigation only affects a subset of risks
- Each risk is affected to a different degree
- The effect of a mitigation on a risk may need to be adjusted from one project to another

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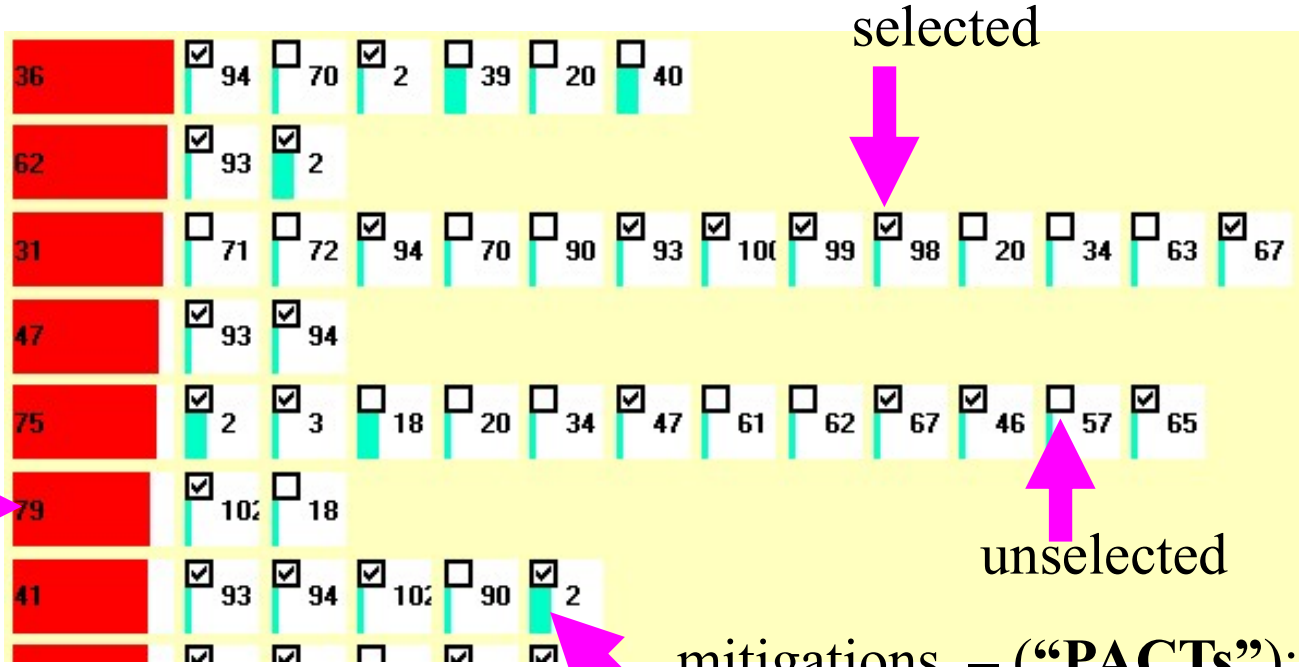
Phase 2: Tune Risk Strategy

Tune Mitigations to Maximize Resources

FMs & their PACTs

FMs : red width ≅ log outstanding Σ impact

item number in FM tree



Select mitigations

- Which have a greater impact on a single risk
- Affect a range of risks

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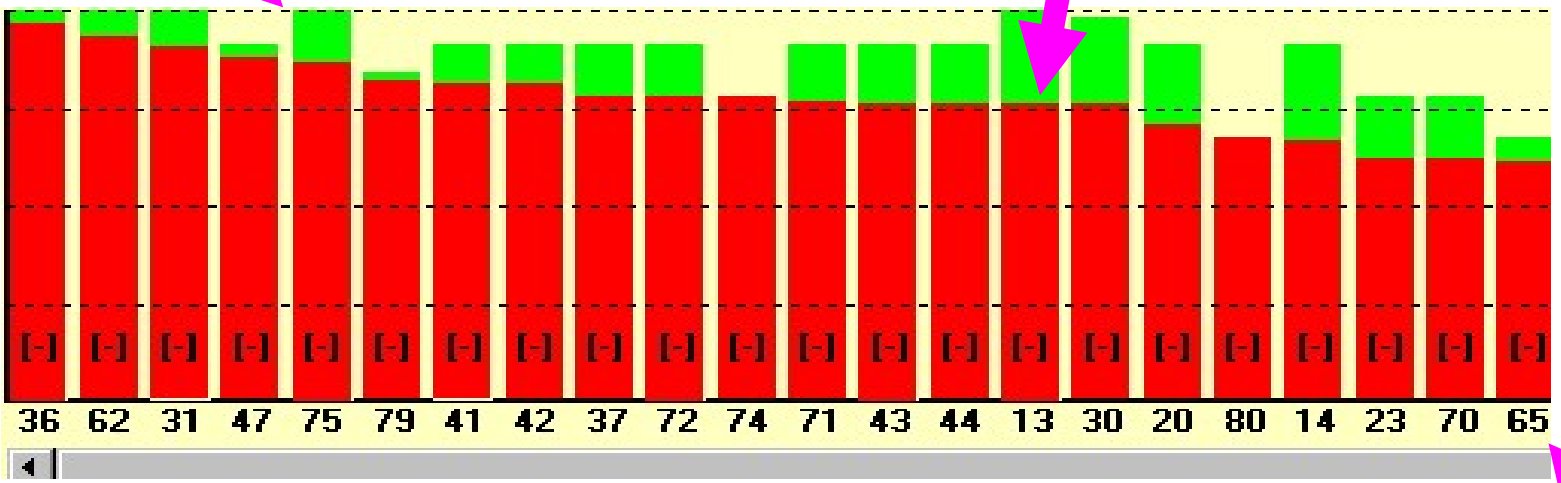
Phase 2: Tune Risk Strategy

Tune Mitigations to Maximize Resources

Green indicates mitigated risk impact

Red indicates impact outstanding



Pareto risks to determine which have to be mitigated further to reach an acceptable level

Item number in Risk tree

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Phase 2: Tune Risk Strategy

Outcomes

A tailored set of risk mitigations for the project which includes

- A set of risks applicable to the project
- A set of risk mitigations applicable to the project risks
- The costs of the risks and mitigations in time and effort

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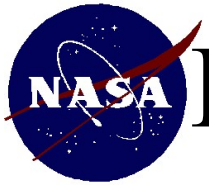

Phase 3: Planning and Implementation
Combine and Implement Mitigations

- Original estimates are supplemented based on selected mitigation strategies
- Resulting impact on the project can be reviewed and adjusted
  - Budget
  - Schedule
  - Development activities
  - SPA activities
  - IV&V activities

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Phase 3: Planning and Implementation Develop Plans

- Project Development and Product Assurance plans are developed based on
  - Characteristics of the project
  - Risks
  - Risk mitigations
  - Organization's development activities
  - ISO 9001
  - COCOMO II estimates

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Phase 3: Planning and Implementation Development Plan

- Start with a development plan for a Critical Control project
- Tailor the plan to the appropriate level by removing activities and deliverables that don't provide the needed cost/benefit ratio for the effort.
- Address each development phase and associated documentation

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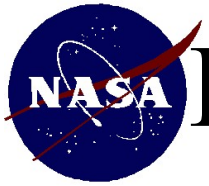

Phase 3: Planning and Implementation
Other Project Tasks

Software Product Assurance Plan

- Lists needed Software Product Assurance activities for the level of control
- Provides Software Product Assurance effort estimates based on the results

Level of IV&V

- Identifies if Independent Assessment or IV&V necessary for the project
- Suggests activities and processes
- If IV&V is indicated: level and tasks should be negotiated and documented in Software Management Plan

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Phase 3: Planning and Implementation Outcomes

- Development Plan based on:
  - control level
  - documentation requirements
  - risk
- Product Assurance Plan based on:
  - development activities
- Risk mitigation activities based on:
  - control level
  - risks
  - resources

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Summary for Putting It All Together

- Provided approach for managing software development
- Described a process
  - Coordination between factors
  - Tailoring to specific project needs
- Presented a Framework, incorporating
  - Estimation
  - Corporate Processes and Resources
  - Risk Management
  - Planning

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