The Square Kilometre Array
The International Radio Telescope for the 21st Century

Industry Engagement Strategy
Version 3.0

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## Revision History

<table>
<thead>
<tr>
<th>Revision Date</th>
<th>Version</th>
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</thead>
<tbody>
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<tr>
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<td>2.1</td>
<td>Updated section 11 to explain pathway for industry participation</td>
</tr>
<tr>
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<td>2.2</td>
<td>Clarification of SPDO-SPO transition, Work Package allocation</td>
</tr>
<tr>
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<td>2.3</td>
<td>General update, &amp; detail for practical industry participation</td>
</tr>
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<td>3.0</td>
<td>General update to reflect start of PEP phase and processes, formation of The SKA Organisation, and recent SPO announcements and directions. Mainly sections 3 &amp; 9.</td>
</tr>
</tbody>
</table>
Table of Contents

1.0 Introduction and Purpose of this Document
2.0 The Square Kilometre Array (SKA) Project
3.0 The SKA Organisation & Consortia and Membership
4.0 Overall Goals of Industry Engagement for the SKA
5.0 Expectations of The SKA Organisation, and Understanding of Requirements
6.0 Assumptions, Framework, and Principles of Engagement
7.0 Expectations of Industry, and Understanding of Requirements
8.0 SKA Domains with Potential for Industry Engagement
9.0 Practical Industry Participation
10.0 Global Capability Assessment
11.0 Communication of Opportunities
12.0 SKA Procurement and Process
13.0 Intellectual Property
14.0 Industry Engagement Risk Management
15.0 References

Appendix A – Indicative time-chart for the SKA
Appendix B – PEP Stage 1 & Stage 2 steps
1. Introduction and Purpose of this Document

This document provides guidance to industry and other stakeholders to assist business planning, help guide capability development, and describe practical participation in the SKA project.

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 2019. 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 ahead of the detailed SKA design. (See Appendix A).

As the SKA project moves through the design and development, 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. The scale of the SKA and the inherent requirement to 'productise' many of its components necessitates the engagement of industry at levels now being seen for radio-astronomy projects such as the ALMA instrument in Chile, and the LOFAR pathfinder centred in the Netherlands.

It is therefore vital that SKA stakeholders keep abreast of the requirements, and contractual timelines during the SKA design and construction. This allows potential industry partners to align their planning and development to meet future needs and position global industry to provide ‘value for money’ solutions.

Industry participation with the SKA means early collaborations with a variety of organisations, among them niche R&D companies, followed by increasing engagement through commercial contracts with high-volume manufacturers, technology systems vendors, site services and installation firms, and power and data transmission specialists. Engagement will naturally occur with larger technology and civil engineering firms, and is also encouraged with smaller local vendors, including teaming arrangements and supply chain exploitation. The measure of success of this strategy, and of industry participation in the SKA, will be the extent that industry can deliver technologies and services against profitable value-for-money contracts fairly awarded to vendors across the SKA Consortia member states.

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 €1.2 billion.

The Office of the SKA organisation, and its associated national and regional consortia programs, welcomes interest from existing and potential industry partners.
2. 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 world community is pooling resources and expertise to design and construct powerful telescopes that will probe the entire electromagnetic spectrum.

The Square Kilometre Array (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 will make the transition from an early formative concept to a fully operational instrument (SKA$^2$) via a 10% phase 1, known as SKA$_1$. (See Table 1).

SKA$_1$ will be a sparse aperture, low frequency array covering 70 – 450 MHz, plus a nearby dish array probably equipped with phased array feeds (PAFs) and single pixel feeds covering 450 MHz to 3 GHz. Parallel to phase 1 construction will be an advanced instrumentation program to allow for development of cutting technologies (e.g. dense aperture arrays) without these being on the critical path.

Coming later, SKA$_2$ will be an array of coherently connected antennas spread over an area about 3000 km in extent, with an aggregate antenna collecting area of up to $10^6 \text{m}^2$ at centimetre and metre wavelengths. A key scientific requirement is the ability to carry out fast, sensitive observations of the sky over large areas (surveys), enabled by the application of the most up-to-date signal-processing technology available. Although the precise range of frequency bands has not yet been determined, SKA$_2$ will eventually produce images and other data over wavelengths from around 4.3 metres (70 MHz) to 1 centimetre (30 GHz).

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.

The key applications and science goals for the SKA$_2$ 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;
- Understanding of the formation and evolution of black holes of all sizes;
- The formation of stars and their planetary systems, and the birth and evolution of giant and terrestrial planets (the ‘cradle of life’ questions);
- An understanding of how the astronomical environment affects Earth.

The project has shortlisted two excellent radio-quiet sites for the SKA, one centred in Southern Africa, the other in Western Australia. A site decision is expected by May 2012.
### Table 1. Top level schedule (indicative) for the SKA

<table>
<thead>
<tr>
<th>Technical</th>
<th>Programmatic</th>
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<tbody>
<tr>
<td>2008 -12   Telescope concept design and cost</td>
<td>Late 2011 Approve pre-construction funding</td>
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<tr>
<td>2013 -15   Detailed design &amp; pre-construction cost</td>
<td>Late 2011 Establish SKA organisation as a legal entity</td>
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<tr>
<td>2016 -18   Phase 1 (SKA_1) construction</td>
<td>Early 2012 Site selection</td>
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<tr>
<td>2016       Advanced instrumentation program decision</td>
<td>2014 Phase 1 construction funding approved (350 M€)</td>
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<tr>
<td>2018 -23   Phase 2 (SKA_2) construction</td>
<td>2017 Phase 1 construction funding approved (1.2 B€)</td>
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<tr>
<td>2018 -&gt;    Full science operations with phase 1</td>
<td></td>
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<tr>
<td>2024 -&gt;    Full science operations with phase 2</td>
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3. The SKA Organisation & Consortia Membership

The SKA project was born global. SKA Consortia were established in the Europe, Australia, South Africa, Canada, India, and USA, supported by institutions grouped in India, China, Japan, and Korea. The initial collaboration agreement established the SKA Science and Engineering Committee (SSEC) as the primary management forum for interactions and decisions on scientific and technical matters 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. Led by Prof. Richard Schilizzi and internationally staffed at its host institution (University of Manchester (UK), the SPDO was funded via an SKA collaborative agreement during the SKA preparatory (PrepSKA) phase.

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). (Canada joined the international organisation in March 2012.)

In November 2011, the Founding Board announced the formation of The SKA Organisation, a UK registered, independent not-for-profit company established to formalise relationships with international partners and centralise the leadership of the project. The new SKA Organisation (“the SKA Office”) builds on the work of the SPDO by ramping up staffing, taking 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 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.
4. Overall Goals of Industry Engagement for the SKA

This Industry Engagement Strategy establishes a framework supporting full, fair and reasonable opportunity for businesses within SKA Consortia regions to supply goods and services to the project.

The document describes how the SKA Office will communicate the broadly described opportunities to industry in a timely and appropriate manner and encourages opportunities for industry to engage, find potential partners and access supply chains. Opportunities are also described for longer term industry development to encourage research and development (R&D) and specific innovation in SKA-related areas.

Industry engagement falls 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).

Some of the benefits to industry of participating with the SKA community are:

- 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 and profitable contracts in a funded, multi-billion Euro project spanning a wide range of infrastructure, engineering and computing disciplines.

5. Expectations of the SKA Organisation, and Understanding of Requirements

The primary goal of the SKA Office is to effectively and efficiently manage and organise the development, construction, and operation of the SKA telescope, while satisfying the national science and industry aims of the SKA Consortia.

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

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

Being an active SKA Consortium member sends a powerful signal reflecting that country or regional Government’s commitment to science, and its local industries. This has positive effects for the attraction, training and retention of scientists and engineers, and for young peoples’ attitudes to science and engineering – vital issues for underpinning the human resource base for sustaining regional economic growth.

Participation in the SKA 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. This will increase, especially in the areas of manufacturability, and mass production.

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 (power supply, remote access, and remote operations of high tech infrastructure) will also have applications around the world.

Skills development and transfer (academia to business, business to academia, etc) is likely to occur through contractually procured training, testing, commissioning and handover, embedding of personnel within SKA Consortium institutes or a contractors’ location, as well as courses. Skills transfer may form a mandatory or optional part of a Request for Proposal (RfP), or quotation request (RFQ). Skills transfer is also likely to occur during the operational phases of the SKA.
The skill levels required for execution of the SKA are generally high, with a requirement for trade, degree, and post graduate qualified personnel with world recognised qualifications. Due to the specialist nature of radio astronomy, and the breakthrough nature of the technologies, skill levels of most project personnel will be escalated with excellent potential for application to adjacent industries.

Industry specifically has certain expectations reflecting a professional, efficient, mutually beneficial, and above all fair, approach to participation in the SKA project:

First, it will be expected that the SKA Office takes a ‘world-view’ of procurement, that applied procurement policies will be well researched, and that a level of harmonisation is in place across the SKA Consortia regions and countries. Industry can expect dealings with the SKA Office and Participating Organisations (PO) to be professional, non-discriminatory, and efficient. 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.

Second, any project capability ‘scouting’ processes (see Section 10.0) will be impartial, diligent, and recognise actual and potential capability, and not result in early elimination of potential suppliers. EoI, RfP, vendor selection and contract award processes will be managed professionally, ethically, and efficiently, operate according to an approved procurement policy, and withstand proper scrutiny. Industry will expect that weightings applied as a result of any juste retour, and capacity building policies will be applied evenly, and that due notice is taken of offerings that support strategic (win-win) collaborations, and generation of potential intellectual property.


As the new SKA Office becomes established, policies and procedures covering the management and execution of procurement processes will be developed and implemented. These documents will be guided by the outputs from PrepSKA Work Package 5 (WP5) – principally the “Towards a Procurement Strategy for the SKA” report that offers relevant recommendations.

The realisation of the SKA instrument will begin with a pre-construction phase leading to the Phase 1 SKA (SKA₁). This effort will be managed by the SKA Office and enacted with certain members of the SKA Partner nations known as Participating Organisations (POs), most likely in consortia with their regional industry associates. This phase is described in the SKA Preconstruction Project Execution Plan (PEP). See also Appendix B – Stage 1 & stage 2 steps.

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

- Design authority for system engineering;
- 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
• Initiating procurement arrangements for SKA design and pre-construction, mainly via contractual procurements as part of the in-kind contribution from POs.

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 procurement data control, and the authority for design decisions.

A large fraction of the Work Package deliverables from the POs will be “in-kind” funded from local or regional sources, thereby effecting a de facto *juste retour* for the partnering nations. Work Package structures will be similar to those for commercial contracts, including contract awarding processes. Much of the industrial involvement will be as part of these 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 contracts to industry may continue to be managed directly from the SKA Office.

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, the SKA procurement office 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;

• Tender documents will be made available to selected suppliers at the same time and with reasonable time frames for a response, in accordance with the complexity of the specification;

• Supplier tenders for each procurement will be assessed using the same set of criteria. The cost of responding to tenders will be kept as low as possible, in line with industry best practice;

• Where it is considered necessary and feasible, 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;

• The SKA Office, and/or SKA Consortia members, will collaborate and consult on a ‘without prejudice’ basis in joint learning sessions to develop or exchange best practice tools with industry. Such activities will be structured so as to avoid ‘lock-out’ of any future vendor to the project; and

• The SKA Office’s policy is to pursue 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.
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. Expectations of Industry, and Understanding of Requirements

In the context of this Strategy, industry is defined as 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.

It is expected that industry suppliers (whether part of a consortium with a PO or not) conduct their dealings with the SKA Office with the highest standards of integrity and 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.

Industry may be asked for general advice concerning the manner of requirements setting, programmatic effectiveness, and possibly specific contractual performance requirements that reflects genuine capability.

Where viable, industry working with the SKA Office will 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.

Industry will welcome opportunities to engage strategically with the SKA program, as it has at the pre-cursor and pathfinder stages. Industry will be encouraged and welcomed when offering (without prejudice) resources for teaming, knowledge sharing, lobbying, and promotion of the SKA for long-term benefits.

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 recognise the need to factor in a degree of flexibility and tolerance when engaging with the SKA project;
- 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 ‘PEP phase especially is highly collaborative between suppliers, and SKA engineers and scientists, especially software specialists. 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 many 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

- **Development and construction of the SKA** will explore and reveal many new applications and know-how across fields as diverse as mega-data transport, remote power management, 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. SKA Domains with Potential for Industry Engagement

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

### 9. Practical Industry Participation

**Strategic Positioning**

Through the 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 (contact details on front cover).

Large global organisations with mega-scale R&D and high-technology programmatic experience have a special capability to engage with the SKA office early under the aegis of a Statement of Mutual Interest (SoMI) that permits strategic interaction and high level technical planning and communication to occur for the benefit of the project. Five SoMI partners are currently in this category.

Industry Development

Industry organisations are encouraged to create/join regional or national consortia to effectively grouped capability for the project at the preconstruction stages. These industry clusters offer opportunities to strengthen local ties for creation of compelling bid offers with POs, and new and expanded industry sectors. Organised industry enables ‘start-ups’ or expansion of companies, meeting of local content targets, SME development, and integration of supply chains. Several SKA participating nations have spawned local industry groups.

Current Industry Participation

Requests for Proposals (RfP) concerning SKA pre-construction will be released from the SKA Office during 2012 (See appendix B). The SKA Board has determined that bids for pre-construction Work Packages must be led by POs from member countries, however POs are encouraged to form consortia with other organisations including commercial arrangements with industrial partners. These consortia will assess the business opportunities and if attractive, develop compelling bids. Contracts will be awarded against specified activities, funded largely against cash commitments from the participating member countries.

Member countries will self nominate their lead PO (institution), which then takes charge of a national process to determine most relevant Work Packages to bid on, and the make-up of the bidding group or consortia. These processes are taking place now (as at April, 2012).

The final output from the pre-construction phase is a group of ‘datapacks’ containing full document sets for the awarding of construction contracts for SKA.

10. Global Capability Assessment

A global industry capability assessment (‘scouting’) process has been recommended to the SKA Office that aims to usefully inform SKA Procurement policies. This is particularly in relation to ensuring fair competition, and understanding potential industry capability and any local procurement barriers or 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.

By applying the model, the SKA Office 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?

11. Communication of Opportunities

Potential suppliers will become aware of SKA supply opportunities through:

- Prior involvement with one or more SKA stakeholders;
- Attendance at a local or SKA Office organised SKA road-show, briefing or conference;
- Announcements in an SKA newsletter or web material;
- Active seeking of markets by Business Development personnel;
- Notification from a public database of SKA (and pre-cursor) vendors;
- Via the SKA 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.
The SKA program’s communication strategy will also include:

- Provision of information and facilitation of project briefings to industry in order for local/global suppliers to have adequate time to identify potential opportunities and establish their competitive position;
- Early issue of indicative technical specifications to permit industry to begin research and development of detailed proposals;
- Support of round-table workshops with industry groups to examine approaches to technology development and implementation;
- Regular updates to the SKA Organisation internet sites (www.skatelescope.org);
- Contribution to any SKA Forum website;
- Promotion through media releases and industry publications;
- Posting of public tenders on appropriate websites;
- Undertaking, as appropriate, company visits (to validate capability and capacity) to potential suppliers interested in tendering for major procurements as part of the overall project;
- Providing confidential feedback to unsuccessful suppliers so as to assist them in future opportunities; and
- Notification via this Industry Engagement Strategy.

12. SKA Procurement and Process

SKA Office procurement policy is underpinned by the principle of best ‘value-for-money’ acquisition, with primary consideration given to project mission and performance. Other factors include value, reliability, supportability, ease of integration, purchase risk, and price.

The points below inform the 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;
- evaluation of the risks associated with the alternative choices;
- the cost-benefits of an accelerated delivery schedule; and
- Evidence of a formal agreement among the bidder organisations (e.g. collaborators, funders, supply chain partners) as assurance of resources commitment.

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.

For the pre-construction period, global procurement for the SKA project will use a dispersed procurement model, where the funding contributions of the SKA project member countries are applied to POs and their industry partners via the lead institute.

The relationships among the SKA Office, POs, consortia of POs and industry are shown schematically in Figure 2, and their roles and relationships are described in more detail below.

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**Fig 2: The relationships between the SKA Office, POs, and Industry**

The SKA project is operated by a tightly controlled project office (the SKA Office) with centralised management and system design authority. The SKA Office will allocate approved Work Packages covering major subsystems to a small number of successful bidders, who may be POs, PO led consortia with institutes and/or industry. By forming consortia, the talent, capacity and ideas required to carry out large work packages can be assembled from several organisations so as to make maximum use of expertise. The close links between the various levels indicates the close collaboration and involvement between the SKA Office and consortia, as well as inside each consortium.

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 Office, the PO-consortium, and its Government, while the bidding consortia is required to implement a (self-defined) formal contract between the parties. While the contractual (legal) obligation for compliant delivery rests between the bidding consortia, the MLA details the obligation of POs to deliver final conformance and value, and thus satisfy the SKA office as to satisfactory project credit among the global partners.

13. 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 Consortia. The SKA Office is currently finalising an “SKA Intellectual Property (IP) Policy” which continues the early commitments of the SKA Consortia members to share IP within a defined framework.

In summary, the (draft) policy recognises the right of all SKA partners 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 (whether formal or informal) with members of the SKA community, or Third Parties where the Party is aware or should reasonably be aware that the information was obtained subject to an obligation of confidentiality;

**Fig 3. Proposed process for SKA Work package allocation**
• disclose promptly (by registering with the SKA Office) background IP developed/owned pursuant to this Policy or created pursuant to funded research or other 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 the 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 relevant 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 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
• Take 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. 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:

(i) software
(ii) technical designs including blueprints (with detailed methodologies), configuration diagrams, Integrated Circuit Designs
(iii) algorithms, formulas and codes describing any compounds or material
(v) integrated Circuit Designs, mask works, and
(vi) data arising from SKA research and experimentation


Apart from the strategic risk of lack of interest or capability within industry (already largely retired through active early engagement); the principal risk lies in the procurement process and fulfilment of the contract. Procurement outcomes may be endangered by several kinds of risk as listed below, some only partly within SKA Office control;

• Poorly drafted contracts
• Inadequate resources assigned to contract management
• Insufficient procurement team skills or experience at SKA office and/or PO
• Context, complexities and dependencies of contracts not well understood
• Failure to test or otherwise validate supplier assumptions or assertions
• Unclear authorities or responsibilities relating to commercial decisions
• Lack of performance measurement or benchmarking by the buyer
• Lack of flexibility or innovation in procurement
• Failure to monitor and manage retained risks, or procurement barriers (statutory, political and commercial)
• Lack of supplier capacity, or scope creep beyond ability
• Loss of supplier’s key staff
• Change of supplier’s business focus
• Financial insecurity, and 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, 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’). The SKA Office will avoid ‘lock-out’ through the techniques described in SKA Memo 129, published on the SKA Telescope website.

15. References

• SKA Pre-construction Phase Project Execution Plan (‘PEP’)
• SKA System Engineering Management Plan (SEMP)
• SKA Stage 1 Statement of Work / Work Breakdown Structure
• Stage 1 Engineering Work in Pre-Construction Phase (Dewdney presentation – Perth Nov 2011).
• Draft SKA Intellectual Property Policy Rev 0.9
• Towards a Procurement Strategy for the SKA (ver 5.1) – Perna C, Crosby P, Colengo R.
• SKA Capability Assessment Model (ver 1.3) – Crosby P.
• SKA Website www.skatelescope.org
• Procurement strategies enabling success in high-technology mega-projects: Preparatory work for the SKA (Memo 129) Crosby P.
Appendix A – Indicative time-chart for the SKA Project (as at November 2011)
SKA Pre-construction Phase -
Stage 1 & Stage 2 steps

Pre-Construction PEP

2012-2015

NOW

SKA R&D foundation
Studies -> CoDRs
SKA Precursors

Jan-Apr 12
Plan for
PEP
Stage 1.
Draft
SoW/WBS

May-Jun 12
Release/
respond
EoIs for
involve-
ment in
Stage 1

Jun 12 – Jun 13
RfPs and
awarding of
Stage 1.
Work delivery

Jun 13 - Dec 15
PEP WP Stage 2
delivery
Contracts

SKA build
Phase I
2016 - 2018

Q4 2013 – PDR
Q4 2014 – CDR
Q1 2015 – PRR

SKA build
Phase 2
2018 -

Stage 2 PEP work contracts. RfP issued ~March 2013. Contracts awarded August 2013

End of Stage 2 Deliverables = data-packs (document sets for construction contracts.

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Stage 1 PEP work includes detailed planning for Stage 2 (the major prototyping work phase). Contracts awarded by end 2012. Deliverables = Sys Req Review, and input for final WBS