The Square Kilometre Array

The International Radio Telescope for the 21st Century

Industry Engagement Strategy

Version 1.0

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REVISION HISTORY

Revision Date	Version	Summary of Key Changes
11/08/09	0.1	Draft contents page only
21/10/09	0.2	Revised contents page
29/10/09	0.3	Most headings part populated
02/12/09	0.4	General edit and expansion of text
19/01/10	0.5	Minor amendments following RTS review. Clarified description of the procurement office & process.
27/04/10	0.6	Add procurement risk, harmonised approach to global IE
25/06/10	1.0	First release version

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PART A

1. Introduction and Purpose of this Document

The international Square Kilometre Array (SKA) project aims to construct the world's largest radio telescope – 50 times as sensitive as present instruments – by around 2017. A number of design concepts for the instrument will emerge from the precursor and demonstration phase and a selection of technology for the SKA will be made around 2010-2011, starting with Phase 1 design (SKA_1)

As the SKA project moves through the design, development, construction and operational stages, industry will play a crucial role in the 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 only beginning to be seen for radio-astronomy projects such as the ALMA instrument, and the LOFAR pathfinder.

It is therefore vital that SKA stakeholders keep abreast of the requirements, timelines and budgets 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 necessarily occur with larger technology and civil engineering firms, and is also encouraged with smaller local vendors, possibly including teaming arrangements and supply chains. 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 to around 2017 and beyond, covering the period when SKA project (in whatever legal form it is constituted) will invite industry involvement in the vicinity of € 1.2 billion of funded procurements.

The information contained within this document aims to provide helpful guidance to industry and other stakeholders to permit business planning and capability development, and facilitate government-institution-industry-project dialogue.

The international SKA project, 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 well-defined design via a 10% phase 1, known as SKA_1.

SKA_1 will be a sparse aperture, low frequency array covering 70 – 450 MHz, plus a nearby dish array with 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 being on the critical path.

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 $10^6 m^2$ at centimetre and meter wavelengths. A key scientific requirement is the ability to carry out 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 in Southern Africa, one in Western Australia. A site decision is expected by end of 2012.

Top level schedule for the SKA

Technical	
2008 -12	Telescope system design and cost
2013 -15	Detailed design & pre-construction cost

2016 -19	Phase 1 construction
2016	Advanced instrumentation program decision
2018 -23	Phase 2 construction
2010 ->	Full science operations with phase 1
2024 ->	Full science operations with phase 2
Programmatic	
2011	Approve pre-construction funding
2011	Establish SKA organisation as a legal entity
2012	Site selection
2014	Phase 1 construction funding approved (350 M€)
2017	Phase 1 construction funding approved (1.2 B€)

3. The SKA Organisation & Consortia

The SKA organisation is truly global. SKA Consortia have been established in the United States, Europe, Australia, Canada, India, Australia, South Africa, and supported by Asian institutions grouped in India, China, Japan, and Korea.

Evolving from earlier agreements, an International Collaboration Agreement for the SKA Program became effective on 1 January 2008. It was signed by the European, US, and Canadian SKA Consortia, the Australian SKA Coordination Committee, the National Research Foundation in South Africa, the National Astronomical Observatories in China, and the National Centre for Radio Astrophysics in India. This agreement established the SKA Science and Engineering Committee (SSEC) as an executive management group and acts as the primary forum for interactions and decisions on scientific and technical matters for the SKA among the signatories to the International Collaboration Agreement. The SSEC may make decisions on scientific and technical matters but has no financial responsibilities or authorities.

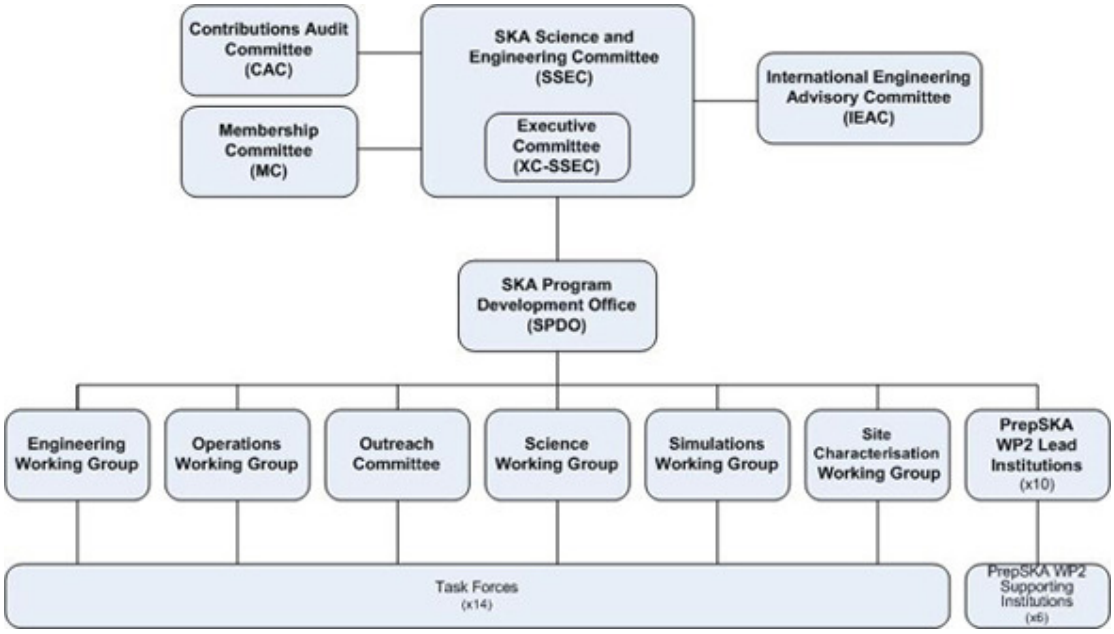
In 2007, a Memorandum of Agreement to Establish the SKA Program Development Office (SPDO) was drawn up to provide a framework to internationalise the technology development and design effort of the SKA through the creation of a coordinating project office. This agreement, which became effective on 1 January 2008, was signed by the CSIRO Australia Telescope National Facility, University of Calgary, Cornell University, the Joint Institute for VLBI in Europe, and the National Research Foundation in South Africa. The SPDO is funded by signatories of the agreement, with payments being made into the SPDO Common Fund and used to finance the SPDO's operational activities.

The SPDO is responsible for:

- Co-ordinating the global activities of the SKA program in terms of engineering, science, site evaluation, operations, telescope simulations, industry participation, and public outreach.
- Providing the secretariat for the SSEC.
- Developing a costed design for the SKA and,
- Undertaking site characterisation studies in the two shortlisted SKA host nations in Australia and Southern Africa, with regional partners.

At around mid 2011, the SPDO will evolve or be replaced by a legal entity (nominally the 'SKA Project') which will manage global funding and construction of the SKA instrument at the selected site.

The current (2010) governance structure of the SKA organisation is shown below:



4. Overall Goals of Industry Engagement for the SKA

A basic premise of this Industry Engagement Strategy is to establish a framework supporting full, fair and reasonable opportunity for businesses within SKA Consortia regions to supply goods and services to the project. (Refer section 11 - SKA Procurement and Process).

The document describes how the SKA Project 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.

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 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 project spanning a wide range of engineering and computing disciplines.

Industry engagement falls broadly into three areas, each characterised below;

INDUSTRY PARTICIPATION

Contracts awarded
Goods and services provided
Jobs maintained and created
Industry leadership i.e. industry doing it largely themselves
Industry collaboration with academia (with possible generation of new IP)

INDUSTRY DEVELOPMENT

Wealth creation for nations (new jobs, better jobs)
Growth in human capital
New and expanded industry sectors
IP generation – measured by patents or other means
Socially accessible infrastructure e.g. broadband network
Start-up or expansion of companies
Meeting of local content targets
Integration in global supply chains

STRATEGIC POSITIONING

Teaming between industry-industry, industry-government, industry-institutes
Marketing advantages through association with the SKA project (visibility)
Specialist placement, secondments, facility access, etc., for long-term benefits
Knowledge-sharing between industry and others (institutes, agencies, etc.)
Synergies through industry associations (people, technologies)

5. Expectations of the SKA Organisation.

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. 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 project.

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 Tender (RFT), 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.

The SKA organisation expects industry to approach engagement in a spirit of partnership to achieve a complex and demanding goal, reflecting the inspirational nature of mega-science projects, whilst achieving a return on its investment commensurate with the risk and funding capacity of a non-defence program.

6. 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 organisations, industry associations and consortia, and other groups or individuals with an interest in provisioning the SKA program in some way.

Industry engagement, falls into the three areas (described in section 4) - Industry Participation, Industry Development, and Strategic Positioning. For each of these areas, industry will have certain expectations reflecting a professional level, efficient, mutually beneficial, and above all fair, approach to participation in the SKA project.

First, it will be expected that the SKA project 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 procurement office to be professional, non-discriminatory, and efficient.

Second, the initial capability 'scouting' process will be impartial, diligent, and recognise actual and potential capability, and not result in early elimination of potential suppliers. EoI, RFT, 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. Contract documents and other industry engagement material will be expected to express requirements clearly, be realistic in terms of commercially risk, and incorporate realistic milestones and payment arrangements.

Third, industry offers pathways to 'spin-off' benefits and legacy capability that it expects to be recognised and supported both by national Governments, and the global SKA program. This may be manifested through new infrastructure, new jobs, exploitation of Intellectual Property, compliance with local indigenous content rules, and creation of new supply chains.

Finally, industry will welcome opportunities to engage strategically with the SKA program, as it has at the pre-cursor and pathfinder stages. Industry will expect to be encouraged and welcomed when offering (without prejudice) resources for teaming, knowledge sharing, lobbying, and promotion of the SKA for long-term benefits. Large global organisations have a special capability to engage with the SKA project 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.

7. 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

8. Assumptions, and Principles of Engagement

The current (2010) assumption is that the SKA organisation will steer a transition from the SKA program Development Office (SPDO) into a formal legal entity effectively becoming the (as yet unnamed) SKA Project. Within the SKA Project,

there will be established a procurement and contracts office, staffed by competent and qualified personnel who will manage the procurement process under the direction of an SSEC approved procurement policy devised under PrepSKA WP5.

The (expected) principles of industry engagement are assumed 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 procurement office will be cognisant of the industry 'scouting' work performed during the PrepSKA phase and use this information to support 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 all global 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 Project, 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.

- The SKA Procurement Office will pursue an open, value for money approach to the market, and will demonstrate fairness in negotiating and awarding contracts to national and international entities, in accordance with an approved procurement rules and policy. It is envisaged that such policy will permit techniques such as balancing and juste-retour to fulfil global goals for collaborative return on investment and capacity building.

9. Global Capability Assessment

The global industry capability assessment ('scouting') process aims to usefully inform SKA Procurement policies, particularly in relation to fair competition and potential industry capability. 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,
- by government agencies to assist in focusing support schemes to support industry capability growth.

By applying the model, users 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 SKA project. This information will support procurement planning, and strategically direct the RFQ/RFT and major contract award phases of the project. It will essentially answer the question – who can reliably and competitively do what?

10. Communication of Opportunities

Potential suppliers will become aware of SKA purchasing needs through;

- Prior involvement with one or more SKA stakeholders
- Attendance at an SKA related road-show, briefing or conference
- Sighting of 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, RFT, etc)
- Direct approach by an SKA stakeholder person or group
- Membership of an industry group, e.g SKA industry consortium
- 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 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.

11. SKA Procurement and Process

The decision criteria for SKA acquisition policy will consider project mission and performance, in relation to other requirements including value, reliability, supportability, ease of integration, purchase risk, and price. These criteria combine under the banner of best 'value-for-money' acquisition.

Generally, there are a number of factors that will be used to that determine whether a proposal provides value-for-money, including:

- 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;
- An avoidance of a 'faster-better-cheaper' mindset by procurement agencies or suppliers.

At this time, several contracting models are under consideration, and although the general expectation is that the SKA Project will adopt the position of prime contractor, the engagement of a commercial project management entity is not ruled out.

Modern procurement approach generally concentrates on what is required in terms of the final capability or performance, and is largely unconcerned with the detail of the product or service beyond obvious limits of physical size or power draw, etc.

Whilst this approach may be valid for certain SKA components, systems and services, the more traditional approach (build-to-print) will be applicable in some situations, e.g. where various suppliers must each deliver numbers of identical product, or where the detail of the physical design is paramount.

Although restricted, or closed RFTs, may be appropriate for certain supply acquisitions (i.e. where only one or few suppliers have been identified as possible bidders), open tenders are likely to be the preferred approach. This more likely guarantees both the largest numbers of industry enquiries, and a fair approach in gathering industrial information, supply offers, and R&D collaborations. Price enquiries (based on the capability assessment outcomes) and R&D contracts performed via open tenders could provide the following advantages:

- guarantee to the SKA project the full access to a worldwide market to identify the best available technologies, free from any geographical boundary restrictions;
- stakeholders will be able to continuously monitor the industrial involvement for fairness;
- the ability to look strategically at regional capability for possible bundling or split of contracts, or to address any 'juste-retour' issues. Also, early 'chunking' of the project systems or subsystems may be appropriate.

The RFT model will include the following components;

1. a tenders issuing office to ensure RFT preparation is conducted according to set rules, and the RFT release process is globally fair;
2. a tenders management system to ensure that RFT documentation is properly controlled, updates and clarifications are distributed equitably, tender offers are received officially and are secure until opened;
3. a supervision body to receive, review, and decide on shortlisted or winning offers, with properly documented records of the decision process supported by factual and objective procedures.

The RFT process will itself comply with declared international codes, e.g. the EC Rules, and operate with approved procedures and templates.

In the framework of the SKA, the RFT model is planned to be deployed in the following way;

i) <u>High level engagement to discover new technologies or industrial information at the concept level.</u>

Information from industry about cutting-edge solutions, new discoveries and scientific contributions are welcomed by the SKA project. Such approaches should involve Regional Industry Contacts, be covered by an officially approved Memorandum of Understanding (MOU) or equivalent and where appropriate a Non-Disclosure (Confidentiality) Agreement (NDA). Industrial technical information coming from the pathfinders/precursors is important for the work of WP2 in providing a costed design. Liaison with the pathfinder/precursor organisations will occur through the SKA Program Development Office (SPDO) Domain specialist meetings. When this involves transfer of technology, formal agreements will be put in place, including where possible unfettered Intellectual Property (IP) agreements.

ii) <u>R & D contracts for prototyping & design</u>

The project office will issue a specification (drafted by the technical domain), normally using an output specification, and encouraging innovation and emerging technologies. A copy will go to the Regional Industry Contact. The project office will manage the receipt of offers, and work with the technical domain on selection of suppliers. The supervising body will review and approve the issued contract.

iii) <u>Global price enquiries for COTS requirements</u>

The project office will issue a specification (drafted by the technical domain), and encourage innovation and emerging technologies. A copy will go to the Regional Industry Contact. The SKA project office procurement department

will manage the receiving of pricing information, and liaise with the technical domain, and manage approvals if a contract is issued.

iv) 'In-kind' contributions of personnel, tools, technical services, or other resources

Offers of support from industry are generally welcomed as strategic support for the SKA project and with the goal of a win-win outcome. Such approaches must come through the Regional Industry Contacts, and be approved by the SKA project office. All in-kind support of this nature must be transparent to all stakeholders.

12. Organisational Profiles Aligned to SKA Needs

The SKA Program 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 and construction problems will have been entirely solved at contract award time. Suppliers with experience in this environment having allowed for contingency would be well placed to realise longer term success.

- Approach to risk. Whilst 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 around 'first light'. This phase 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.

- 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 whilst 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 quite acceptable. Suppliers should not build in costs to ensure 100% system availability.

- 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.

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 and institutes. The SKA Program also encourages worldwide competitiveness in terms of regional industries, and the development, production, and deployment of their technologies and applications.

The SPDO has developed a specific document titled the "SKA Intellectual Property Policy" which continues the early commitments of the SKA Consortia members through to the eventual SKA Project legal entity.

In summary, the policy recognises the right of the SKA partners to;

- create, retain, use, assign, share and promptly protect 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;

- disclose promptly (by registering with the SPDO and its legal successor) IP developed/owned pursuant to this Policy or created pursuant to funded research or other contractual arrangements with Third Parties;

- unless otherwise agreed, Parties will formally permit 'freedom of use' of such IP to the SKA Project to enable the SKA Project to proceed unhindered, or to satisfy the terms of any applicable Third Party Contracts or patent application or other regulatory requirements;

- not unreasonably restrict any party interested in the commercial exploitation of the IP.

The SKA Project will;

- provide all reasonable co-operation and assistance, to the Parties to secure, protect and commercialise the IP, including
- providing information and executing 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
- generally encourage and assist, when IP protection is secured, in the marketing and promotion of IP to industry as and when required
- Take steps to protect the SKA brand against usage not approved by the SSEC

In the case of copyright, if research by a Party leading to any IP has been funded by or through the SKA Project, all rights, title and interest in the IP will jointly

belong to that Party and the SKA Project. Further, the Parties agree and accept that copyright ownership of all other Copyrighted Works, 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

shall be owned by, or granted free access to, the SKA Project.

14. Industry Engagement Risk Management

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, only some of which are within SKA Project control;

- Poorly drafted contracts
- Inadequate resources assigned to contract management
- Procurement team not matched to the supplier team in terms of either skills or experience (or both)
- Context, complexities and dependencies of contracts not well understood
- Failure to check supplier assumptions
- Unclear authorities or responsibilities relating to commercial decisions
- Lack of performance measurement or benchmarking by the buyer
- Focus on current arrangements rather than what is possible or the potential for improvement
- Failure to monitor and manage retained risks (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*

Risks are heightened by procurement itself, with a dependency on one or more external providers, leaving the buyer with reduced ability to command and manage variables. Even when a risk is notionally subrogated to the supplier it cannot be dismissed, "*transferred risks…cannot be forgotten about simply because the contract obliges the provider to deal with them. A key point is that business risk can never be transferred to the provider"* (OGC 2002 p25)

Risk of Pre-competitive relationships (lock-out)
(adapted from Hall & Khan 2006)

As a general principle, potential bidders should not be given foreknowledge of contractual requirements and it is good practice to avoid direct contact between contracting personnel and potential bidders once a purchase action has commenced. In 'high-tech' mega-projects such as the SKA there is likely to be contact between project personnel and industry; nevertheless policies must be observed and a culture of internal discipline is required from both parties.

Where a company is involved in an early (and vital) stage of the project there is a risk that the (potential) bidding firm might be excluded from subsequent participation precisely because of its prior knowledge (also known as 'lock-out'). This could mean exclusion of precisely those organisations that have specific relevant knowledge or skills from the early stages of a project. This situation creates difficulties for the strategic engagement potential for early involvement in multi-billion 'high-technology' projects such as the SKA.

Another extreme example is when one of a number of potential bidders for a contract has already been given a contract for a prior phase of the work. The advantages to the supplier include a better understanding of what will be needed, reduced costs through familiarity of system interfaces, and the possibility of customer developed hardware.

However, it *is* possible to operate properly within the rules and still do what is technically and scientifically necessary (as shown by 'real world' examples such as LOFAR, ALMA, etc) but it does require a lot of care, forethought and advance preparation regarding the procurement scheme.

Some of the approaches that the SKA project can take include:

- Placing a study or technology development contract on the basis of a competition, thus providing a justification for continuing relations with the contractor.

- Assign the study or R & D work with provision for the results to be made available to all potential bidders for the main contract.

- Employ parallel competitive studies. These can sometimes produce better results, as well as justifying the further selection of one contractor, though cause added expense.

- Seek contractors for early stage work who do not have the capacity or desire to engage in large scale manufacture. A contractual condition can be that the contractor agrees to be available as a potential sub-contractor to any future potential main bidder.

- In extreme circumstances a developed technology that is regarded as vital can be treated either as customer furnished equipment or as an imposed sub-contract. This has the disadvantage that it entails considerable customer responsibility for the results.

PART B (To be Developed)

15. Participation in the Construction Phase

16. Transition to SKA Operational phase.