



Signal Processing Costs

R. McCool

2011-04-15

Contents



- SKA Costing strategy
- Concept costs introduction
- Concept cost presentations
 - Correlator
 - Central Beamformer
 - Non-Imaging Processing
 - PAF Beamforming

Costing Strategy



Cost estimation will be an on-going and iterative process

Confidence levels in cost estimates are predicated on

- Maturity of the SKA design
- Substantiating & Supporting Evidence

When estimating sub-system costs, data is provided for the lowest sub-assembly for which reliable cost information is available.

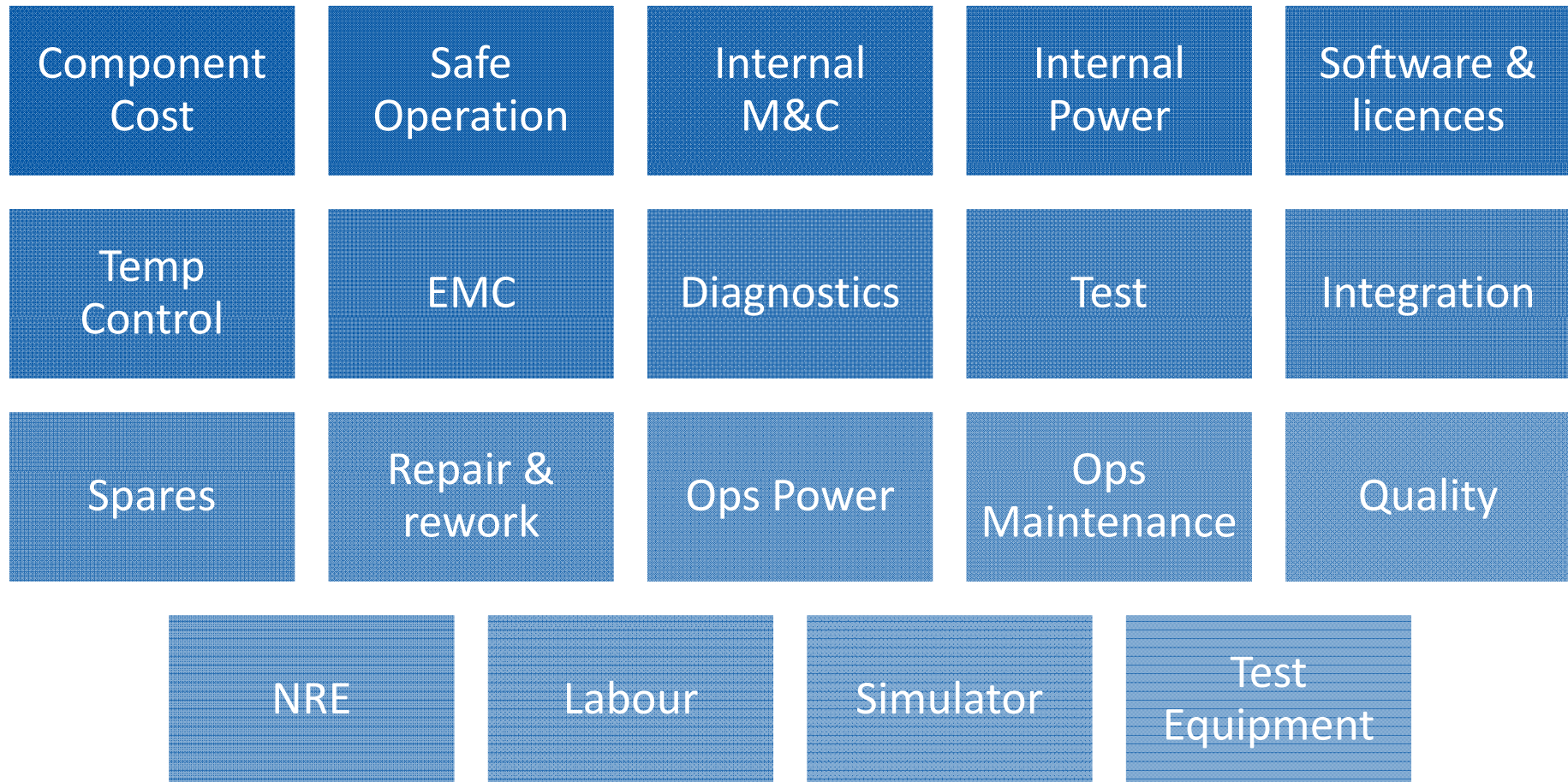
Basis of Estimate



BECL #	Description
5	Lowest BE rating. Costs based on anecdotal evidence and best guess scenarios. (CoDR)
4	Technical specifications in r guess. Quantities reasonably well known. (SRR)
3	Technical specifications under peer review. Costs obtained from reliable sources and reiterated several times. Quantities known to high degree. (CDR)
2	Technical Specifications finalized. Schedule of delivery finalized. Quantities finalized. Contractual arrangements being concluded. Variations unlikely. (PR)
1	Highest BE rating. Meets all of the requirements for BE2. Corroborative evidence from actual costs incurred elsewhere (Precursor). Supply contract firm. (Contract)

Signal Processing CoDR BECL Level 5

Cost Components



Cost Component Coverage



Description of cost	software correlator 1	software correlator 2	GSA Correlator	ASKAP (scaled)	Uniboard (scaled)	Casper scaled	Dense AA Correlator (scaled)	Sparse AA Central	Beamformer uniboard	beamformer ASIC Station	beamformer NonImaging	Processing PAF Beamformer	Uniboard pulsar	timing
Component Cost	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Safe Operation	Y	Y	N	N	N	Y TBC	N	N	N	N	N	N	N	
Internal M&C	N	N	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	
Internal Power	Y	Y	Y	Y SKA1	N	Y	Y	Y	N	N	Y	N SKA2	N	
Internal Software &	N	N	N	N	N	N	N	N	N	N	N	N	N	
Localised or Internal	Y	Y	Y	Y	N	Y	N	Y	N	N	Y	Y	N	
EMC (shielding and	NA	NA	N	N	N	Y	Y	N	N	Y	NA	N	N	
Integrated diagnostics	Y	Y	Y	Y	Y	Y TBC	Y	Y	Y	Y	Y TBC	Y	Y	
Test, Verification,	N	N	Y	N	N	N	N	Y	N	N	N	N	N	
Internal Integration	N	N	N	N	N	N	N	N	N	N	N	N	N	
Spares	N	N	N	N	N	N	N	N	N	Y	N	N	N	
Repair and rework	N	N	N	N	N	N	N	N	N	N	N	N	N	
Quality control	N	N												
NRE development costs	N	Y												
Labour (manufacture &	N	N												
Simulators	N	N												
Test Equipment	N	N												
Lightning protection	N/A	N/A												
Environmental protection	Y	Y												
Hardware Sub?system														
Maintenance	N	N												
Annual power costs	Y	Y												
Upgrades	N	N												
Labour	N	N												

Cost Coverage for Signal processing.
 Start based on component and power costs of principle items
 Plan to complete for Preliminary Design Review
 NRE especially needs to be considered

Concepts for Correlators



- Software Correlators (*gpu*)
- GSA Correlator (*asic*)
- Programmable chip based correlators based on:
 - ASKAP (scaled)
 - Uniboard (scaled)
 - CASPER (scaled)
 - SKADs Dense AA design (scaled)

Cost Estimates (BECL 5)



Correlator Name	Cost Estimates €Million	Notes
Software Correlator 001	10	SKA0 - SKA1 Only
Software Correlator 002	22	SKA0 - SKA1 Only
GSA (scaled)	6	Scaled from SKA2 figures, based on N^2 scaling
ASKAP (scaled)	2	SKA1 extensible to SKA2
Uniboard (scaled)	7	SKA1
Casper (scaled)	98	SKA1
SKADs	38	AIP

Beamforming and Non Image Processing



- Central Beamformer
- Station beamformer
 - Uniboard
 - Hybrid ASIC/FPGA
- PAF beamformer
- Non Imaging processing
- Pulsar processing on Uniboard

Cost estimates (BECL 5)



Concept Name	Cost Estimates €Million	Notes
Central Beamformer	7.5	Adjunct to ASIC Correlator
Station Beamformer Uniboard	22	SKA1 AA-lo
Station Beamformer Hybrid ASIC/FPGA	15	SKA1 AA-lo
PAF Beamformer	11	AIP
Non Imaging Processor	28	SKA1
Pulsar processing on Uniboard	34	SKA1

Conclusions



Cost estimates at BECL 5

- Confidence expected to increase over time
- Many cost estimates based on existing pathfinder project concepts

Cost coverage 1/3 of cost components

- Expect this to increase over time
- Consider NRE in the next phase

Costs for SP feasible within cost capped SKA1 (€350M)