Technical Maintenance in the ELT Era

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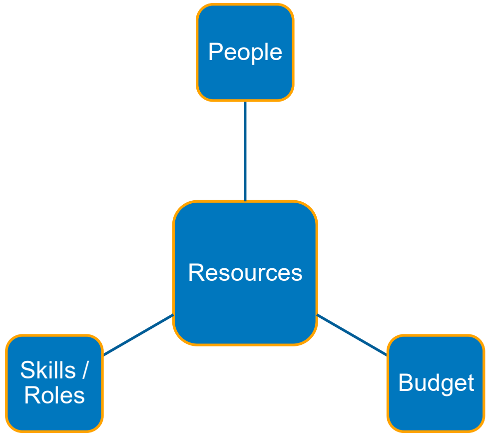
Technical Maintenance In the ELT Era.

Our vision in short.

"Right Maintenance Right"

This means performing the <u>right maintenance</u>

<u>at the right time</u>



<u>with the right resources</u>

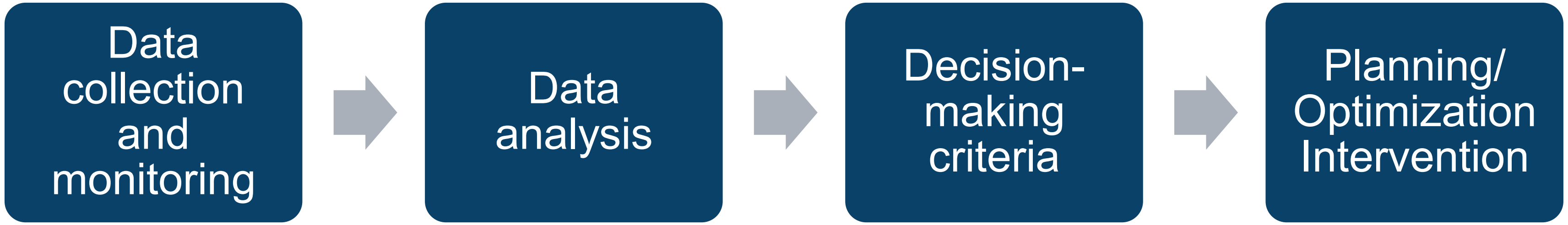
<u>using the right processes</u>

<u>the first time every time</u>

Condition-based Maintenance

CbM and Technical Maintenance improvement areas

End-to-End Solutions

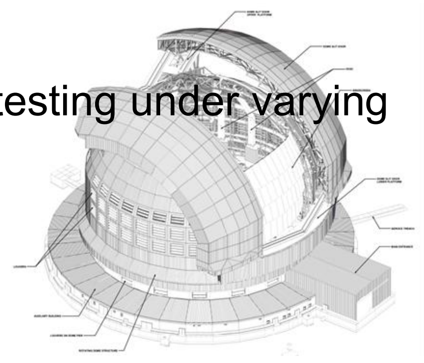


Development/Project Areas

Innovative Solutions for Enclosure Inspections

Autonomous and High-Precision Structural Assessment

- **Objective**
  - Due to the structure's large size and volume, it is essential to adopt unconventional inspection methods to ***reduce the risks of working at height***, ***limit exposure to adverse weather conditions***, and ***optimize overall inspection time***.
  - The solution will provide ***autonomous***, ***weather-resistant*** inspection with ***high-resolution imaging*** to reduce time and improve accuracy compared to current methods. Using advanced analytics, including image processing, vibration monitoring, and sensor integration, it will detect loose materials and wind-driven vibrations to prevent hazards.
  - The installation test would be carried out on the VLT, ensuring smooth integration and scalability, with a view to the future implementation on the ELT.
- **Timeline (Proposal)**
  - Year1: Solution Design, Technology Selection and Prototype Development.
  - Year2: Optimization based on pilot results, scalability improvements, and extended operational testing under varying weather conditions. Final adjustments and documentation.



Machine Learning-Driven Monitoring of DC and Stepper Motors.

Predictive Performance Monitoring for Critical Motion Systems

- **Objective**
  - Implement a ***predictive monitoring system*** for DC and stepper motors used in astronomical instruments, using the machine learning on historical and real-time motor telemetry (current draw, actuation timing) to ***detect early signs of failure or wear***.
  - Detect motor performance degradation proactively to avoid unexpected downtime.
  - Support predictive maintenance planning and extend motor lifespan.
  - Improve operational efficiency by minimizing failures and interruptions.

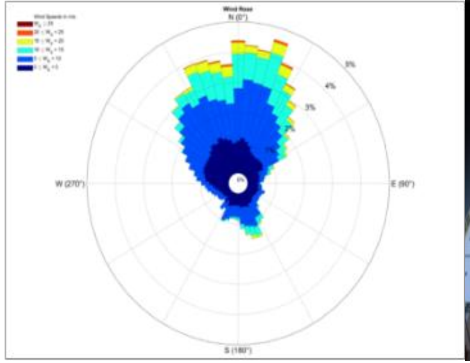
- **Timeline (Proposal)**

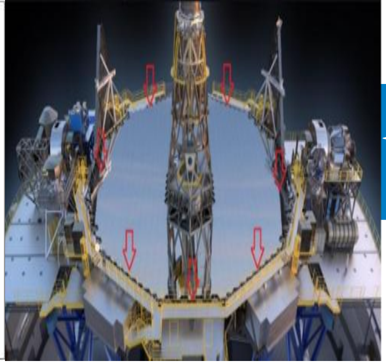
Year1: Gather requirements and historical motor data, develop and train machine learning models, integrate real-time telemetry data, pilot testing and validation of predictive system.

Year2: Expand deployment and train operational staff, Implement alerts and monitoring dashboards, Full integration with existing systems (OPC-UA), Optimize system and finalize documentation.

Dust monitoring during operations

Environmental Contamination Control for Mirror Preservation





- **Objective**
  - Measure the ambient dust contamination outside telescopes, i.e., the telescope platform, and the actual contamination that simultaneously reaches the primary mirror at every telescope. Hence, to ***measure the airborne and settled contamination on top of the primary mirror surface***, which are two different kinds of contamination measurements.
  - The measurement can trigger the dome's closing in case the contamination levels exceed a certain critical amount of dust settled on the M1 optical surface. The critical amount is related to the capability of removal of the settled contamination on the M1 surface, provided by a subsequent CO2 cleaning or other suitable dust removal process available to maintain the M1 surface. The implementation test can be carried out on a VLT, ensuring smooth integration and scalability, with a view to future implementation on the ELT.
- **Timeline (Proposal)**

Stage 1: Select and install ambient dust and surface contamination sensors suitable for Paranal/Armazones conditions on ASM towers and mirror surfaces (VLT M1, ELT M1), ensuring continuous operation, easy maintenance, and calibration.

Stage 2: Assess correlation between ambient dust and mirror contamination; define threshold levels to trigger dome closure during high dust events.

Stage 3: Monitor for one year to evaluate the effect of dust-triggered dome closures on slowing mirror reflectivity loss.

Optimize Maintenance Administrative Tasks

Increase Wrench Time

- **Objective**
  - ***Optimize maintenance administrative tasks,*** such as maintenance work order reporting, preparation and return of tools, consumables, and spare parts, recording costs.
  - Develop optimal methods/flows for materials management, control, dispatch, receipt, and safekeeping
  - Ensure the correct materials are delivered at the correct time/location
  - Develop tool tracking technology within the telescope to control the entry and exit of tools and prevent potential damage
  - Automate maintenance work order reporting through the integration of portable tools/AI/others

- **Timeline (Proposal)**

Year 1: Conduct a full process analysis of current maintenance admin workflows. Identify key bottlenecks in tool, spare part, and consumable management. Pilot a materials tracking and tool control system within one telescope. Develop and test automated work order reporting tools.

Year 2: Expand deployment of tool tracking and materials management system across all telescopes and facilities. Integrate reporting automation into our CMMS (Maximo) and operational workflows. Train maintenance staff on new procedures and technology. Finalize optimized processes and prepare long-term performance metrics to measure wrench time improvements

Thank you!

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