Project Initiation, Planning and Execution

Ken Herwig

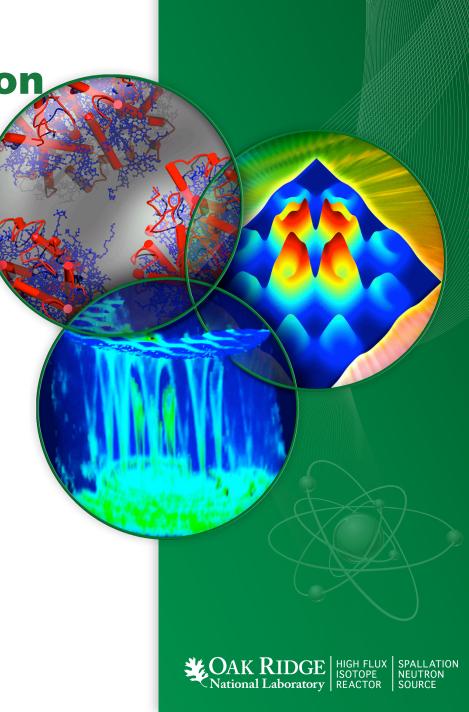
Instrument and Source Development Division

Oak Ridge National Laboratory

April 4, 2015

With many thanks to Barbara Thibadeau

ORNL is managed by UT-Battelle for the US Department of Energy



Outline

- Decision Points/Sponsor Expectations
- Project Initiation (Instrument proposal)
 - Definition
 - Conceptual Design Report
- Project Planning
 - Work Breakdown Structure a project outline

Part 1

Part 2

- WBS rules and guidelines
- Schedule
 - Resources
 - Float
- Cost
 - Top-down, bottom-up estimating

Project Baseline – the "ruler" by which you get measured

WHAT

WHEN

HOW MUCH

- Scope work breakdown structure
 - Conceptual design
- Timeline schedule
 - Milestones
 - Float
 - Duration
- Cost budget
 - Associated with work breakdown structure
 - Cash flow

Decision points (ORNL) – sponsor requirements (DOE order 413.3B)

- CD-0 recognition of the mission need for the project (acceptance of the science case)
 Project Initiation
- CD-1 approval of cost range
 - Conceptual Design completed, CDR review completed
 - Approval to move to detailed engineering and project planning (90% complete)
- CD-2 approval of baseline
 - Definitive scope, schedule and cost established
 - Complete the final design
- CD-3 approval of start of construction/execution
 - Buy, fabricate, install, test
- CD-4 approval of project completion (start of operations)
 - Review project completion criteria



NSS Project; Neutron Instrument project phases

Pro	posal and Pla	anning	De	esign and (Constructio	on	Insta	llation and	Comr	nissioning
Instrument Proposal	Phase 0 Preparation for Design	Phase 1 Preliminary Design		nase 2 led Design	Phas Manufacto Procure	uring and	Insta	hase 4 llation and egration	Hot (Phase 5 Commissioning
Deliverables	Deliverables	Deliverables	Deli	verables	Delive	rables	Deli	verables		Deliverables
 Science case covering scientific relevance, impact and usage Conceptual design with credible estimates of performance Preliminary costing. 	 Conceptual design updates Prototyping Definition of facility requirements and interfaces Clarification of institutional responsibilities Resource planning 	 Scientific and technical requirements Technical design concept Delivery plan for all phases (including hot commissioning) Delivery Schedule covering all phases Resource plan Staging plan for later enhancements Budget with contingency at 10% of cost to complete 	all major compone Complet plan for l Refined l Refined l Refined l schedule path iten depende	ion of detailed Phase 3 plan for phase Resource plan delivery e, with critical ns and encies budget with ncy at 10% of	 Procurement manufacturi major techni components Completion plan for pha Site prepara Refined plan 5 and for state Refined Ress Refine instru- delivery schi Maintain but contingency cost to com 	e of all ical s of detailed ise 4 ation ns for phase aging ource plan ument edule idget with at 10% of	 Assembly installation component Integration of technic component Installation and testin Safety Sy Submissina application 	on of technical ints on and testing cal ints on, integration ng of Personnel stem on of on of on for approval mmission roject	 perfores Persone System Proof with limits Critical demonstration of the second demonstration of t	f of compliance radiation dose
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		• NSS > scope re	eview ost book value	ICB reviewNSS appro		ICB revieNSS appr		• NSS app	proval	NSS approval

Project Definition – moving beyond the instrument proposal

- Success criteria (project completion criteria)
 - Measurable by end of the project (tests with in-beam neutrons?)
 - Demonstrated capability
 - Standard set of measurements?
 - Flux, resolution...
- Constraints
 - Moderator types, space, neighbors, magnetic fields
 - Operating schedule
- Assumptions
 - Access dates, work force (resources), interfaces, equipment/support from outside the instrument project
- Background
- Objectives
- Deliverables

Defining the team

Roles and responsibilities

- Project lead
- Engineering
- Support groups (DAS, detector, chopper, installation team, sample environment, software)
- Stakeholders
- Sponsor
- Advisory boards



Conceptual Design Report

- A narrative description of the instrument
- Should include
 - Science requirements derived from science case
 - Sample size, beam divergence, resolution...
 - Preliminary equipment specifications based on science requirements
 - · Lengths, choppers, detector, beam line, guides, moderator
 - Definition of the scope required to build the instrument
 - Analysis of project feasibility (any needed R&D identified)
 - Assessment of project risk and mitigation strategy
 - Reliable cost and schedule ranges estimated
 - Define key performance parameters (expect completion/ demonstration is part of completion criteria)
 - Derived from the science case, e.g. wavelength resolution $\Delta\lambda/\lambda=0.002$



Part 2

Project Planning

- Work Breakdown Structure a project outline
 - WBS rules and guidelines
- Schedule
 - Resources
 - Float
- Cost
 - Top-down, bottom-up estimating



Purpose of Project Planning

- Clarify project objectives and expectations
- Serve as a basis for negotiating commitments
- Record commitments
- Provide a baseline* against which actual performance can be compared
- Help identify optimal assignment of people and resources
- Facilitate early identification of potential problems
- Communicate project activities
- * *Baseline* is used in projects to describe original estimates of cost, schedule and technical performance



Sequential planning activities

- Define the scope
- Create the work breakdown structure
- Define activities
- Sequence activities
- Estimate resources required for activities
- Estimate duration required for activities
- Develop a feasible resource profile
 - Resources include people, cranes, buildings, laboratories ...
- Develop a cost profile (when do you need budgetary authority - \$'s to spend)
- Develop a plan to mitigate risk (look at what might go wrong)
 - Identify risk, quantify risk (schedule, \$'s, likelihood), track, respond



Work Breakdown Structure (WBS) helps to define the project scope

- Defines work in terms of deliverables
- Forms the basis for estimating effort/cost
- Is the basis for developing the schedule
- Hierarchical structure (outline) with increasing detail at each level
- Must be able to assign a responsible person for each WBS element

WBS rule: Work not in the WBS is not part of the project



Setting up a WBS

- Start from the top
 - Project
 - Systems
 - Sub-systems
 - Work-packages
 - Individual tasks in the schedule
- Activities should be coherent, have a single manager, be done by a single group
- Every WBS element must have one and only one owner
 - Owner is accountable for completing the task
 - The higher the WBS element, the more senior (in general) the manager/owner of that element

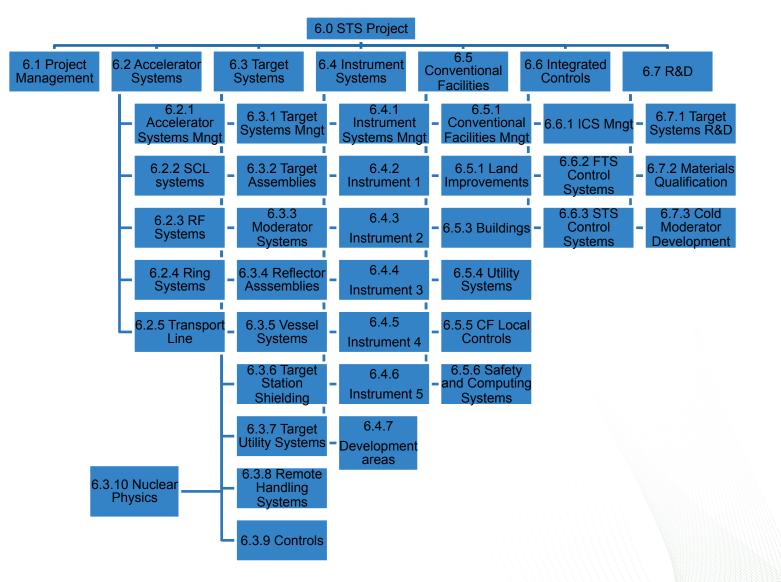


WBS guidelines

- How many levels?
 - To the level desired to track progress
 - Accounting might (will) roll up to higher levels
- Rule of thumb: 0.5% to 2.5% chunks of total budget
 - Low enough to track deviations from plan before a crisis develops
 - High enough so as to not be unwieldy
- Avoid level of effort tasks that do not have associated deliverables or milestones



Example – SNS Second Target Station



HIGH FLUX

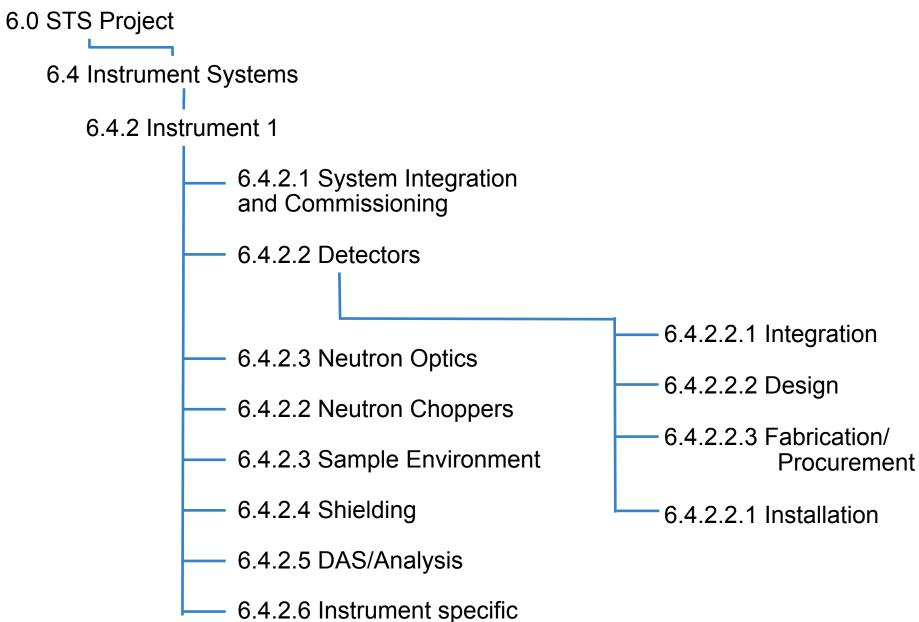
SPALLATION NEUTRON

SOURCE

CAK RIDGE

National Laboratory REACTOR

Look deeper at Instrument 1



Scheduling

- Tasks identified in WBS are the basis for
 - Developing the project schedule
 - Estimating the resources required
 - Assigning responsibility for getting work done
- Scheduling includes
 - Identifying all activities to be performed
 - Determining the dependencies (relationships between activities)
 - Estimating the time required
 - Adjustments
 - Match schedule and funding requirements to available cost profile
 - Level need for resources
 - Derive a final schedule that can be supported financially, for which resources are available when needed, that completes the project ahead of the deadline (early completion date)

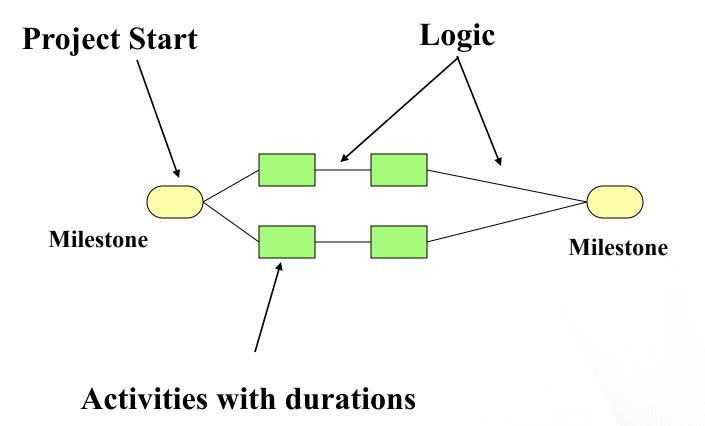


Terminology

- Activities detailed tasks (action verbs- design, build, receive, test)
- Logic the relationship of tasks to one another within a schedule
- Lag used to control the number of work periods between activity and successor
- Constraint a predetermined start or finish time that must be factored into the schedule
 - Constraints should be used very sparingly and generally only after most of the schedule elements are well developed
- Milestone an event, product, or deliverable
- Duration the time needed to complete the activity with no breaks



Network Elements





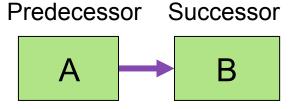
19 Neutron Science and Instrumentation - Erice, April 4, 2016

Critical Schedule Information

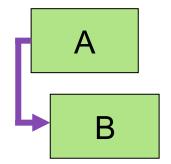
- Critical Path sequence of activities which takes the longest time to complete; i.e., the shortest time in which you can complete the project
- Float Time time which an activity can be delayed without affecting the overall time to complete the project
- Total Float Time cumulative float time placed in a project network which buffers delays without affecting the overall project completion
- Earliest Start Date earliest date that an activity may be started
- Earliest Finish Date earliest date that an activity may be finished
- Latest Start Date latest date that an activity may be started without affecting the overall project schedule
- Latest Finish Date latest date that an activity may be finished without affecting the overall project schedule



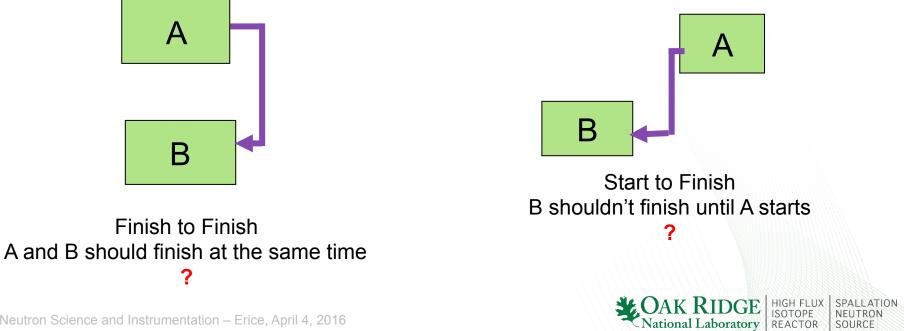
4 types of schedule relationships



Finish to Start B shouldn't start until A is finished

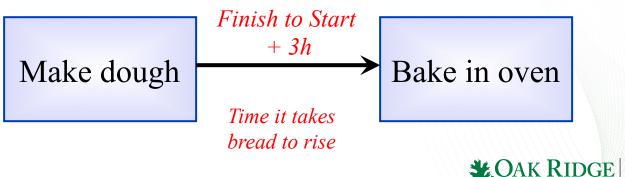


Start to Start (B shouldn't start until A at least starts)



Lag simulates work delays

- Used to control amount of time between an activity and its successor
- Can be positive or negative
- Default is 0 (zero)
- Can be used in lieu of tasks
- Also known as delay
- Can be confusing because not obvious



Schedule Contingency

- Difference between the late ("must") finish and the early ("desired") finish
 - We work to complete by the early finish date
- Should NOT be added to individual activity durations
- Should be based on risk and uncertainties
- External (e.g. weather)
- Internal (e.g. there really will be no learning curve)



Ways to display a schedule

- The network diagram
 - Supports the analysis of the project logic
- Key events list
 - List of project milestones
- Activities plan
 - List of project tasks
- Milestone chart
 - Graphical representation of project milestones
- Bar (Gantt) chart
 - Graphical representation of project tasks

While each format presents easy-to-read schedule information, none of them highlights task inter-relationships well



Gantt charts (VENUS instrument project) (often become eye test charts)

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Gantt charts

- Useful for showing schedule
 - Critical path for example
- Can rapidly become illegible if too much detail shown

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t.	Design Core Vessel Insert		10-Aug-16	75d	11-	÷۲	h	<u> </u>	+-4													
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ł	7.03 VENUS Procurement	28-Nov-17	31-Dec-18	18d		ŧ				·	I			-#				-H				
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ł.	Receive Shutter Insert & Cartridge	29-Nov-17		10d		!	1							- !!								
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ł	Receive 1 single disk Bandwidth Chopper			13d	ł	÷		;		<u></u>			+	-ŀ				-H				
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	Install shutter (w / Insert and cartridge)	22-Jun-18	03-Aug-18	100	L	1							+	6-ti	71							
i.	Beam Profile Measurement using Image Plate	20-Aug-18	-	Od										•								
	Re-establish beam center line	22-Aug-18	23-Aug-18	Od	ł	÷	i	i		<u></u>	├			-ŀ	-#-			-H				
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	System Test of the Single Disk Bandwidth		24-Jan-19	4d		ĺ								İ								
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	Complete PPS Certification		07-Feb-19	60	 	Ļ	ļ	ļ		ļ	Ļļ	L	ļļ	_į			Ļ	Ļ_µ́	L	Ļļ	L_į	ļ
	Install Epithermal Aperture Install Double Disk Bandwidth Choppers #	02-Jul-19 09-Jul-19	05-Jul-19 12-Jul-19	16d 16d																		
	Install Flight Tubes w/windows / Scrapers & Supports section # 1 from double disk chopper # 1 to Attenuator	19-Jul-19	25-Jul-19	16d										İ				•				İ
	Install Sample Stage - 25 Meter Location	26-8ep-19	23-Oct-19	217d		1			i i	1				İ				4				l
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Estimating costs

Basis of estimate

- Actual costs (but may need to adjust for timing escalation)
- Actual vendor quotes
- Budgetary quotes (non-binding vendor estimates)
- Expert experience (based on similar but not identical task)
- Expert estimates (otherwise known as a guess)
- Science projects have particular challenges to estimation
 - No historical basis
 - Use of state-of-the-art, first of a kind technology
 - Scarcity of qualified vendors
 - Competition for the small set of vendors available
 - Little basis for the estimate (R&D needed)



Top-down, bottom-up estimation

- Initial cost and schedule estimates are likely to be created by the project proponents by *comparison* with similar projects
- This is called a *top-down* estimate
 - It is usually the basis for requesting approval of the project
 - The budget assigned by the source of funds is also likely to be based on the top-down estimate
- Building the project requires a detailed estimate of each task
 - Summing up the costs of all the tasks gives the *bottom-up* estimate



Other topics I didn't talk about

- Risk Management
- Scope creep the bane of a science project
- Resource estimation/leveling
- Reviews
 - External usually a sponsor requirement
 - Internal correct problems before they become a crisis
 - Can be practice (dry run) for external review
 - If it is on the agenda, speak to it; if it is on the charge, put it on the agenda
- Performance metrics
 - Cost performance index (CPI)
 - Schedule performance index (SPI)