Costing Workshop Summary

Chris Rogers, RAL, 30 Mar 2010

- Establish a common framework for costing of neutrino facilities
  - Compare Beta Beam, Super beam and Neutrino Factory on an equal footing
  - In context of EuroNu – EU “funded” neutrino facility study
- Well attended by European Neutrino facility community
  - 30 registrants, mostly work package managers etc
  - (But all projects have more managers than workers it seems)
- Discussion:
  - How is project costing done in general
  - What goes in the costing – and what is excluded
  - Practicalities – which site, which currency, etc
  - Who has responsibility for which bit (e.g. detectors, proton driver)
  - Costing Tools
  - Case Studies/EuroNu cost status
- Some things loosely decided, TBD by costing subcommittee
  - First iteration – another workshop in November/December
- Disclaimer: my own personal view

Project Costing in General

- Basic approach:
  - Split project into portions (Project Breakdown Structure) and cost portions based on parameter fit to historical data
  - Iterate at successively higher levels of detail until you run out of time or you are getting quotes from manufacturers
- E.g. for a house,
  - First costing based on number of floors, area, ground conditions
  - Second costing based on cost of each bathroom, kitchen, etc
  - And so on
- For comparison with historical data
  - Use scale factor for relative costs between different countries
    - Currencies and economic factors (plumbers in UK are expensive)
  - Use scale factor for different years
    - Inflation and economic factors
  - Published tables e.g. costdataonline.com
- I expect we can't make a useful costing unless we at least break down to level of individual magnets, cavities, power supplies

More on Project Costing

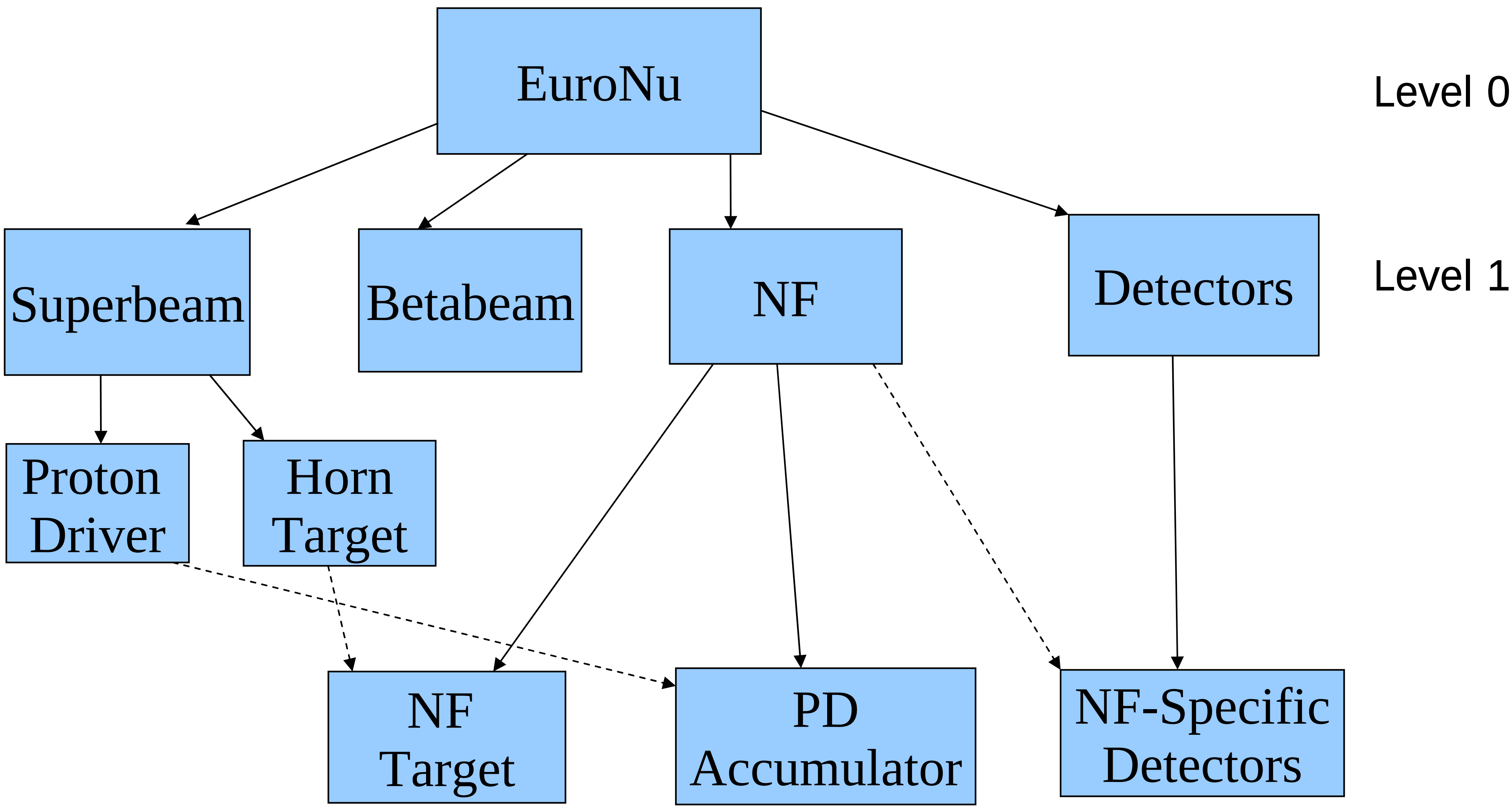
- Need to enumerate risks
  - Expensive, high-risk items are bad
- Include cheapest solution as baseline
  - If risk mitigation is needed, include it as a (costed) alternative
- Cite sources for costings
- Cost at <todays date> in <project currency>
- Include non-financial criteria
  - Location, eco-impact, etc

Practicalities

- Discussed site independent cost with site-dependent terms added
  - Sounds difficult/impossible
- Suggestion of study at CERN (EuroNu context)
  - Do we do a study for CERN and a study for e.g. Fermilab?
  - We need to put everything in tunnels
    - Is this necessary anyway? Muons loose about 0.5 GeV/m in concrete, => 5 GeV muons need about 10 m shielding
    - Depending on pessimism of safety guys
  - Relies on engineering, civil engineering support from CERN
- Presumably costs in Euros or Swiss Francs (TBD)
- R&D to be costed but not included in the final total
- Include maintenance, operation, dismantling
- Manpower estimate included as FTE

Division of work

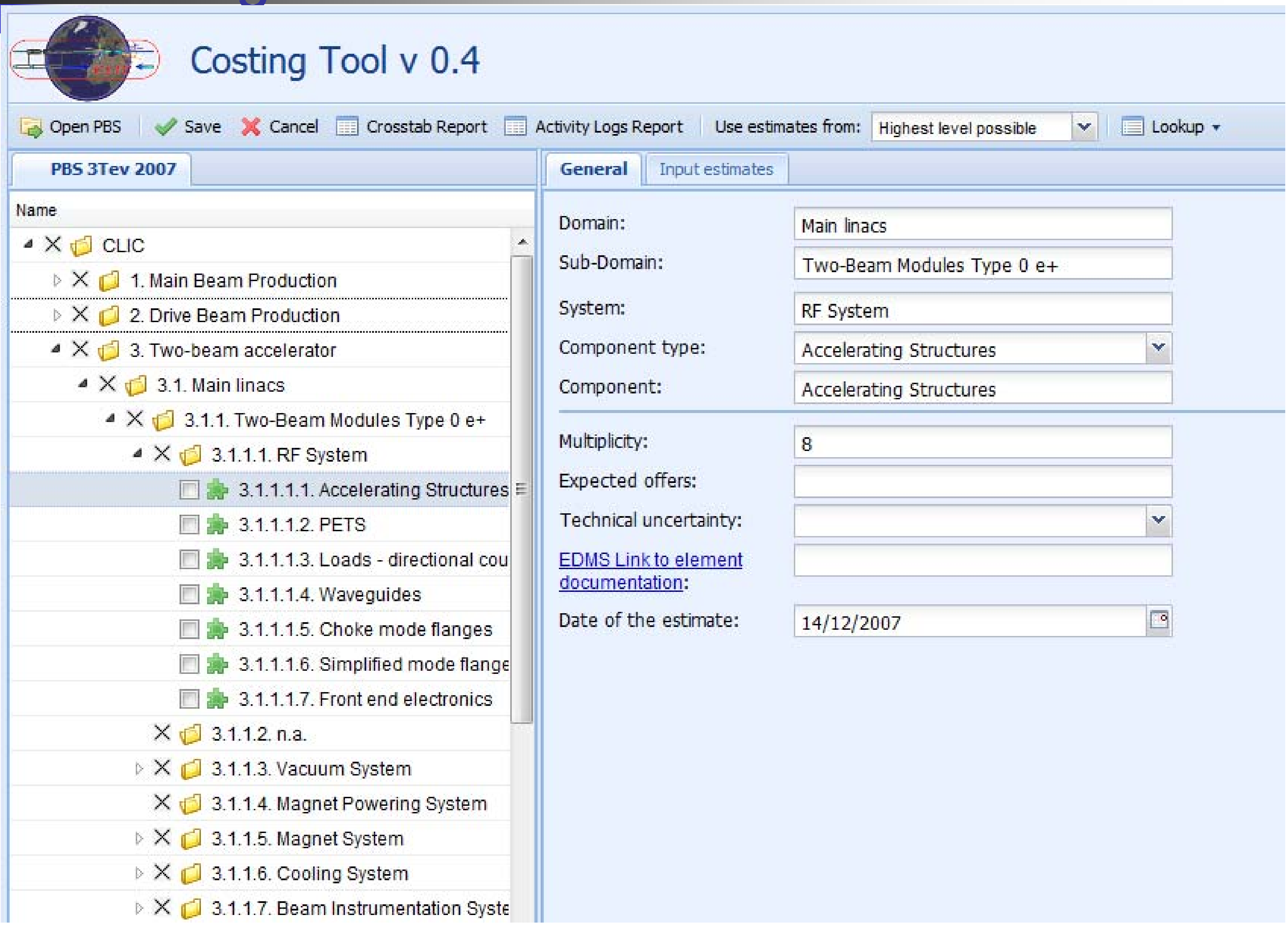
- Interface between overlapping work packages not entirely clear
  - Most Work Packages are not shown!



Costing Tool

- Costing tool to handle some bureaucracy
  - I couldn't find a URL – so haven't looked at it directly
  - Actively supported by CERN
    - And they have promised to support us also
  - Used for CLIC – they are keen for more users
  - About 1-2 years old
- Keeps a list of Project Breakdown Structure
  - Version control
  - Handles currency conversion, Economic factors conversion, etc
  - Various reporting tools
    - Export to excel, etc
- It does not tell you the cost of an RF cavity, magnet, etc
  - AFAIK

Costing Tool

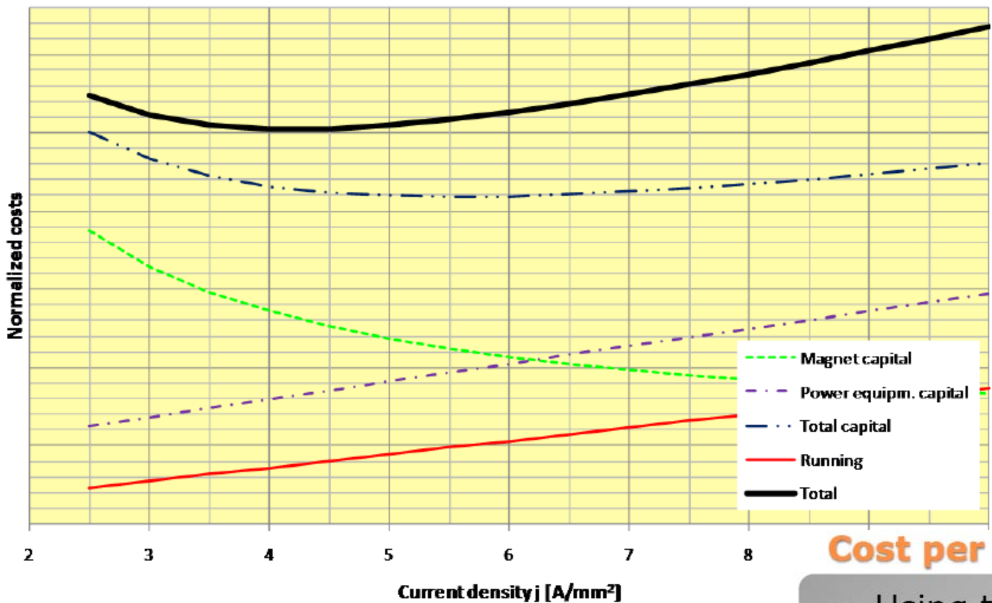


Case Studies

- Summary of case studies
  - Needs contribution from hardware experts involved in design
  - Takes significant resources
  - Needs quite a bit of detail
    - Determine tunnel layout => determine tunnel size => CE cost
- Speaking qualitatively
  - NuFact is most organised, most advanced
    - Technical solutions, lattice design + R&D programmes in place
  - But NuFact has most accelerator subsystems, most work
  - NuFact costing aim:
    - Capital cost, staff effort, timescale
    - Uncertainty, risk analysis
    - Present, and prepare, cost for different funding agencies, etc

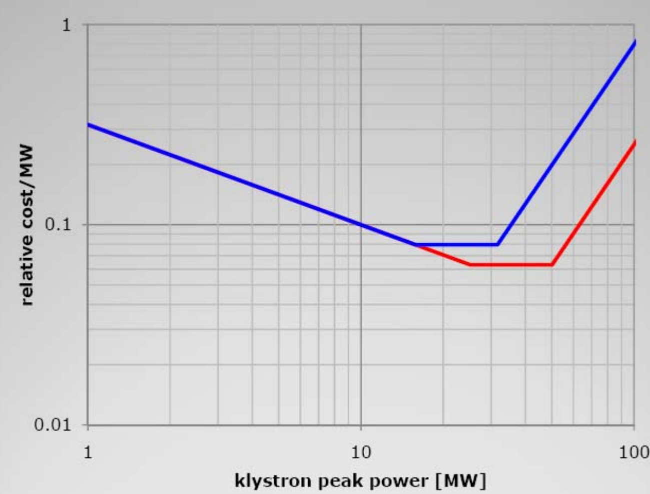
Level 2	Level 3
	proton driver
	pion production
	proton beam dump
	decay region
	phase rotation region
	bunching region
	cooling channel
	cooling→linac transfer line
	muon linac
accelerator	linac→RLA 1 transfer line
	(double chicane 1)
	muon RLA 1
	linac→RLA 2 transfer line
	(double chicane 2)
	muon RLA 2
	RLA 2 → FFAG transfer line
	muon FFAG
	FFAG → ring transfer line
	muon decay ring

E.g. CLIC



Cost per MW

- Using the above model, here's the klystron cost per MW (peak)



E. Jensen

- Blue: present state of the art
- Red: assuming a major investment into the development of a dedicated 30 MW tube