National Ecological Observatory Network

Cost Estimation

R. Munro/J. Ryan/D. Scott/D. Randall/C. Moler -
NEON Project Team

Topics

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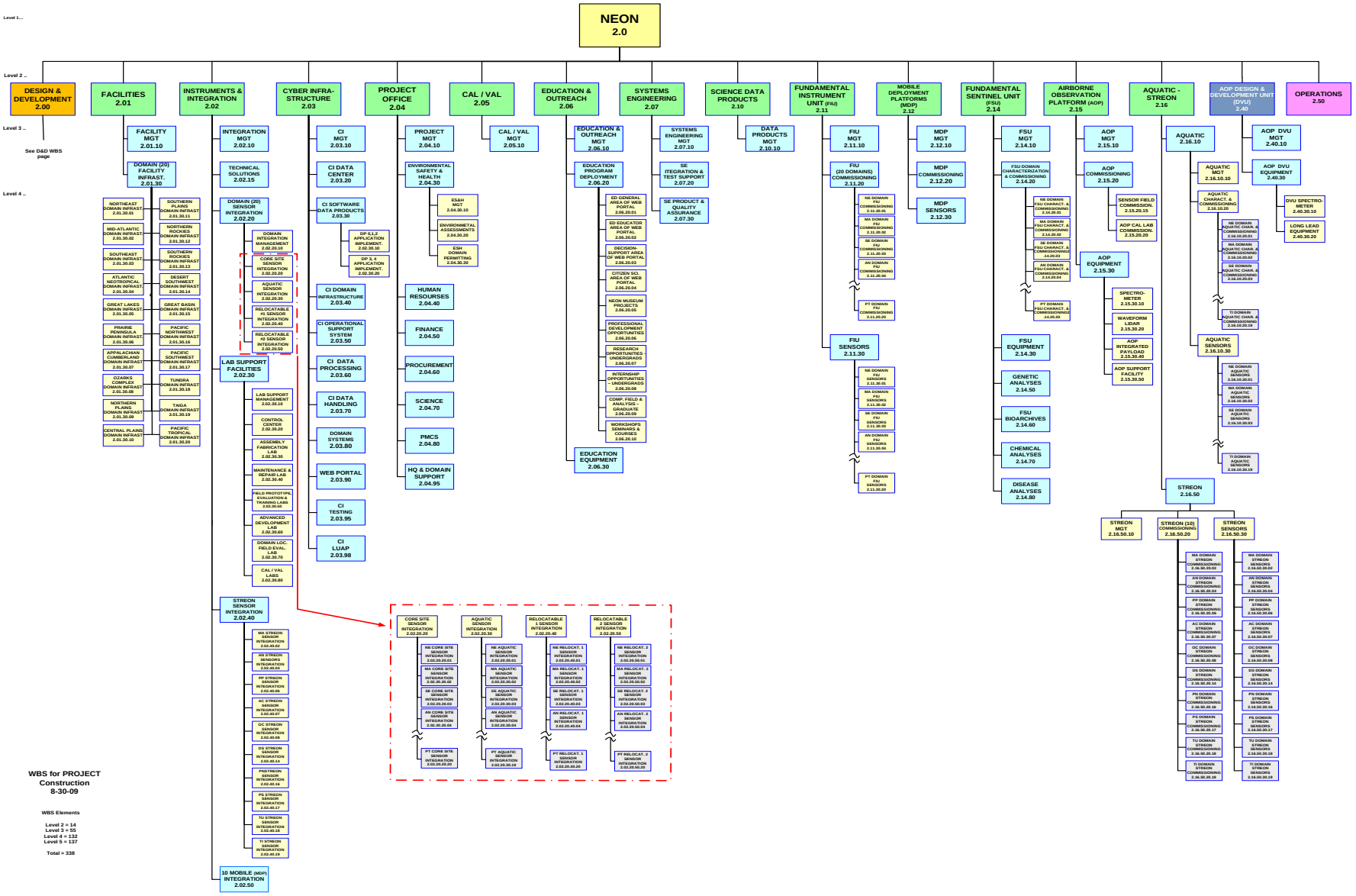
- WBS
- PMCS - Pulling it together (software, data integration, methodology & reporting)
- Cost Estimating
  - Methodology
  - BOE
  - Rate Tables (labor, travel, non-labor)
  - Escalation
  - Contingency
- Schedule – Jill Ryan

NEON Work Breakdown Structure
(WBS)

- The WBS is a product-oriented hierarchy that includes all elements of NEON.
- The NEON team develops the WBS structure and documents the WBS elements in the Work Breakdown Structure Dictionary.
- The scope of each WBS element is described in the WBS dictionary. The cost estimates for each WBS element are based on the scope of work defined in the WBS dictionary.
- A detailed bottom-up cost estimate is developed at the lowest reasonable level of activity.
- The WBS is used to summarize cost estimates to the upper levels of the WBS.

NEON Construction WBS



PMCS Overview

Project Management Controls Systems (PMCS)

The PMCS utilizes both software databases and formal procedures as tools for organizing and managing the project.

- Basic Components include:
  - The Detailed Cost Estimate Database
  - The Integrated Project Schedule Database
  - The Cost/Schedule Management Database
  - Accounting System
  - Change Control Board (CCB) Process

Process and Methodologies

Cost Estimating –

- Uses consistent methodologies from the Cost Estimating Plan
- Details a bottoms-up cost estimate with all budget elements related to the project WBS (Labor, Capital Equipment, Travel, Material, and Supplies)

Scheduling –

- Requires detailed development of an Integrated Project Schedule (IPS) using a consistent, defined methodology from the project's scheduling procedure
- Identifies the overall critical path and the near critical paths for the project
- Identifies Critical Resources
- Level Resources

Performance Measurement Baseline (PMB)

- Incorporates Project Cost Estimate
- Integrates Project Schedule
- Develops Cost Accounts and Work Packages
- Creates Time-phased budgeting based on the Project Schedule
- Tracks approved budget and schedule changes from the CCB in a CCB log
- Imports schedule progress from the schedule software
- Imports Project Accounting Costs: labor, overhead, capital equipment, and other direct costs
- Generates reports to compare schedule and cost progress against ***the Project Baseline***

Software Tools Set

- **Cost Estimating:** is a relational database that houses the Cost Estimate for a Project.
- **Scheduling System (Primavera P6):** Provides multi-project analysis, critical path planning, and resource management.
- **Cost Management (Cobra):** is used for managing project costs, measuring Earned Value, and analyzing budgets, actual costs, and forecasts.
- **n-Path (Project Information Center**): is an Interface Portal that integrates project management information.
  - Cost Estimating Management
  - Compatible with cost and schedule software
  - Interfaces with Document Management Systems (Reporting)

Cost Estimating

- Initial cost estimates are made in current year dollars (Now Year 2009)
- The cost estimates are produced form the detailed bottoms-up resource loaded schedule (for the labor) and from the non-labor items, which are from vendor quotes, catalog pricing, and engineering estimates primarily (NEON.MGMT.PMC.004801.PLA)
- Within each WBS element items estimated include staff labor, contract labor, equipment, travel, materials and supplies, consultants, computer related costs, and subcontracts and sub-awards.

Basis of Estimate

- The cost estimators provide supporting information substantiating each cost data item by specifically indicating if the line item is based on a vendor quotation, catalog price, engineering estimate, professional engineering estimate, professional judgment, or historical data.

- The elements of the cost estimate are assigned the categories indicating the type of estimate which include the following:
  - Vendor Quotation (VQ)
  - Catalog Prices (CP)
  - Engineering Estimates (EE)
  - Historical Data (e.g., Ameriflux, LTER) (HD)
  - Professional Engineering Estimate -(PE)
  - Professional Judgment (PJ)

Cost Estimating – Rate Tables

- NEON Labor
  - Salary Job Description and Labor rates are based on the NEON Salary and Wage Manual and use the 50% point in the salary range
  - Actual hourly rate = Annual rate / 2080 hrs
  - One FTE Yr = 1800 work hrs/yr ((52$_{wks}$x 40$_{hrs/wk}$ – PTO(7$_{wks}$ x 40$_{hrs/wk}$))
  - Fully burdened hourly rates include Fringe Benefits (40%) and Overhead (20.2%) e.g. (Hourly Rate x Fringe (1.4))x(Overhead (1.202))
  - Example of NEON Job Titles & Grades

Resource Description	Res ID	Grade
Chief of Science	CSC	15
Deputy Chief of Science	DCS	13
Senior Supervising Scientist	SSSCI	11
Senior Scientist	SSCI	10
Scientist	SCI1	9
Post doctorate Scientist	PDOC	7
Graduate Research Assistant	GRA	3
Research Assistant	RA	2

Escalation (description)

- Initial cost estimates are made in current year dollars
- The work effort (labor, equipment, travel) for each WBS element is time phased in the schedule.
- In order to determine the estimated costs for performing work in future years the cost estimates must be adjusted to the expected future cost.
- NEON is using the OMB Alternative Price Measures Indexes for price escalation.
- These escalation factors are applied to adjust costs to the anticipated year of expenditure.

Contingency

- Risk assessment is used to calculate contingency.
- A standardized risk analysis is applied to establish contingency and is applied individually to each WBS component or activity. The Product Team cost estimators evaluate the risk and provide risk factors (see Table 1 below) for each element.
- Together the Product Team cost estimators and the PMCS team evaluate the technical, cost and schedule risk for each element. Technical, cost and schedule risk factors are entered into the cost sheets. Standard ranges for these parameters are 1 to 15 for Technical and 1 to 10 for the Cost and Schedule risk.

Contingency Matrix

Contingency Factor	Technical	Cost	Schedule
1	Existing design can be purchased off the shelf.	Off the shelf catalog item.	Schedule slippage has little or no impact on another item.
2	Minor modifications to an existing design	Vendor quote from established drawings.	Schedule slippage delays completion of a non-critical-path item.
3	Extensive modifications to an existing design	Vendor quote from design sketches.	Schedule slippage delays completion of several non-critical- path items.
4	New design within established product line	In-house estimate from previous experience.	Schedule slippage of this item delays completion of a major component in a subsystem.
5	New design required: Non-routine.	In-house estimate backed by limited experience.	Schedule slippage of this item delays completion of several major components in a subsystem.
6	New design different from established product line	Existing technology. In-house estimate for item with minimal company experience but related to existing capabilities	Schedule slippage of this item delays completion of a minor subsystem.
7	New design required: More than half the design requires R&D to solve novel problems.	In-house estimate backed by no direct experience.	Schedule slippage delays completion of multiple minor subsystems.
8	New design required: More than 90% of the design requires R&D to solve novel problems.	Top down estimate from a similar program.	Schedule slippage delays completion of a major subsystem.
9	State of the art design required: All problems are novel or untried.	Top down estimate from very roughly similar program.	Schedule slippage delays completion of multiple major systems.
10	State of the art design required: Design is untried and exotic compared with any existing design	Engineering judgment with no available comparables.	Schedule slippage delays completion of the total project.
15	New design way beyond the current state-of-the-art	Not used	Not used

	Condition	Contingency Percentage
Technical	Design or manufacturing concerns only	2%
	Design and manufacturing concerns	4%
Cost	Material cost or labor rate concern	1%
	Material and labor rate concern	2%
Schedule	Schedule concerns	1%

Table 1

Example Contingency Calculation - NEON Labor

Contingency Factor	Technical	Cost	Schedule
1	Existing design can be purchased off the shelf.	Off the shelf catalog item.	Schedule slippage has little or no impact on another item.
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	Condition	Contingency Percentage
Technical	Design or manufacturing concerns only	2%
	Design and manufacturing concerns	4%
Cost	Material cost or labor rate concern	1%
	Material and labor rate concern	2%
Schedule	Schedule concerns	1%

Labor Contingency % = T + C + S

= (1 x 2) + (4 x 1) + (6 x 1) = 12%

NEON Travel - Contingency Calculation

Contingency Factor	Technical	Cost	Schedule
1	Existing design can be purchased off the shelf.	Off the shelf catalog item.	Schedule slippage has little or no impact on another item.
2	Minor modifications to an existing design	Vendor quote from established drawings.	Schedule slippage delays completion of a non-critical-path item.
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	Condition	Contingency Percentage
Technical	Design or manufacturing concerns only	2%
	Design and manufacturing concerns	4%
Cost	Material cost or labor rate concern	1%
	Material and labor rate concern	2%
Schedule	Schedule concerns	1%

Labor Contingency % = T + C + S

= (1 x 2) + (5 x 1) + (1 x 1) = 8%

Contingency Calculation

- Technical Risk = Technical Risk factor x Risk %
- Cost Risk = Cost Risk factor x Risk %
- Schedule Risk= Schedule Risk factor x Risk %
- Contingency = Technical Risk + Cost Risk + Schedule Risk

Contingency = T (Risk Factor x Risk %) +
C (Risk Factor x Risk %) +
S (Risk Factor x Risk %)

Contingency Matrix

- This matrix is generally accepted as the standard guideline and has been used by similar projects such as LIGO, Superconducting Super Collider's GEM Detector, ICECube, TMT, LSST, ATST and ALMA.
- For Technical risk the value of 1 implies "normal industry supplied off-the-shelf items," and 15 is reserved for components significantly "beyond the current state-of-the-art."
- For Cost risk, a value of 1 is used to indicate "Off-the-shelf catalog price for Specific item," and 10 is used for estimates where "Engineering judgment with no available comparables"`.
- Schedule risk factors used are from 1 to 10.

The National Ecological Observatory Network is a project sponsored by the National Science Foundation and managed under cooperative agreement by NEON Inc.