NGAO Cost Estimation Guidelines

Richard Dekany
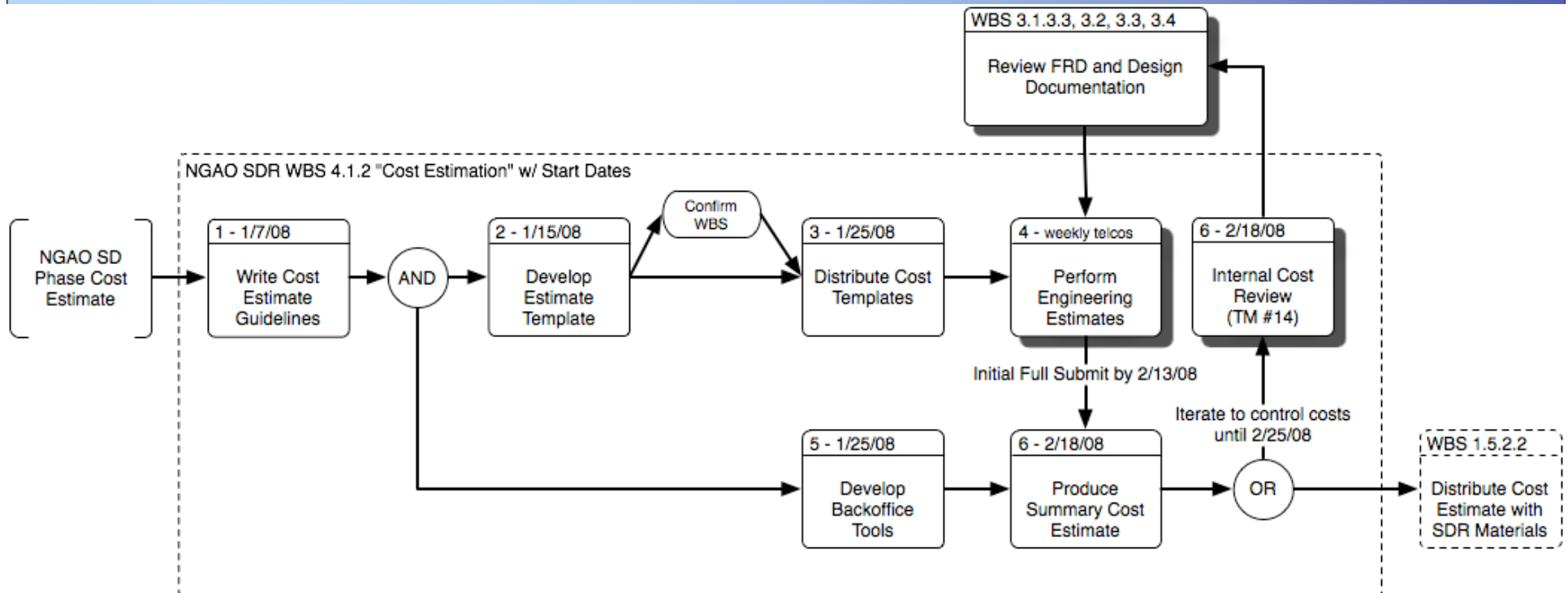
January 25, 2008

NGAO Cost Estimation Guidelines Document

- KAON 546

- Describes
  - SD Phase WBS 4.1.2 Cost Estimation Process
  - Cost Estimation Methodology
  - Risk Contingency Methodology
  - Includes Level 3 WBS Reference
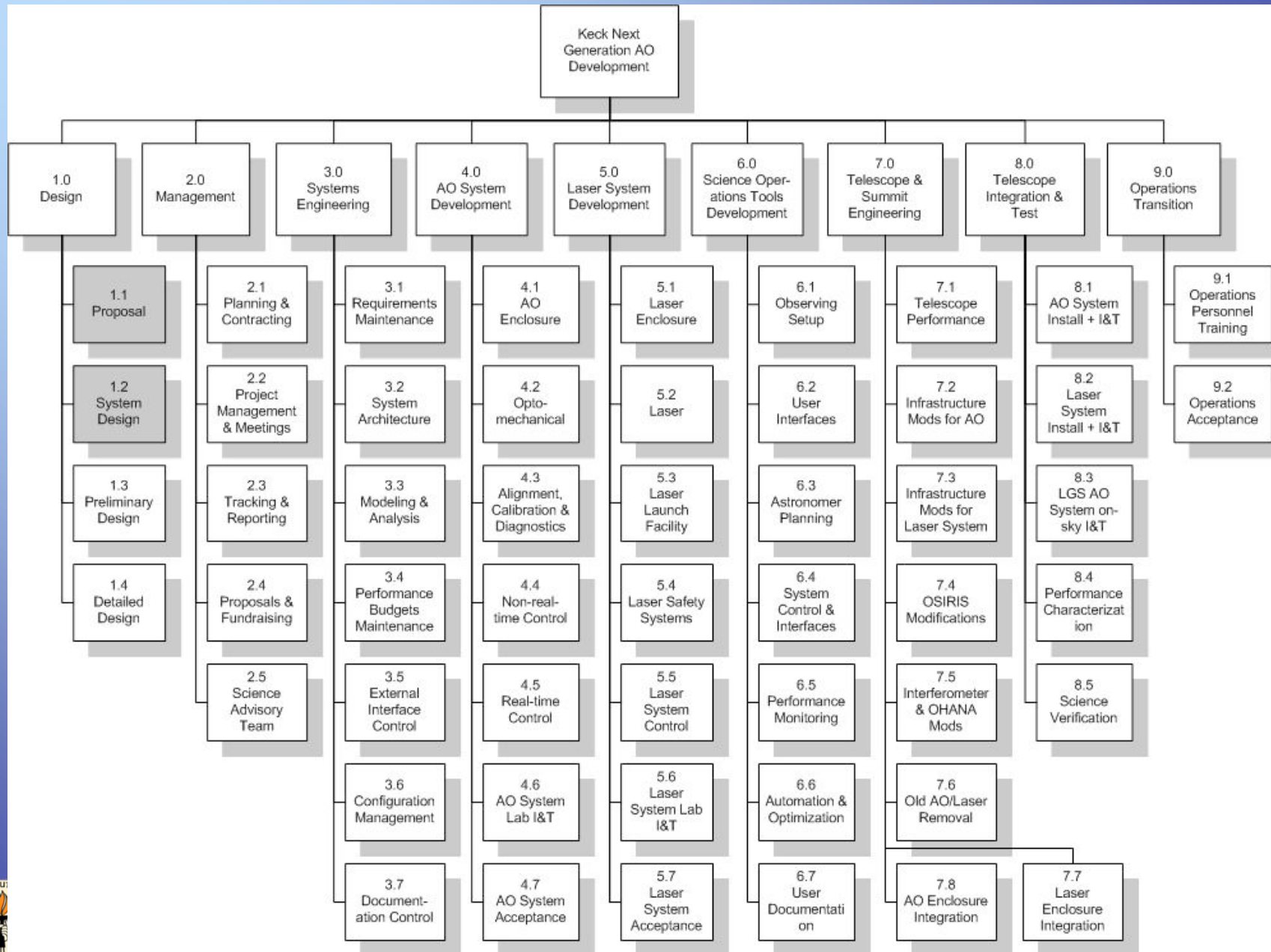
Cost Estimation Process

Completed cost estimate worksheets should be considered project confidential and be emailed to Rich Dekany, and not posted to TWiki.
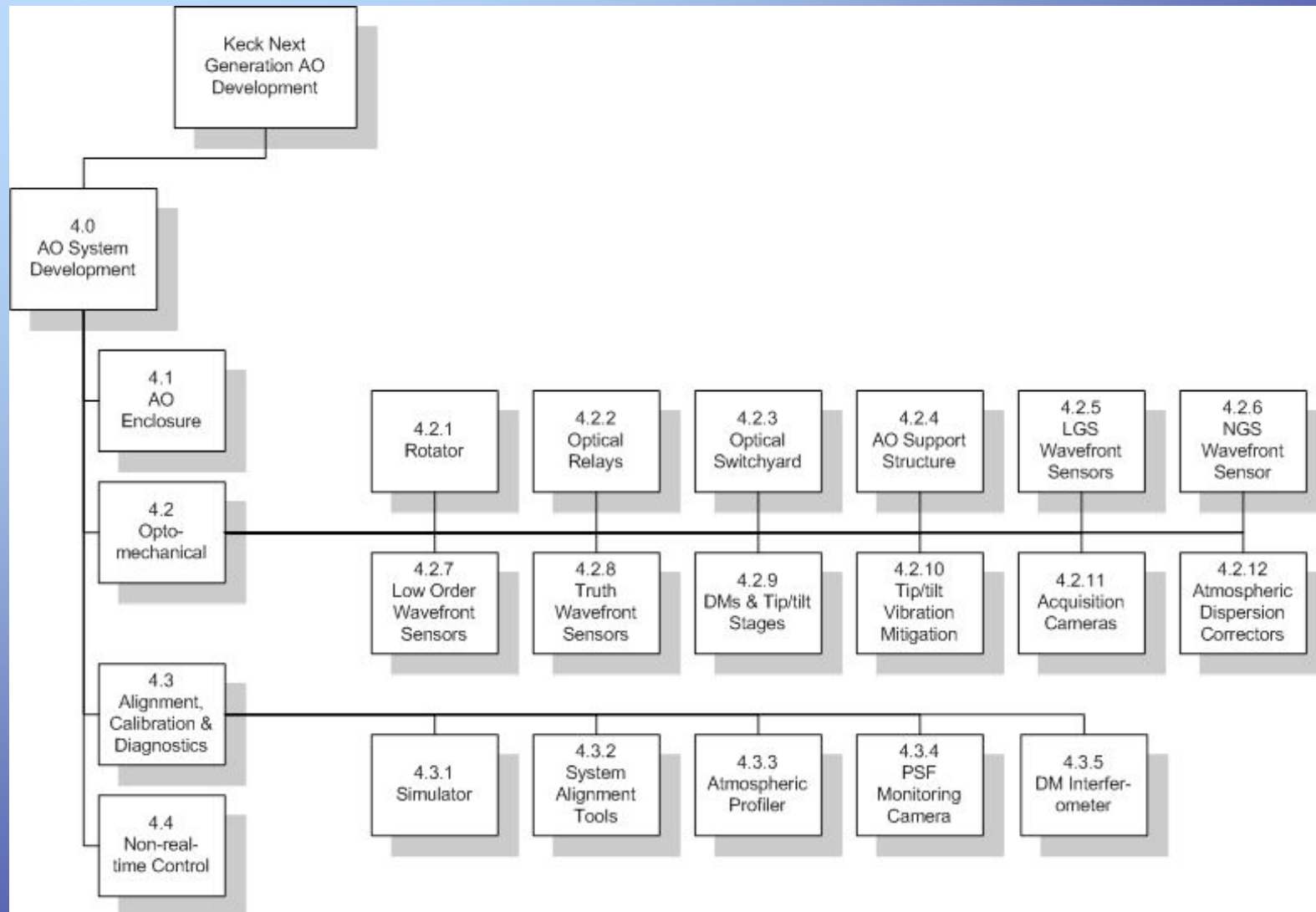
Inadvertent disclosure of our planning figures could seriously compromise future negotiations with subcontractor and vendors.

Work Breakdown Structure (Level 3)

Work Breakdown Structure (Level 4, partial)

Level	WBSElement	Title	Resonsible Cost Estimator	Consultant 1
1	NGAO	Next Generation AO Program		
2	1	Design		
3	1.1	Proposal	Richard Dekany	
3	1.2	System Design	Richard Dekany	
3	1.3	Preliminary Design	Peter Wizinowich	
3	1.4	Detailed Design	Peter Wizinowich	
2	2	Management		
3	2.1	Planning & Contracting	Peter Wizinowich	
3	2.2	Project Management & Meetings	Peter Wizinowich	
3	2.3	Tracking & Reporting	Peter Wizinowich	
3	2.4	Proposals & Fundraising	Peter Wizinowich	
3	2.5	Science Advisory Team	Claire Max	
2	3	Systems Engineering		
3	3.1	Requirements Maintenance	Erik Johansson	
3	3.2	System Architecture	Richard Dekany	
3	3.3	Modeling & Analysis	Richard Dekany	
3	3.4	Performance Budget Maintenance	Richard Dekany	
3	3.5	External Interface Control	Erik Johansson	
3	3.6	Configuration Management	Erik Johansson	
3	3.7	Documentation Control	Erik Johansson	
2	4	AO System Development		
3	4.1	AO Enclosure	Don Gavel	Jim Bell
3	4.2	Optomechanical	Don Gavel	
4	4.2.1	Rotator	Don Gavel	Reni Kupke
4	4.2.2	Optical Relays	Don Gavel	Reni Kupke
4	4.2.3	Optical Switchyard	Don Gavel	Reni Kupke
4	4.2.4	AO Support Structure	Don Gavel	Jim Bell
4	4.2.5	LGS Wavefront Sensors	Viswa Velur	
4	4.2.6	NGS Wavefront Sensor	Viswa Velur	
4	4.2.7	Low Order Wavefront Sensors	Richard Dekany	
4	4.2.8	Truth Wavefront Sensors	Viswa Velur	
4	4.2.9	DM's and Tip/Tilt Stages	Don Gavel	Reni Kupke
4	4.2.10	Tip/Tilt Vibration Mitigation	Peter Wizinowich	
4	4.2.11	Acquisition Cameras	Viswa Velur	
4	4.2.12	Atmospheric Dispersion Correctors	Don Gavel	Reni Kupke

Level	WBSElement	Title	Resonsible Cost Estimator	Consultant 1
3	4.3	Alignment, Calibration, and Diagnostics		
4	4.3.1	Simulator	Chris Neyman	
4	4.3.2	System Alignment Tools	Chris Neyman	Reni Kupke
4	4.3.3	Atmospheric Profiler	Richard Dekany	
4	4.3.4	PSF Monitoring Camera	Viswa Velur	
4	4.3.5	DM Interferometer	Chris Neyman	
3	4.4	Non-real-time Control	Erik Johansson	
3	4.5	Real-time Control	Don Gavel	
3	4.6	AO System Lab I&T	Peter Wizinowich	
3	4.7	AO System Acceptance	Peter Wizinowich	
2	5	Laser System Development		
3	5.1	Laser Enclosure	Chris Neyman	
3	5.2	Laser	Sean Adkins	
3	5.3	Laser Launch Facility	Chris Neyman	Viswa Velur
3	5.4	Laser Safety Systems	Chris Neyman	
3	5.5	Laser System Control	Chris Neyman	
3	5.6	Laser System Lab I&T	Chris Neyman	
3	5.7	Laser System Acceptance	Peter Wizinowich	
2	6	Science Operations Tools Development		
3	6.1	Observing Setup	David le Mignant	
3	6.2	User Interfaces	David le Mignant	
3	6.3	Astronomer Planning	David le Mignant	
3	6.4	System Control & Interfaces	Erik Johansson	David le Mignant
3	6.5	Performance Monitoring	David le Mignant	
3	6.6	Automation and Optimization	David le Mignant	
3	6.7	User Documentation	David le Mignant	
2	7	Telescope & Summit Engineering		
3	7.1	Telescope Performance	Peter Wizinowich	
3	7.2	Infrastructure Mods for AO	Chris Neyman	Jim Bell
3	7.3	Infrastructure Mods for Laser	Chris Neyman	Jim Bell
3	7.4	OSIRIS Modifications	Sean Adkins	
3	7.5	Interferometer and OHANA Mods	Chris Neyman	
3	7.6	Old AO/Laser Removal	Peter Wizinowich	Jim Bell
3	7.7	Laser Enclosure Integration	Chris Neyman	Jim Bell
3	7.8	AO Enclosure Integration	Chris Neyman	Jim Bell
2	8	Telescope Integration & Test		
3	8.1	AO System Install + I&T	Peter Wizinowich	
3	8.2	Laser System Install + I&T	Chris Neyman	
3	8.3	LGS AO System On-sky I&T	David le Mignant	
3	8.4	Performance Characterization	Richard Dekany	
3	8.5	Science Verification	David le Mignant	
2	9	Operations Transition		
3	9.1	Operations Personnel Training	David le Mignant	
3	9.2	Operations Acceptance	David le Mignant	

Cost Estimating Worksheet

WBS*:
WBS Title*:
Phase*:
Responsible Estimator*:
Estimators*:

Estimate Date:

Links:
Cost Estimating Plan
Input Cheat Sheet

* - Required Fields

Element Scope / WBS Dictionary Entry*:

Deliverables*:

Labor
BOE*:

	Resource	Estimate Type	Hours
1			
2			
+			

Non-Labor
BOE*:

	Expense Item	Description	Category	Estimate Type	Unit Cost	Number of units
1						
2						
+						

Travel
BOE*:

	Trip Type	Duration	Number of Trips
1			
2			
+			

Risk Factors

	Factor	%	Basis*:
Technical*:			
Cost*:			
Schedule*:			
TOTAL:	0%		
Override:			

Misc Comments:

Scoping Options:

WBS Dictionary Definition

- Describes what the work package is and what is is not
- Example:
  - WBS Element 4.3.2 - System Alignment Tools
    - This element includes the effort to identify requirements, specify types and quantities of optomechanical alignment tools, and procure such equipment as needed to support

      AO System Lab I&T process (WBS 4.6),
      AO System Install + I&T (WBS 8.1), and
      LGS AO System On-Sky I&T (WBS 8.3)

      It includes procurement of a $C_n^2(h)$ monitor but does not include expected subcontract management of the same, which is included in WBS 2.1, Planning and Contracting.

      It does not include development of detailed alignment plans, which is included in WBS 4.6.

      It does not include any alignment tools for the Laser Launch Facility, which are included in WBS 5.3.

Working Project Phase Durations

NGAO Project Phase	Phase Code	Duration
Preliminary Design	PD	18 months
Detailed Design	DD	20 months
Full Scale Development	FSD	24 months
Delivery and Commissioning	DC	18 months

These durations may be revised for subsequent cost estimate refinements

Estimate Type

Estimate Type	Input Code
Direct Historical Data ("done before")	DH
Catalog Prices	CP
Vendor Quotes	VQ
Cost Estimating Relationship	CER
Engineering Estimate	EE

- Direct Historical Data - The use of costs demonstrated in immediate, applicable history for the same product or service.
- Catalog Prices - A known, advertised price from a potential supplier for a specific product or service.
- Vendor Quote - A quote from a potential supplier within the program estimate. Note: although useful to refining our current cost estimates, a balance must be found that satisfies project needs while not alienating vendors who often commit considerable resources for the generation of detailed price quotes.
- Cost Estimating Relationship – An estimate based on **parametric relationships**, **analogy to another program**, or by **"Rule of Thumb."**
  - Parametric Estimate – A statistical model based on characteristics and costs of multiple previous observations.
  - Estimate by Analogy - Scaling of costs demonstrated in previous observations using subjective or objective factors.
  - Rule of Thumb - General cost relationships demonstrated by informal studies of past programs.
- Engineering Estimate – An estimate based on the judgment of a recognized authority.

Labor Resource Codes

Resource	Input Code
Technical Functions:	
Post Doc	PostDoc
Technician	Tech
Junior Scientist / Engineer	JunSci
Associate Scientist / Engineer	AssoSci
Information Tech. Specialist	IT
Senior Scientist / Engineer	SrSci
Lead Scientist / Engineer	LdSci (use sparingly)
Business Functions:	
Administrative I	AsstAdmin
Administrative II	AssoAdmin
Management Functions:	
Subsystem Manager	SubMgr
Project Manager	ProjMgr

Non-Labor Expense Codes

Category	Input Code
Equipment	EQP
Material	MAT
Subcontract	SUB
Shipping	SHIP
Other Direct Cost	ODC

- Material describes raw materials (e.g. steel), expendables (e.g. cryogens, cleaning agents), etc.

Travel Codes

Destination	Input Code
Intra - California	CALIF
Hawaii - California	HAWAII
International (Origination/Destination unspecific)	INTER
Other locations not included in above list	OTHER

Miscellaneous

- Travel costs per WBS element should only include those costs directly needed for completion of that work element
  - Team meetings, conference travel included in WBS 2.2
- WBS 1.3 and 1.4 will include those activities not described elsewhere in the WBS for the PD and DD phases
  - This may involve risk mitigation activities, additional trade studies, or contingency planning
- Software licenses
  - SolidWorks, Zemax, development kits, OS license fees, etc. should be costed at the appropriate Level 3 WBS element only (TBC)

  Or
  - SolidWorks, Zemax, development kits, OS license fees, etc. will be included for all design work within WBS 1.3 and 1.4 (TBC)

Questions / Discussion Notes

- Discussion notes from TM#13 will go here