SKA South Africa Designs for Reliability on Global Mega-Science Initiative

Bentley AssetWise Optimizes Data Management and Information Mobility for World's Largest and Most Sensitive Radio Telescope

Project Summary

Organization
SKA South Africa

Location
Carnarvon, South Africa

Project Objectives:

- Design and construct a world-class radio telescope within budget and on an aggressive timeline.
- Implement a disciplined configuration and change management process to optimize performance and reliability of MeerKAT.
- Facilitate accurate information mobility and collaboration among a multi-discipline global team.

Products used
AssetWise

Fast Facts

- This ZAR 2 billion telescope consists of 64 unshaped offset Gregorian dishes, each with a projected dish diameter of 13.5 meters.
- AssetWise allowed SKA South Africa to hand over a complete as-built configuration to operations and maintenance while still enabling project management to maintain control over asset infrastructure.

ROI

- Using AssetWise ensured complete and accurate data was available at all times to the widely dispersed project team, minimizing rework and reducing costs.
- AssetWise delivered a disciplined engineering management and configuration system that improved performance of MeerKAT that, according to the baseline specification, could be valued at close to ZAR 1 billion.
- MeerKAT and the SKA will provide significant and sustainable economic benefit to South Africa with imaging capabilities that will transform astronomy and science around the globe.

A World-class Telescope

The Square Kilometer Array (SKA) project is a global effort comprising organizations from 10 member countries, including South Africa and Australia, that aims to answer fundamental questions about the origin and evolution of the universe. A mega-science initiative that will push the limits of engineering and scientific endeavors over the coming decades, the SKA project required the development of cutting-edge technology and innovation, including the design of the world's fastest supercomputers, to process data at rates greater than the current Internet traffic. It will use thousands of dishes and up to 1 million antennas, and will incorporate a collection of telescopes spanning the globe that will enable astronomers to probe the universe in unprecedented detail, and survey the entire sky much faster than any radio astronomy facility currently in existence. The SKA will be built in two phases, SKA1 in South Africa and Australia, and SKA2, which will expand the science infrastructure into other African countries and throughout Australia.

As part of the SKA1 phase, SKA South Africa is designing and constructing the ZAR 2 billion MeerKAT radio telescope in the remote, arid region of Karoo, 90 kilometers outside the small town of Carnarvon, South Africa. MeerKAT is a precursor to the SKA telescope and will be integrated into the mid-frequency component of SKA1. It is the largest and most sensitive radio telescope in the southern hemisphere until it is surpassed by the SKA, and includes civil infrastructure (including 160 kilometers of buried cables), structural design for the massive dishes, purpose-built housing for all the electronic equipment, software development, and networks and communications. To optimize MeerKAT's performance, ensure accurate information mobility, and enhance collaboration among the project team, SKA South Africa needed to implement asset and information management processes throughout design, construction, maintenance, and operations of this world-class telescope.

AssetWise delivers reliability at every stage of the asset, ensuring affordable maintenance of the final asset over its 30-50-year life span with maximized uptime.

Working in a Connected Data Environment

The MeerKAT telescope is an array of 64 interlinked receptors, each consisting of an antenna positioner with a projected dish diameter of 13.5 meters, a set of radio receivers, and a set of associated digitizers. Referred to as an offset Gregorian optical layout, this design ensures excellent optical performance, sensitivity, and imaging quality, while rejecting unwanted radio frequency interference. It enables installation of multiple receiver systems and provides numerous operational advantages.

SKA South Africa provided project management and system engineering services for MeerKAT. Given the complexity of the structure, SKA South Africa contracted with organizations and academic institutions around the globe to design and manufacture the antennas, receivers, optical fiber network, digitizers, and correlator. With multiple contractors geographically dispersed, it was crucial for optimal management of the project to have a tight grip on the design and asset information, with accessibility of accurate information being a top priority for the entire project team. "It's about the asset information and documentation management system; and it's one of those things that seems easy, but it never is," commented Willem Esterhuyse, MeerKAT project manager, SKA South Africa.

SKA South Africa deployed AssetWise to implement its asset and information management system, giving all sites within the organization access via a password and security group,

"By ensuring that complete and accurate data was available at all times, and that engineering change procedures were completed efficiently and in a timely manner, we were able to reduce rework to a minimum, achieve our aggressive timescales, and exceed the user requirement."

– Willem Esterhuyse, MeerKAT project manager, SKA South Africa

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1-800-BENTLEY (1-800-236-8539)
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and providing external project team participants access to the system via a web interface. Using virtual/physical hierarchies for each project piece allowed workers easy access to their respective projects, in context, and the security groups provided a controlled environment allowing users to see only relevant information. Working within a controlled and connected data system optimized collaboration and information mobility spanning global distances, and ensured data integrity to streamline workflows, minimize rework, and meet aggressive deadlines. Furthermore, the interoperability of Bentley's asset performance software will enable the integration of the documents and asset data with SKA South Africa's logistics and maintenance management systems while still maintaining control of the design and asset infrastructure in AssetWise.

Optimizing Configuration and Change Management

The key performance indicator of a radio telescope is sensitivity. To achieve improvement in sensitivity for MeerKAT, SKA South Africa implemented a disciplined system requiring validation of analyses results through to qualification of components, subsystems, and final installed systems. Using Bentley technology enabled SKA South Africa to apply best practice configuration management principles resulting in improving MeerKAT's sensitivity to the equivalent of adding between 36 and 99 percent more dishes, without increasing the budget.

In addition to managing asset configurations, given the scope and scale of MeerKAT, it was equally imperative that a process be put in place to accommodate and effectively communicate changes. Using AssetWise allowed all project participants to be informed of any change, who made the change, and the effects of the change, saving significant maintenance time and minimizing rework and risk. With an integrated change management system, SKA South Africa has all the information available to understand the impact of the changes, ensure their implementation, make decisions based on the changes, and communicate the changes timely and efficiently to all stakeholders.

Bentley's asset lifecycle information software provided SKA South Africa a collaborative, controlled solution to efficiently maintain and manage baselines, changes, and asset configurations. Having approved documentation available to all participants facilitated information mobility and improved asset performance, enabling the team to meet project deliverables timely, effectively, and within budget.

Establishing a Model Approach to Science Megaprojects

A precursor to the SKA, MeerKAT not only serves as a pathfinder telescope to be integrated into the SKA1, but also provides a platform for managing the challenges and complexities of global mega-science projects. With AssetWise, SKA South Africa implemented an information management system that enhances overall accessibility, quality, integrity, and relevance of asset data throughout the project and asset lifecycle.

The software is an invaluable solution for managing the complex design of MeerKAT – and as assets are handed over to operations and maintenance, the AssetWise integration with other logistics and maintenance management systems will provide staff with a single view of the digital asset and control over the design and asset infrastructure.

MeerKAT already is attracting great interest internationally with more than 500 international astronomers and 58 from Africa having submitted proposals to conduct scientific research with the telescope once it is complete. MeerKAT's first light image revealed more than 1,300 galaxies in a tiny corner of the universe compared to the original 70 known in that location; and the telescope was able to capture that using only 16 of its 64 receptors. Using AssetWise provided SKA South Africa the collaborative information management and asset performance technology necessary to make this world-class project a reality. "I think we have almost industrialized the way science projects are being rolled out and managed," stated Mr. Esterhuyse.

Bentley Advancing Infrastructure