The Square Kilometre Array

The International Radio Telescope for the 21st Century

Industry Engagement Strategy

Version 2.3

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REVISION HISTORY

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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
1/7/10	1.1	Minor typo corrections, and long term support added
28/01/11	2.0	Updated to reflect the PEP. Add indicative time-chart for the SKA
03/04/11	2.1	Updated section 11 to explain pathway for industry participation
28/07/11	2.2	Clarification of SPDO-SPO transition, Work Package allocation
28 /11/11	2.3	General update, & detail for practical industry participation

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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 more sensitive than present instruments – by around 2018. A number of design concepts for the instrument are emerging from the precursor and technical demonstration phase and a selection of technologies for the SKA will be made in early 2012 ahead of the detailed Phase 1 design (SKA_1). (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 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, 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 naturally 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 2015-16, covering the period when SKA project will invite industry involvement in procurements valued in the vicinity of €1.2 billion.

The information contained within this document aims to provide helpful guidance to industry and other stakeholders to permit business planning capability development, and practical participation in the SKA project.

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 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 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 these 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 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 March 2012.

Table 1. Top level schedule (indicative) for the SKA

Technical	
2008 -12	Telescope concept design and cost
2013 -15	Detailed design & pre-construction cost
2016 -18	Phase 1 construction
2016	Advanced instrumentation program decision
2018 -23	Phase 2 construction
2018 ->	Full science operations with phase 1
2024 ->	Full science operations with phase 2
Programmatic	
Late 2011	Approve pre-construction funding
Late 2011	Establish SKA organisation as a legal entity
Early 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 Membership

The SKA organisation is truly global. SKA Consortia have been established in the United States, Europe, Australia, Canada, India, 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 signed by seven nations. This agreement established the SKA Science and Engineering Committee (SSEC) as an executive management group acting as the primary forum for interactions and decisions on scientific and technical matters for the SKA.

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. The SPDO, operating at its host institution (University of Manchester (UK), is funded by the five signatories of the MoA, with payments used to finance the SPDO's operational activities throughout the SKA preparatory (PrepSKA) phase.

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 concept design and costing for the SKA and,
- Undertaking site characterisation studies in the two shortlisted SKA host nations in Australia and Southern Africa, with their regional partners.

During 2011, background work commenced on establishing the SKA project as a stand-alone legal entity to be known as The SKA Organisation (TSO). In late November the Members' Agreement and Articles of Association were signed by the seven initial members of TSO (Australia, China, Italy, The Netherlands, New Zealand, South Africa and UK). It is anticipated Germany and Canada will also become Members in 2012.

The project is now entering a transition period that will see many functions of the SPDO transferred to the new organisation by March 2012. Meanwhile it will manage central funding and work allocations for the pre-construction phase of the SKA instrument at the selected site. By end 2012 the organisation will be relocated to newly built headquarters within the Jodrell Bank radio astronomy complex outside Manchester, UK. The governance structure of The SKA Organisation is shown in Fig 1:

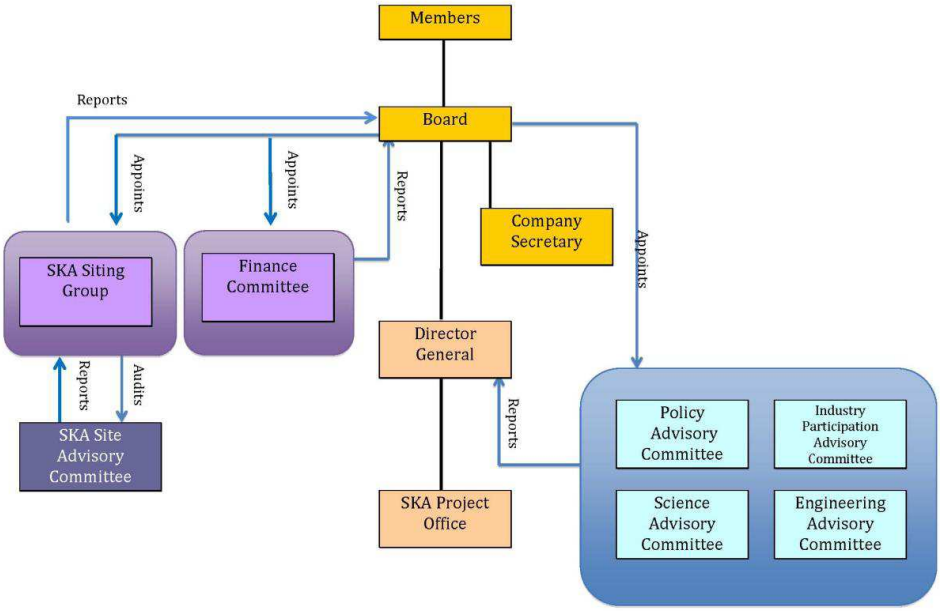

Fig 1: The SKA Organisation governance structure

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 SPDO/TSO 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 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. Assumptions, Framework, and Principles of Engagement

As the SPDO transitions into the autonomous TSO, policies and procedures covering the management and execution of procurement processes will be developed and implemented. These documents will be informed and guided by the outputs from PrepSKA WP5 – principally the *"Towards a Procurement Strategy for the SKA"* report that offers relevant recommendations.

In practical terms, the realisation of the SKA instrument will begin with a pre-construction phase leading to the Phase 1 SKA (SKA_1). This effort will be managed by the SPDO/TSO and enacted by certain members of the SKA Consortia known as Participating Organisations (POs), most likely in consortia with industry.

In the preconstruction era, the main activities of the SPDO/TSO will be:

- Design authority for system engineering,

- Interaction with the SKA partner/sponsoring institutions and industry,

- Project management (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 domain knowledge in the project, and they will have carried out most of the 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 SPDO/TSO being the central procurement data control, and the authority for decisions.

A large fraction of the Work Package deliverables from the POs will be “in-kind” funded from local or regional sources. Work Package structures will be similar to those for commercial contracts, including contract awarding processes.

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

The principles of industry engagement are 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 SPDO/TSO procurement group will be cognisant of any 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 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 SPDO/TSO, 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 SPDO/TSO will set policy to 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. Such 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 SPDO/TSO Industry Liaison Officer will focus on sustainable industrial engagement, and communications support between the project and industrial agencies and groups.

6. Expectations of The SKA Organisation, and Understanding of Requirements

The primary goal of the SKA project 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 Consortia parties.

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 SPDO/TSO 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 TSO 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, the project capability 'scouting' processes 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.

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 organisations, 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 SPDO/TSO 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 will respond to requests for general advice concerning the manner of requirements setting, and respond to specific contractual performance requirements with honesty that reflects genuine capability.

Where practicable, industry 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 SPDO/TSO 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 of the SKA. 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.

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

In the transition period between the end of PrepSKA and the pre-construction phase, strategic relationship development remains welcome, especially for organisations (including SMEs) that have a specialist product or capability related to the SKA. Individual approaches to the SPDO/TSO should be directed through the Manager – Industry Engagement Strategy (crosby@skatelescope.org).

Specialist placements, secondments, facility access, project tools, training, etc., offer opportunities for long-term engagement with the SPSO/TSO.

Large global organisations with mega-scale R&D and programmatic experience have a special capability to engage with the SPDO/TSO 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.

Industry Development

Industry organisations are encouraged to create/join regional or national consortia to more effectively present grouped capability to 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, and integration of supply chains.

Industry Participation

Requests for Proposals (RfP) concerning SKA preconstruction will be released from the SPDO/TSO during 2012. Industry – alone or more likely in consortia with POs – will assess these business opportunities and if attractive, be prepared to develop compelling bids. Contracts will be awarded against specified activities, funded largely against cash commitments from the SKA Consortia nations.

The output from the pre-construction phase is a group of ‘datapacks’ containing full document sets for the awarding of construction contracts for SKA_1.

10. Global Capability Assessment

A global industry capability assessment ('scouting') process has been recommended to the SPDO/TSO 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,
- by government agencies to assist in focusing schemes to support industry capability growth.

By applying the model, the SPDO/TSO 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 TSO 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
- 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
- Notification via this Industry Engagement Strategy

12. SKA Procurement and Process

SPDO/TSO procurement policy will likely adopt 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 underpin the determination of whether a proposal (from a 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;
- 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.

As previously described, it is likely that global procurement for the SKA project will use a dispersed purchasing model, where the funding contributions of the SKA Participating Organisations (POs) are applied to regional/local supply contracts against centrally devised and allocated Work Packages.

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

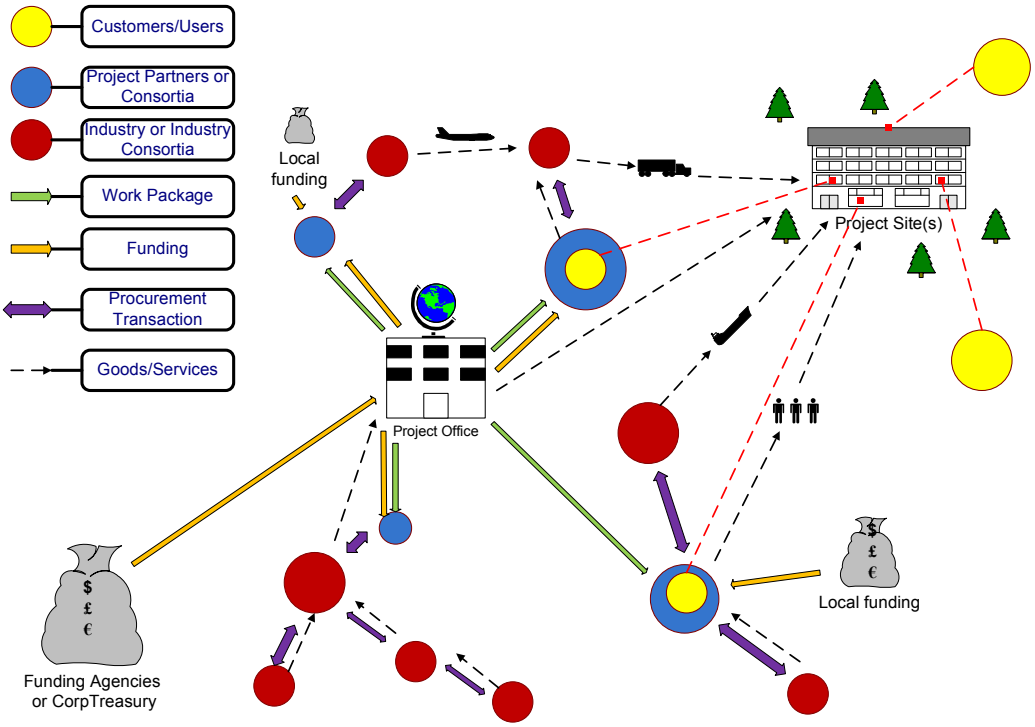

Fig 2: The relationships between the SKA project office, POs, and Industry

The SKA project will have a strong central Project Office (SPO) with management and system design authority. Once approved, the SPO will allocate the Work Packages covering major subsystems to 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 SPDO/TSO and consortia, as well as inside each consortium.

The proposed process for allocation 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, while the bidding consortia will be required to set in place a formal contract between the parties.

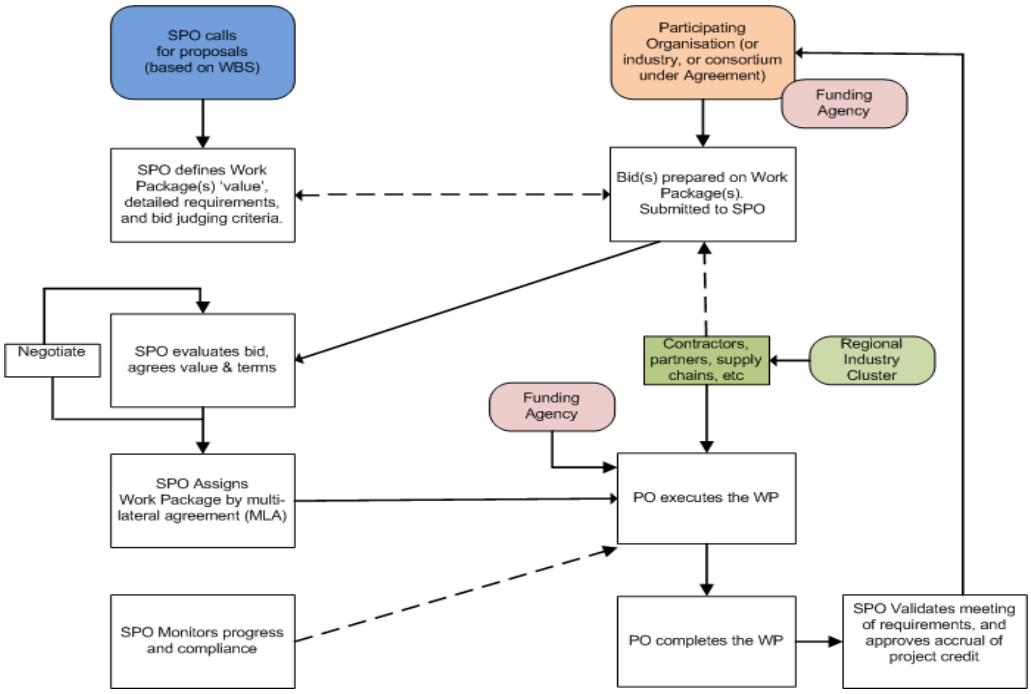

Fig 3. Proposed process for SKA Work package allocation

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 SPDO/TSO is currently finalising an "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 (draft) 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/TSO) 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 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

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

The SPDO/TSO 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 SPDO/TSO, all rights, title and interest in the IP will jointly belong to that Party and the SPDO/TSO. 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 SPDO/TSO.

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, not all within SPDO/TSO control;

- Poorly drafted contracts
- Inadequate resources assigned to contract management
- Insufficient procurement team skills or experience
- Context, complexities and dependencies of contracts not well understood
- Failure to test 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 should not be given foreknowledge of contractual requirements. In the case of the SKA, there is a high likelihood of contact between project personnel and industry. Nevertheless policies must be observed and approaches adopted from both parties to avoid exclusion from subsequent participation because of its prior knowledge (also known as 'lock-out'). The SPDO/TSO will avoid 'lock-out' through the techniques described in SKA Memo 129, published on the SKA Telescope website.

Appendix A – Indicative time-chart for the SKA Project (as at November 2011)