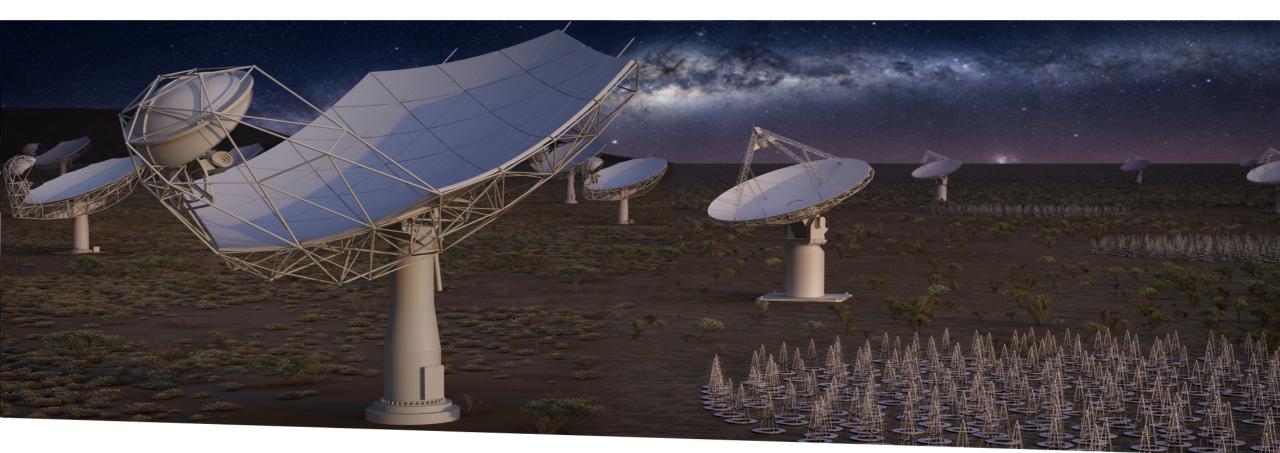
SKA Logistics Modelling





SQUARE KILOMETRE ARRAY



Agenda

- 1. The Engineering Operations Objective
- 2. Aspects explored by modelling
- 3. Overview of the Model
- 4. Status and the way forward

Science, Operational and Inherent Availability:



Telescope Availability

Critical Failure

Time to Replace

Software updates

Schedule Maintenance

Logistic Delays

Weather Utility

Inherent Availability

Operational Availability

Science Availability

1. Engineering Operations Objective:



MID Telescope – South Africa 350 MHz to 15.3 GHz 133 Dishes + 64 MeerKAT

LOW Telescope – Australia 50 MHz to 350 MHz 131,000 Antennas

Challenges

Availability – serial signal chain Testability – remote sites Reliability @ 40° C RFI – radio quiet zone

Approach

99% (of 95%) A_i 95% (of 95%) A_o 85-90% (of 95%) A_s Support Database Simulation and Sensitivity





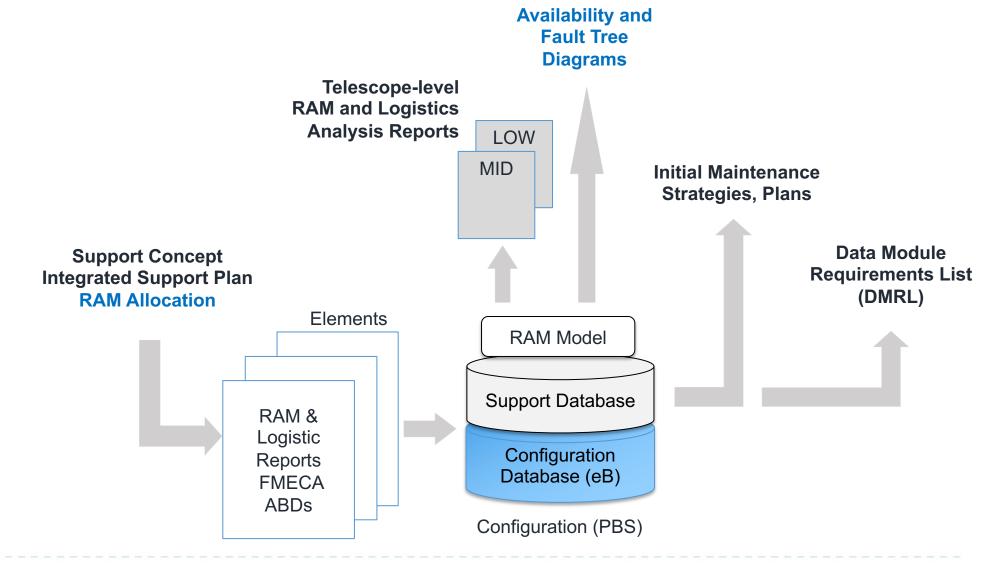


2. Logistic modelling explores:

- a) Availability compliance, sensitivity, the failure prevention/correction balance.
- b) Support organization, support flows, working patterns.
- c) Maintenance team structure, size and utilization
- d) Support element (spares, support equipment) levels and distribution.
- e) Operational Phase. Key Performance factors, sensitivity analysis.

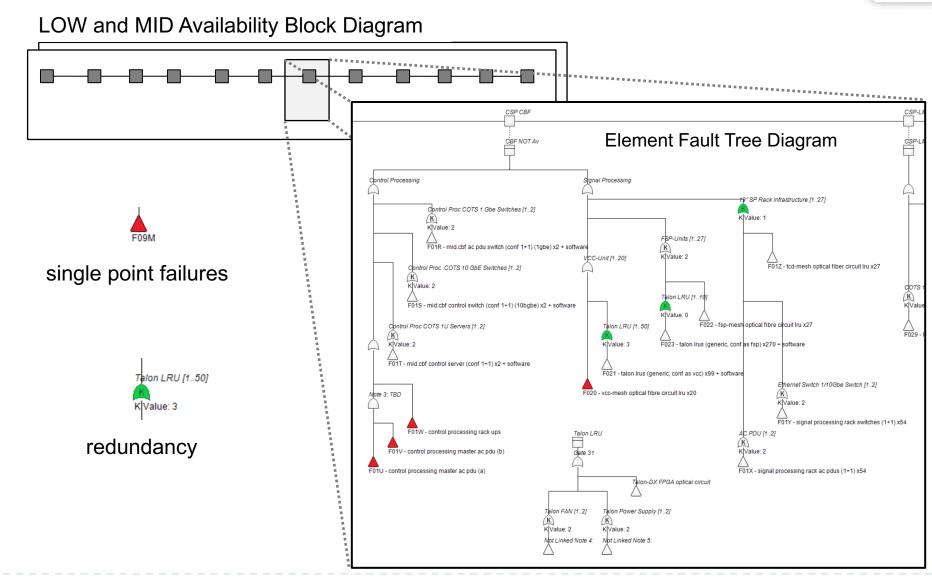
Modelling base data:





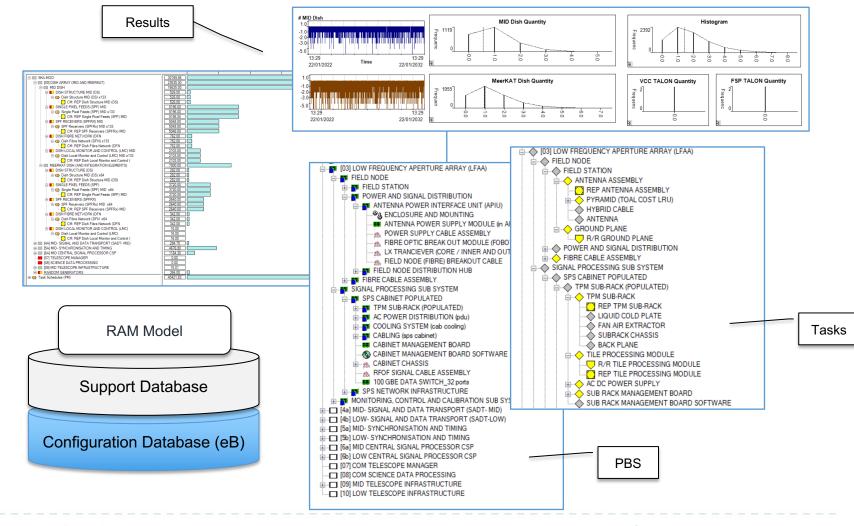
Telescope Availability Block Diagram:





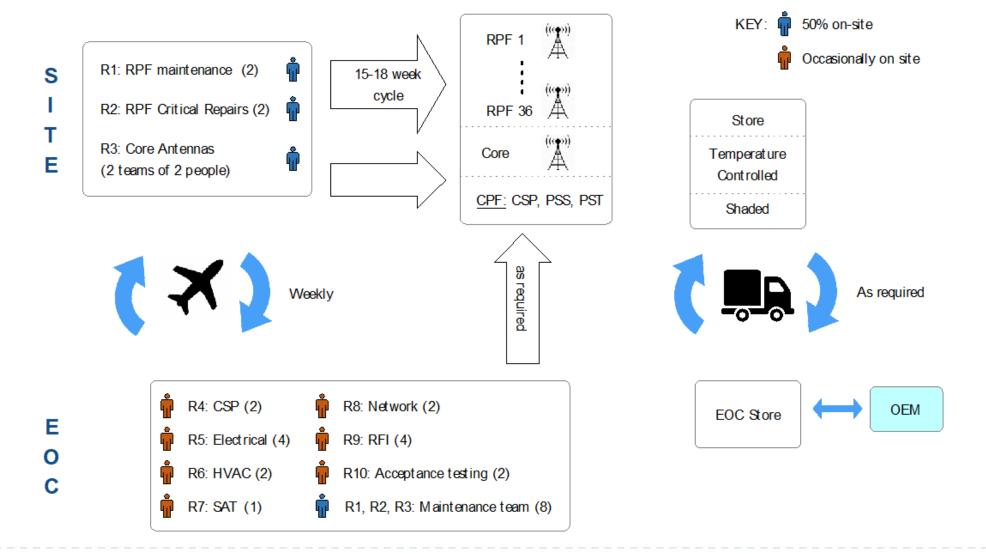






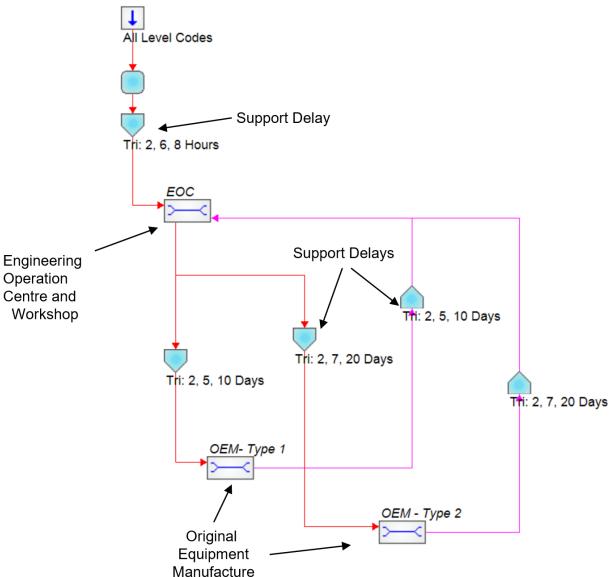
Maintenance Operations Simulation:





Simulating support topology and processing times:







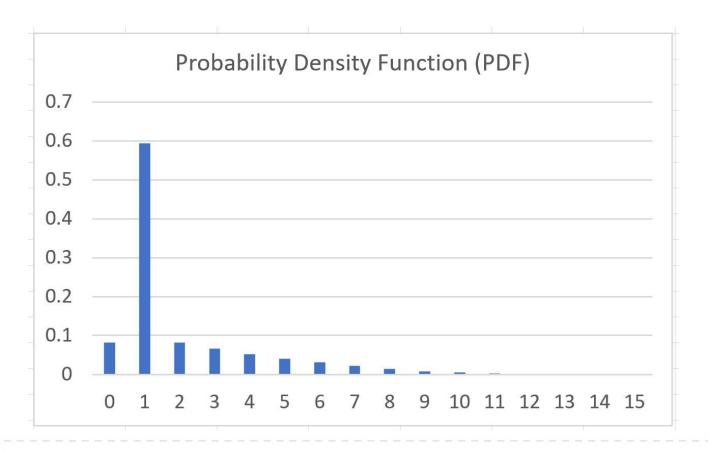
Applied to:

- Explore sensitivities and compliance
- Assess concepts
- Evaluate allocation of resources
 - Feasibility of the SKA work pattern and a 5-day week.
 - Manpower scaling for the maintenance roles assigned on basis of required skills and capabilities.



Probability Density Function (PDF):

Model computes probability (y-axis), at any given time, of the number of stations / dishes (x-axis) not available for science operations.



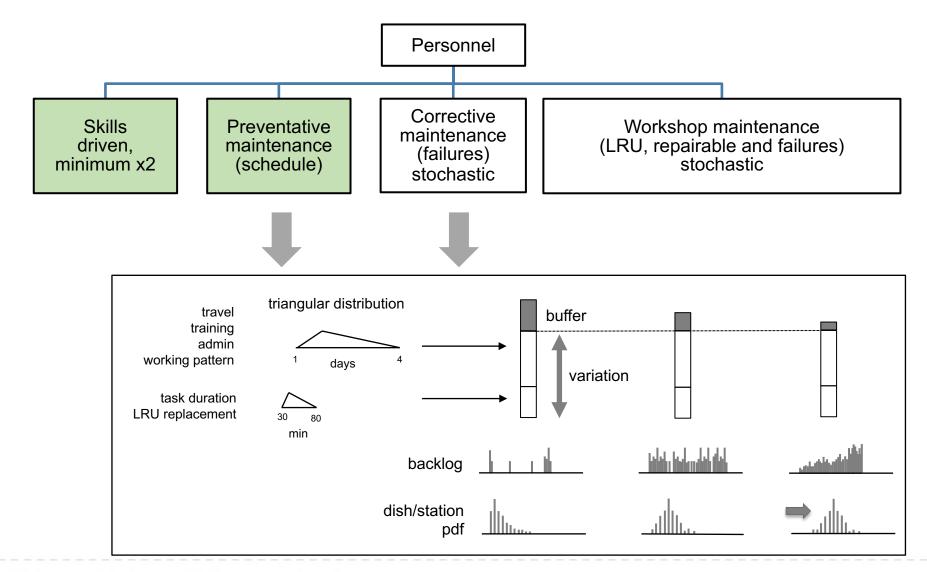


Notes:

- Failures will generally be stochastic. For a fully-loaded personnel scenario that can result in maintenance backlog.
 (Risk of Telescope down time and degradation).
- Model evaluates the buffer (uncommitted manpower capacity) required to mitigate backlog.
- Optimal buffer size:
 Sustaining Telescope operational availability with minimized idle resources.



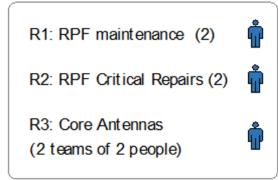
Manpower Balancing:





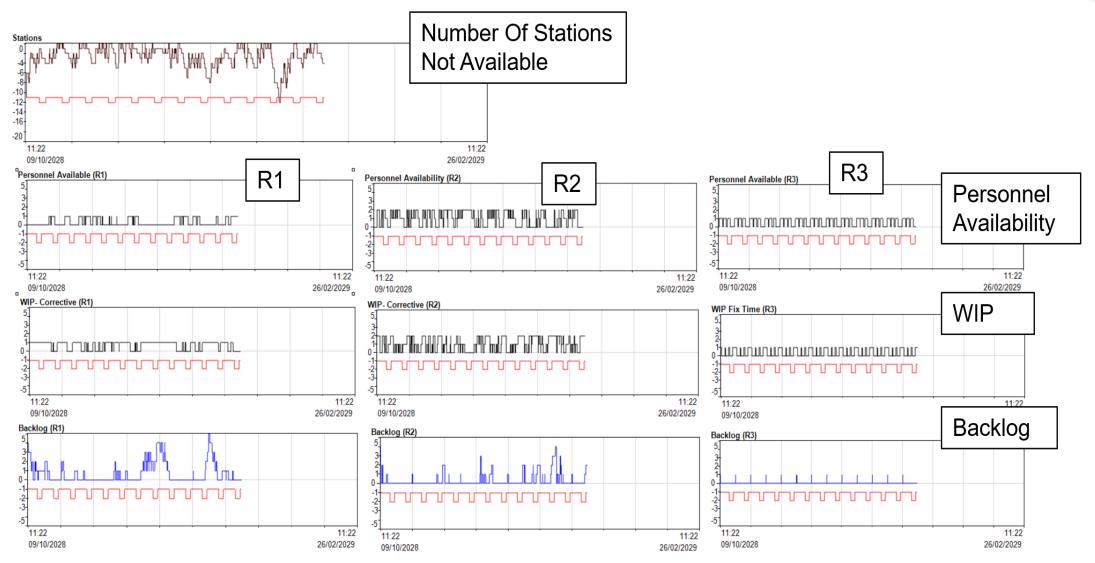
Sensitivity Analysis:

- Receptor availability.
- Work in Progress (WIP), staff availability.
- Maintenance Backlog queue per maintenance role e.g.:



Sensitivity Analysis:







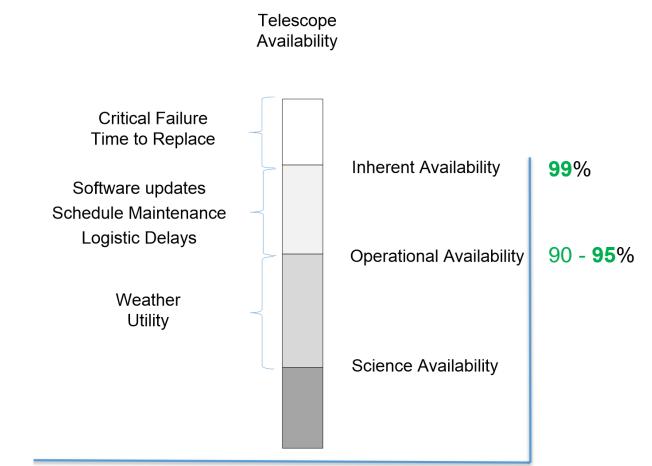




4. Way Forward

Availability compliance (Yes – the design phase RAM and Logistic Engineering work is paying off).

Future: FFMECA (Optimise redundancies, manage single points of failure. Mature modelling base data (pre-cursor experience, field data), maintenance strategies. optimization (Corrective vs. Preventive, Intervals, Condition-based).





4. Way Forward

- **Availability** compliance (Yes, the design phase initiatives are paying off). Future: FFMECA (Optimise redundancies, managing single points of failure. Maturing base data (field data, pre-cursor experience), maintenance strategies (Corrective vs. Preventive, Intervals, Condition-based).
- **Support organization**, support flows, working patterns. (Firm confirmed feasible) Future: Assess specific RFI constraints to maintenance. Maintenance patterns exceeding 10 years (Antenna re-coating) etc.
- **Maintenance team** structure, size and utilization. (Framework established) Future: Liaison on base data. Explore integration/ cross-skilling opportunities. Elaborate SLA performance requirements.
- **Support element** (spares, support equipment) **levels and distribution** (Future) Model probabilities of resources ready when required (P(Spares in store) etc.) Diagnostic delays.
- e) Operational Management.

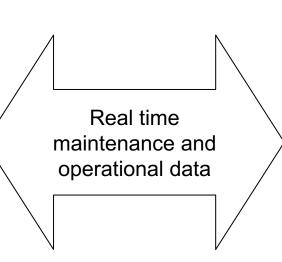
 (Future) Systematic transition from estimates to factual data (SKAO Engineering Management Information system). Key Performance tracking. Enabler for continuous improvement.

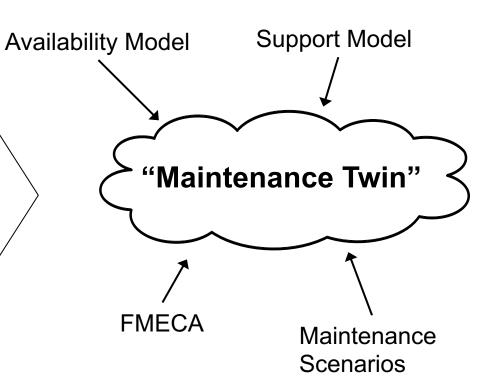












Enabler for Engineering Operations Commissioning







REALITY

Maintenance

Operations

Monitor and Control

Systems

Support Infrastructure



DATA

Operational Data **Activity Data** Failure and Repair Data **Monitor Data Configuration Data**



ABD and FTA Maintenance Schedule Task Procedures Personnel Requirement **Spare Requirements** Failure Modes (FMECA) Task Lists **Physical Configuration Audit**



VIRTUAL TWIN

Availability and Support Model

Support Analysis Database (LSAR)

> Configuration Management





Thank You

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Exploring the Universe with the world's largest radio telescope

