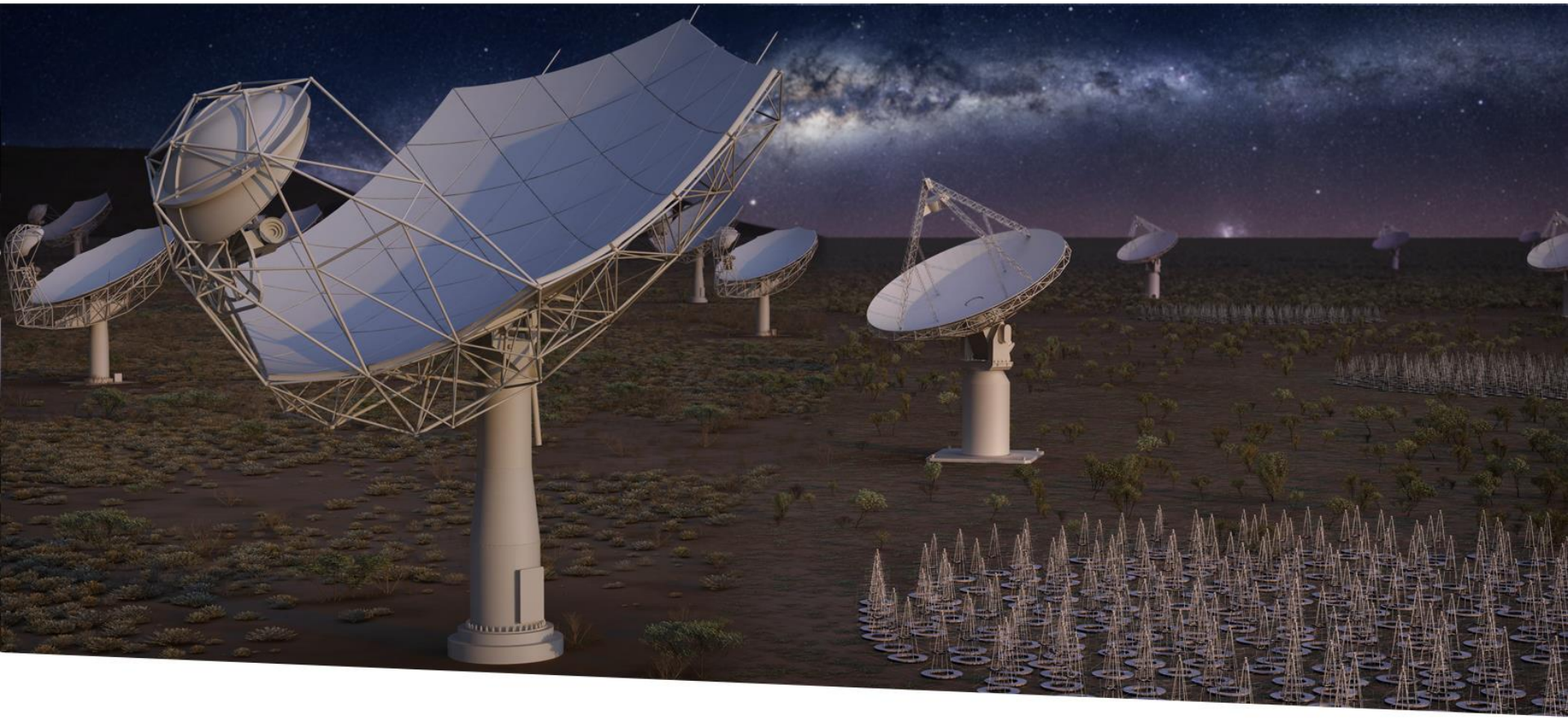
EMEA Workshop 2019

Reliability Engineering: RAM and Support Modelling



SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope

C Taljaard

11 October 2019

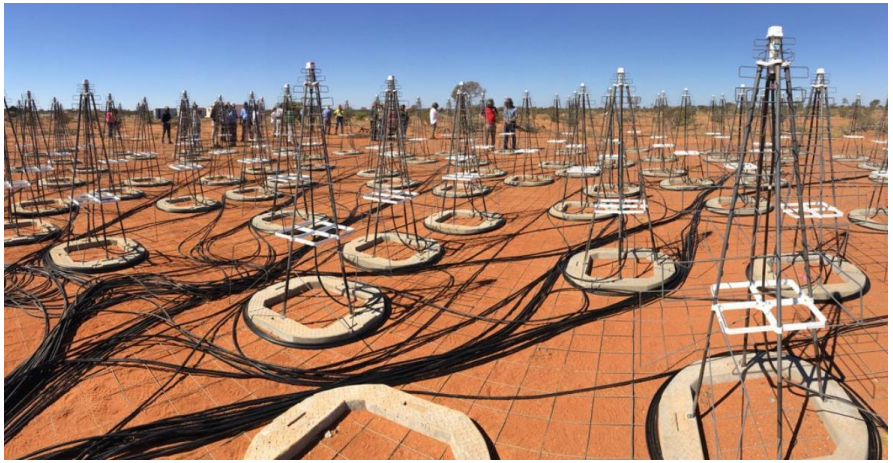
SKA Two Telescopes

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

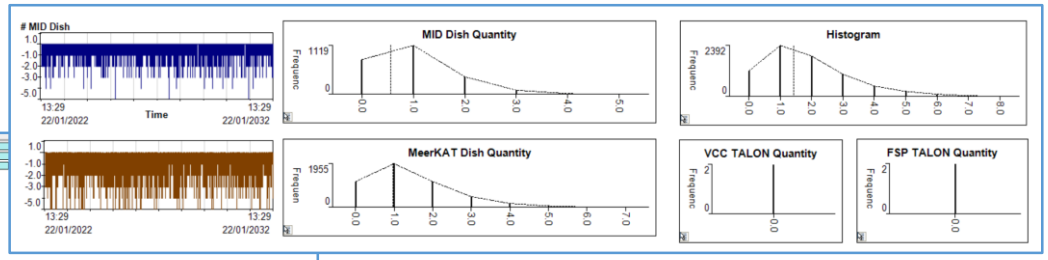
Challenges
- Availability – serial signal chain
- Testability – remote sites
- Reliability @ 40° C
- RFI – radio quiet zone

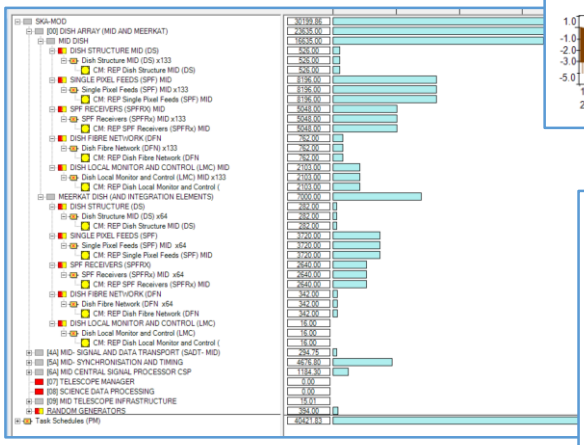
Approach
- 99% (of 95%) A_i
- 95% (of 95%) A_o
- 85-90% (of 95%) A_s
- Support Database
- Simulation and Sensitivity



Support Database and Model

Results

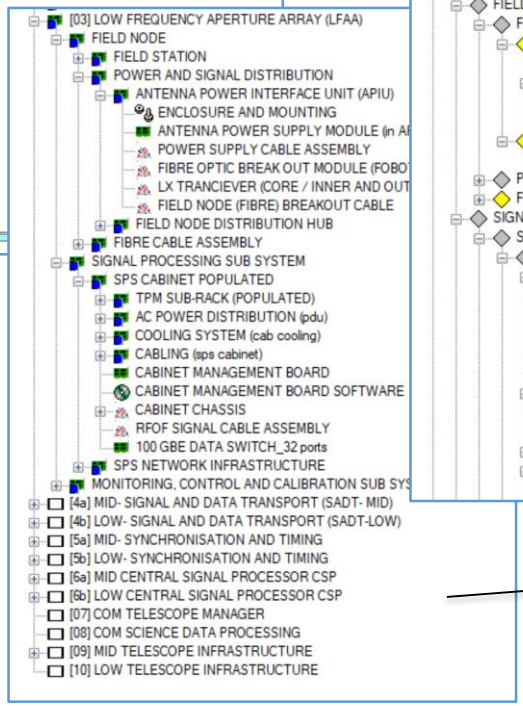


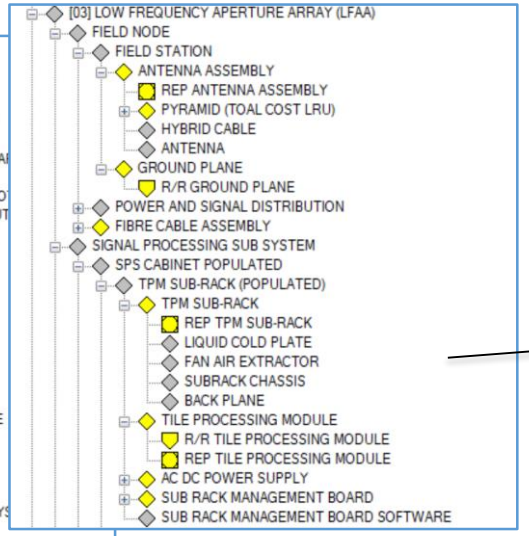


RAM Model

Support Database

Configuration Database (eB)



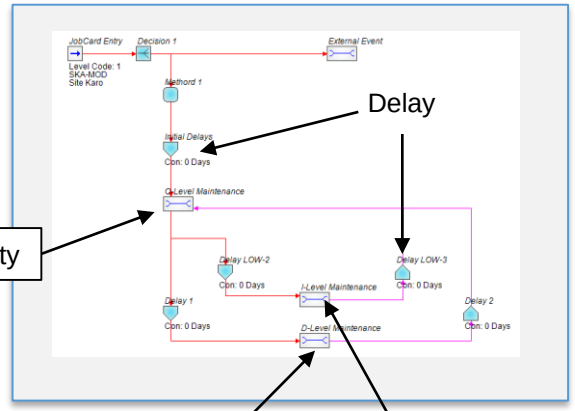


Tasks

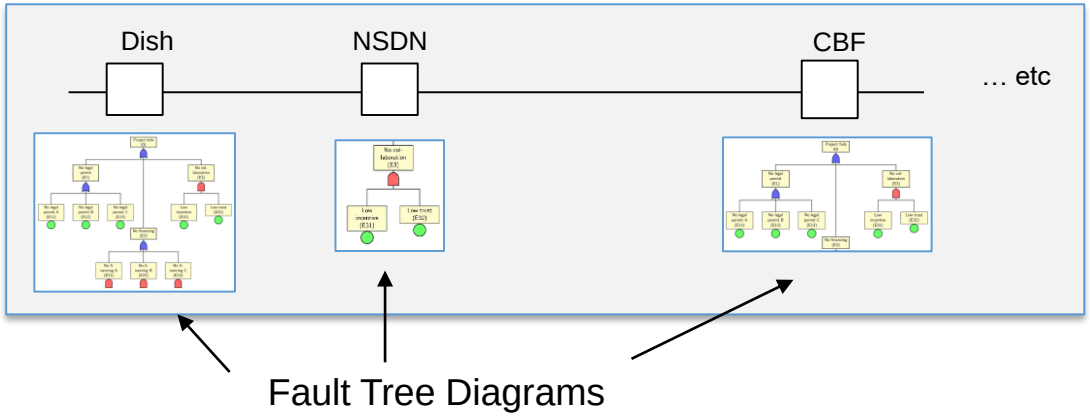
PBS

Availability and Support Model

- Availability Block Diagram and Fault Tree Combination
- Extract Data from the Support Database
- Simulate the Support Plan/Concept



Availability Block Diagram



$$A_{tot} = \prod_{i=1}^{M} A_i$$

AND (redundancy)

OR gate (serial)

k out of n

single point of failure

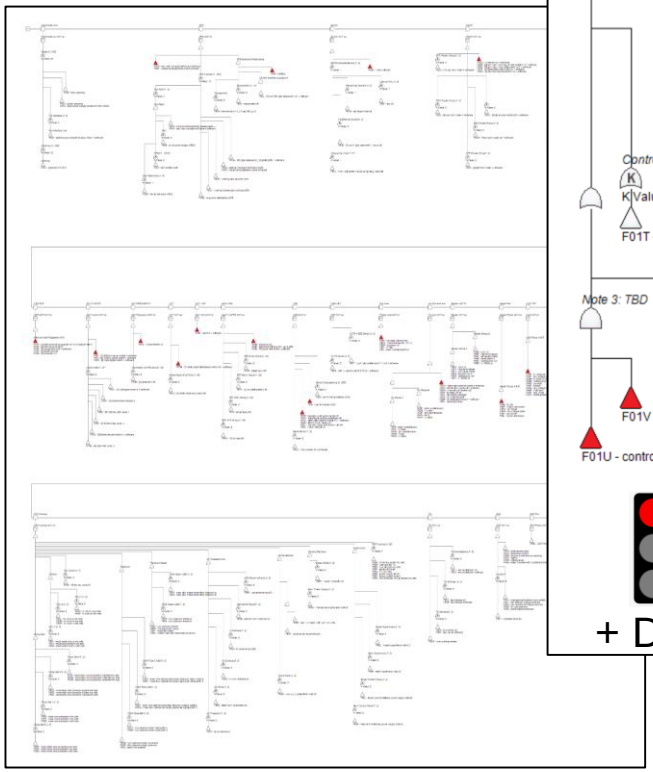
degradation

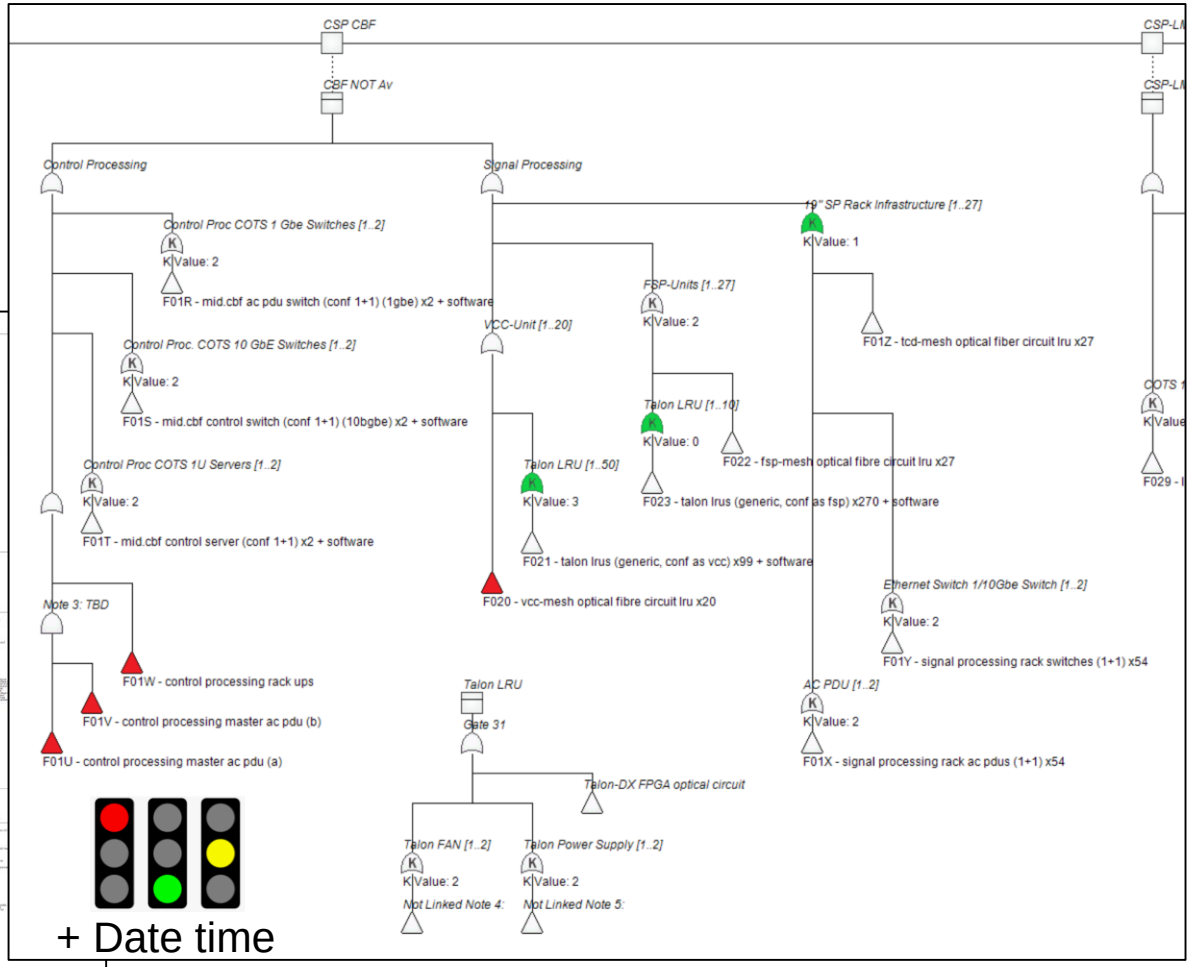
failure

Availability Model

Three Types of Redundancy

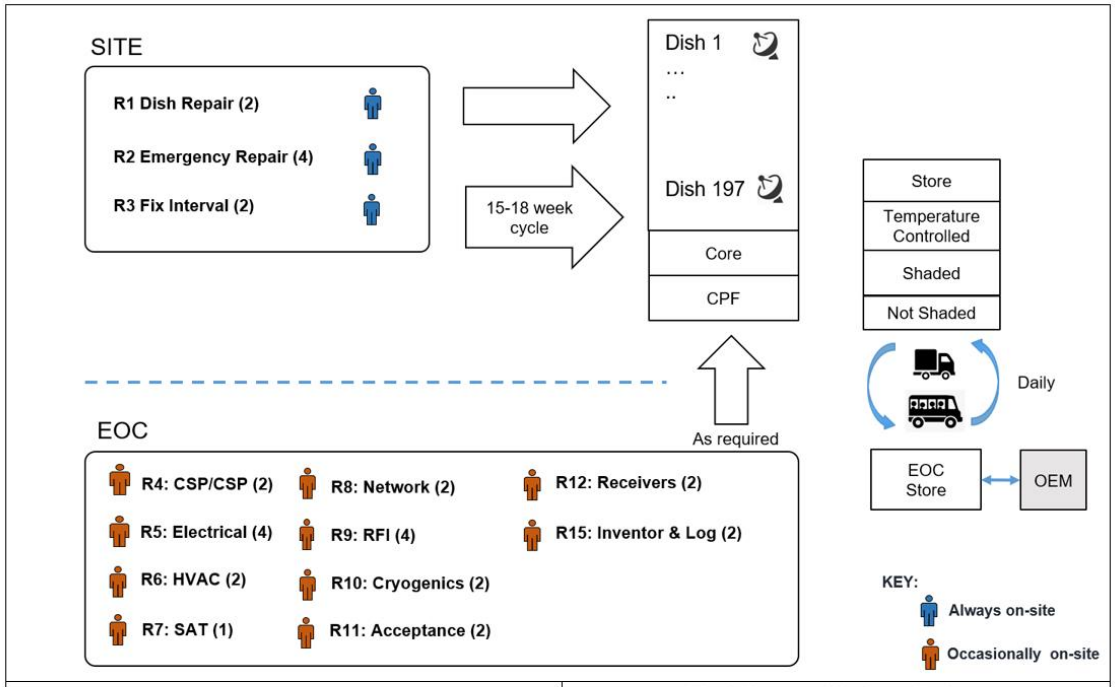
- Array & Processing
- Built-in/Designed-in
- Single Point of Failures

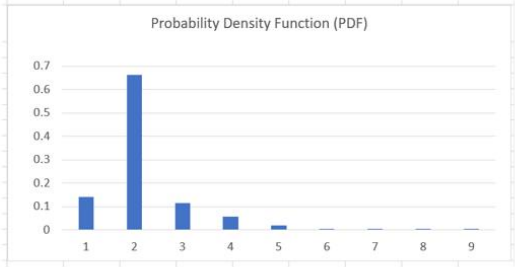


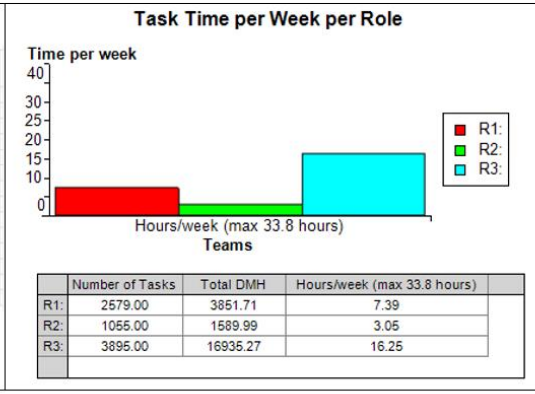


+ Date time

Modelling Results

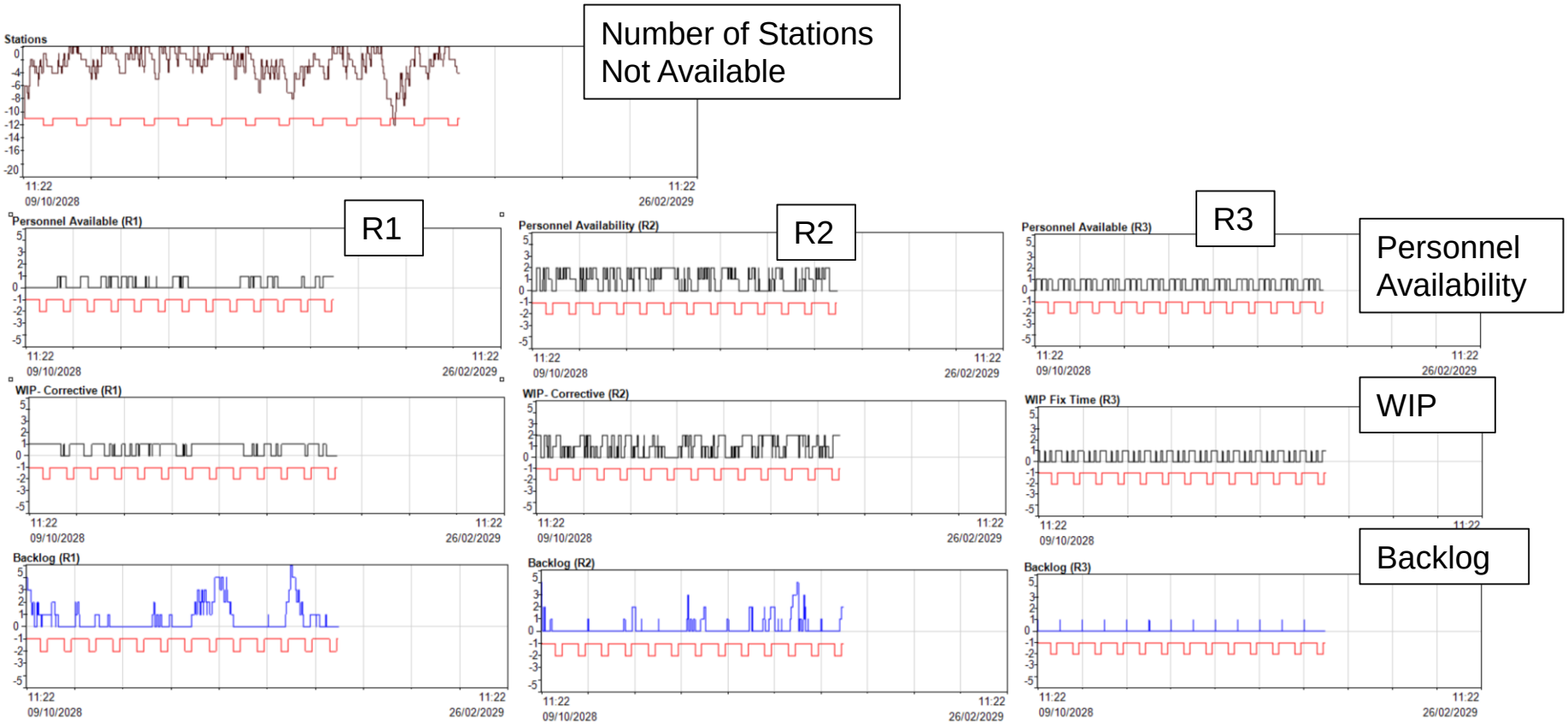




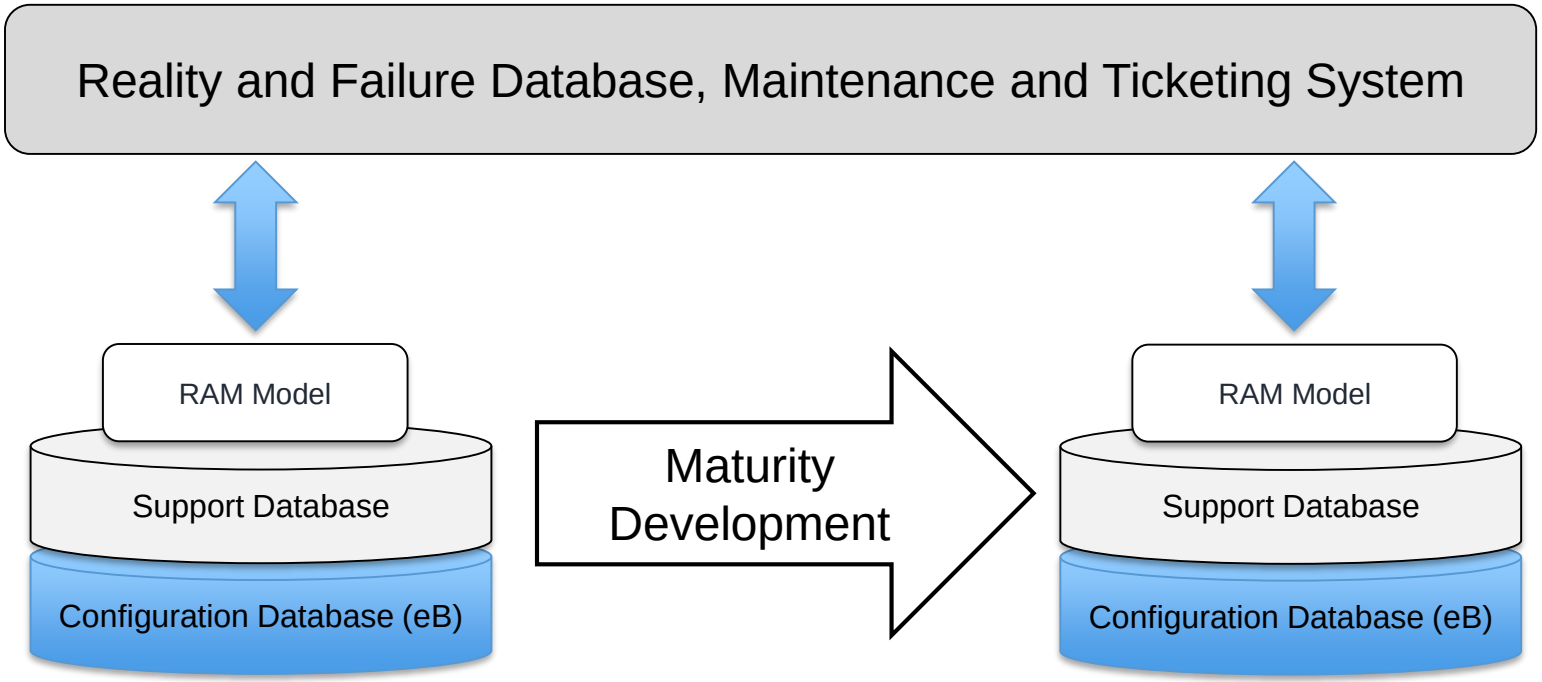


	Number of Tasks	Total DMH	Hours/week (max 33.8 hours)
R1:	2579.00	3851.71	7.39
R2:	1055.00	1589.99	3.05
R3:	3895.00	16935.27	16.25

Modelling Results



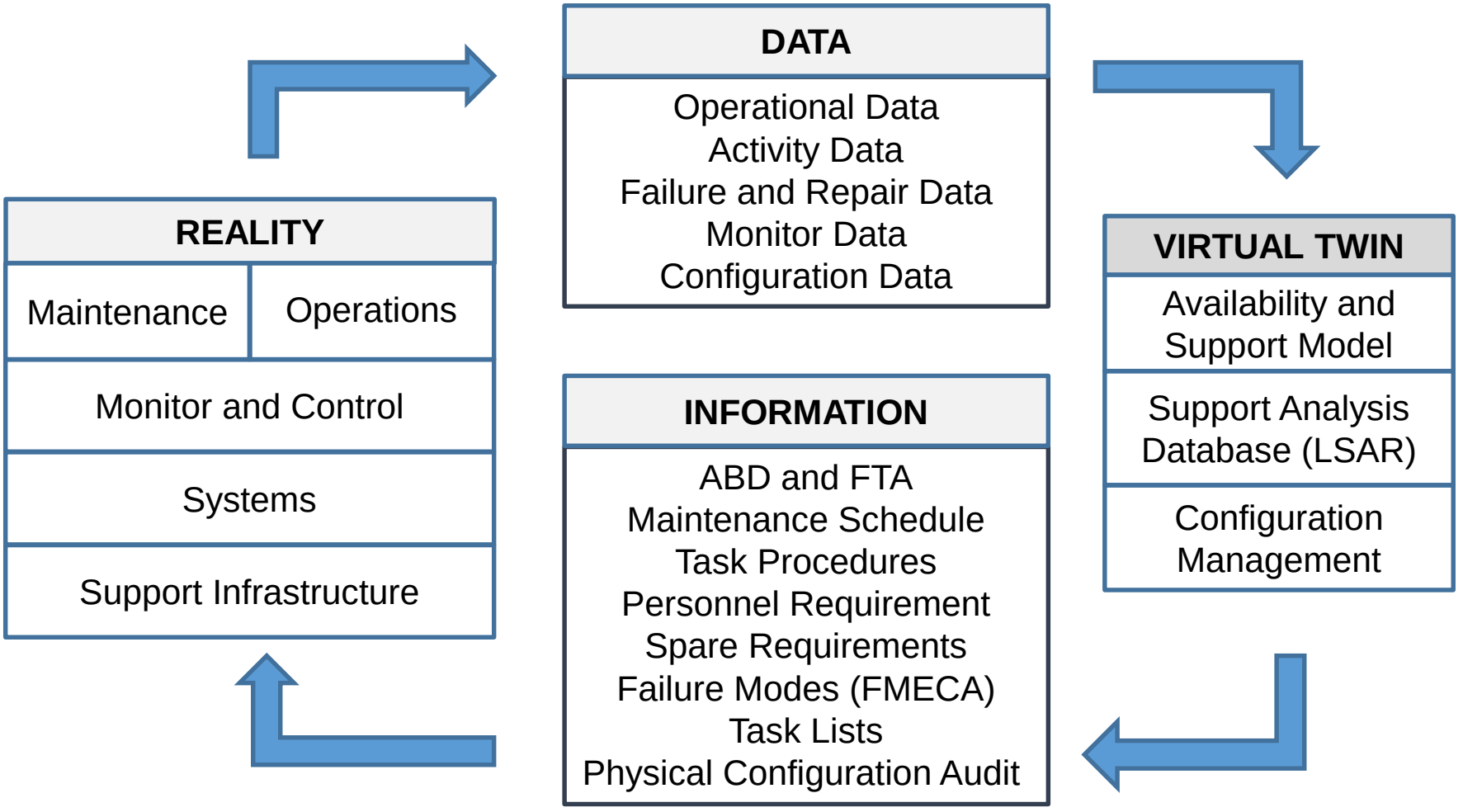
Continuous Improvement



"If you do not measure it you cannot manage it"
W. Deming

Digital twin… support system

Digital Twin



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