Schedule, Resources and Risks

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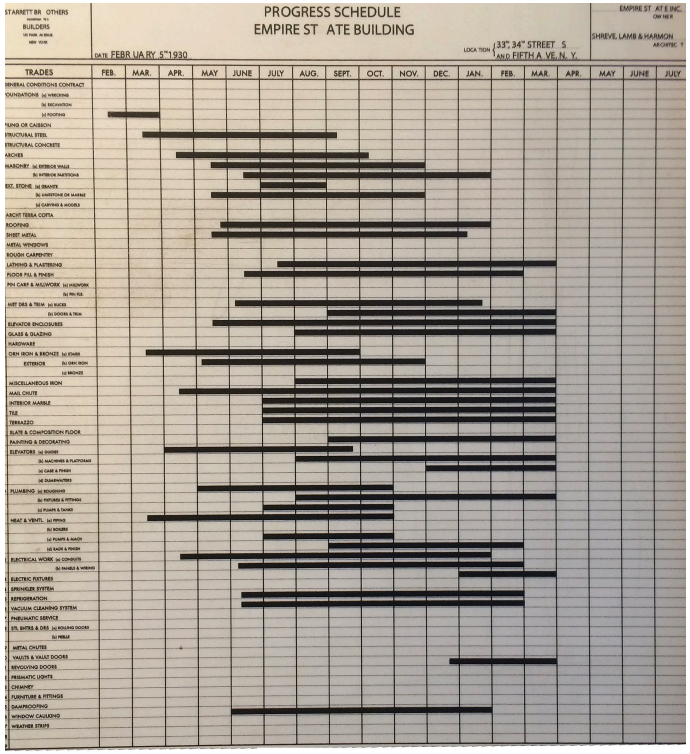
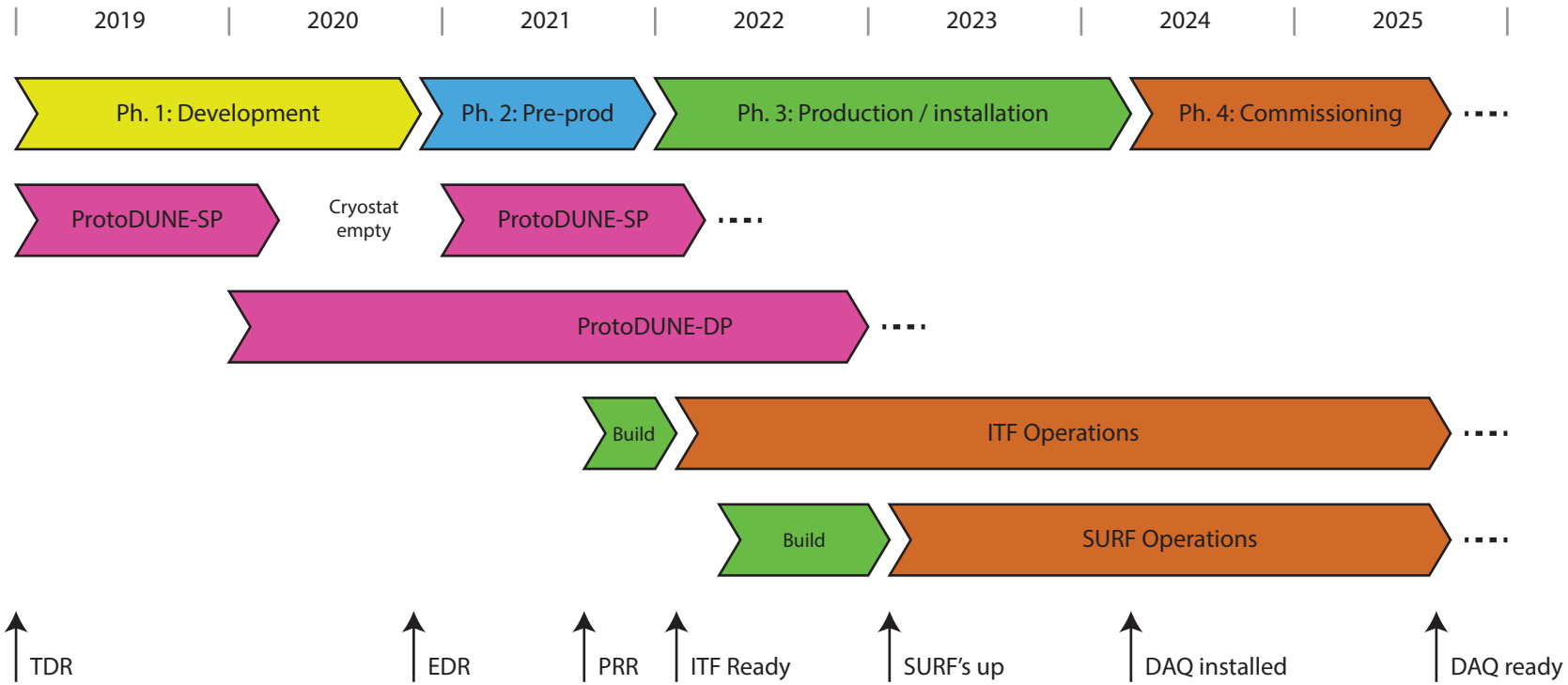


Outline Planning Documents

- Requirements: covered earlier
- Top-level schedule
  - Driven by DUNE international schedule (i.e. top level experiment planning)
  - Allows conflicts / critical path to be identified
  - More detailed month-to-month schedule under construction for R&D phase
    - Will interact strongly with ProtoDUNE planning for 2019-20
- Work Breakdown Schedule
  - In accordance with DUNE standard, for review by NCG -> RRB
  - Loaded with first cost estimates for capital and labour
  - Not yet consistent on task-by-task basis with DAQ schedule
- Risk register
  - Captures top-level risks for the DAQ system
- All of these are living documents
  - They will be refined, expanded and amended over the next two years, frozen at EDR

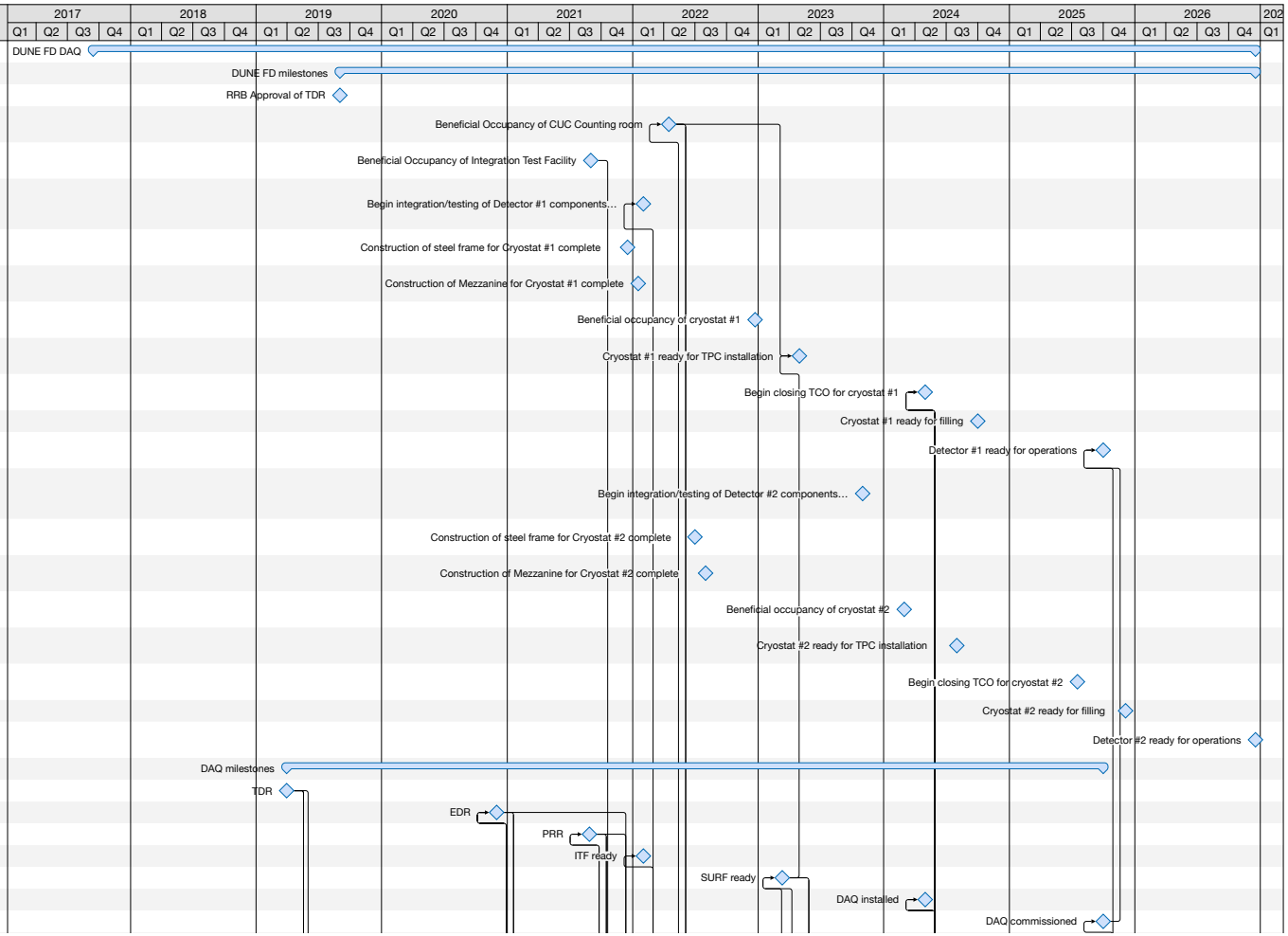
Outline Schedule



- 2021/22 will be our busiest years
  - Project focus will move from CERN to ITF / SURF over this period
- More details on each phase in Jim and Alec's talks

International / DAQ Milestones

#	Traits	Title	Resources
0		**DUNE FD DAQ**	
1		**DUNE FD milestones**	
2		RRB Approval of TDR	
3		Beneficial Occupancy of CUC Counting room	
4		Beneficial Occupancy of Integration Test Facility	
5		Begin integration/testing of Detector #1 components at ITF	
6		Construction of steel frame for Cryostat #1 complete	
7		Construction of Mezzanine for Cryostat #1 complete	
8		Beneficial occupancy of cryostat #1	
9		Cryostat #1 ready for TPC installation	
10		Begin closing TCO for cryostat #1	
11		Cryostat #1 ready for filling	
12		Detector #1 ready for operations	
13		Begin integration/testing of Detector #2 components at ITF	
14		Construction of steel frame for Cryostat #2 complete	
15		Construction of Mezzanine for Cryostat #2 complete	
16		Beneficial occupancy of cryostat #2	
17		Cryostat #2 ready for TPC installation	
18		Begin closing TCO for cryostat #2	
19		Cryostat #2 ready for filling	
20		Detector #2 ready for operations	
21		**DAQ milestones**	
22		TDR	
23		EDR	
24		PRR	
25		ITF ready	
26		SURF ready	
27		DAQ installed	
28		DAQ commissioned	



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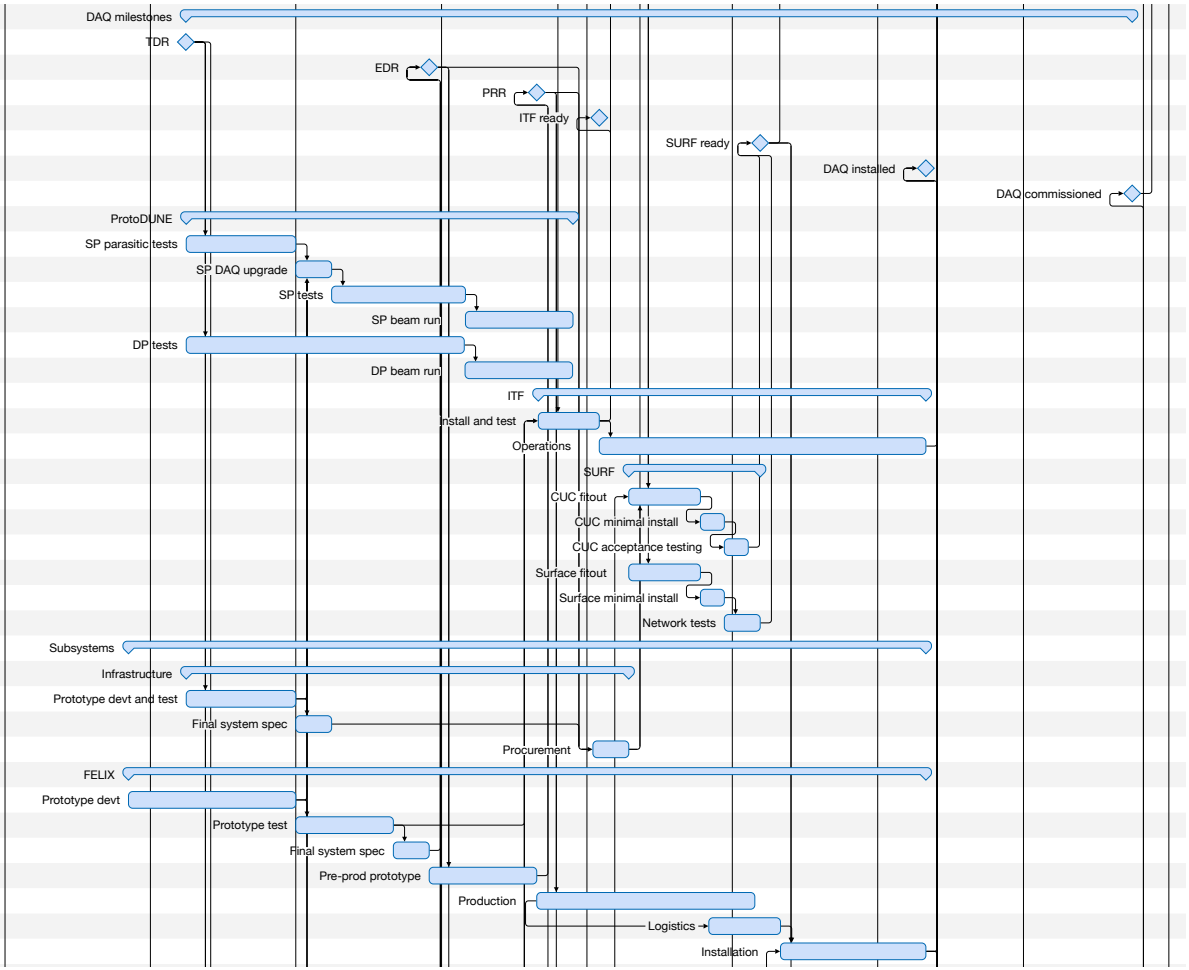
Typical Subproject Plan

21	**DAQ milestones**
22	TDR
23	EDR
24	PRR
25	ITF ready
26	SURF ready
27	DAQ installed
28	DAQ commissioned
29	**ProtoDUNE**
30	SP parasitic tests
31	SP DAQ upgrade
32	SP tests
33	SP beam run
34	DP tests
35	DP beam run
36	**ITF**
37	Install and test
38	Operations
39	**SURF**
40	CUC fitout
41	CUC minimal install
42	CUC acceptance testing
43	Surface fitout
44	Surface minimal install
45	Network tests
46	**Subsystems**
47	**Infrastructure**
48	Prototype devt and test
49	Final system spec
50	Procurement
51	**FELIX**
52	Prototype devt
53	Prototype test
54	Final system spec
55	Pre-prod prototype
56	Production
57	Logistics
58	Installation

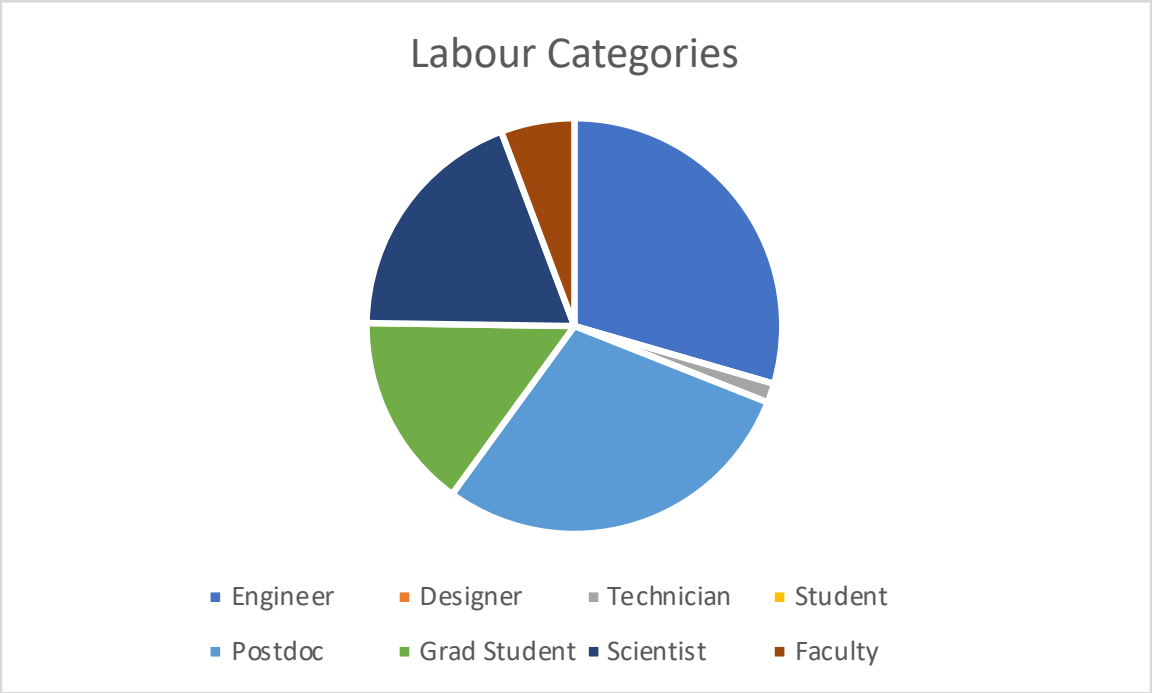


WBS Resource Estimate

WBS	WBS name	Capital ($k)	Labour (SY)
	DUNE		
2	Single-Phase Far Detector		
2.9	Data Acquisition (SP-DAQ)	6268.7	285
2.9.1	Management	0	24
2.9.2	Physics and Simulation	0	18
2.9.3	Design, Engineering, and R&D (includes subsystem test facilities and QA)	156	110.825
2.9.4	Production (includes component production, assembly, testing and QC)	6037.7	84.825
2.9.5	Integration	50	17.25
2.9.6	Installation at SURF	25	30.1

3.9	Data Aquisition (DP-DAQ)	2007.1	95.775

Labour Breakdown



- Estimates adequate to motivate national planning, highlight critical areas
  - Much more refinement at subproject level is needed before approval-to-spend
- Peak effort estimate: 60 FTE
  - Clearly much more work to do in finding more contributors

Risk Register

Detector noise specs not met	External	0.25	0.5	50% increase in cost of FPGAs, + $2M	Add additional filtering using larger FPGAs or computing system. Add L2 farm.
Externally-driven schedule change	External	0.25	0.5	TBD	Adjust schedule for stand-alone testing and commissioning phases
Lack of expert personnel	Project-wide	0.5	0.25	TBD	Adapt DAQ schedule, using float
Power / space requirements exceed CUC capacity	Project-wide	0.25	0.25	Cost of surface facility and network equipment. ~$2M.	Expend additional resource on surface facility.
Excess fake trigger rate from instrumental effects	Project-wide	0.1	0.75	50% cost increase for FPGAs, ~$2M. Additional network bandwidth and computing resources.	Substantially increase data volume. Add L2 farm. Additional filtering using larger FPGAs or computing system.
Calibration requirements exceed acceptable data rate	Project-wide	0.1	0.5	100% cost increase for BE farm, ~$300k	Add more EB and L2 capacity.
Cost / performance of hardware / computing excessive	Project-wide	0.1	0.25	TBD	Reduce performance or identify additional funds
Optical components obselete before production	FE	0.25	0.25	Schedule delay	Change of design for both DAQ and WIB / uTCA.

Risk Register

Insufficient FPGA processing resources	FE	0.25	0.25	Replacement FPGAs, ~$4M	Replace FPGAs or sustain higher data rates.
Insufficient throughput in computing system	FE	0.25	0.25	Cost of additional computing	Expand system capacity before commissioning
Event builder throughput insufficient	BE	0.25	0.25	Cost of additional computing	Expand system capacity before commissioning
Additional data reduction steps required after BE	BE	0.5	0.25	Cost of L2 farm, O($200k)	Add expanded L2 farm
PDTS fails to scale for DUNE SP requirements	Timing	0.1	0.25	Cost of enhanced PDTS hardware, O($100k); schedule delay	Replace PDTS with upgraded hardware
Full remote operation of DAQ proves non-viable	Infrastructure	0.1	0.25	Cost of human interface provision on site; operations costs	Allocate surface or underground control room space and facilities for DAQ operations at SURF.
DAQ system does not meet overall DUNE FD uptime specification	Project-wide	0.5	0.25	Cost of rplacement for non-compliant components, and / or increased scientific risk.	Replace non-compliant components with alternatives during future DUNE programme.
External services do not allow reliable operation of DAQ system	Project-wide	0.5	0.25	No direct cost to DAQ; increased scientific risk	None possible after construction.

Risk Strategy

- Close control of requirements, specifications and interfaces
  - Top-level requirements owned by DUNE EB (hard requirements plus ‘goals’)
  - DAQ specifications to be frozen before EDR
  - Interfaces already well established, and under change control
- Full extended system tests with ProtoDUNE
  - At least a one-year run using pre-production systems and software: find the long-term issues
- Expansion capability
  - Additional of processing or storage capacity possible at any point (at cost)
  - Expansion of filter cluster into a true HLT as a fall-back
- Provision of full infrastructure for four modules from start
  - Ensures power / space / comms envelope is sufficient
    - Even if detector performance is not initially as expected
- Conservative data selection strategy for first years
  - Assume no clever zero-suppression, minimal data compression
  - Leave substantial margin in total data rate (~factor of three)

Responsibilities

- We are not yet at the stage of a full responsibility matrix
- Most ‘firm funding’ not yet in place
  - UK approval process under way now (first presentations: Dec 17th)
  - CERN internal discussions ongoing, direction becoming clear
  - US Universities NSF proposal in next week
  - US DoE contribution via FNAL lab funding; under discussion internally
  - Discussions in several other countries are at an earlier stage
- Ownership of key subprojects becoming established:
  - Front end: CERN / BNL / NIKHEF (FELIX); UK (FPGA)
  - Back end: FNAL (ArtDAQ), UK (filter, run control, storage), FNAL computing (network, services)
  - Data selection: US NSF, UK, widespread interest
  - Timing system: UK, US (Penn)
  - Technical planning : UK, FNAL computing, US (UMD)
- Main gaps: run control, monitoring, data management, databases

Tightest Paths

- Current evaluation, subject to change
- Path 1 (start now, end at commencement of APA installation)
  - ProtoDUNE-SP setup ->
  - ProtoDUNE-SP run ->
  - EDR ->
  - CUC procurement ->
  - CUC installation ->
  - ‘SURF ready’
- Path 2 (start at cryostat closure, end at ‘DAQ ready’)
  - Data selection installation ->
  - Data selection commissioning