



1 Introduction

The Square Kilometre Array (SKA) is an ambitious project to build a radio telescope that will enable breakthrough science and discoveries not possible with current facilities. Built over two sites in Australia and Africa it will eventually provide over a million square metres of collecting area through many thousands of radio receivers feeding unprecedented data volumes to scientists.

Three types of radio telescopes will be used by the full SKA to provide continuous frequency coverage from 50 MHz (6 m wavelength) to 20 GHz (1.5 cm wavelength); a frequency range enabling a wide range of transformational science objectives to be addressed.

SKA is envisaged to be delivered in two phases. With construction of the first phase, SKA1, starting in 2020, first science operations will begin in the mid-2020s. Phase 2 (SKA2) is intended to follow, with construction starting in late 2020s. Once completed, the telescope is expected to be operational for over 50 years.

SKA1 will comprise two types of radio telescope in two locations, together with a distributed science and operations network and a Headquarters that will co-ordinate development, construction and operations. SKA1 is currently entering the bridging phase between design and procurement. SKA2 will be the subject of a separate, later, decision to proceed.

The SKA has been developed as an international partnership that will draw on the scientific, technological, industrial and financial resources of its participants, and deliver to them substantial benefits. These will include the scientific advances in our understanding of the Universe; returns to industry, both through provision of components of the telescope (whether in-kind or through direct contracts) and in the longer term through technological spin-outs; and significant social returns through human capital development. Engagement in the development and realisation of such a massive and revolutionary scientific project will stimulate advances in the industrial, social and technological spheres and inspire future generations.

2 A role for Industry

This document outlines the proposed approach for practical participation by industry (and other interested parties) in the coming construction era of the SKA1 project. It describes the framework for engagement, procurement, and communication in relation to direct and indirect (i.e. in-kind) contracting. This note should be read in conjunction with information available from the project website: <http://www.skatelescope.org/ska-industry/>

The scale of the SKA, and the need to 'productise' and mass-produce many of its components, requires innovative levels of industry participation new to astronomy. Industry will play a crucial role in the design, delivery and through-life support of the technologies and infrastructure. Industry participation with the SKA is already occurring through early interactions, collaborative development work (including liaison with Member country industry consortia), and paid/unpaid involvement at the pre-construction phase.

Future participation is anticipated with a variety of organisations, among them niche R&D companies, followed by increasing engagement with medium-high volume manufacturers, technology systems vendors, site services and installation firms, and power and data transmission specialists.

Benefits and innovation seeding with the SKA

In the longer term, the global SKA Organisation (SKAO) is keen to promote broader industry benefits flowing from involvement with the project, for example:

- Development and optimisation of leading-edge techniques and products in a very demanding application, as well as interaction with highly technologically sophisticated users;
- Generation and sharing of information with other R&D partners – both institutional and industrial – in a commercially benign environment;
- Visibility flowing from association with an innovative, high profile, international mega-science project;
- Social benefits through thousands of engineers, radio astronomers and astrophysicists inspired within universities and other research institutions around the globe, many of whom go on to pursue discoveries and careers in allied industry sectors.
- Technologies developed for astronomy being applied to industry sectors including ICT, medicine, environmental monitoring, and mega-data management. Solutions for the non-astronomy challenges for the SKA (sensor networks, power supply, remote access, and remote operations of high technology infrastructure) have global applications.
- Industry exploitation of ‘spin-off’ benefits and new capabilities that offer social, technical, and economic benefits beyond the global SKA program.

3 Organisation and timeline

At the time of writing, the SKA Organisation is preparing to transition to an International Government Organisation (IGO). This is expected to become a reality during 2019.

Several governments are in the process of negotiating a Convention that will establish the Square Kilometre Array Observatory. The Observatory organisation will be governed through a structure similar to that of the European Southern Observatory (ESO) and similar bodies. Development of the organisation structure is proceeding in parallel with the current detailed design phase of the project. At the top level, the timeline of the project’s phases are:

- Now – 2018: Design & prototyping phase
- 2019 - 2020: Procurement activities and start of construction
- 2020 – 2023: SKA₁ acquisition and construction
- 2024 onwards: SKA₁ science proposals
- 2028 SKA1 science programmes underway



4 Contributing to the SKA

The underlying principles of the SKA Observatory will be to ensure equitable distribution of both costs and benefits. The funding model that has been developed to initiate inter-government negotiations links Members' contributions to their eventual capability to exploit the SKA. Similarly, the benefits, in terms of both work return and ultimately access to the telescope, will be broadly in proportion to the Member's contribution.

Membership of SKAO is therefore an attractive proposition, since both contractual/industrial opportunities and access to observing time for non-members will be extremely limited. Special terms apply for the host countries, which are all also Members, recognising that they will gain additional local benefits from the presence of the SKA facilities.

The SKA will primarily be an engineering and construction project for the next ten years, carried out through a mixture of in-kind contributions and contracts directly let by the SKA Observatory and overseen and co-ordinated by the Observatory's project office. The first and most immediate benefits from investment in SKA are guaranteed access to both direct contracts and the opportunity to make in-kind contributions, which are only open to Members of the Organisation.

Discussions are underway to determine potential percentage share contributions towards the SKA1 (a fixed capital cost of around €650M) between governments, and how future partners might contribute to the project.

5 The Procurement Framework

A Procurement Policy will feature within the legal structure supporting the operations of the new organisation. This policy will define a procurement framework, expected to apply to all contracts and agreements for the provision of goods, works and services, concluded between the Observatory organisation, Members and third parties. Contracts and agreements shall be awarded or concluded by the Observatory in accordance with the guidance described below.

SKAO anticipates that the procurement framework will comprise a number of defined *Articles* that will translate the Procurement Policy and Board intent into practical guidance to help shape a globally consistent institute and industry engagement, while allowing for national policies to apply. While yet to be approved, the following sections outline the expected topics, and the effect for industry.

5.1 Propriety

It is expected that all SKAO Member country organisations, and contracted parties (whether institutions, agencies, or commercial organisations), will comply with the spirit and intent of fair and ethical behaviour and transactions. Some form of audit process will be established.

5.2 Return on Investment

The SKAO will actively seek to balance Member country investment in the project with fair industrial returns, although in a project of this scale and complexity, precise equity cannot be promised. To ensure that returns to host nations (and their industrial partners) are not unfavourably apportioned to low technology infrastructure works, such procurement will be considered as a separate procurement category.

5.3 Project Procurement Control

Procurement specifications (and value) will be determined by the SKAO, although the method of procurement or goods acquisition will be largely unconstrained to permit innovation and best value. SKAO will conduct, or arrange, final acceptance or otherwise of the deliverable against the specification.

It is likely that SKA project procurement processes, contract management and payments during the course of the SKA project will be the SKAO in the case of cash procurements, or the Member country in the case of an in-kind (in-country) procurement from industry and/or institution.

5.4 Planning for Procurement

During the construction and operation of the SKA, major procurement opportunities, and any bidder restrictions, will be identified in announced Procurement Plans. These plans, and any updates, will be communicated through Member country agencies to nationally defined industry contacts.

Procurement Plans will link to a project Cost Book that will detail the value of goods, works or services to be procured. The determination of works and contract values will be in accordance with a Financial Protocol using an agreed Cost Book Valuation Methodology.

5.5 Vendor Qualification

Prior to any major procurement, the SKAO Project Office may require and lead a process of industrial pre-qualification to ensure that a proposed in-kind deliverable can be delivered by the proposed Member country's institutes and/or industry partners, or to identify a smaller number of potential suppliers in the case of a cash procurement.

The method of pre-qualification will not be prescribed by SKAO, but can be expected to include processes such as Member country capability surveys, discussions around member country industrial development aspirations, supplier surveys and expressions of interest.

5.6 Advertisement of Procurement Opportunities

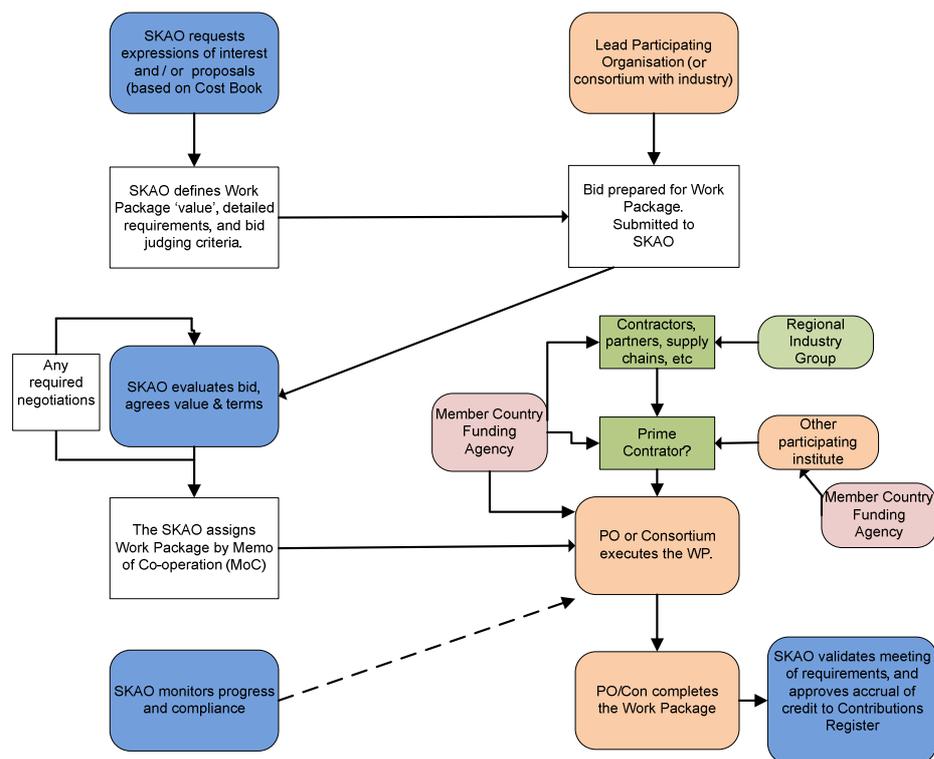
Procurement for the SKA project is expected to range from globally open, restricted to the participating Members, or restricted within particular Member States. This policy opens the way for sourcing beyond the 'standard' RFT approach. It recognises the benefits of innovative procurement including, where appropriate, strategic alliances, single source supply, shared risk contracts, technology transfer arrangements, etc. SKAO regulations will define the scope and method for publicity of tenders or in-kind contribution opportunities.

The SKAO procurement and supplier selection processes will take into account the whole-of-life costs, including where appropriate, disposal after 50 years. Best mix of quality and effectiveness will

be sought, taking into account advantageous warranty provisions, cost of spares and disposables, cost of maintenance, proven reliability, and benefits of commercial-off-the-shelf products.

6 An example of the process flow for award and allocation of a Work Package from SKAO.

The diagram below presents an indicative flowchart of how the procurement process will likely work in the future SKA Observatory organisation.



7 SKA Technology Areas

The requirements of the SKA telescopes and supporting infrastructure places demands in a range of technical and engineering domains. The specific requirements are being firmed up through the current design phase and coming procurement/construction phase. However some of the primary opportunities for industry involvement are:

High-speed (Tb/s) digital fibre optic links for distance regimes extending from 100 m to >3000 km. Data routers and switches

High-speed digital signal processing engines (Pb/s) and ultra-fast supercomputing (at exaflop rates), and mega-scale data storage systems

Low-cost, high-speed (Gs/s) analogue to digital converters

Low-cost, mass manufacturing of wideband single pixel feeds

Broadband, active, phased array feeds, and decade bandwidth feed antennas for dishes
Low-cost, mass manufacturing of small to medium diameter dishes, and aperture arrays
Low-noise, highly integrated, receivers for both cryogenic and uncooled applications
High dynamic range (>70 dB) image formation using sparsely-sampled Fourier plane data
System Engineering. Power design and engineering
Project Management, EPC services, construction camps
Radio-frequency interference mitigation using coherent and incoherent techniques
Site studies and infrastructure engineering, and through-life maintenance
Software engineering for robust, intelligent, array monitoring, control and data processing

8 Communication of Opportunities

Member country Agencies, Institutes, and Industry partners are encouraged to monitor the SKA Organisation's communication channels and information outlets as follows:

- Regular updates posted on the SKA Organisation website (www.skatelescope.org);
- Promotion through newsletters, and media releases, and project briefings to industry;
- Posting of public tenders or request for EoIs on Member Country agency websites;
- Provision of information and facilitation of early release of *indicative* technical specifications to permit industry to begin research and development of detailed proposals;
- Support of meetings and workshops with industry groups in Member countries;
- General communication via the SKAO Industry Engagement Strategy, or Information Notes.

In addition, potential suppliers can become aware of SKA project opportunities through;

- Contact and involvement with one or more SKA stakeholders or Consortia;
- Active seeking of markets by industry Business Development personnel;
- Notification from a public database of SKA (and pre-cursor) vendors;
- Via any SKA Global Capability Assessment process;
- Direct approach by an SKA stakeholder, Member country agency, or person;
- Membership of an industry group, e.g. SKA industry consortium; and
- Encouragement by member Country Government agencies.

9 Disclaimer

The SKA Organisation has produced this Information Note in good faith to present an accurate picture of current intent and outlook for effective industry participation in the SKA project, however the information is subject to change. Before making any commercial or investment decisions related to the SKA, please consult the latest project material and official policies.