

Integrated Operations Programme – Operations Performance Management in the ELT Area

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Where we are!

The Challenge & Opportunities

SWOT Analysis across all stakeholders



Strengths:

- Deep domain expertise in all major functions
 - Rich data from CMMS, Science, and logs
 - Culture of operational resilience
 - VLT as testbench for ELT

Weaknesses:

- Fragmented indicators and tools
- Many silos (engineering vs science vs project)
 - Reliance on local expertise and memory
 - No integrated tool

Opportunities:

- Integrated view of science and ops performance
- Forecasting and predictive maintenance potential
- Support staff transition with structured knowledge
 - Alignment with ELT scale and expectations

Threats:

- Loss of operational knowledge with staff turnover
 - Overestimate AI/ML capabilities
- Size and amount of data from ELT
 - Data quality and integrity



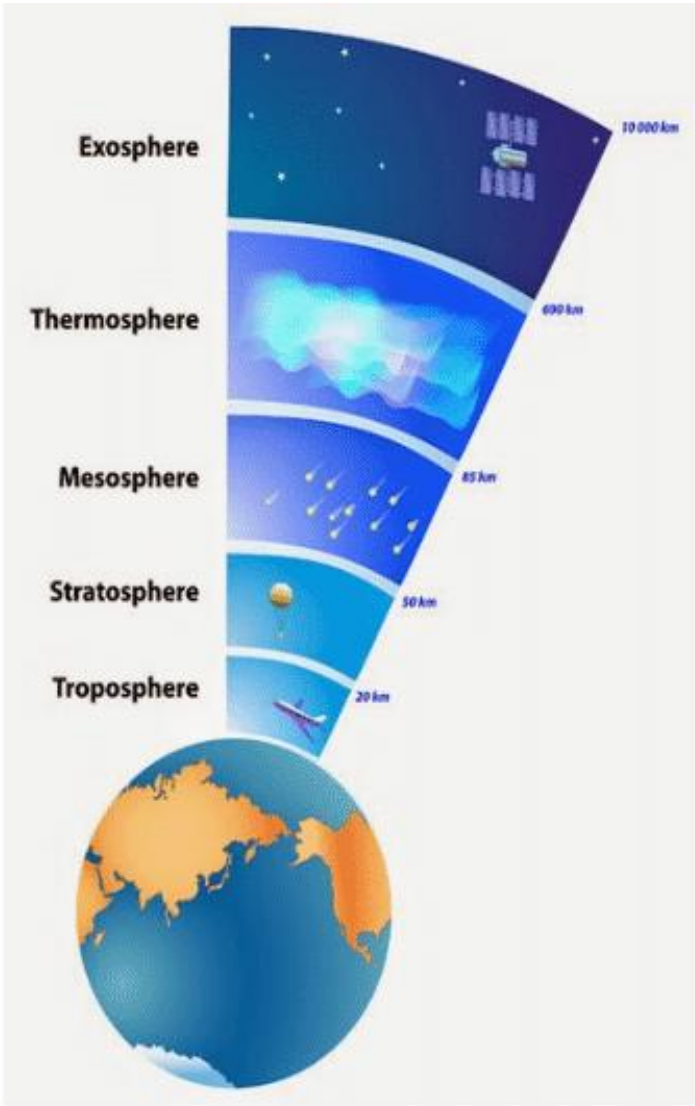
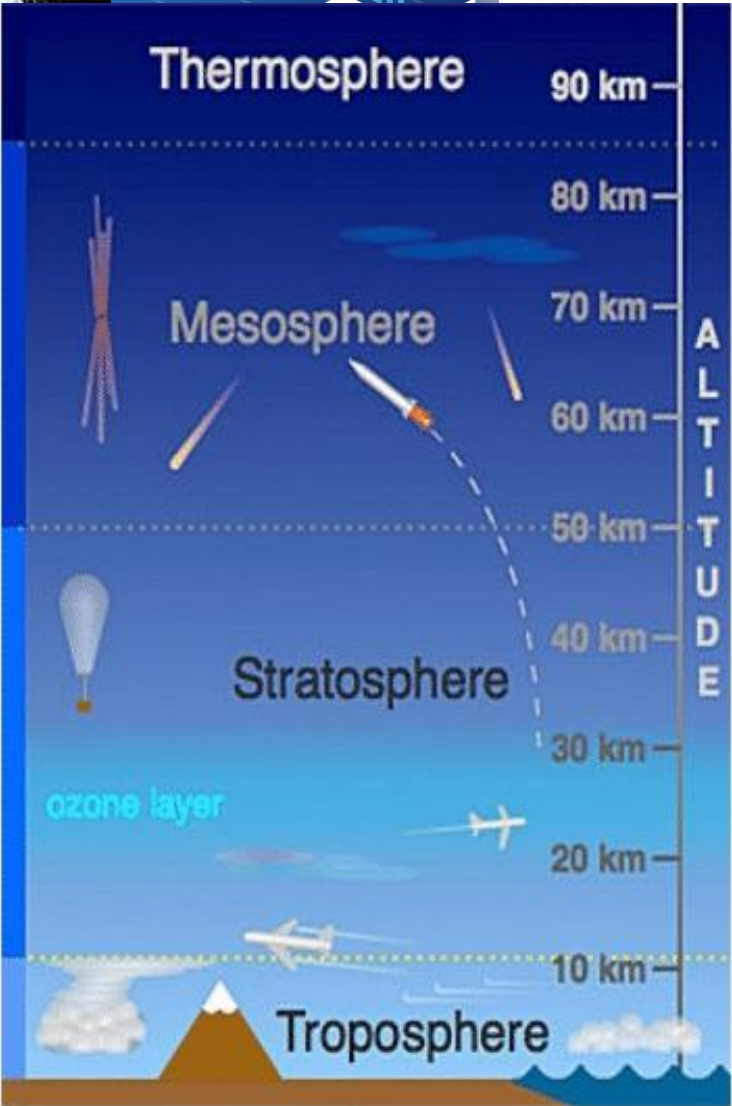
Where we want to go!

Develop and implement a **team** and **system** to understand, maintain and enhance Observatory performance and enable **data driven** operations!

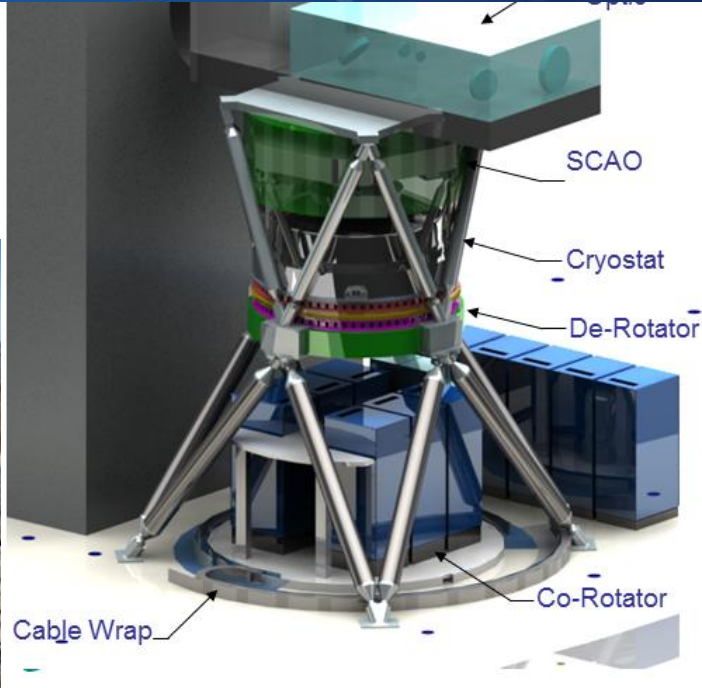
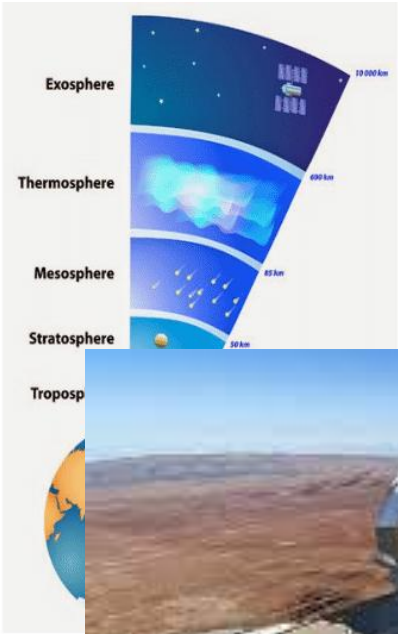
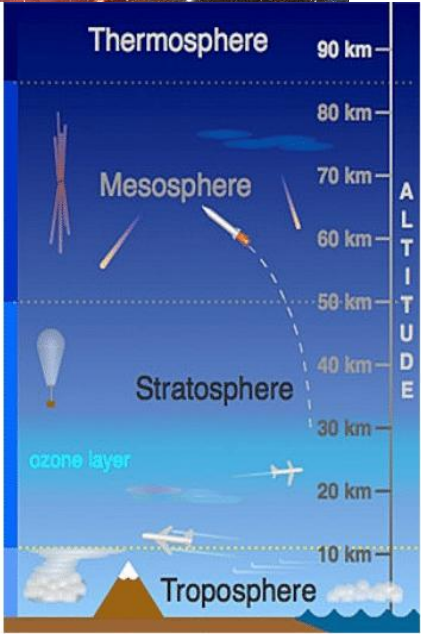
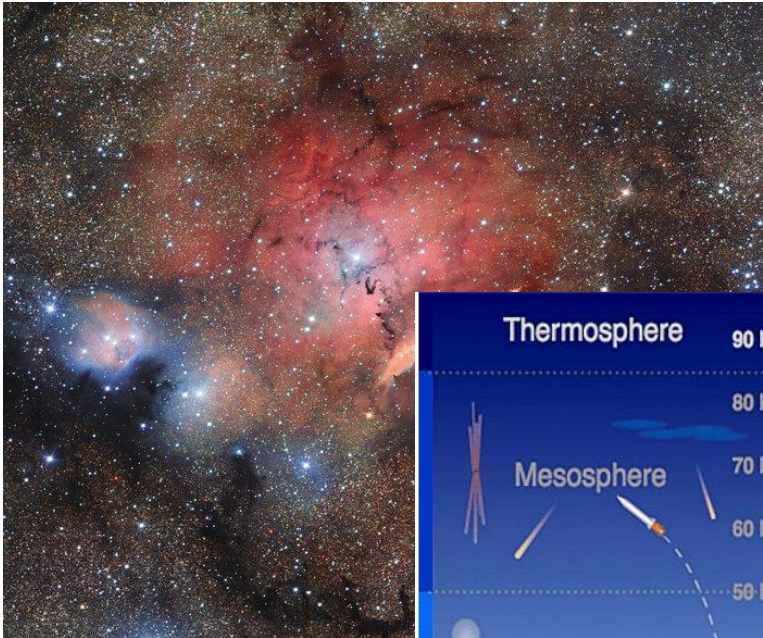
- Secure remote operations
- Predictive maintenance and operations
- Data-supported planning/scheduling of all Observatory functions

What involves Operations Performance?

What do we need to monitor/manage to enable data driven operations / data aided decisions?



End-to-End Performance



Architecture Building Blocks – Overview



Operations Performance Management Architecture

Strategy & Concept of Operations

Process Model

KPI System



Holistic E2E Performance Mgmt. Approach

Quality & Performance Mgmt. Process Team

Integrated Performance Mgmt. Platform

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Main area for collaboration

Implementation of Future Integrated Performance Mgmt. Platform



Phased implementation of future Smart Performance Management Platform



- Define L0 KPI
- Identify and optimize Observatory KPI
- Define and implement a centralized KPI Repository that allows configuration and quality control
- Define and implement a (set) Dashboard(s) that allow easy access to all FBS KPI relevant for specific stakeholders
- Visualize FBS
- Set basic thresholds and alarms
- Create automatic basic performance reports
- Define and implement a system that allows to breakdown all Observatory KPI and create a Value Chain or 'Error Budget'
- Provide the means to do perform advanced analytics for trouble shooting and preventive maintenance
- Provide the capability to:
 - Model performance
 - Predict system performance for given conditions



Possible Collaboration Areas (a quick overview)

Integrated Quality and Performance Managment



Project Objective: Develop a smart, modular performance management system integrating real-time KPIs, anomaly detection, predictive analytics, and automated reporting.

Core Goals, Scope & Responsibilities

- **Data Science & Modeling**
 - Develop and validate ML models for trend analysis, anomaly detection, and forecasting
 - Contribute to lifecycle risk scoring and predictive maintenance logic
- **System Architecture & Integration**
 - Support modular system design and integration of dashboard components
 - Participate in API design and data pipeline engineering
- **Evaluation & Testing**
 - Design test protocols, KPIs, and validation routines
 - Perform benchmarking and comparative studies

Project Framework

- First demonstrator on a system that is jointly selected
- Timeline: Mid-2026 for 2 years



"After careful consideration of all 437 charts, graphs, and metrics, I've decided to throw up my hands, hit the liquor store."

Experiment with advanced prediction and modeling



Project Objective: Prepare and validate capabilities for modeling and predicting system performance across multiple operational scenarios. This supports lifecycle decision-making and risk-based optimization.

Core Goals:

- Develop and test models for system performance under varying input and environmental conditions
- Explore data-driven and hybrid modeling approaches
- Enable scenario-based forecasting and simulation of future states
- Contribute to the design of Phase 4 tools for performance prediction and evaluation

Tasks & Responsibilities:

- Develop prototype models (statistical, ML, or hybrid)
- Analyze historical and synthetic datasets to build robust predictors
- Validate prediction accuracy using test cases and defined KPIs
- Document modeling assumptions, data requirements, and generalizability

Project Framework:

- Establish a first demonstrator on a selected system
- Start: Mid-2026 · Duration: ~2 years

Predictive Maintenance Toolkit



Project Objective: Increase system uptime by enabling predictive maintenance through early failure detection using AI and machine learning.

Core Goals:

- Automate detection of failure precursors in critical subsystems, train ML models on telemetry and CMMS data
- Identify component-specific failure signatures (e.g., pumps, drives, coolers)
- Implement intelligent alerting linked to performance thresholds
- Provide model support for Root Cause Analysis (RCA)

Tasks & Responsibilities:

- Co-develop AI/ML models for trend and anomaly detection
- Analyze historical and real-time operational data
- Research failure patterns and build predictive signatures
- Design and test model integration with performance systems

Project Framework:

- Develop demonstrator on selected system(s)
- Start: Mid-2026 · Duration: 1–2 years ·

Advanced Inspection & Monitoring System



Project Objective: Replace manual inspection routines with a smart, sensor-based system for continuous, high-resolution equipment and structural monitoring.

Core Goals:

- Design and evaluate automated visual and sensor-based inspection platforms
- Implement mobile and fixed imaging units for infrastructure monitoring
- Integrate thermal, acoustic, and vibration sensors for multi-modal diagnostics
- Develop AI models for defect detection and progressive deterioration analysis (e.g., wear, corrosion, contamination)
- Enable early warning and decision support capabilities

Tasks & Responsibilities:

- Research and prototype AI-enabled imaging & sensor systems
- Develop and test algorithms for condition interpretation and anomaly detection
- Contribute to sensor fusion methods and diagnostics logic
- Participate in lab-based and field-based test setups
- Support validation, evaluation, and academic dissemination

Project Framework:

Start: Mid-2026 · Duration: 3–4 years · Phase-aligned with broader digitalization initiatives

Thank you!

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