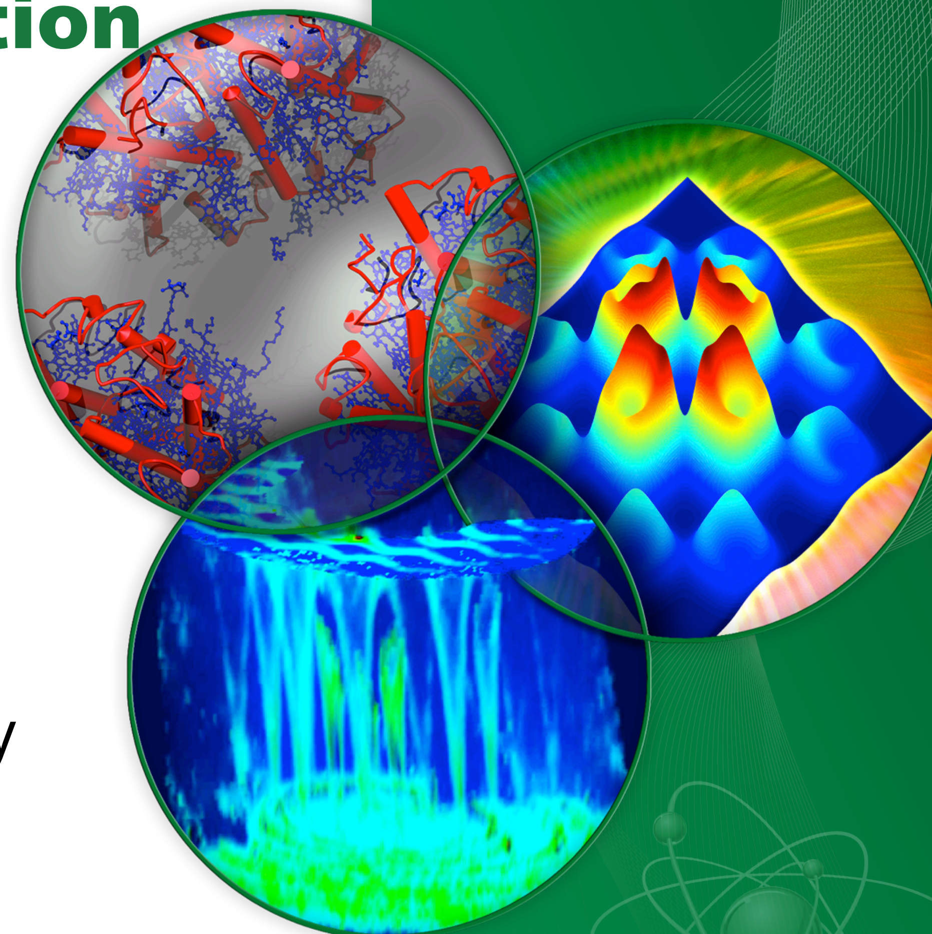
Project Initiation, Planning and Execution



Ken Herwig

Instrument and Source Development Division

Oak Ridge National Laboratory

April 4, 2015

With many thanks to Barbara Thibadeau

Outline

- Decision Points/Sponsor Expectations
- Project Initiation (Instrument proposal)
  - Definition
  - Conceptual Design Report

Part 1

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

Part 2

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

- Scope – work breakdown structure
  - Conceptual design

WHAT

- Timeline – schedule
  - Milestones
  - Float
  - Duration

WHEN

- Cost – budget
  - Associated with work breakdown structure
  - Cash flow

HOW MUCH

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

Proposal and Planning

Instrument Proposal

Deliverables

- Science case covering scientific relevance, impact and usage
- Conceptual design with credible estimates of performance
- Preliminary costing.

Phase 0 Preparation for Design

Deliverables

- Conceptual design updates
- Prototyping
- Definition of facility requirements and interfaces
- Clarification of institutional responsibilities
- Resource planning

Phase 1 Preliminary Design

Deliverables

- 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

Design and Construction

Phase 2 Detailed Design

Deliverables

- Complete definition of all major technical components
- Completion of detailed plan for Phase 3
- Refined plan for phase 4
- Refined Resource plan
- Refined delivery schedule, with critical path items and dependencies
- Refined budget with contingency at 10% of cost to complete

Phase 3 Manufacturing and Procurement

Deliverables

- Procurement and manufacture of all major technical components
- Completion of detailed plan for phase 4
- Site preparation
- Refined plans for phase 5 and for staging
- Refined Resource plan
- Refine instrument delivery schedule
- Maintain budget with contingency at 10% of cost to complete

Installation and Commissioning

Phase 4 Installation and Integration

Deliverables

- Construction of physical infrastructure on site.
- Assembly and installation of technical components
- Integration and testing of technical components
- Installation, integration and testing of Personnel Safety System
- Submission of application for approval to hot commission
- Formal project completion

Phase 5 Hot Commissioning

Deliverables

- Verification of performance of Personnel Safety System
- Proof of compliance with radiation dose limits
- Critical performance demonstration of basic functionality
- Scientific performance demonstration
- Friendly user experiments
- Completion of technical and user manuals

Tollgates

Tollgate 1

- STAP review
- SAC recommendation
- NSS recommendation
- STC approval

Tollgate 2 (PDR)

Preliminary Design Review

- STAP review
- NSS
  - ➢ scope review
  - ➢ assign cost book value
  - ➢ approval

Tollgate 3 (CDR)

Critical Design Review

- STAP review
- ICB review
- NSS approval

Tollgate 4 (IRR)

Installation Readiness Review

- ICB review
- NSS approval

Tollgate 5 (SAR)

Safety systems acceptance review

- NSS approval

Tollgate 6 (ORR)

Operations readiness review

- 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

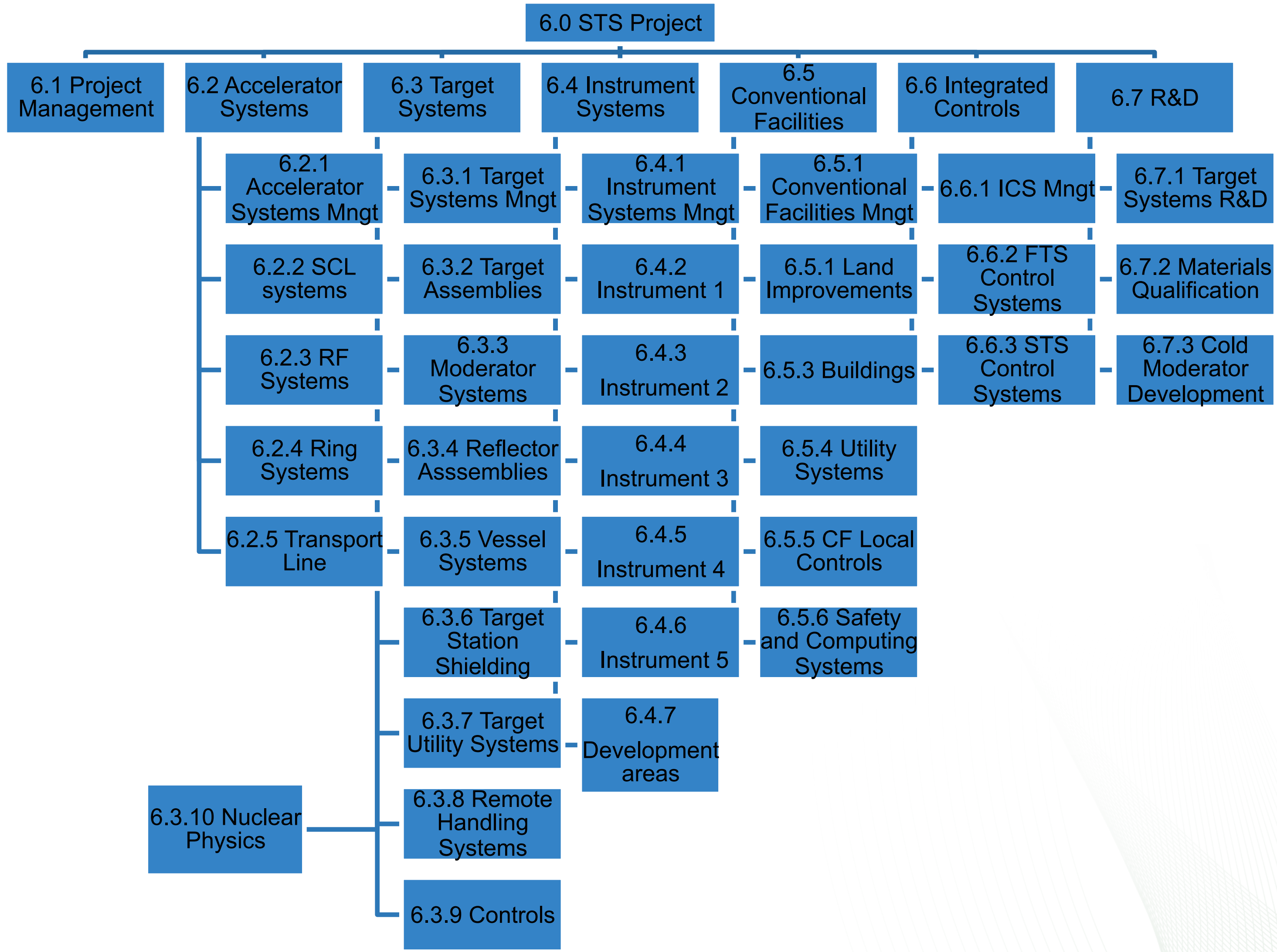
Setting up a WBS

- 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



Look deeper at Instrument 1

- 6.0 STS Project
  - 6.4 Instrument Systems
    - 6.4.2 Instrument 1
      - 6.4.2.1 System Integration and Commissioning
      - 6.4.2.2 Detectors
        - 6.4.2.2.1 Integration
        - 6.4.2.2.2 Design
        - 6.4.2.2.3 Fabrication/ Procurement
        - 6.4.2.2.1 Installation
      - 6.4.2.3 Neutron Optics
      - 6.4.2.2 Neutron Choppers
      - 6.4.2.3 Sample Environment
      - 6.4.2.4 Shielding
      - 6.4.2.5 DAS/Analysis
      - 6.4.2.6 Instrument specific

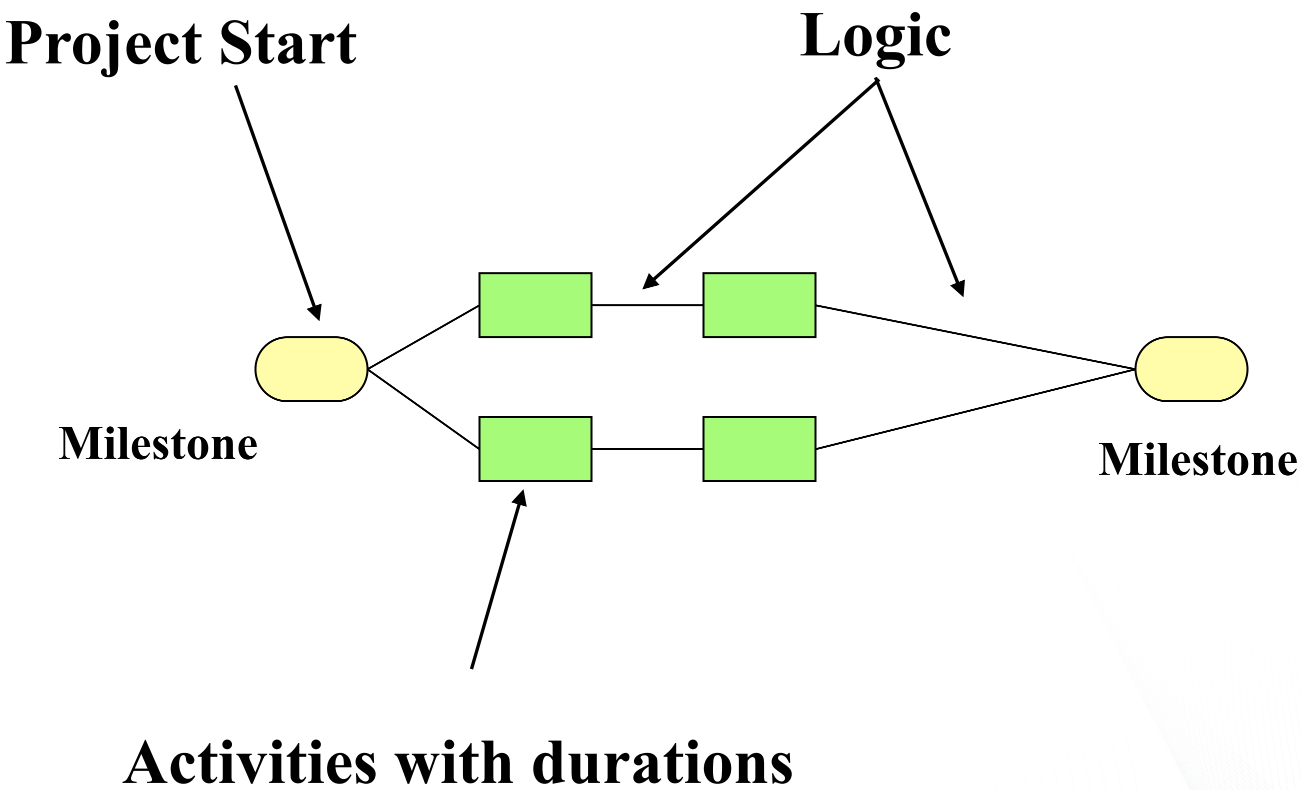
Scheduling

- 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

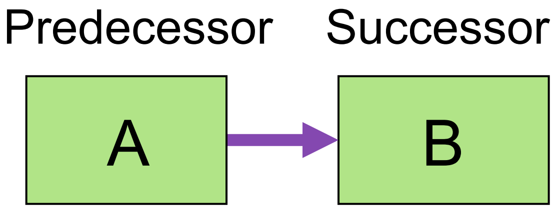
Network Elements



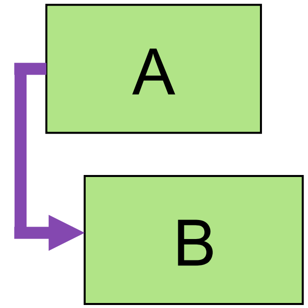
Critical Schedule Information

- 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

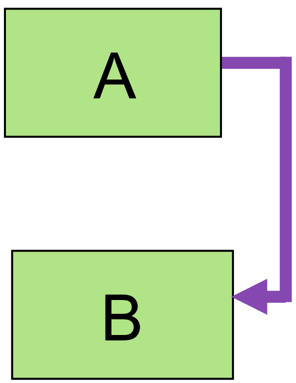
4 types of schedule relationships



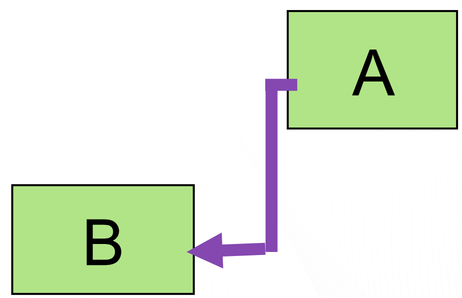
Finish to Start
B shouldn't start until A is finished



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



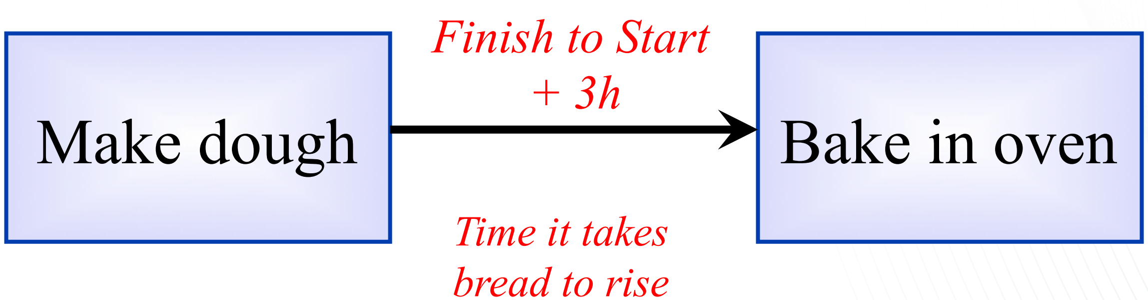
Finish to Finish
A and B should finish at the same time
?



Start to Finish
B shouldn't finish until A 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)

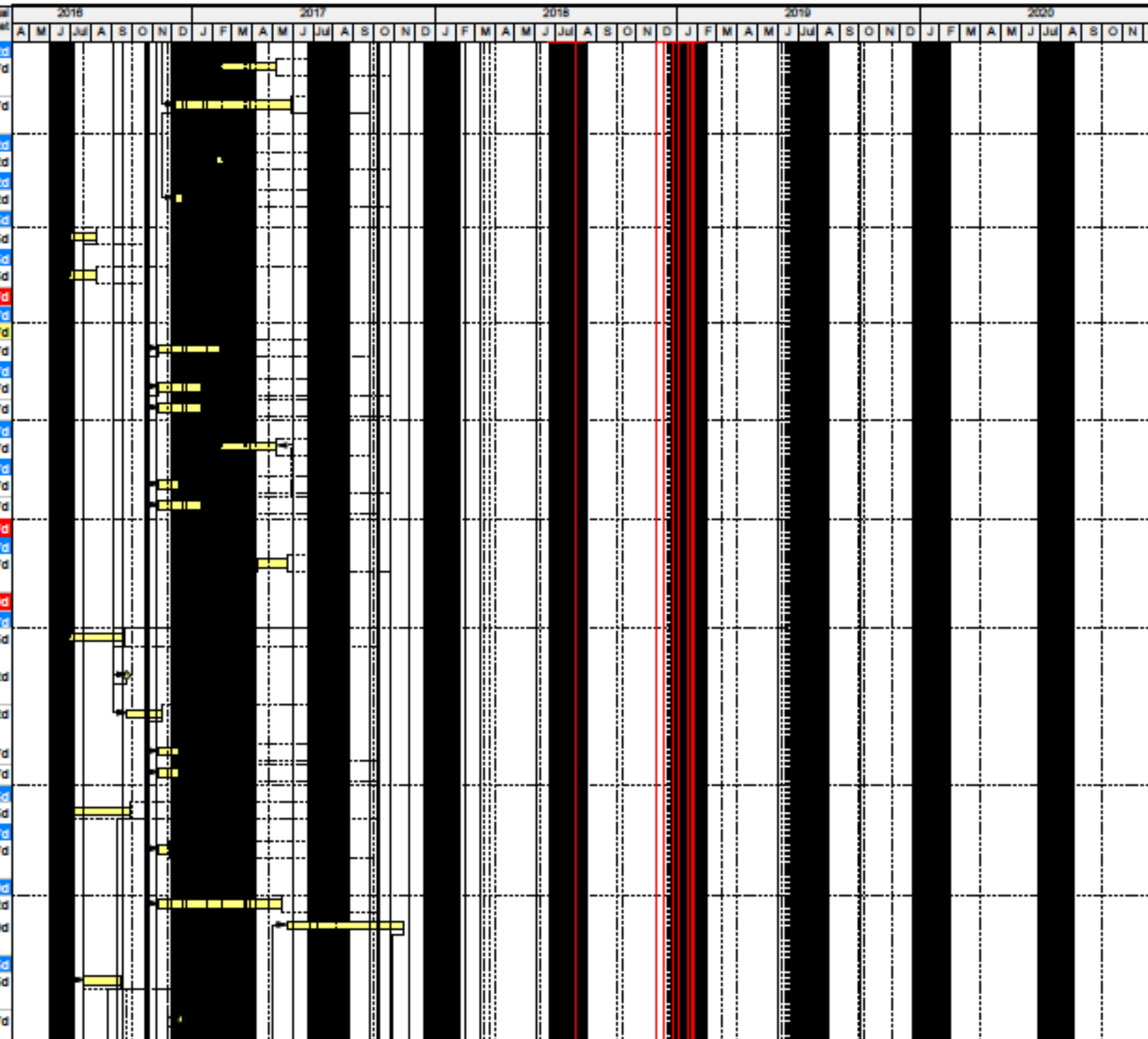
Ways to display a schedule

- 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)

Activity ID	Activity Name	Start	Finish	Total Float
Flight Tubes & Supports		06-Dec-16	30-May-17	42d
VE0200145	Design Flight Tube w/windows positioning system in cave	13-Feb-17	08-May-17	57d
VE0200150	Design Flight Tubes w/windows / Scrapers & Supports	06-Dec-16	30-May-17	37d
Thermal / Cold Attenuator		06-Feb-17	17-Feb-17	112d
VE0200155	Design Thermal / Cold Attenuator	06-Feb-17	17-Feb-17	112d
Slits		06-Dec-16	19-Dec-16	152d
VE0200165	Design Slits	06-Dec-16	19-Dec-16	152d
Core Vessel Insert		29-Jun-16	10-Aug-16	75d
VE0200125	Design Core Vessel Insert	29-Jun-16	10-Aug-16	75d
Shutter Insert & Cartridge		29-Jun-16	10-Aug-16	75d
VE0200130	Design Shutter Insert & Cartridge	29-Jun-16	10-Aug-16	75d
Choppers		11-Nov-16	08-May-17	57d
T0 Chopper		11-Nov-16	10-Feb-17	57d
T0 Chopper		11-Nov-16	10-Feb-17	57d
VE0200170	Design T0 Chopper	11-Nov-16	10-Feb-17	57d
Chiller and Vacuum Piping		11-Nov-16	12-Jan-17	137d
VE0200175	Design T0 Chiller and Helium Piping	11-Nov-16	12-Jan-17	137d
VE0200180	Design Bandwidth Vacuum Piping	11-Nov-16	12-Jan-17	137d
Bandwidth Choppers		13-Feb-17	08-May-17	57d
VE0200185	Design Bandwidth Chopper	13-Feb-17	08-May-17	57d
Chopper Stands & Carriages		11-Nov-16	12-Jan-17	137d
VE0200190	Design T0 Carriage Test Assembly	11-Nov-16	12-Dec-16	157d
VE0200195	Design Chopper Stands & Carriages	11-Nov-16	12-Jan-17	137d
Sample Environment		10-Apr-17	22-May-17	47d
Sample Stages		10-Apr-17	22-May-17	47d
VE0200200	Design Sample Stages - 25 Meter positioning system in Cave	10-Apr-17	22-May-17	47d
Shielding		29-Jun-16	16-Nov-17	599d
P-I-P Phase 1		29-Jun-16	12-Dec-16	157d
VE0200230	Design P-I-P Phase 1 (1 to 10 meters)	29-Jun-16	22-Sep-16	35d
VE0200235	Meeting to discuss and start target building door relocation (DCN)	23-Sep-16		172d
VE0200240	Design target building door relocation (DCN by Structural Engineer)	23-Sep-16	17-Nov-16	172d
VE0200220	Design Chopper Cavity Steel	11-Nov-16	12-Dec-16	157d
VE0200225	Design Temp Shielding	11-Nov-16	12-Dec-16	157d
10m to Cave Shielding		07-Jul-16	29-Sep-16	35d
VE0200250	Design 10m to Cave Shielding	07-Jul-16	29-Sep-16	35d
Baseplates		11-Nov-16	28-Nov-16	167d
VE0200255	Design base Embed Plates and rails - all sections	11-Nov-16	28-Nov-16	167d
Roll-in Shielding		11-Nov-16	16-Nov-17	599d
VE0200260	Design Roll-in shielding	11-Nov-16	15-May-17	52d
VE0200525	Design cover plates over holes in shielding at front end	23-May-17	16-Nov-17	599d
Cave (including doors)		21-Jul-16	07-Apr-17	35d
VE0200265	ORNL concept design of Cave and Cave floor (including doors)	21-Jul-16	14-Sep-16	35d
VE0200275	Cave and Cave floor (including doors) Design Review - 30 %	13-Dec-16		57d



Remaining Work ◇ Start Milestone ● PEP Milestone ◆ Finish Milestone % Complete

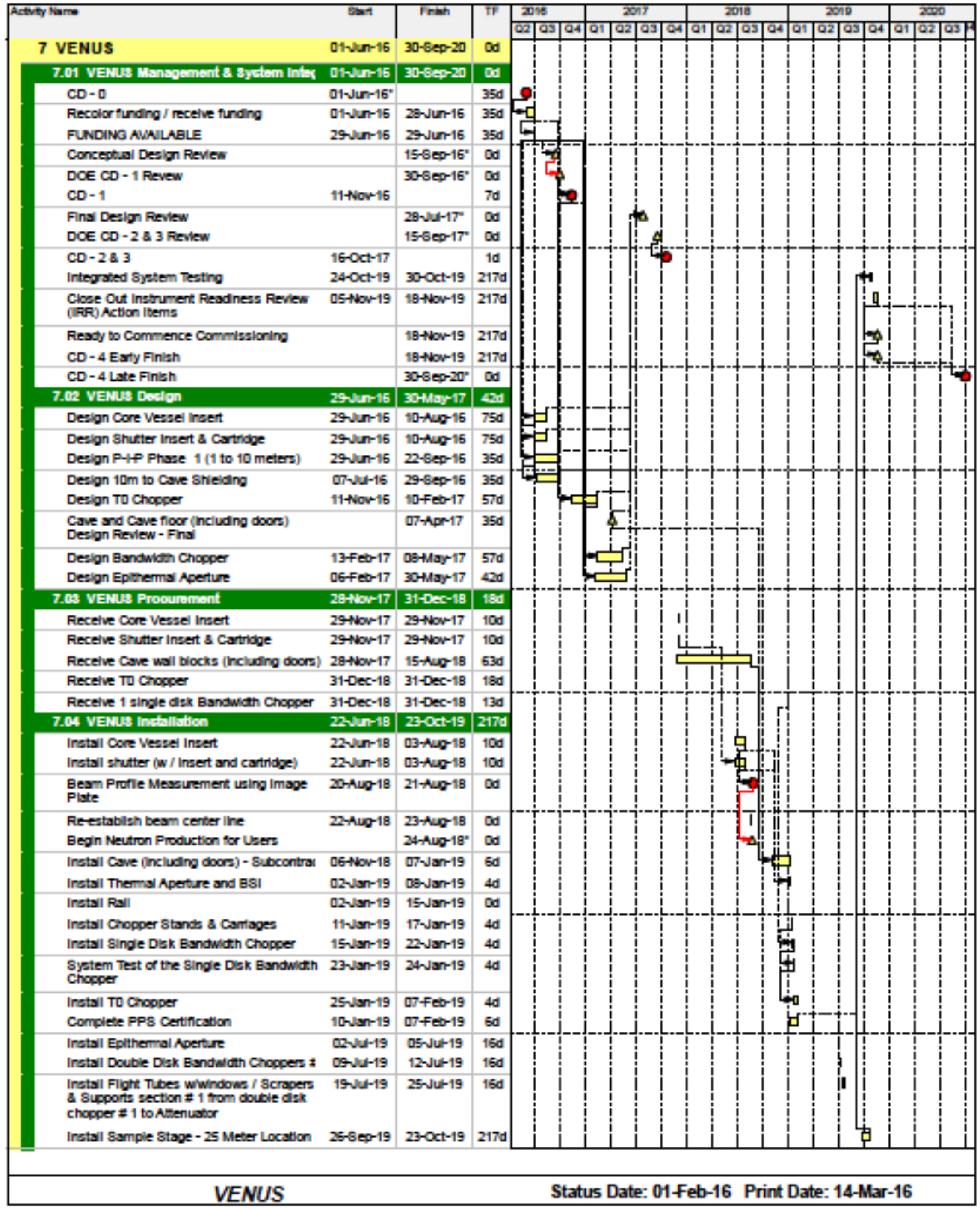
VENUS

Status Date: 01-Feb-16 Print Date: 14-Mar-16

Page 3 of 21

Gantt charts

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



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)