ASKAP Industry Engagement Case Study: Manufacturing

How CSIRO is working with Australian industry to solve complex challenges involved in building a next generation radio telescope, the Australian SKA Pathfinder (ASKAP), and planning for the future international Square Kilometre Array (SKA) telescope project.

SHARED EXPERTISE HELPS SOLVE UNIVERSAL MYSTERIES

CSIRO's newest radio telescope, the Australian SKA Pathfinder (ASKAP), is an internationally significant project using cutting-edge Australian technologies to demonstrate the innovative capacity of Australian science and industry.

Industry collaboration also allows for testing of technologies that may potentially be used in the future international Square Kilometre Array (SKA) telescope project.

As CSIRO moves through the design, development, construction and operational phases of the ASKAP project, industry collaboration plays a crucial role in the delivery and ongoing support of the ASKAP telescope.

Key to the project is research and development, then prototyping and production, of the antenna and receiver system components, processing electronics and support structures.

> *"ASKAP is being developed by CSIRO scientists and engineers; support from industry specialists brings together local and international expertise in production, construction, installation and commissioning."*

Industry participation has created strong collaborations with a variety of organisations, among them niche R&D companies, and resulted in commercial contracts with high-volume manufacturers, technology systems vendors, site services and installations firms, and energy and data transmission specialists.

Engagement occurs with larger technology and civil engineering firms, and also with smaller local suppliers.

Benefits that arise from such collaboration include:

- Technology transfer between astronomy and industry
- Access to new technology and/or larger markets
- Collaborative R&D between global firms and Australian producers, leading to up-skilling and enhanced capability

Solutions for the non-astronomy challenges for ASKAP, including power, remote access and operations, and high-tech infrastructure will also have applications elsewhere in Australia and around the world.

INNOVATION COMPOSITES - NOWRA, NSW

Innovation Composites are a precision composites and fibreglass manufacturer, with expertise that has evolved from the marine industry into a broader spectrum of work.

CSIRO is working with *Innovation Composites* to develop and produce RFI-shielded, high-strength, weather-proof and insulated casings for ASKAP's innovative phased array feed (PAF) receivers that are lighter and more cost-effective that previous designs.

To house the PAF receivers, installed on ASKAP antennas, the design must integrate a number of functional requirements into a single part, robust enough to endure the extreme climate and remote nature of Murchison Radio-astronomy Observatory, located in the Mid-West region of Western Australia.

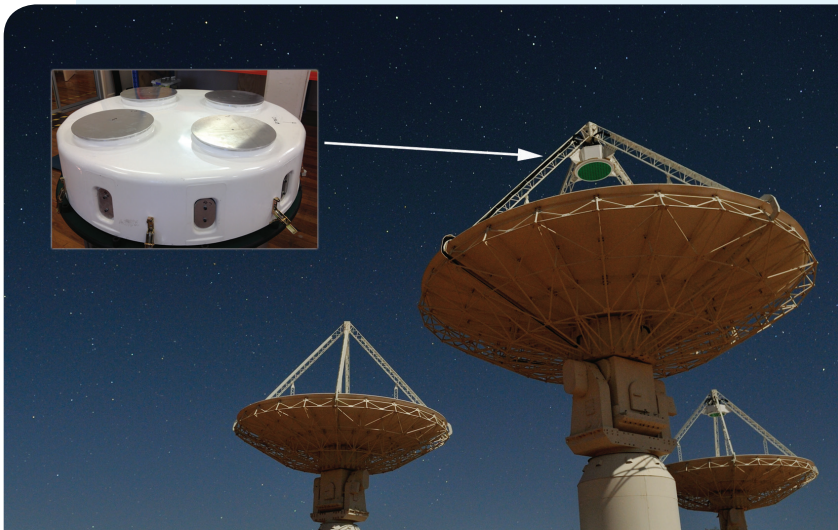
The company works collaboratively with CSIRO engineers to develop and manufacture a bespoke design that meets the special requirements demanded by the working environment of ASKAP.

Success was achieved through applying specialist production knowledge of *Innovation Composites* to the problems of electrical interference – a well understood challenge of radio astronomy.

The PAF casing design incorporates marine composites technology to manage structural loading, thermal insulation and environmental protection in a single part, using a multi-skin foam-cored composite design with both glass-fibre and carbon-fibre reinforcement.

The carbon-fibre will also provide a level of RFI shielding, to prevent radio-frequency interference from the PAF's internal electronics impacting the radio-quiet atmosphere of the Murchison Radio-astronomy Observatory.

The design also demonstrates how the application of industrial skills from disparate fields can be applied to problems in the construction of instruments for advanced science.



> The specialised casing for the ASKAP Mk II PAF (inset), shown for context with an ASKAP antenna installed with a Mk I PAF.

PUZZLE PRECISION - NEWCASTLE, NSW

A project on the scale of ASKAP relies on industry providing expertise in production, construction, installation and commissioning to demanding quantity and quality requirements, and introduces technical challenges that must be overcome in the design and construction of the telescope's components.

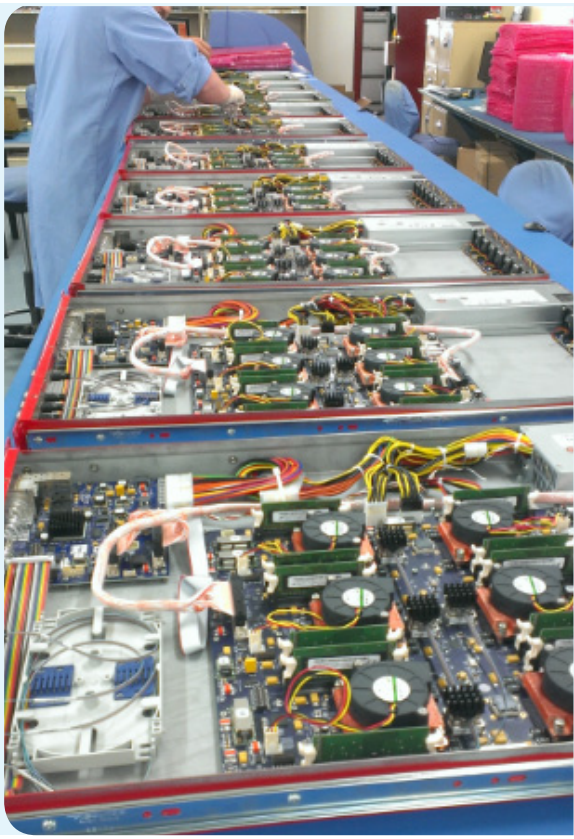
Advanced high-performance phased array feed (PAF) receivers mounted on ASKAP antennas will produce an instantaneous and wide field-of-view using simultaneous electronic beams.

CSIRO is working with *Puzzle Precision*, a high-quality electronic assembly service provider, to jointly develop and produce sophisticated electronic circuit boards and major components of the ASKAP digital systems. The high quality and accurate assembly equipment used by *Puzzle Precision* ensures large scale delivery of the intricate and complex components that make up these electronics boards for ASKAP.

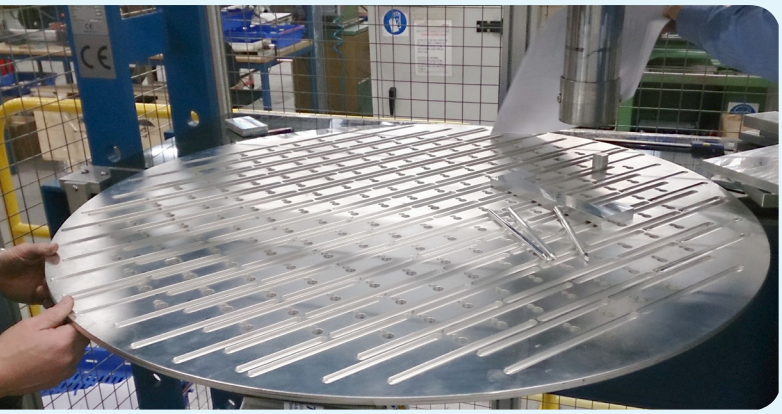
What started as 30-40 boards manufactured for CSIRO's Compact Array Broadband Backend (CABB) project, has now grown to thousands of units of work required for ASKAP's innovative PAF receivers and associated digital systems.

The ability of *Puzzle Precision* to meet the stringent demands of the ASKAP electronic boards design demonstrates how small industry partners can provide useful solutions to meet the production demands and scientific grade standards of highly technical equipment.

This relationship with CSIRO and the ASKAP team has resulted in expanded production base for the company, and enhanced Australian capability in production.



> An assembly line of electronics boards for the ASKAP Mk II PAF at Puzzle Precision.



> The ASKAP Mk II PAF groundplane, assembled by Thermacore Europe.

THERMACORE EUROPE

The second generation (Mk II) ASKAP receiver – or PAF – includes a requirement for a specially designed groundplane to maintain a low and stable temperature cruicial to system performance and reliability.

The overall efficiency of the heat management system is a major contributor to ASKAP power consumption and operating costs.

Thermacore Europe is a world-leader in the field of passive thermal management systems, specialising in the custom design, development and manufacture of highly-engineered components.

CSIRO has engaged with *Thermacore* for the purpose of designing and prototyping the Mk II PAF groundplane, a bespoke design with features and characteristics that meet strict ASKAP specifications including thermal and electrical conductivity, operating and storage temperatures, manufacturability and repeatability.

The ASKAP groundplane is a unique component that features embedded heat pipes for thermal management, designed by *Thermacore* based on specifications developed and provided by CSIRO. Prototyping activities have led to a solution proven to meet the unique requirements of the ASKAP telescope, tested and validated against the complex groundplane specifications.

The development of *Thermacore* ground planes for the Mk II ASKAP PAF design has allowed minimised temperature gradients and a predictable temperature uniformity to be maintained across the highly sensitive electronics. This allows more accurate information to be received by the telescope and minimises distortions in the processed image.

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FOR FURTHER INFORMATION

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