INDUSTRY ENGAGEMENT STRATEGY

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ORGANISATION DETAILS

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LIST OF ABREVIATIONS

EoI ..... Expression of Interest
ICT ..... Information and Communications Technology
IP ..... Intellectual property
MLA ..... Multilateral Agreement
PO ..... Participating organisation
R & D ..... Research and Development
RfP ..... Request for proposal
RfQ ..... Request for Quotation
SKA ..... Square Kilometre Array
SME ..... Small and Medium (sized) Enterprises
SoMI ..... Statement of Mutual Interest
SPDO ..... SKA Program Development Office
WPC ..... Work package Consortium

IMPORTANT INTRODUCTORY NOTE

This document is formative, and aims to describe the anticipated approach for industry (and other stakeholder) engagement with the SKA project, and the SKA organisation. The strategies and policies expressed in this document are yet to be formally approved by the Board of the SKA Organisation, particularly in relation to sections 10, 11 and 12.

The SKA Office acknowledges the advice of industry in the development of this document.

1 Definitions

ALMA	The Atacama Large Millimetre/submillimeter Array.
ASKAP	The Australian SKA Pathfinder telescope.
Industry	The collection of various public and private companies ranging from large multi-nationals to small and medium enterprises (SMEs), research firms, industry associations and consortia, and other groups or individuals with an interest in provisioning the SKA program in some way.
In-Kind contribution	A non-cash input which can be given a cash equivalent value, and consisting of goods or services, time or expertise.
LOFAR	The Low Frequency Array (built in the Netherlands).
MeerKAT	The (South African) Karoo Array Telescope .
Participating Organisations	Institutes or Agencies of SKA Member countries that are actively involved in supporting the realisation of the SKA telescope, largely through participation in Work Packages.
Pathfinder	SKA-related technology, or science and operations activity.
Precursor	A telescope on one of the two SKA candidate sites, carrying out SKA-related activity.
SKA Associate Member	A non-voting membership category
SKA Members (or SKA member countries)	Instead of shareholders, the Members of the SKA Organisation are the guarantors (with limited liability). The Directors of the Board are appointed by the Members.
SKA Organisation	A private UK company limited by guarantee, formed to manage and execute the SKA project.
SKA stakeholders	The SKA organisation and its Members, funding agencies, participating organisations, suppliers, and users.
Work Package Consortia	Collaborative groups (possibly including industry participants) led by an organisation(s) from Member country, formed for the purpose of responding to SKA Work Package opportunities.

2 Introduction and Purpose of this Document

This document describes the principles, framework, and arrangements for industrial involvement with the Square Kilometre Array (SKA) project. It aims to provide guidance to industry and other stakeholders to assist practical engagement.

The international Square Kilometre Array (SKA) project aims to construct the world's largest radio telescope – around 50 times more sensitive than present instruments – by around 2025, with Phase 1 science commencing in 2020 A number of design concepts for the instrument are emerging from the preparatory stage and precursor demonstration sites. 'Down-select' of technologies for the SKA will occur during the preconstruction phase commencing in 2012.

The scale of the SKA and the inherent requirement to 'productise' many of its components necessitates and exceeds the type and level of industry engagement experienced in radio-astronomy projects such as the ALMA instrument in Chile, the LOFAR pathfinder centred in the Netherlands, and the SKA precursor projects of MeerKAT and ASKAP. As the SKA project moves through the

detailed design, pre-construction, construction, and operational stages, industry will play a crucial role in the research, design, delivery and through-life support of the technologies and infrastructure.

It is therefore vital that industrial parties, and other SKA stakeholders are kept abreast of the opportunities and contractual timelines during the SKA design and construction era. This allows potential industry partners to align their planning and capability development to meet future needs and position global industry to provide 'value for money' solutions.

Industry participation with the SKA means early collaborations (see section 8.1) with a variety of organisations, among them niche R&D companies, followed by increasing engagement through commercial contracts with medium-high volume manufacturers, technology systems vendors, site services and installation firms, and power and data transmission specialists. Engagement is anticipated with larger technology and civil engineering firms, and is also encouraged with smaller local vendors, including industry teaming arrangements that include supply chain exploitation. A measure of success of this strategy will be the extent that industry can deliver the required technologies and services against profitable value-for-money contracts.

This Industry Engagement Strategy spans the SKA project technology and infrastructure needs from now to around 2015-16, covering the period when the SKA project will invite industry involvement in procurements valued in the vicinity of €70 million. SKA_1 construction has a notional budget of €350, million, and SKA_2 construction (2018-19) will be procuring goods and services in the order of €1.5 billion (2007).

The Office of the SKA Organisation (hereafter called 'the SKA Office'), and its associated national and regional consortia programs, welcomes interest from existing and potential industry partners.

3 The Square Kilometre Array (SKA) Project

Advances in astronomy over the past decades have brought the international science community to the verge of charting a complete history of the Universe. In order to achieve this goal, the global community is pooling resources and expertise to design and construct powerful telescopes that will probe the entire electromagnetic spectrum.

The SKA will be one of these instruments; an ultrasensitive radio telescope with an aperture of up to a million square meters, built to further the understanding of the most important phenomena in the Universe. Over the next few years, the SKA project will transition from an early formative concept to a fully operational instrument (SKA_1) approximating 10% of the proposed full SKA_2 instrument. (See Table 1).

SKA1 will consist of two dish arrays. One in South Africa, incorporating the MeerKAT SKA precursor and equipped with single pixel feeds and with a frequency range from 450 MHz to 3 GHz. The other dish array will have Phased Array Feeds, cover a frequency range from 800-1600 MHz, and be combined with the ASKAP SKA precursor in Western Australia. In addition a sparse aperture low frequency array covering 70-450 MHz will built in Australia.

Coming later, SKA_2 will be a much larger array of coherently connected antennas spread over an area about 3000 km in extent, with an aggregate antenna collecting area of up to $10^6 m^2$ at the longest wavelengths. A key scientific opportunity is to exploit the wide field-of-view (FoV) mid-frequency

aperture arrays and/or PAF receptors to carry out fast, sensitive observations of the sky over large areas (surveys), enabled by the most up-to-date signal-processing technology available. Designed with a baseline frequency range of 70 MHz to 10 GHz, the SKA_2 will eventually produce images and other data over wavelengths from around 4.3 metres (70 MHz) to 3 centimetres.

The SKA will give astronomers insight into the formation and evolution of the first stars and galaxies after the Big Bang, the role of cosmic magnetism, the nature of gravity, and possibly even life beyond Earth. Unquestionably, the SKA will make more discoveries than we can imagine.

The key applications and science areas for the **SKA_1** are;

- Neutral hydrogen in the Universe from the Epoch of Re-ionisation to now;
- Pulsars, general relativity, and gravitational waves.

SKA_2 extends the key applications and science goals, to include;

- Determining the large-scale properties of the Universe: the amount, distribution, and nature of its matter and energy, its age, and the history of its expansion;
- Study of the dawn of the modern Universe, when the first stars and galaxies formed;
- The formation of stars and their planetary systems, and the birth and evolution of giant and terrestrial planets (the 'cradle of life' questions);

Table 1: *Top level project timeline (indicative) for the SKA*

Technical	
2008 - 12	Telescope system design and cost
2013 - 15	Detailed design & pre construction phase
2016 - 19	Phase 1 (SKA_1) construction
2014	Advanced instrumentation program decision (SKA_1)
2018 - 23	Phase 2 (SKA_2) construction
2020 - >	Full science operations with phase 1
2024 - >	Full science operations with phase 2
Milestones	
Early 2012	Establish SKA organisation as a legal entity
Early-mid 2012	SKA_1 Site selection
Late 2012	Establish the SKA Office at Jodrell Bank, UK
2013/14	Phase 1 construction approval (~350 M€)
2017 - 2020	Phase 2 construction funding confirmed (1.2 B€)

4 The SKA Organisation, Membership, and the SKA Office

The SKA project was born global. SKA Consortia were originally established in Europe, Australia, South Africa, Canada, and USA, supported by institutions from India, China, Japan, and Korea. The initial collaboration agreement established the SKA Science and Engineering Committee (SSEC) as the primary management forum for the SKA. In 2007, the SKA Program Development Office (SPDO) was formed as the technology research, concept design, cost investigation, industry engagement

planning, and outreach arm of the SKA project. Staffed by an international team and hosted by the University of Manchester (UK), the SPDO was funded by members of an SKA preparatory (PrepSKA) phase collaborative agreement.

In April 2011, nine national governmental and research organisations established a Founding Board for the SKA project. Australia, China, France, Germany, Italy, the Netherlands, New Zealand, South Africa, and the UK agreed to work together to fund the Pre-Construction phase of the SKA project, and announced new headquarters to be built at the Jodrell Bank Observatory near Manchester (UK).

In December 2011, the SKA Organisation, a UK registered, independent not-for-profit company limited by guarantee was established to formalise relationships between international partners and centralise the leadership of the project. The founding full Members were Australia, China, Italy, the Netherlands, New Zealand, South Africa and the UK. Canada joined as a full Member in March 2012, and India joined as the first Associate Member in April 2012. The new SKA Organisation builds on the work of the SPDO by ramping up staffing, by being able to make legally binding (contractual) decisions, and leading the work of the international partners on the design of the telescope. Dr Michiel van Haarlem became Interim Director-General of the new SKA Organisation at the end of 2011.

The current Board of Directors, and SKA Member country organisations can be found here http://www.skatelescope.org/the-organisation/board-directors/

The proposed governance structure of The SKA Organisation is shown in Fig 1, although as at April 2012, the Advisory Committees are yet to be formed.

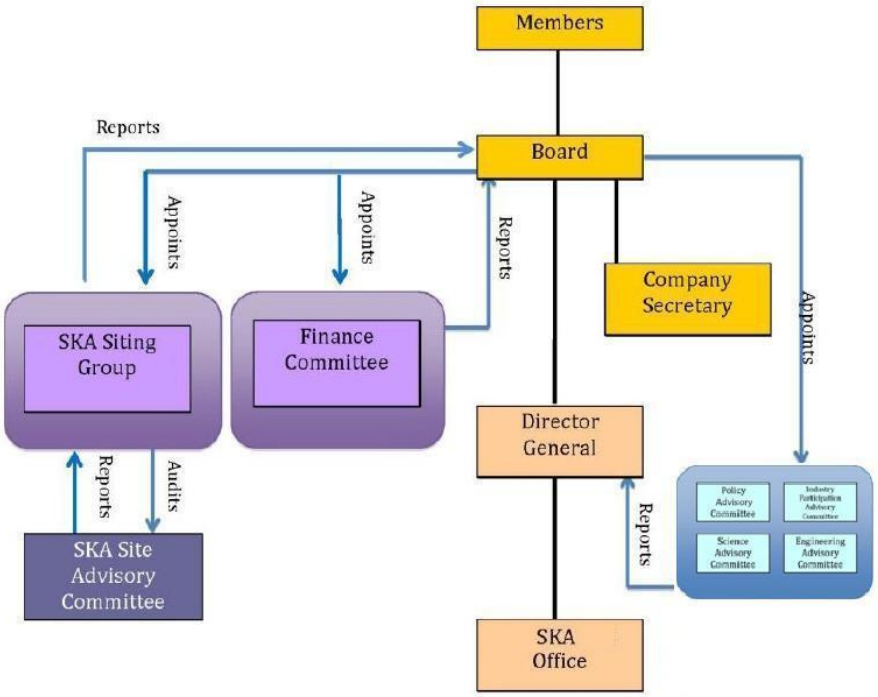


Figure 1: *The SKA Organisation governance structure.*

The realisation of the SKA instrument will begin with a pre-construction phase (2012-2015) leading to the construction of Phase 1 SKA (SKA_1). This effort will be managed by the SKA Office (see below)

and delivered in collaboration with Participating Organisations within the Members countries of the SKA Organisation, possibly in consortia with other POs, and/or their regional industry associates. This phase is described in the SKA Preconstruction Project Execution Plan (PEP). See also Appendix A – Stage 1 & stage 2 steps.

The SKA Office is the central location for overall project management, under the leadership of the SKA Director-General. To execute the managerial and integrative work the SKA Office will steadily build on its core team to include an overall SKA Project Manager, Project Engineer, Project Scientist, Chief Systems Engineer, System Engineers, and Engineering Project Managers functioning at SKA Element (subsystem) level (and working closely with Work Package Consortia (WPC)). Supporting the team will be a Project Officer, a Mission Assurance Officer, Configuration Management Officers, and an Industry Liaison Officer.

The Engineering Project Managers and System Engineers have the responsibility for the successful development and eventual delivery of all aspects of the subsystems in terms of schedule, cost, quality and performance. They will oversee the execution and management aspects of the work carried out by the WPCs, and collect and integrate project management information from the WPCs into the overall project. Regular project reviews at both system and subsystem levels will be performed.

5 Overall Aims of Industry Engagement for the SKA

This Industry Engagement Strategy establishes a framework that sets out the challenges and opportunities of the SKA project, focusing on engagement and practical participation with collaborators and industry in the phase leading to SKA_1. The Strategy describes the aim of the SKA Office to communicate opportunities to industry in an effective manner, and thus encourage industrial relationships. Frameworks are suggested for longer term industry capability development to encourage research and development (R&D) and specific innovation in SKA-related areas. The principal technical domains embraced by the SKA project are shown in Table 2.

Table 2: *SKA Domains with potential for industry involvement*

Broadband, active, phased arrays for aperture and focal plane applications
Decade bandwidth feed antennas for dishes
High dynamic range (>70 dB) image formation using sparsely-sampled Fourier plane data
High-speed (Tb/s) digital fibre optic links for distance regimes extending from 100 m to >3000 km
High-speed digital signal processing engines (Pb/s) and ultra-fast supercomputing (at exaflop rates)
Low-cost, high-speed (Gs/s) analogue to digital converters
Low-cost, mass manufacturing of small to medium diameter dishes
Low-noise, highly integrated, receivers for both cryogenic and uncooled applications
Outreach and public education
Power design and Engineering
Project Management
Radio-frequency interference mitigation using coherent and incoherent techniques
Site studies and infrastructure engineering

SKA scheduling, operations and maintenance models
Software engineering for robust, intelligent, array control and data processing
System Engineering

Figure 2 (below) shows the potential opportunities for industry expressed in relation to the SKA signal path.

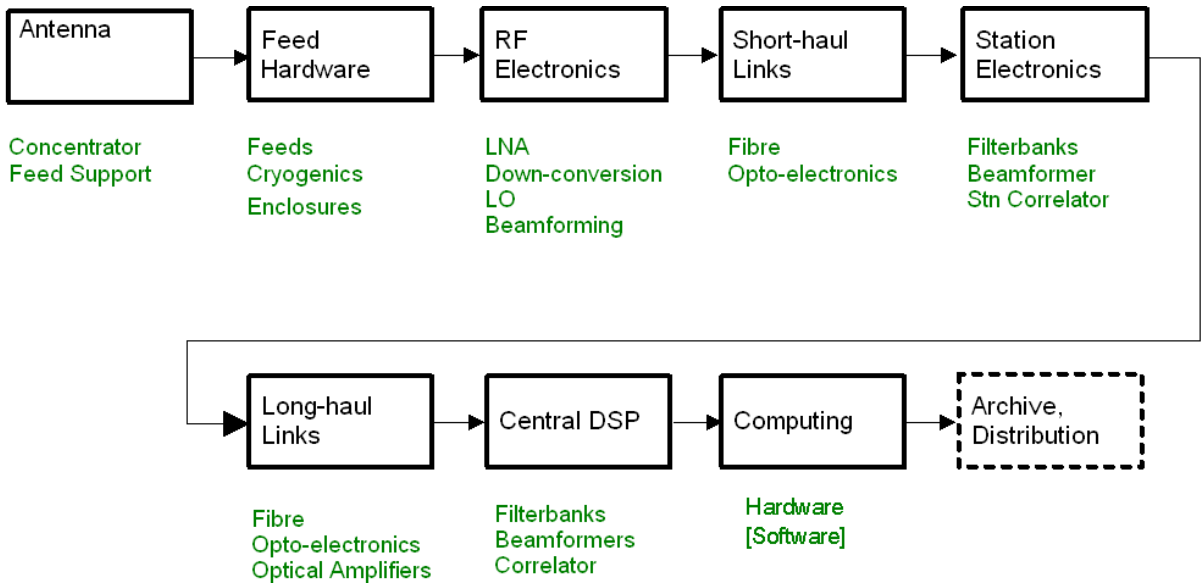


Figure 2: *Areas of potential industry opportunity in relation to the SKA signal path.*

In the longer term, the SKA Organisation is keen to see industry benefit from its involvement with the project, for example:

- The opportunity to grow and hone the creative energies of the best professionals in an imaginative project whose aim is no less than to chart the history of the Universe;
- The ability to develop and perfect leading-edge techniques and products in a very demanding application and to interact with highly technologically sophisticated users;
- The ability to generate and share information with other R&D partners – both institutional and industrial – in a benign and commercially non-threatening environment;
- The visibility flowing from association with an innovative, high profile, international mega-science project; and
- The potential for early involvement contracts with tangible payback in a funded, cutting-edge project spanning a wide range of infrastructure, engineering and computing disciplines.

SKA Industry engagement is anticipated to fall broadly into three areas, characterised as; **strategic positioning** (teaming, market and industry exploitation, specialist exchanges); **industry development** (business creation, new sectors, IP generation, supply chain integration); **industry participation**; (contracts awarded, jobs and skills maintained, industry collaboration with academia).

6 Assumptions, Framework, and Principles of Engagement

As the SKA Office becomes established, policies and procedures covering the management and execution of procurement processes will be developed and implemented in accordance with Member expectations and Board approval. These documents will be guided by the outputs from PrepSKA Work Package 5 (WP5) – principally the "*Towards a Procurement Strategy for the SKA*" report.

In the preconstruction phase, the main activities of the SKA Office will be:

- Design authority for the SKA;
- Interaction with the SKA partner/PO institutions and industry;
- Project management, System engineering design (including risk management), and schedule and budgetary control;
- Integration of the project activities and work package deliverables; and
- Definition of procurement arrangements for SKA design and pre-construction, conducted by the WPCs.

The POs represent the largest reservoir of detailed domain knowledge in the project, and have carried out most of the practical work to reach the end of the Preparatory Phase. The requirements and specifications for the SKA and sub-systems will be developed collaboratively with the POs; the SKA Office being the central authority for procurement standards, policy and design decisions.

Much of the industrial involvement will be as part of Work Packages taken on by consortia of POs, in which case the primary relationship with industry will be with the consortia rather than the SKA Office directly. However some minor contracts to industry may continue to be managed directly from the SKA Office.

The Work Package deliverables from the POs will be 'in-kind' funded from local or regional sources, thereby achieving a measure of *juste retour* for the partnering nations. The seeking of interest and proposals will resemble processes for commercial contracts. However commitment to funding is established by multi-lateral agreements between Members of the SKA Organisation and the SKA Organisation itself. Since the bidding Work Package Consortia (WPC) are funded by their respective member countries, and are unlikely to be legal entities, work contracts are expected between the POs (or possibly their Funding Agencies) and industry. If industry is self financing, they will be bound by the terms of the Consortium Agreement.

The size and complexity of the SKA means that an industry culture in managing and costing the project is essential, while retaining the domain knowledge and experience of the POs. The principles of industry engagement, whether directly with the SKA Office or via SKA POs, is to be consistent with the following;

- The design, construction and commissioning of the SKA will herald a significant step in the technology and performance of radio telescopes. Consequently, specifications are demanding, and only the best quality and reliability will be acceptable. To reach this standard, procurement processes will scan globally for suppliers able to meet the rigorous demands of the instrument;
- The SKA Office procurement function may undertake global industry 'scouting' work and use this information to inform a 'smart' procurement approach for greater efficiency and effectiveness, and also to assist in understanding the capability landscape for procurement balancing;

- Requirements, as they progress from general performance aspirations through to specifications, will be appropriately communicated, and developed with the benefit of industry consultation. At the contractual stage, requirements will be clear, realistic in terms of commercial risk, and incorporate appropriate milestones and payment arrangements;
- Procurement documents will be made available to potential bidders/suppliers at the same time and with reasonable time frames for a response, in accordance with the complexity of the specification;
- Received tenders for each procurement will be assessed on a fair and equitable basis. The cost of responding to tenders will be kept as low as possible, in line with industry best practice;
- Where it is considered necessary, feasible and is permitted, briefings will be held and/or information will be made available in relation to specific tenders, as well as sector-specific information on coming tenders;
- Capability 'scouting' processes initiated by the SKA organisation (see Appendix B) will be impartial, diligent, and recognise actual and potential capability, and not result in early elimination of potential suppliers. Similarly, the SKA organisation promotes EoI, RfP, vendor selection and contract award processes which are managed professionally, ethically, and efficiently, operate under a procurement policy, and withstands proper scrutiny;
- The SKA Office will collaborate and consult on a 'without prejudice' basis in joint learning sessions to develop or exchange best practice tools with industry, and seek general advice concerning the manner of requirements setting, programmatic effectiveness, and possibly specific contractual performance. Such activities will be structured so as to avoid 'lock-out' of any future vendor to the project;
- The SKA Organisation will encourage an open, value for money approach to the market, and will demonstrate integrity and fairness in negotiating contractual matters with national and international entities, in accordance with an approved procurement rules and policy. SKA Office procurement policy will permit techniques such as balancing and *juste retour* to fulfil global goals for collaborative return on investment, and capacity building; and
- Industry suppliers (whether part of a WPC or not) will conduct their dealings with the SKA Office with the highest standards of integrity and commercial behaviour, recognising that the SKA project is characterised by an open, yet trusted, collaboration of global science organisations, led by a not-for-profit entity.

Industrial liaison, beyond the procurement interaction, is planned to continue into the construction phase of the project. The role of the SKA Office Industry Liaison Officer will focus on sustainable industrial engagement, and communications support between the project and industrial agencies and groups.

7 Broader Benefits of Engagement with the SKA Project

Apart from delivering the performance to meet the science goals of the instrument, the SKA project has the potential to seed direct social and economical benefits, including industry benefits.

The world's radio astronomy infrastructure, of which the SKA will form a key element, supports the research of thousands of professional and student radio astronomers and astrophysicists employed in universities and other research institutions around the globe. Many student scientists and engineers go on to pursue discoveries and careers in allied industry sectors, often employing techniques and technologies derived from astronomical research.

Participation in the SKA through involvement in Work Package Consortia (WPC) has the potential to showcase regional industry capability. As a next generation telescope, the SKA requires technological innovation and complex system integration on a challenging scale. The project has already drawn significantly on the expertise of industry in the pre-cursor (pathfinder telescope) countries, as well as from multi-national corporations (See examples in break-out boxes 1 and 2 below). This will increase, especially in the areas of manufacturability, and mass production.

Box 1: Poseidon Scientific Instruments

Through strategic positioning and R&D investment as a niche supplier of timing technology, Poseidon Scientific Instruments (Western Australia) has been awarded a $1.3million contract to help deliver a key SKA precursor located at the Murchison Radio astronomy Observatory. Poseidon's initial work to design, prototype and integrate the complex digital receiver central to the Murchison Widefield Array (MWA) has culminated in the company winning the contract to build the receivers for the telescope's full scale construction.

Box 2: Tellumat

In South Africa, TelluMAT (responsible for a significant amount of RF-engineering work on KAT7) has been contracted to develop a prototype of the "digitizer" for MeerKAT. The digitizer does RF conditioning and converts the signal from RF to digital close to the focus of the antenna. RFI shielding is of particular importance in this application.

Traditionally, technologies developed for astronomy have been taken up by diverse range of industries including ICT, medicine, ecology, and system management. It is anticipated that there will be similar transfer of new technology and new applications from both the pre-cursors, and the SKA itself. Solutions for the non-astronomy challenges for the SKA (sensors, power supply, remote access, and remote operations of high tech infrastructure) will also have global applications. (See example in break-out box 3 below.)

Box 3: Radio Astronomy spawns WiFi chip

An invention originating from radio astronomy lies at the heart of modern WiFi networks. A key technique to resolving the multiple paths of wireless signals was the Fast Fourier Transform (FFT) - a mathematical procedure that can be used to allow signals to be divided up, transmitted and then recombined in a way that mostly eliminates the problem. CSIRO invented and patented the wireless technology in the 1990s – a technology that has given us the freedom to work independently using devices such as laptops and smart phones. The development team is credited with creating a technology that will be in over five billion devices worldwide by the end of 2013.

Skills development and skills transfer is anticipated through contract works, training, testing, commissioning and handover, embedding of personnel within SKA Member country institutes or contractors involved in the WPC. Skills transfer may form a mandatory or optional part of a Request for Proposal (RfP), or quotation request (RFQ).

Industry working with the SKA Organisation may seek approval to exploit pathways to 'spin-off' benefits and legacy capability that offers social, technical, and economic benefits beyond the global

SKA program. This may be manifested through new infrastructure, new jobs, exploitation of Intellectual Property, new indigenous capability, and creation of new supply chains.

The SKA Office has no preconceived notions as to the size, location, structure, or governance of potential suppliers to the project. However, without contradicting any specific requirements expressed in procurement materials or documents, the following may be a helpful guide to organisational profile characteristics that reflect the nature of the project;

- **Reputation.** The SKA will require technologies, goods and services from dependable suppliers who are likely to have a demonstrated track record of working successfully with highly innovative partners;
- **Flexibility.** The nature of the SKA instrument, its 'greenfield' location, and cutting edge design, means that not all development, integration, and construction problems will have been entirely solved at contract award time. Suppliers with experience in this environment will realise the need to factor in a degree of flexibility and tolerance when engaging with the SKA project, and avoid a 'contract variations claim' stance;
- **Approach to risk.** While there is certainly technological risk to the project, the astronomical community has deep understanding and experience of the effort required at the test and commissioning stage of the SKA. The pre-construction phase especially is highly collaborative between suppliers, and SKA engineers and scientists, and software specialists. Potential suppliers should understand that final performance is achieved only after extensive configuration testing and systems integration work, and appropriate levels of contingency for unknown factors should also be considered;
- **System Reliability.** It is expected that some suppliers will have experience in the defence sector, reflecting its high reliance on cutting edge electronics and software. It should be realised though, that while the SKA is no less demanding in terms of technology, individual component failure leading to a fraction of the instrument being unserviceable for a period is possibly acceptable. Potential suppliers should clearly understand the reliability requirements and match their offer to the specific project application; and
- **Extended relationships.** Development and construction of the SKA will explore and reveal many new applications and know-how across fields as diverse as high-capacity data transport, remote power management, Radio Frequency Interference (RFI) mitigation, 'systems of systems' control and behaviour, and even human management challenges. Organisations are encouraged to look beyond supply contracts and seriously consider the potential for other (non-financial) project involvement benefits including exploitation of IP in adjacent markets, organisational learning, and capability expansion.

8 Practical Industry Participation

8.1 Strategic Positioning

Through the SKA Preparatory (PrepSKA) period up to 2012, the SPDO encouraged relevant industrial organisations of all kinds to make contact with the project office, particularly when niche capabilities were identified. As a result, the SPDO held many exploratory meetings with industry, with each contact identified in an Industry Contact Register, since made available to SKA POs. Direct approaches remain welcome, particularly in relation to specialist placements, secondments, facility access, project tools, training, etc., and other opportunities for long-term engagement with the project. Enquiries should be directed to the SKA Office Industry Liaison Officer.

Large global organisations with mega-scale R&D and high-technology programmatic experience have potential to engage with the SKA Office early under the aegis of a Statement of Mutual Interest (SoMI) arrangement that permits strategic interchange restricted to general technology directions and programmatic advice. This in no way implies pre-selection or advantageous positioning for contracts, and business development and commercial discussions are not permitted. A small number of SoMI partners are currently in this category.

8.2 Collaborative Development

Industrial organisations are encouraged to make contact with their Member country or regional industry groups[1], or with lead SKA Institutions, in order to become known as potential industry contributors to the SKA, through strategic positioning, and/or participation in EoI/RfT responses. Industry groups encourage efficient global dealings with the project through their combined experience and capability. Following consideration of SKA Work Package opportunities, industrial organisations may join regional or national Work Package Consortia (WPC) to effectively link or combine capability at the pre-construction stages.

These consortia offer opportunities to strengthen local ties for creation of compelling bid offers with POs, and can foster new and expanded industry sectors. Such industrial collaborations can help meet any nationally policy prescribed local industry content targets, SME development, and integration of supply chains. Several SKA participating nations have already spawned local industry groups.

8.3 Current Industry Participation

Expressions of Interest (EoI) and Requests for Proposals (RfP) concerning stage 1 of the SKA pre-construction will be released by the SKA Office during 2012 (See appendix A). The SKA Organisation has determined that bids for pre-construction Work Packages must be led by POs or industry from Member countries, however POs are encouraged to form consortia with other organisations including commercial arrangements with industrial partners who are encouraged to assess the business opportunities and if attractive, develop compelling bids. Parts of Work Packages subcontracted to industry may be awarded against specified activities, funded through the Participating Organisations within the Member countries.

The make-up of the bidding consortia is not prescribed, and will vary according to member country individual circumstances and institutional policies. However the basis of composition will be ‘self assembly’, and may contain international participants, including industry. These processes are taking place now (as at April, 2012), leading to the anticipated issue of Stage 1 RfPs mid 2012.

In most cases, the final output from the pre-construction phase is a group of ‘datapacks’ containing full document sets for the awarding of construction contracts for SKA1.

9 Communication of Opportunities for the overall SKA Project

The SKA Organisation’s main communications are via:

- Regular updates posted on the SKA Organisation website (www.skatelescope.org);

[1] A Regional or country SKA industry group may be formed as a cluster, alliance, consortium, cohort, etc.

- Promotion through newsletters, and media releases;
- Posting of public tenders on appropriate websites; and
- Direct emails

In addition, the SKA Organisation's may utilise other channels from time to time, including:

- Provision of information and facilitation of project briefings to industry;
- Early issue of indicative technical specifications to permit industry to begin research and development of detailed proposals;
- Support of meetings and workshops with industry groups;
- General communication via this Industry Engagement Strategy.

Potential suppliers can become aware of SKA supply opportunities through;

- Prior involvement with one or more SKA stakeholders;
- Attendance at a local, or SKA Office organised, briefing or conference;
- Announcements in an SKA newsletter or website material;
- 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;
- Public advertising of business opportunities (EoI, RfP, etc);
- Direct approach by an SKA stakeholder, PO, or person;
- Membership of an industry group, e.g. SKA industry consortium; and
- Encouragement by Government agencies.

10 SKA Procurement and Process

The SKA Organisation's approach to procurement is underpinned by the principle of best 'value-for-money' acquisition, with primary consideration given to project mission and performance. Factors include reliability, supportability, ease of integration, purchase risk, and total acquisition cost.

The points below frame the general determination of whether a proposal (from a PO-industry consortia or individual bidder) provides genuine value-for-money:

- the capability of the supplier to deliver to the agreed terms, where possible assessed on the basis of past contractual performance;
- the extent to which the product on offer meets or exceeds the specifications sought;
- the flexibility to adapt to possible change over the lifecycle of the product or service, including the extent to which it can be evolved to meet future capability needs;
- financial considerations including all relevant direct and indirect benefits and costs and risks over the whole procurement cycle, and beyond in the case of lifetime costs;
- evaluation of the risks associated with the alternative choices;
- the cost-benefits of an accelerated delivery schedule; and

The SKA procurement approach will generally concentrate on what is required in terms of the final capability or performance, and not on the detail of the product or service beyond obvious limits of physical size or power draw, etc. However for certain SKA components, systems and services, the more traditional approach (build-to-print) will be applicable, e.g. where various suppliers must each deliver numbers of identical product, or where the detail of the physical design is paramount.

The RfP process will not contravene declared national and international codes, e.g. the EC, WTO type rules, and operate with approved procedures and templates.

The relationships among the SKA Office, POs, consortia of POs and industry are shown schematically in Figure 3, and their roles and relationships are described in more detail below.

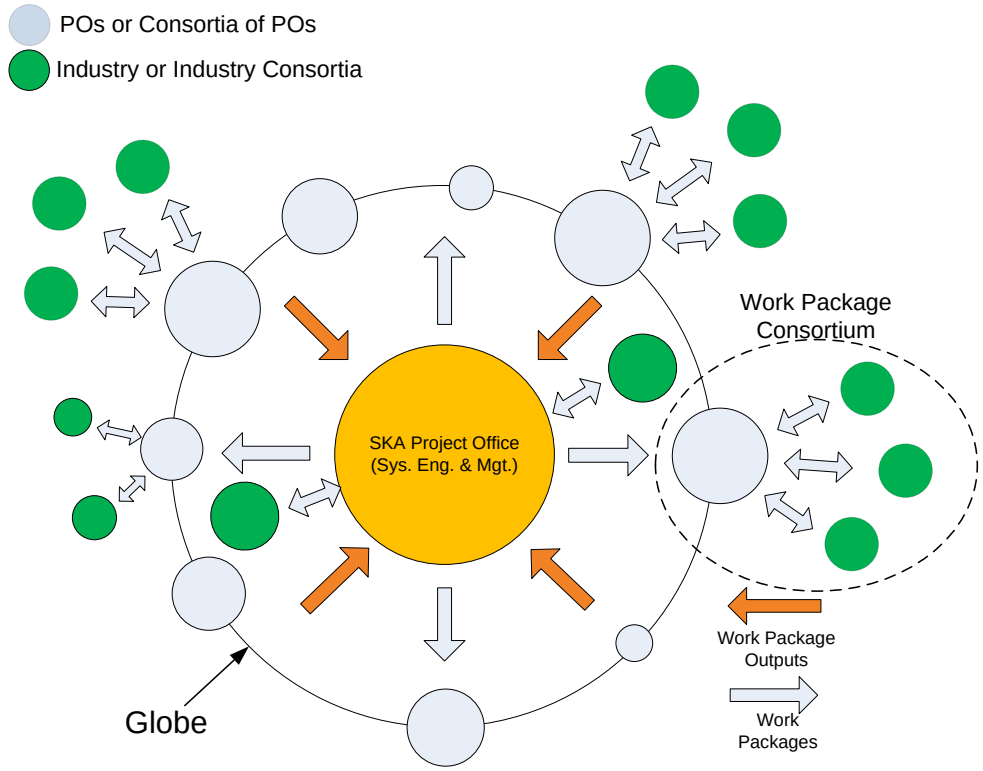


Figure 3: *The relationships between the SKA Office, WPC, POs, and Industry.*

The SKA project is operated by a strong project office (the SKA Office) with centralised management and system design authority. The SKA Office will allocate Board-approved Work Packages covering major subsystems to a small number of successful bidders, who may be POs alone or Work Package Consortia (WPC) including industry. By forming WPC, the talent, capacity and experience required to carry out large work packages can be optimised.

The proposed process for allocation and validation of the Pre-construction phase Work Packages is shown in Figure 3. The instrument covering the award of the WP will be a form of multilateral agreement (MLA) between the SKA Organisation, the Member country funding agencies , while the bidding consortia is required to implement a Consortia Agreement between the parties. The Office of the SKA Organisation will monitor progress and any delays and/or non delivery will be enforced through the Board of Directors and Members of the SKA Organisation.

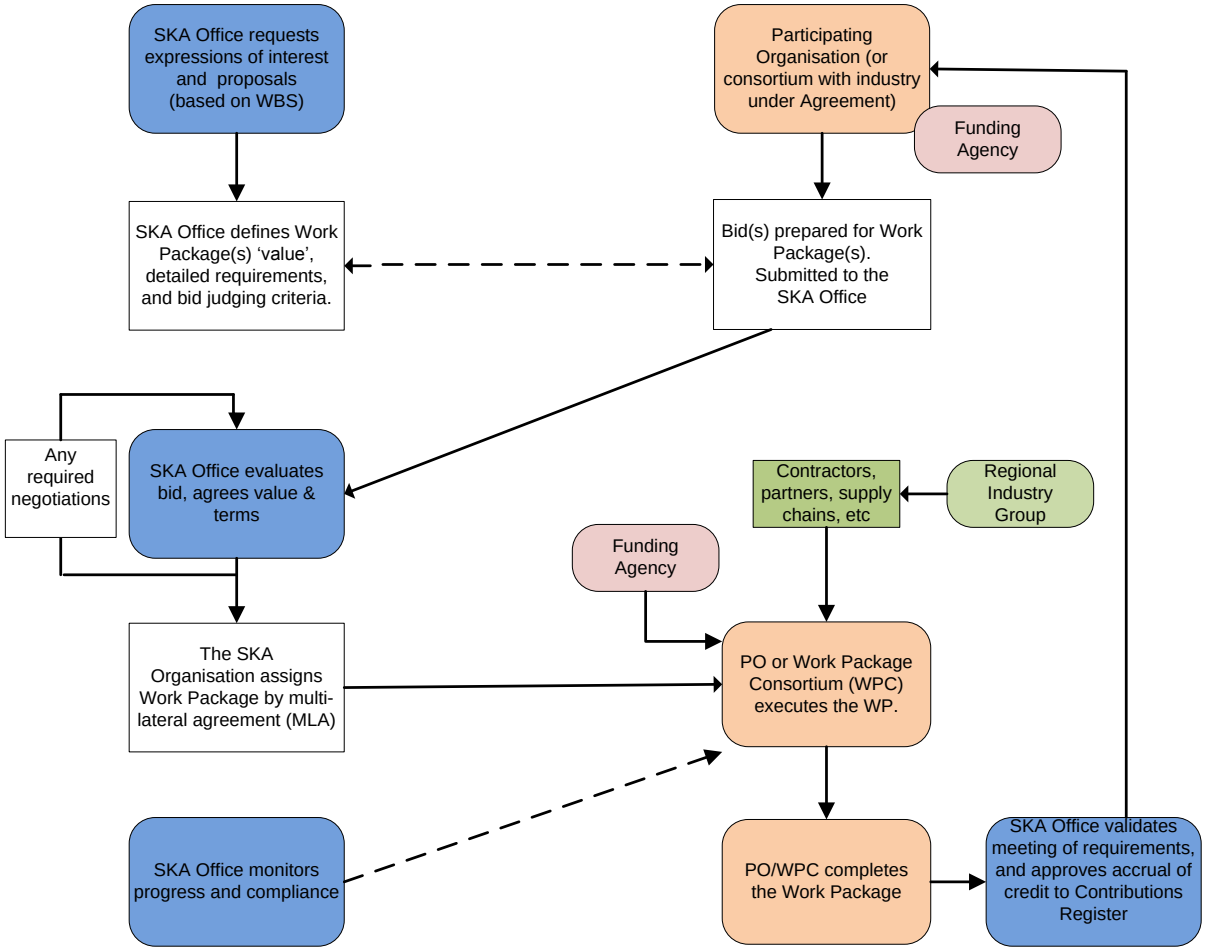


Figure 4: *Proposed process for SKA Work Package allocation and execution.*

11 Intellectual Property

As a large global, cutting-edge science enterprise, the SKA program strongly encourages innovation in order to fulfil its mission of developing, constructing, and operating a 'next-generation' radio telescope through cooperation among the SKA stakeholders. The SKA Office is currently developing an *"SKA Intellectual Property (IP) Policy"* which continues the commitments of the original SKA Consortia to share IP within a defined framework. This is expected to be issued mid 2012.

In summary, the approach to IP management supports the right of all SKA stakeholders to;

- create, retain, use, assign, share and promptly protect (foreground) IP relating to the SKA Program, including its sub-systems, and production technologies, according to the applicable local and international laws;
- maintain confidential all confidential information, whether made/developed alone or in collaboration with other Parties, or acquired through discussions among SKA stakeholders or Third Parties where the Party is aware, or should reasonably be aware, that the information was obtained subject to an obligation of confidentiality;

- disclose promptly (by registering with the SKA Office) background IP developed, owned or created by means of funded research or contractual arrangements with Third Parties;
- unless otherwise agreed, the Parties will formally permit (or otherwise licence) 'freedom of use' of such IP to the project to enable the project to proceed unhindered, or to satisfy the terms of any applicable Third Party Contracts or patent application or other regulatory requirements; and
- Not unreasonably restrict any party interested in the commercial exploitation of foreground IP (assuming approval from the IP originator).

The SKA Office will provide all reasonable co-operation and assistance, to the Parties to secure, protect and commercialise foreground project IP, including:

- providing supporting information and documents which may be required to obtain patent, copyright, or other suitable protection for the IP developed by the Party;
- providing (non financial) assistance in legal actions taken in response to infringement prosecutions and defences, where such infringement may impact on the SKA;
- generally encourage and assist, when IP protection is secured, in the marketing and promotion of IP to industry; and
- steps to protect the SKA brand against usage not approved by the SKA Office.

In the case of copyright, if research by a Party leading to any IP has been funded by or through the SKA Office, all rights, title and interest in the IP will jointly belong to that Party and the SKA Office, unless agreed otherwise. Further, the Parties agree that copyright ownership of all other Copyrighted Works shall be owned wholly or partly by, or free access granted to, the SKA Office, including:

1. software;
2. technical designs including blueprints (with detailed methodologies);
3. configuration diagrams, integrated circuit designs, and masks;
4. algorithms, formulas and codes describing any compounds or material; and
5. data arising from SKA research and experimentation.

12 Industry Engagement Risk Management

The SKA Organisation will adopt a prudent approach to risk mitigation, including adoption of the risk reduction tactics outlined below:

- Well drafted, and legally clear, contracts;
- Adequate resources assigned to contract management;
- Competence within the SKA Office;
- Context, complexities and dependencies of contracts well defined and understood;
- Sufficient testing or other validation of supplier assumptions or assertions;
- Clear authorities or responsibilities relating to commercial decisions;
- Proper performance measurement or benchmarking by the SKA organisation;
- Appropriate flexibility and/or innovation in procurement in order to optimise value-for-money outcomes and to ensure that supplied goods and services comply with requirements;
- Proper monitoring and management of retained risks, and procurement barriers (statutory, political and commercial);

- Sensitivity to competent supplier capacity, and scope creep beyond capability; and
- Awareness of financial transactions environment, and potential force majeure.

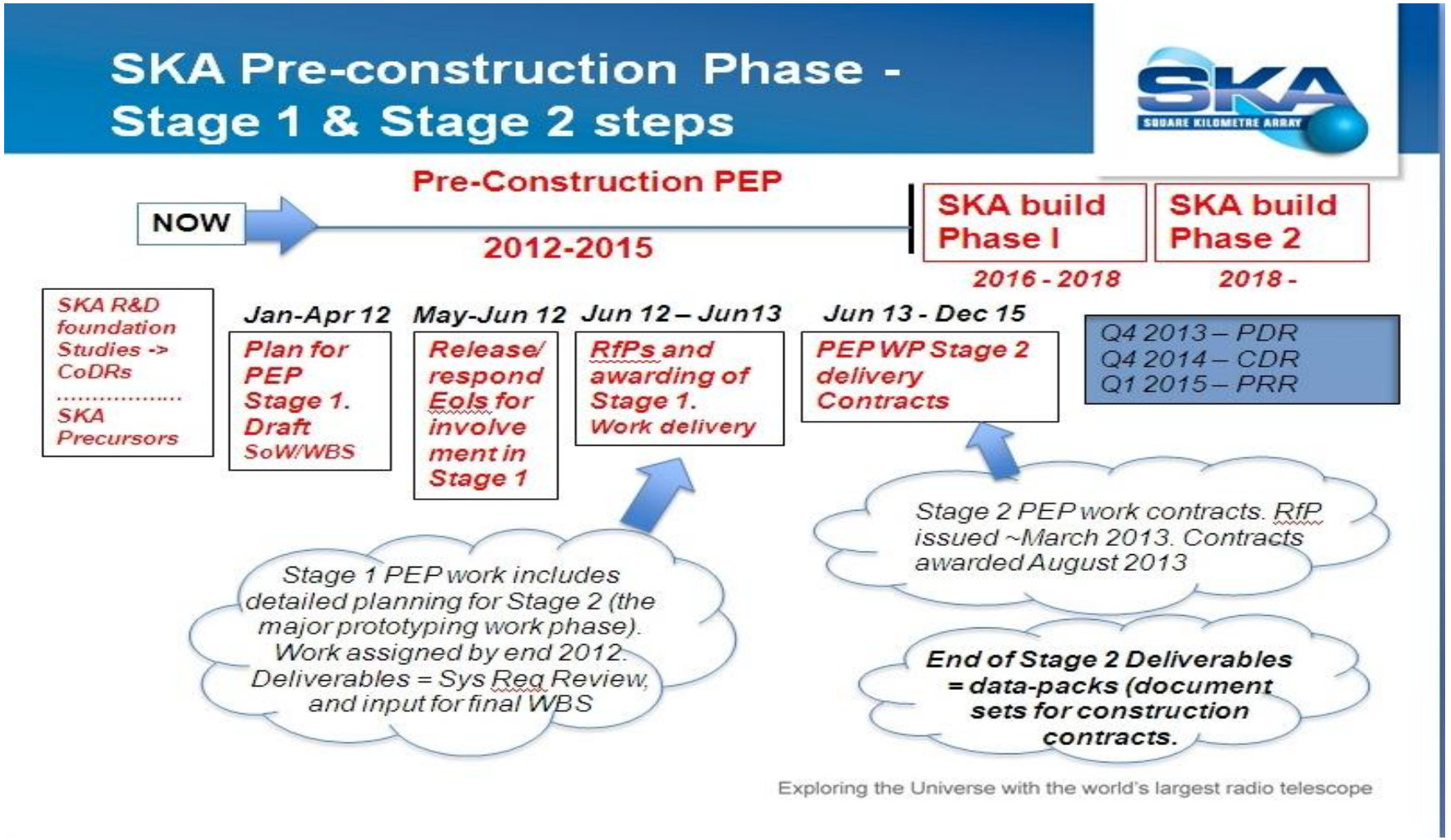
As a general principle, potential bidders for pre-construction or construction work must not be given unfair foreknowledge or detailed contractual specification requirements. For the SKA project, there is a high likelihood of contact between project personnel and industry at all phases. Nevertheless policies must be observed and methodologies adopted by all parties to avoid exclusion from subsequent participation because of its prior knowledge (a situation also known as 'lock-out').

Examples in large scientific infrastructure projects show that it is possible to operate properly within official procurement rules and still do what is technically and scientifically necessary. For example, the LOFAR project found success with software correlator development through effective nurturing and management of industry collaboration with a major computer vendor. The ALMA radio telescope also features pre-competitive engagement with industry mostly via conventional contracts.

13 References

[1] SKA Pre-construction Phase Project Execution Plan ('PEP')
[2] SKA System Engineering Management Plan (SEMP)
[3] SKA Stage 1 Statement of Work / Work Breakdown Structure
[4] Stage 1 Engineering Work in Pre-Construction Phase (Dewdney presentation – Perth Nov 2011.
[5] Draft SKA Intellectual Property Policy Rev 0.9
[6] Towards a Procurement Strategy for the SKA (ver 5.1) – Perna C, Crosby P, Colengo R.
[7] SKA Capability Assessment Model (ver 1.3) – Crosby P.
[8] SKA Website www.skatelescope.org
[9] Procurement strategies enabling success in high-technology mega-projects: Preparatory work for the SKA (Memo 129) Crosby P.

Appendix A – Pre-construction Phase Stage 1 & Stage 2 Steps



Appendix B – Global Capability Assessment

A global industry capability assessment ('scouting') process has been recommended by PrepSKA WP5 that aims to usefully inform SKA procurement policies. This is particularly in relation to ensuring fair competition, and understanding potential industry capability, local procurement requirements, and political/regulatory issues. The assessment process also provides an economic context by being cognisant of the broader impact of SKA contracts on employment, skilling, regional development, and indigenous involvement.

The model, as described in the PrepSKA WP5 document "Capability Assessment Model", is proposed as the initial strategic review process to assess the maturity and capability of a country/region to achieve and sustain contractual supply expectations (especially concerning on-time and on-quality deliveries) in response to the procurement intentions for the SKA.

The model can be used:

- to internally formalize, before starting the assessment of a country/region or key suppliers, the level of capability expected for an activity by the SKA Organisation;
- to establish an initial assessment of country/region and/or key suppliers;
- to identify, between the SKA organisation and country/region or key suppliers, any gap(s) between the actual assessment and the expected capability;
- to facilitate planning to cover the gaps identified during assessment;
- for country/region or key suppliers self-assessment;
- to assist selection of country/region or key suppliers for the development/construction of the SKA;
- by companies to assess/select sub-tier suppliers for the development/construction of the SKA; and
- by government agencies to assist in focusing schemes to support industry capability growth.

The global capability process, while contributing value and integrity to the SKA procurement system, does require significant resources in terms of qualified 'scouting' personnel and travel budget. In particular, a high level of professional skill is required in the international business arena to ensure impartiality and to overcome language and cultural issues.

By applying the model, SKA stakeholders will obtain a global vision of strengths and weaknesses regarding regional, national, and business processes in support of practical capability to deliver goods and services to the project. This information will support procurement planning, and strategically direct the RfQ/RfP and major contract award phases of the project. It will essentially answer the question – who can reliably and competitively do what?