

## **Report Deliverable 1 PrepSKA Work Package 4**

**“Best practices governance and legal framework as applied to other international science projects in the context of developing viable options for the Square Kilometre Array”**

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## **EXECUTIVE SUMMARY**

PrepSKA is an EC-funded Preparatory Study for the SKA radio telescope, Square Kilometre Array, [www.ska-telescope.org](http://www.ska-telescope.org). The SKA telescope will serve science in the field of radio astronomy. The objective of the PrepSKA project is to integrate the Research and Development work from around the globe in order to develop the fully costed design for Phase 1 of SKA, and to deliver a Implementation Plan for the fully operational SKA telescope. The policy-related questions are being investigated with active collaboration of funding agencies and research institutes. One of the PrepSKA Policy work packages (Work Package 4) is tasked with the development of viable options for the SKA legal framework and governance. PrepSKA started in April 2008 and ends in April 2011. PrepSKA is funded by the European Community as a global project.

SKA is a revolutionary radio telescope providing up to 50 times the sensitivity and 10,000 times the survey speed of the best telescopes currently available. The SKA telescope will be an interferometric array of over 3000 radio antennas spread across a surface of about 3000 km in diameter. SKA has two candidate locations in the southern hemisphere that are under consideration: Australasia and South Africa. Both candidate core sites are planned to have remote stations in neighbouring countries. SKA is aiming for construction readiness in 2012 and being fully operational in 2023. The target cost for SKA is 1.5 billion euro (2007).

This document is the first deliverable of PrepSKA Work Package 4 on the governance structure and legal framework for SKA. The next two deliverables will be a paper describing the options for the legal framework and governance and a white paper on the legal framework and governance.

This deliverable provides the PrepSKA Board with an overview of the best practices of existing multinational collaborations which are relevant for SKA. Furthermore, this deliverable should promote an informed discussion about the different models and facilitate a further focussing of ideas as well in the PrepSKA Board as in the Agencies SKA Group, that will result in the drafting of an implementation plan for SKA by the end of PrepSKA phase.

The selection of the most appropriate legal form will be based on the requirements of the SKA governance and therefore also requires a thorough understanding of SKA's operational design. However, many of the SKA facility characteristics are not known yet: one of the work packages of PrepSKA is tasked with developing the design of the instrument and so many important details will not be known before the end of that PrepSKA project or even after. Other important issues, such as the siting of SKA, will be decided after the end of the PrepSKA project. Therefore we have had to put forward the best practice that appears to be most applicable to SKA based on the limited current information and making assumptions or leaving possibilities open for those aspects which are not yet known.

We describe the different models of a legal framework based on national and international law. The models vary from international organisations to different types of national legal entities and combinations thereof. These models were compared with the SKA characteristics and requirements to see which models are relevant for SKA.

In order to compile the requested overview of best practices we studied the governance models of a selected number of existing facilities. The study of the legal documents and the discussion with experts from these facilities helped us to identify the similarities and differences with respect to SKA, and also to learn about the issues encountered by these facilities and how these are dealt with. All of this information allowed us to reach a preliminary conclusion concerning a preferred model for the legal framework.

The main conclusion of this study is that the characteristics of an international organisation, an agreement on intergovernmental level, are best suited to the global SKA organisation. SKA is a global project in terms of the involvement of the research institutes, the potential funding agencies, a multinational site and international staff. Moreover, we believe the choice for an international organisation is further necessitated by the need to multilaterally protect the antennae of the SKA telescope and its central office for a long period of about 50 years, the estimated lifecycle of the SKA telescope. The protection of the site area and safeguarding of the investment will be best served by the status of an international organisation.

However, the establishment of an international organisation also has its drawbacks. The lengthy procedure for the establishment of an international organisation is a particular threat for the scheduling and progress of the project. The length of such a procedure will almost certainly fail to meet the current timeline for having appropriate governance in place for further preparatory work for SKA up to initial construction after PrepSKA has been completed, the post-PrepSKA period.

Moreover, from our discussions we conclude that support for the establishment of new international organisations for new research infrastructure projects cannot be taken for granted.

In addition to all of this the current SKA Memoranda of Understanding and the PrepSKA project have a limited duration and funding that will end in December 2011. However, the decisions on the site selection and final design, which must be known for participants to conclude an Implementation Agreement for the SKA project, are scheduled later in 2012. Consequently a gap in the governance will arise after PrepSKA has ended. An appropriate (provisional) governance should be timely in place to avert this potential problem. Several options are available for such a provisional governance of SKA. We shall refer to this situation in our ongoing work.

## **INTRODUCTION**

This report is the first deliverable of the EC-funded Preparatory Phase Study of the Square Kilometre Telescope Work Package 4 on governance and legal framework. In this document we describe the best practices on governance and the legal framework for international research infrastructures with the aim of providing PrepSKA Board with an overview of the best practices relevant for the SKA organisation.

We will describe our methodology in Chapter I, in Chapter II we will present the conclusions, and Chapter III explains our future work. In Annex I we describe the current SKA organisation consisting of SKA Collaboration, Agencies SKA Group and PrepSKA. The SKA fact sheet is attached as Annex II.

First we will explain the Square Kilometre Array telescope and after the preparatory phase study of SKA, PrepSKA.

### **SKA**

The SKA radio telescope is an revolutionary instrument for astronomers and unique in the world according to the scale. It is an interferometric array of radio antennas spread across a surface of about 3000 km in diameter. This means a formidable challenge in ICT application and technology. The conceptual thinking of the telescope is prepared and developed by the radio astronomy community and started back in 1995. It is commonly perceived as a genuine bottom up project. In the SKA fact sheet the more technical details are described and is attached to Annex I.

SKA has two candidate locations in the southern hemisphere which are under consideration: Australasia and South Africa. Both candidate core sites will have remote stations stretching into neighbouring countries. SKA is aiming for initial construction (10% of the SKA telescope) in 2015 and will be fully operational in 2023. The target cost for SKA is 1.5 billion Euro (2007). The current SKA Collaboration consists of 50 research institutes originating from 19 countries.

The current SKA timeline (SKA fact sheet, Annex I) foresees 5 stages of development. From 2008-2012 the preparatory phase, 2013-2014 detailed design, 2015-2018 initial construction (10%) and ratification of governmental funding for full SKA, 2019-2022 completion of construction and finally in 2023 science operations of the full SKA telescope. However the first science of SKA is expected after completion of the first phase (10%) of SKA .

### **PrepSKA**

PrepSKA is the preparatory phase study for the SKA (Square Kilometre Array) telescope funded under the EU Seventh Framework Project in which 11 research institutes and 11 funding agencies of different continents do participate. This study will integrate the R&D work from around the globe in order to develop the fully costed design for Phase 1 of SKA, and to deliver an Implementation Plan for the full instrument. With the active collaboration of funding agencies and scientists, policy-related questions are also being investigated.

The PrepSKA project started in April 2008 and is now scheduled to end by December 2011. Most of the Work Packages are scheduled to deliver in April 2011 but the design and siting studies require longer to finish than the other Work Packages. PrepSKA's objective is to prepare for the realisation of the construction and operation of SKA, a Square Kilometre Telescope. The overall deliverable of PrepSKA is an Implementation Plan for SKA that will form the basis of a funding proposal to governments to start the construction of SKA. The PrepSKA project consists of 7 Work Packages of which 3 policy Work Packages: Governance and Legal Framework, WP4, Procurement and industrial involvement, WP5, Funding Model, WP6, and; 2 technical Work Packages: design and siting study; and 2 coordination Work Packages.

Work Package 4 (WP4) is tasked with the development of viable options for the SKA legal framework and governance. One of the milestones in the work plan of WP4 is to develop a comparative study on best practices of governance and legal frameworks for international large science projects. This will provide the input for developing the options of the legal framework and governance for SKA and a white paper as a final deliverable of this Work Package.

WP4 will focus on a study of the governance models for existing multinational collaborations; it will attempt to distil the best practice that has emerged from these projects, thus ensuring that SKA can benefit from previous experience. WP4 will then develop options for the optimal structure that might be proposed for SKA during its construction and operational phases. It will also study in greater depth the potential legal frameworks under which the SKA project might ultimately be established and in so doing shall once again building on the experience gained in similar complex projects.

WP4 will also give input to the Agencies SKA Group for the SKA project. The ASG is a group of funding bodies and others who share the aim of realising the Square Kilometre Array (SKA) as a global project. This group aims to deliver a non-binding Joint Agreement on the Implementation of SKA to coincide with the conclusion of PrepSKA in 2011/2012.

## **CHAPTER I: APPROACH AND ANALYSES**

PrepSKA Work Package 4 (WP4) is tasked with the development of viable options for the SKA legal framework and governance. One of the milestones in the work plan of WP4 is to develop a comparative study on best practice governance and legal frameworks for international large science projects.

We approached our milestone using the following work schedule:

1. Inventory of legal and governance models of existing facilities (long list)
2. Inventory of candidate legal models for SKA
3. Inventory of SKA characteristics and requirements
4. Short listing governance models for SKA
5. Conditions for success of the governance of SKA
6. SWOT analysis of candidate legal models for SKA

Each of these steps was approached from two different points of view:

- On the one hand we focussed on the understanding the characteristics of the SKA instrument and the provisions required, so as to identify the elements that need to be taken into account in shaping the governance model;
- At the same time we looked at SKA from the legal point of view, to define what legal framework is appropriate for an international project. We did this by examining governance models of other existing international research infrastructures.

To reach our conclusions we gathered information from several sources inside and outside the SKA project

We have consulted the PrepSKA participants and experts via the WP4 Core Group and PrepSKA Working Group. We have searched for and selected international facilities, both astronomical and in other scientific fields, based on documents and the results of a policy survey among funding agencies participating in PrepSKA. We have organised a governance workshop in November 2008 and have invited experts from large research infrastructures, ESRF, GEMINI, ALMA and ESO to share their experiences and their advice on do's and don'ts.

We further refined our knowledge of the selected facilities by arranging meetings with the experts and executive staff of ITER, CERN, ESO and ESRF, with the objective of learning lessons from their daily practice for the operational, organisational and legal models. We held discussions with legal experts from international large facilities currently at different stages of development (facilities in construction phase or facilities already operational) but also experts with experience in international projects.

In this way we have established a network of experts in the research infrastructures. We are also participating in the EC DG Research working group on exchange of experiences within the preparatory phase projects in the EU Seventh Framework Programme, organised by the directorate General for Research of the European Commission.

Finally we were of course provided information about the operational model and design of SKA by the organs of the SKA Collaboration: SSEC, SPDO and the technical Work Packages of PrepSKA, our colleagues of the other PrepSKA Work Packages and our home organisation NWO.

In this approach we also identified the lessons learned from the selected existing facilities and translated these into conditions for success. We summarized these items in Chapter I.6. to be used as guidance for the discussion of a viable governance structure for SKA.

### **I.1. Inventory of legal and governance models of existing facilities (long list)**

The first natural step in looking for a governance model for SKA is to take existing multinational large scale facilities as an example. Therefore we first of all made a very rough inventory of SKA facility characteristics and then we used this to compose a long list of major international projects that share some characteristics with SKA.

These could be astronomy facilities, although not necessarily: for example, they could be interesting due to their organisational structure, the distribution of tasks and responsibilities between different participating members, or the rules for participation.

In compiling the long list and gathering documentation about these facilities, we were supported by the advice of PrepSKA participants, who helped us with their expertise in the field of astronomy and their experience with large facilities in general. For composing the list we have used generic criteria as budget, number of participants, pan-European or global collaboration, operational or construction phase, astronomy or non-astronomy and experiment or facility. The outcome was the following long list of international facilities.

**Table 1.** Long list of international facilities.

<b>LONG LIST OF INTERNATIONAL FACILITIES</b>
<ul style="list-style-type: none"> <li>• CERN</li> <li>• ITER</li> <li>• ALMA</li> <li>• GEMINI</li> <li>• ESRF</li> <li>• ESO</li> <li>• ESA</li> <li>• INTELSAT</li> <li>• AAT</li> <li>• SALT</li> <li>• ATLAS*</li> <li>• ILC</li> <li>• Hubble Space Telescope</li> <li>• Pierre Auger Observatory</li> <li>• EMBL</li> <li>• Diamond Light Source (DLS)</li> <li>• XFEL</li> </ul>

\*ATLAS is one of the four experiments connected with the LHC project of CERN. It is large scale in terms of the cost of construction approximately 300 million EURO (1999 475 million Swiss Francs).

Our next aim was to reduce this long list to a shortlist of the facilities to be considered as a possible model for SKA, and therefore to be studied in more detail. This mainly involved the continuous process of refining our knowledge of the SKA requirements, based on the work in progress of the PrepSKA technical work packages and the work of the SKA Operations Working Group.

Moreover, in trying to identify the facilities of interest for SKA, our main question was of course what governance models are actually feasible for SKA?

Or more specifically:

- What are the pros and cons of the existing models?
- How should the governance change as the project evolves from the current situation to the construction and operational phases?
- How should the governance translate into oversight when it comes to decisions about construction, operations and deliverables?
- Are there formal impediments for countries related to the possible participation in the considered governance models?

## **I.2. Inventory of candidate legal models for SKA**

SKA needs a legal framework that provides the SKA organisation with a legal personality and authority to act in all territories where SKA is active.

In large-scale innovative projects like research infrastructures assumptions on aspects of governance and operations are common practice. The project, for example its operational design (instrument, offices, data centres), will be optimised during the process of developing options for a legal framework and governance. We will therefore need to make assumptions for SKA about aspects such as the number of public funding partners, a procurement model, in-kind contributions, two candidate multinational sites and a draft operational model. The short listing of the viable legal models is based on currently known assumptions. Later on in the project some of the assumptions might need to be revised or adjusted and the operational model might therefore change as well. This might have an impact on the legal model preferred.

For example, if the procurement model is allowing juste retour the model will not be consistent with EU tender regulation. Consequently the legal entity should either be based within international law or based in a national legal system outside European Union allowing this flexibility .The origin of funding has an impact on the selection of the available models. Public entities are only viable if there is public funding. The international organisation can only be established if there is high level of political commitment (agreement at governmental level). The number of public funding partners on state level is deduced from the nationalities of the participating research institutes in the SKA Collaboration Agreement (Annex I).

Looking at the legal models we can distinct the models according to national law and the models according to international law. International law is an independent system of law existing outside the legal orders of states (national legal system) whereas national law is connected with the territory of the individual states.

International law is governed by treaties, custom and general principles of law and has organised its own settlement of disputes. In principle, international law operates only at the intergovernmental level and not within national legal systems. The EU Treaty is an example of international law. The domestic legal systems do of course provide the establishments of a range of national legal entities. The above mentioned examples of national entities according to national law do reflect on the required flexibility of the SKA organisation, SKA timeline and the assumptions made.

Our overview is based on our analysis of the main characteristics of SKA and other existing facilities and the work done by the ESFRI Workshop on the Legal form of Research infrastructures of pan-European interest. The ERIC is a new legal entity, jointly initiated by the ESFRI and the EC, is specifically developed to serve the institution of (new) research infrastructures of European Interest while allowing the participation of non-EU states and international organisations. We have produced an overview of the legal forms in national (table 2) and international law (table 3.) as well as the new ERIC form (table 4.). After we compared in headlines the strengths and weaknesses of these legal forms (table 5.)

## National law

**Table 2.** National Law

NATIONAL LAW	PARTNERSHIP	MANAGEMENT	LIABILITY	FINANCIAL ISSUE	STAFF
- Foundation	- Private/public	- Director or board	- No limitations	- National law - Taxes - Accounting Resources	- National law
- Company - Limited liability	- Private/public	- Director or board - Shareholders	- Limited by shares	- National law - Taxes - Accounting Resources	- National law
- Company	- Private/public	- Director or board - Shareholders	- No limitations, liable in proportion to shares	- National law; - Taxes - Accounting Resources	- National law

## International law

**Table 3 .** International Law

INTERNATIONAL LAW	PARTNERSHIP	MANAGEMENT	LIABILITY	FINANCIAL ISSUE	STAFF
- Joint undertaking - EC convention Art. 171	- Private/public	- Custom-fit defined by founding partners - Director or board - Assembly	- As agreed	- National law of statutory seat - Vat-exemp.	- Flexible limited by national law of statutory seat
- Intergovernmental organisation	- States	- Custom-fit defined by partners - Director or board - Assembly	- As agreed in convention	- Exemptions in partner states - Tender procedures - Fair return in industrial rules	- As agreed to international standards

## ERIC

**Table 4.** ERIC

PARTNERSHIP	MANAGEMENT	LIABILITY	FINANCIAL ISSUES	STAFF	APPLICABLE LAW
<ul style="list-style-type: none"> <li>- EU and non-EU states Intergovernmental organisations</li> <li>- Minimum of 3 EU states</li> </ul>	<ul style="list-style-type: none"> <li>- Assembly of all members</li> <li>- Director or board</li> <li>- EU-states jointly have majority in votes in assembly</li> </ul>	<ul style="list-style-type: none"> <li>- Limited to contribution</li> </ul>	<ul style="list-style-type: none"> <li>- Exemption of tax</li> <li>- Tender</li> <li>- Co-funding</li> </ul>	<ul style="list-style-type: none"> <li>- Applicable law of statutory seat or host country</li> <li>- International standards</li> </ul>	<ul style="list-style-type: none"> <li>- Community law</li> <li>- National law of statutory seat (EU state)</li> <li>- National law of host country (labour, environment, protection, permits)</li> </ul>

## Governance models strengths and weaknesses

**Table 5 .** Governance models strengths and weaknesses

	STRENGTHS	WEAKNESSES
<b>FOUNDATION</b>	<ul style="list-style-type: none"> <li>- Flexibility; custom-fit internal organisation (Dutch and German)</li> </ul>	<ul style="list-style-type: none"> <li>- Based on national law of statutory seat</li> <li>- Differences in national law</li> <li>- Restrictions in some countries</li> </ul>
<b>COMPANY LIMITED LIABILITY</b>	<ul style="list-style-type: none"> <li>- Flexibility for newcomers</li> <li>- Public/private partners</li> <li>- External investment capital</li> </ul>	<ul style="list-style-type: none"> <li>- Based on national law of statutory seat</li> </ul>
<b>COMPANY</b>	<ul style="list-style-type: none"> <li>- Flexibility for newcomers</li> <li>- Public/private partners</li> </ul>	<ul style="list-style-type: none"> <li>- Based on national law of statutory seat</li> </ul>
<b>JOINT UNDERTAKING (EU CONVENTION)</b>	<ul style="list-style-type: none"> <li>- Effective management on programme public/private partners</li> </ul>	<ul style="list-style-type: none"> <li>- Requires initiative of EC (lengthy negotiation)</li> </ul>
<b>INTERGOVERNMENTAL ORGANISATION</b>	<ul style="list-style-type: none"> <li>- Long term Solid and stable</li> <li>- States are partners</li> <li>- Flexible staff policy</li> <li>- Exemptions on tax</li> </ul>	<ul style="list-style-type: none"> <li>- Lengthy negotiation procedures before reaching formal agreement between member states</li> </ul>
<b>ERIC</b>	<ul style="list-style-type: none"> <li>- Flexible procurement</li> <li>- Tax exemptions</li> <li>- States are partners</li> </ul>	<ul style="list-style-type: none"> <li>- European bias because of decision making process</li> <li>- National law of statutory seat (labour, environment, protection, permits)</li> </ul>

### I.3. Inventory of SKA characteristics, constraints and requirements

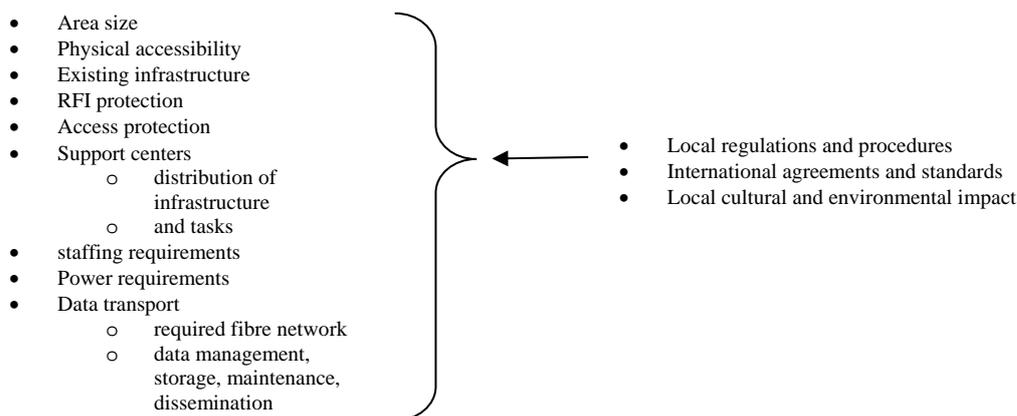
We identified five aspects of the organisation of a large international facility that can influence the governance:

- A. Organisational structure, from the scientific, financial and management point of view;
- B. Interaction between main facility and remote nodes;
- C. Participation of current as well as of future members;
- D. Access to the facility services and to the data;
- E. Interaction with the hosting country

Finally, for each of the five aspects above we can roughly identify the related part of the legal framework as follows: according to aspect A) the related part is the decision making process, the division of tasks and responsibilities is related to aspect B), the procedures of commitment, access and withdrawal is related to the participation aspect C), for aspect D) the access of facility of the services and data need the provision of terms and conditions and for aspect E) we need to consider the applicable law. For each of these aspects we can further specify a number of characteristics that can impact the governance to a greater or lesser extent.

Also, the five aspects as defined above are often interrelated, as some characteristics relate to several aspects. For example, staffing requirements have an impact on aspects A), B) and E). For example, under interaction with the hosting country (E), we can consider a range of issues related to the national legislation and its interdependence with international regulations, or the local environmental and societal issues as is shown in the following figure.

**Figure 1.** Impact on the governance model and legal framework related to aspect E), hosting country



Considering the characteristics of the SKA and lessons learned we concluded that we have to keep in mind the following requirements for the project:

1. Robust structure
2. Large degree of autonomy
3. Safeguarding of initial investments
4. Privileges and immunities
5. Full tax exemptions (not only VAT)
6. Site protection
7. Staffing requirements

All the requirements appear to be fairly straightforward. However, when these are applied to the different legal models then the potential risks of each model for the organisation of the SKA project become clear.

### *Robust organisation*

SKA is expected to have a lifetime of 50 years. Therefore the SKA organisation requires a design that will last for this entire period but which contains sufficient flexibility for the different phases of construction, operation and decommissioning. From our examples the only international facility that has now existed for more than 50 years is CERN and ESO for over 45 years.

### *Large degree of autonomy*

It is assumed that the SKA organisation will have 20 participants on a state level, and that there will be, as in the current situation, no dominant partners (states). SKA should be able to adopt own procedures on purchasing, staffing and financial accounting. The ability to design own procedures of purchasing is particularly important considering the application of juste retour rules in the procurement procedure. It is also preferred that SKA has a large degree of autonomy in the sense of being independent from national politics since the lifetime of SKA will be 50 years. It is very hard to predict future developments in either national or global politics for the forth coming 50 years.

### *Safeguarding of initial investments*

The SKA budget is estimated to be 1.5 billion Euros (2007). This amount of investment will need to be safeguarded by a legal entity which has full legal capacity and authority to act and enforce protection of the site and instrument. The participants would want to have proof and security that their funding will be spent for the defined purpose of SKA. The legal entity should be accountable to agreed financial standards.

### *Privileges and immunities*

Privileges will be needed in terms of exemptions on purchasing, staffing (immigration, transfer, permits for family) or other taxes related to the host countries. In the latter case the majority of the contribution will flow into the SKA organisation itself and not to the treasuries of participating countries or trade partners.

SKA will have a site which is multinational and that extends over an extremely large area. The hosting countries will therefore bear a huge responsibility with respect to the RFI protection and the physical protection of the site area. And the SKA participants will be dependent on the hosting countries ensuring that the necessary enforcement takes place.

If the site is immune, like the sites of ESO, ITER, CERN it means that the organization is excluded from the jurisdiction of the territory of the hosting countries and often that is combined with the inviolability of the premises. That means that SKA controls the area, the hosting countries can only enter with consent of the SKA organization. This aspect will be subject to further negotiation in a host state agreement.

### *Full tax exemptions*

Full tax exemptions provide the participants with the assurance that the contribution paid is spent for the purpose of SKA and not for the purpose of involved treasuries (for example VAT and excise duties).

### *Site protection*

Compared to all the existing facilities the site will have an extended surface. It will be a challenge to protect the site from intruders who can cause damage to the infrastructure (as there are antennas, cyber links, offices, roads, power supply, water supply) and RFI.

### *Staffing requirements*

According to a recent (July 2009) estimation of the Operations Working Group of SSEC, the breakdown of operational staff will be approximately: 200 engineers + 50 PhD level scientists+ 20 computer hardware support personnel + 30 data management (included archiving) support personnel + 40 system support personnel + 20 monitoring control personnel +80 personnel distributed to remote sites+ 50 administrative support personnel. This is considered to be a conservative estimate. A considerable part of the staff, a mix of scientists and technicians should be on site. This makes the conditions for staffing very important and should not be underestimated. The allocation of the specific staff depends on the operational model chosen and the location and function of headquarters and data centres. The staff and users are international. They should have the possibility to travel freely to and from all the territories where SKA is active.

In the construction phase as well as in the operational phases, the social environment around SKA site should be attractive for scientists and their family (partners and children) to move long-term or short-term to the SKA head office, data centres and site. The following elements were mentioned as being important for the attractiveness of a community: work permits for the partners of international SKA staff, healthcare according to international standards, infrastructure, leisure activities, and a pleasant scientific and social environment. For children, education should be provided to international standards.

From the existing facilities we have learned that staffing is the key issue when constructing and operating a research infrastructure. Local staff will be preferred for the construction and maintenance of SKA. The high staff turnover (5 to 8 years) is considered to be a stimulating key element in the human resources policy of a research infrastructure in terms of a continuous renewal of ideas and input.

## **I.4. Short listing of governance models for SKA**

When searching for a method to compare the existing facilities with SKA, we referred more specifically to the organisational structure from a scientific, financial and management point of view (Chapter I.3 aspect A). We identified a number of generic characteristics typical of this field, many of which are actually also important for the other fields of influence.

We examined these characteristics for each of the facilities on the long list to assess their similarities and differences with respect to SKA. The comparison is shown in the figures below in a matrix-like form, where the characteristics are listed on the first column, and the facilities are grouped according to the classification of their legal framework as given in Chapter I.6 as there is Treaty, National legal Entity, Treaty with a National Legal Entity, Agreement and MoU. This approach allowed us to narrow down our options for the viable models for SKA taken from current facilities and to reduce our long list to the aforementioned shortlist of existing facilities.

Our long list was reduced to the shortlist presented in Figure 2. The most interesting characteristics of the facility with respect to the study of a governance for SKA are indicated with arrows. The facilities finally selected for the shortlist are shown in **bold**.

Some other facilities of our long list were actually not completely discarded, as they have one or more characteristics which might need to be examined in specific cases for the SKA governance. These facilities are presented in *italic* in Figure 2.

For example, AAT and SALT are each located at one of the candidate sites and therefore when the site is chosen, the corresponding facility could give important clues for issues related to the hosting country.

Table 6 .Treaty

	<b>ITER</b>	<b>CERN</b>	<i>ESA</i>	<b>ESO</b>	<i>EMBL</i>	<i>AAT</i>
#SITES	<b>One</b>	<b>One</b>	<i>More</i>	<b>More</b>	<i>More</i>	<i>One</i>
# PROJECTS	<b>One</b>	<b>More</b>	<i>More</i>	<b>More</b>	<i>More</i>	<i>One</i>
USERS	<b>Partners</b>	<b>Open</b>	<i>Partners</i>	<b>Partners</b>	<i>Partners</i>	<i>Partners</i>
OWN STAFF OR SECONDED?	<b>Own</b>	<b>Both</b>	<i>Own</i>	<b>Own</b>	<i>Own</i>	<i>Own</i>
SITE ACCESS RESTRICTIONS	<b>Very high</b>	<b>Standard</b>	<i>Standard</i>	<b>High</b>	<i>Standard</i>	<i>High</i>
DATA PROCESSING AND DISTRIBUTION NODES	<b>One?</b>	<b>More (tiers)</b>	<i>One</i>	<b>One</b>	<i>None</i>	<i>One</i>
INTERNATIONAL OR EU?	<b>International</b>	<b>EU</b>	<i>EU</i>	<b>EU</b>	<i>EU</i>	<i>Two countries</i>
FACILITY STATUS	<b>Under construction</b>	<b>Operational</b>	<i>Operational</i>	<b>Operational</b>	<i>Operational</i>	<i>Operational</i>

- ↑
- Recent**
- ↑
- **Open access**
- **Data distribution system**
- **Mixed staff (international and secuded)**
- ↑
- *IPR policy*
- *Data distribution system*
- *Training programmes*
- ↑
- Telescope facility**
- ↑
- Training programmes*
- ↑
- Facility in candidate hosting country*

Table 7 .National Legal Entity

	X-FEL	DLS	INTELSAT	SALT
# SITES	One	One	N.a.	One
# PROJECTS	One	One	More	One
USERS	Partners	Open	Partners	Quota available for non-partners
OWN STAFF OR SECONDED?	Seconded	Own	Own	Own
SITE ACCESS RESTRICTIONS	Standard	Standard	N.a.	Standard
DATA PROCESSING AND DISTRIBUTION NODES	N.a.	N.a.	N.a.	One?
INTERNATIONAL OR EU?	International	UK	International	International
FACILITY STATUS	In construction	Operational	Operational	Commissioning

↑  
 - Recent  
 - Seconded staff

↑  
 Facility in candidate  
 hosting country

Table 8. Treaty with national legal entity

	ESRF
# SITES	One
# PROJECTS	One
USERS	Partners
OWN STAFF OR SECONDED?	Both
SITE ACCESS RESTRICTIONS	Standard
DATA PROCESSING AND DISTRIBUTION NODES	One
INTERNATIONAL OR EU?	EU
FACILITY STATUS	Operational

Table 9. Agreement (with/without handling agent)

	<i>GEMINI</i>	<b>ALMA</b>
# SITES	<i>More</i>	<b>One</b>
# PROJECTS	<i>One</i>	<b>One</b>
USERS	<i>Partners</i>	<b>Partners</b>
OWN STAFF OR SECONDED?	<i>Own</i>	<b>Seconded</b>
SITE ACCESS RESTRICTIONS	<i>Standard</i>	<b>Standard</b>
DATA PROCESSING AND DISTRIBUTION NODES	<i>More</i>	<b>More?</b>
INTERNATIONAL OR EU?	<i>International</i>	<b>International</b>
FACILITY STATUS	<i>Operational</i>	<b>In construction</b>




*Distributed model*      **Very similar design**

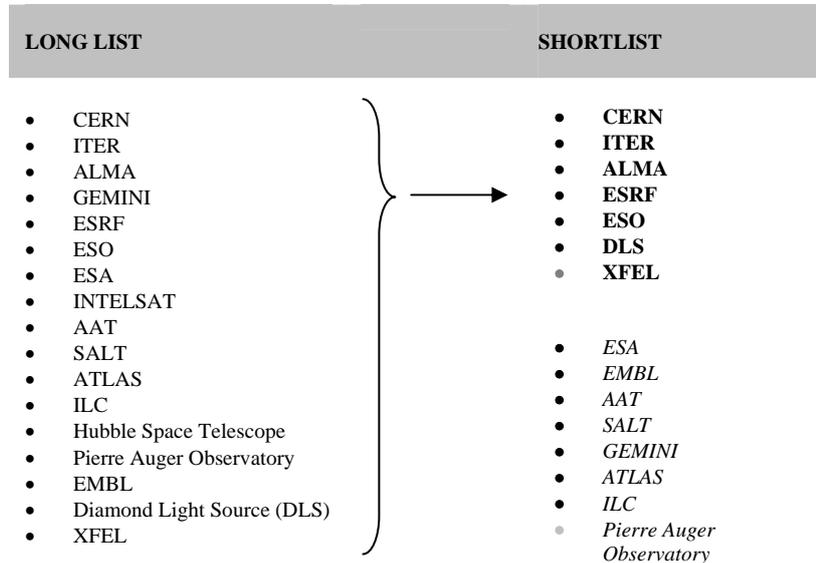
Table 10. MoU

	<i>ATLAS</i>	<i>PIERRE AUGER</i>
# SITES	<i>One</i>	<i>Two</i>
# PROJECTS	<i>One</i>	<i>One</i>
USERS	<i>Partners</i>	<i>Partners</i>
OWN STAFF OR SECONDED?	<i>Seconded</i>	<i>Own?</i>
SITE ACCESS RESTRICTIONS	<i>Standard</i>	<i>None</i>
DATA PROCESSING AND DISTRIBUTION NODES	<i>More</i>	<i>One</i>
INTERNATIONAL OR EU?	<i>International</i>	<i>International</i>
FACILITY STATUS	<i>Operational</i>	<i>In construction</i>




*Large # of participants*      *Large array on extended surface*  
*Large # of participants*

**Figure 2.** Result of the Shortlisting process



**I.5. Conditions for success of the governance of SKA**

Part of our approach of the inventory of best practices was to learn from other existing large scale research infrastructures in order to optimize the future SKA organisation. We have translated the “lessons learned” into “conditions for success” for the governance and legal framework. Our recommendations are based on the current knowledge of SKA and will guide the discussion on the development of the governance structure and legal framework.

In our opinion the guiding principles such as transparency, accountability, responsibility and clear line of authority should be included in the common basis for developing the governance structure.

Furthermore, the governance model should have provisions constituting: a central body with decision-making authority, clear line of management, control in matters of finance, technology and science, strong link between management of facility and science, full legal capacity in host countries and long-term commitment. In addition to the aforementioned principles of good governance, we have grouped the identified conditions for success in 4 areas of governance namely partnership, management, financial issues and staffing.

We have found in the area of partnership that a governance model should allow for the expansion of activities, secure the confidence between council and management of the operational entity, secure the scientific background within the decision making body, and the right to vote should relate to the size of the contribution when the contribution varies.

In the area of management we have found that the governance model should establish a management with a central body with authority, centralised technical/budget control. The management should be professional and the line of management should be clear, specifically with regardance to the tasks and responsibilities of remote nodes in their relationship with the facility.

Before the start of the organisation the IPR arrangement, working language, human resource policy (defined functions) should be in place.

With regard to the area of financial issues and liability we have found that there should be thought given to the convergence of national funding schemes, a centralised budget control provision for late payment, risk sharing for construction of facility (transport/damage), costs related to users in case of update facility and the currency of the payment of the local and science staff. Above all there should be a long term commitment for funding as it is expected that the annual operation costs will be around 180 million Euros'.

Finally in the area of staffing we have found that although the qualifications and the background of the staff will vary most staff for construction and operation will be hired locally. To attract specialised staff (science and science support staff) the working environment (tax, benefits, housing) but also the technical and scientific environment on site should be competitive with other research infrastructures.

The training of related users of the facility and the different cultural backgrounds should be taken into account. The staff turnover period of 5-8 years is desirable due to the dynamics in a research organisation, constant renewal of ideas and knowledge. Consequently the human resources policy should define descriptions of functions and qualifications as soon as the SKA operational model is final.

The legal framework has to provide the SKA organisation with the full legal capacity. An optimal legal form follows the function of the SKA organisation. The decision taken as to which legal form will be most appropriate will be possible when the operational model and governance of SKA is final.

## **I.6. SWOT analysis of candidate legal models for SKA**

We compiled the SWOT models using the results of our own inventory of the legal models and the information arising from our inventory of the existing facilities together with the results of the ESFRI report of the Workshop on Legal Forms of Research Infrastructures of pan-European interests. We have classified the facilities of the shortlist based on their legal model.

This resulted in the following categories.

1. Treaty, Convention (agreement at governmental level)
  - *ITER, ESO, CERN, ESA, AAT, EMBL*
2. National legal entity
  - *X-Fel, DLS, IntelSat, SALT*
3. Treaty with national legal entity
  - *ESRF*
4. Agreement
  - *GEMINI, ALMA*
5. MoU
  - *Atlas, Pierre Auger*

For each model we performed a SWOT analysis in which we incorporated the lessons learned from the existing facilities, insofar as these were relevant for the legal model.

## Treaty

### *Strengths and opportunities*

Participation at a governmental level will give rise to a very robust organisation. The organisation can be specifically tailored to SKA's requirements. The mechanisms for default, accession, withdrawal and contribution will be subject to international politics and prestige. The commitment will be long term and from a political viewpoint it will be hard for participating states to withdraw.

### *Weaknesses and threats*

The treaty and the amendments must be ratified by the national parliaments, and therefore once the structure has been set up it will be difficult to change. This should be taken into account right from the start of designing the model and the document. The treaty should be defined in such a manner that it is flexible enough to serve any needs in the future. The negotiation process towards a treaty is lengthy because of the long-term talks needed for the financial and other obligations. In addition to this, the process of ratification depends on the national procedures of parliamentary control. The length of the ratification procedures can differ per country.

**Table 11.** SWOT: Treaty

<p style="text-align: center;"><b>STRENGTHS:</b></p> <ul style="list-style-type: none"> <li>• Solid organisation</li> <li>• High level political commitment</li> <li>• Privileges, tax exemptions</li> <li>• Long term commitment</li> <li>• Accessible for late joiners</li> <li>• Agreement on liability</li> <li>• Protection of property</li> </ul>	<p style="text-align: center;"><b>OPPORTUNITIES:</b></p> <ul style="list-style-type: none"> <li>• Political pressure on national (science) policies</li> <li>• Strong position in negotiation processes with host countries</li> </ul>
<p style="text-align: center;"><b>WEAKNESSES:</b></p> <ul style="list-style-type: none"> <li>• Lengthy process</li> <li>• Rigid once started</li> <li>• Lengthy access procedure for late joiners</li> </ul>	<p style="text-align: center;"><b>THREATS:</b></p> <ul style="list-style-type: none"> <li>• Rigid, amendments of the convention are subject to ratification</li> <li>• Impact on internal organisation and accession procedure</li> <li>• High level negotiation before new members can access</li> <li>• Funding gap</li> </ul>

## National legal entity

The initiating process for a national legal entity is simple in the sense that it only concerns the national procedure of establishment. This can, however, be misleading. Experience has taught that the negotiation process, especially when it comes to contributions and decision making, is complicated and consequently time consuming.

*Strengths and opportunities*

The legal entity will be embedded in the national law of the statutory seat, most likely one of the SKA participants or the state where the research infrastructure is operated. An advantage of embedding in a national legal system is that it shortens the negotiation processes on organisational issues (staff conditions, safety health and so on) and financial arrangements, as these are defined by domestic legislation. From our case studies we have learned that the host country benefits from the establishment of the research infrastructure and might therefore be prepared to negotiate an attractive (fiscal) arrangement.

*Weaknesses and threats*

The entity is in a sense dependent on bilateral agreements and the common sense of the government when it comes to regulation and legislation that could have an impact on the SKA organisation, since the national legal system depends on the laws passed by the government. The national legislation has to be accepted by every participant. Furthermore, the financial contributions shall partly flow into the national treasuries, depending on the details of the host state arrangement including the fiscal regime.

**Table 12.** SWOT: National Legal Entity

<p style="text-align: center;"><b>STRENGTHS:</b></p> <ul style="list-style-type: none"> <li>• Embedded in national legal system</li> <li>• Public and private partners</li> <li>• Easy access for late joiners</li> <li>• Flexible internal organisation</li> <li>• Shares according to contribution (balanced vote)</li> <li>• Limited liability</li> </ul>	<p style="text-align: center;"><b>OPPORTUNITIES:</b></p> <ul style="list-style-type: none"> <li>• Flexibility</li> <li>• Quick response to business opportunities</li> </ul>
<p style="text-align: center;"><b>WEAKNESSES:</b></p> <ul style="list-style-type: none"> <li>• No tax-exemptions, privileges or immunities</li> <li>• no autonomy: national procurement procedure</li> <li>• National company, tax, labour law</li> </ul>	<p style="text-align: center;"><b>THREATS:</b></p> <ul style="list-style-type: none"> <li>• Acceptance of foreign legislation</li> <li>• Amendments in national law (property)</li> <li>• Contributions are partly flowing into national treasury</li> </ul>

**Treaty with a national legal entity**

This combination is mainly focussed on the strengths of both models but also has the capacity to deal with the weaknesses and threats of both models. The weakness of the treaty model mainly lies in the lengthy procedure and rigid structure and this could give rise to a delay in the construction and operation of an organisation. The weaknesses of the national legal entity lie mainly in the operational period being less autonome to design own procedures and regulations. However the strength of combining the two models applies to the operational period. Weaknesses and threats of the national legal entity still exist, but can be dealt with at the treaty level.

**Table 13.** SWOT: Treaty with a National Legal Entity

<p style="text-align: center;"><b>STRENGTHS:</b></p> <ul style="list-style-type: none"> <li>• Flexibility in operations</li> <li>• Operational entity is embedded in national legal system</li> <li>• Public and private partners</li> <li>• Shares according to contribution</li> <li>• Exemptions on convention level, procurement</li> <li>• Solid construction, long term commitment</li> </ul>	<p style="text-align: center;"><b>OPPORTUNITIES:</b></p> <ul style="list-style-type: none"> <li>• Flexibility in internal organisation</li> <li>• International politics can't lame the operation</li> </ul>
<p style="text-align: center;"><b>WEAKNESSES:</b></p> <ul style="list-style-type: none"> <li>• The chain between council and general director</li> <li>• Access for late joiners maybe difficult</li> <li>• No tax exemptions, privileges or immunities</li> <li>• National company, tax, labour law, migration</li> <li>• No autonomy</li> </ul>	<p style="text-align: center;"><b>THREATS:</b></p> <ul style="list-style-type: none"> <li>• Lack of trust between council and director general</li> <li>• Acceptance of foreign legislation</li> </ul>

**Agreement (with/without handling agent)**

*Strengths and Opportunities*

It provides a legally binding set of arrangements. Once agreed upon, the agreement can be drawn up and undersigned and be effective quickly.

*Weaknesses and threats*

The main weakness is the lack of a clear legal capacity. The parties of the agreement are bound to each other but have no authority to act as such in relation to third parties or local authorities. For practical reasons, a common representative (national or international handling agent with legal capacity) is often appointed in such structures with a specific mandate from the other participants.

**Table 14.** SWOT Agreement (with/without handling agent)

<p style="text-align: center;"><b>STRENGTHS:</b></p> <ul style="list-style-type: none"> <li>• Legally binding between parties</li> <li>• Flexible internal organisation</li> <li>• Easy access for late joiners</li> <li>• Private and public partners</li> </ul>	<p style="text-align: center;"><b>OPPORTUNITIES:</b></p> <ul style="list-style-type: none"> <li>• Quick response to business opportunities</li> </ul>
<p style="text-align: center;"><b>WEAKNESS:</b></p> <ul style="list-style-type: none"> <li>• No legal capacity</li> </ul>	<p style="text-align: center;"><b>THREATS:</b></p> <ul style="list-style-type: none"> <li>• Dominant partners</li> <li>• Liability</li> </ul>

## Memorandum of understanding

The Memorandum of Understanding has different meanings in different countries. Here it is used as an example of a non-legally binding collaboration for a common purpose.

### *Strengths and opportunities*

Parties act to their best endeavour and, therefore, unlike a legally binding agreement, this arrangement is not subject to ratification procedure in most countries. It is often used as a first step towards a more binding structure. Depending on the pressure to perform to the best endeavour, this model can be very constructive. It is a lean and light model to organise collaboration and is acceptable to most parties/governments.

### *Weaknesses and Threats*

The main weakness is the lack of legal capacity and is therefore mostly used for a short limited duration. Every cycle of renewal of the MoU needs new negotiations and consequently there is the risk of laming of the project or initiative. The fact that it is non legally binding can be a risk depending on the prestige of the collaboration. If participating in the collaboration is highly prestigious this will strengthen the collaboration because the partners do not want to lose their face.

**Table 15.** SWOT Memorandum of Understanding

<p style="text-align: center;"><b>STRENGTHS:</b></p> <ul style="list-style-type: none"> <li>• Accessible for different types of partners (governments, international organisations, research institutes, national funding agencies etc.)</li> <li>• Easy access for late joiners</li> <li>• Focuses commitment for specific goals</li> <li>• Provides a forum for collaboration</li> </ul>	<p style="text-align: center;"><b>OPPORTUNITIES:</b></p> <ul style="list-style-type: none"> <li>• Basis for more formal relationships</li> <li>• Step up to a convention or agreement</li> </ul>
<p style="text-align: center;"><b>WEAKNESSES:</b></p> <ul style="list-style-type: none"> <li>• Not legally binding</li> <li>• Short term validation</li> <li>• No legal capacity</li> </ul>	<p style="text-align: center;"><b>THREATS:</b></p> <ul style="list-style-type: none"> <li>• Every cycle new negotiations (risk of laming initiative)</li> <li>• No default provision</li> </ul>

## European research infrastructure consortium (ERIC)

During our investigations we have followed the development of a new legal entity for European research infrastructures: ERIC. A key issue is the provision of flexibility with respect to procurement procedures and tax exemptions on VAT and excise duties. In June 2009, the ERIC Regulation (EC 723/2009) was adopted by the European Council.

Although ERIC specifically designed for research infrastructures the ERIC cannot serve as a model for the full SKA Organisation due to the condition that there has to be an European majority in the decision-making process of the entity. This model is therefore not appropriate for a balanced global collaboration such as SKA. Consequently we excluded ERIC from our list of candidate legal models for a fully operational SKA.

**Table 16.** SWOT: ERIC

<p style="text-align: center;"><b>STRENGTHS:</b></p> <ul style="list-style-type: none"> <li>• Flexibility to design own tender procedure</li> <li>• Tax exemptions (VAT)</li> <li>• Embedding in EU community law</li> <li>• Application procedure (3-9 months)</li> <li>• Acceptance by all the members</li> <li>• Special designed for research</li> <li>• Long term commitment</li> </ul>	<p style="text-align: center;"><b>OPPORTUNITIES:</b></p> <ul style="list-style-type: none"> <li>• Strong basis in European region</li> <li>• Step up to global organization</li> <li>• Intergovernmental collaboration</li> </ul>
<p style="text-align: center;"><b>WEAKNESSES:</b></p> <ul style="list-style-type: none"> <li>• No Legal precedent</li> <li>• Financial arrangement of the host state</li> <li>• Application procedure and approval by the EC</li> <li>• Different types of applicable law</li> </ul>	<p style="text-align: center;"><b>THREATS IN A <u>GLOBAL</u> COLLABORATION:</b></p> <ul style="list-style-type: none"> <li>• European bias</li> </ul>

## CHAPTER II: CONCLUSIONS

### **II.1. Candidate legal models relevant for SKA**

We have analysed the strengths, opportunities, weaknesses and threats of the candidate legal models in a SWOT analysis. When we compare these characteristics with the requirements of the organisation of the SKA we come to the following conclusions.

The legal framework has to provide the SKA organisation with the full legal capacity to act in all territories where SKA is active: the territories of the host countries of the facility, host science centre, data transport through cyber networks/cyber links, data centres, user centres, power supply centre and central offices. An optimal legal form follows the function of the SKA organisation.

However, many details with an impact on the governance have not been decided yet. For example, the final design and operational model but also the site have not been selected yet. Nevertheless, we have identified a number of generic characteristics and requirements of SKA organisation. As previously mentioned, the short listing of the viable legal models is based on currently known assumptions. Some of the assumptions could be revised or adjusted later in the project and this might also influence the preferred legal model for SKA.

From a historical perspective we can see that the way the treaty-based models were designed do reflect on the spirit of the time. When we for example look at the organisational structure of CERN (1954), ESRF (1988) and ITER (2006) we notice that there is a need for privileges (and immunities) and the need to have a flexible operational organisation with the ability to establish a new division in a organisation of projects or to reorganise the operations. Whereas CERN had an extended treaty document the ITER agreement (by its content classified as an treaty) was as lean as possible. The institution of these infrastructures has to be placed in the historical context of international relations: CERN was established shortly after World War II.

#### *Treaty*

In our opinion the treaty-based model provides maximum support for the SKA requirements. Compared to other legal models it provides, in particular, a large degree of autonomy as it is independent from the national law of one of the SKA member states.

It provides maximum flexibility for procurement procedures, immigration of staff and users, and tax exemptions (VAT and excise). Additionally it provides the opportunity to establish inviolability of the site and central offices in the host country. Given the fact that both the candidate sites will be multinational, it could be an advantage being able to abstract these from national politics and jurisdiction.

All the existing examples of an international organisation had a lengthy procedure of over 5 years and they started with less than the 19 participants of SKA. Further do the examples reveal that they did benefit from administrative support provided by another existing organisation on site (construction). Even the most recent example ITER, which is regarded as having a quick establishment, took 5 years from final design to the Implementation Agreement.

According to the current SKA timeline, the treaty model will not be realised in time before the current governance ends in 2011 or probably not even when initial construction of SKA is foreseen in 2015. This is caused by its main weakness, namely the lengthy procedure to establish an international organisation as a consequence of the complicated negotiation process and the subsequent ratification process according to the domestic legislation.

#### *National legal entity*

The process of starting-up a legal entity is less complicated than that for a treaty. The national legal entity will be embedded in the national law of the statutory seat. The country of the statutory seat will be willing to enter bilateral agreements insofar as this is allowed by domestic legislation because it will profit from the establishment.

When it comes to domestic regulation and legislation with an impact on the SKA organisation, the entity is in a sense dependent on bilateral agreements and the common sense of the government of the host state as the government can change domestic legislation regarding the national legal entities. To ensure attention for the SKA Organization and SKA interest the entity should therefore be established within the domestic legislation of a SKA participating state. Whether this model is viable for SKA depends on the Host State Agreement and therefore the model in itself gives less guarantees for a project with long term duration and high investments because it will be subject to domestic legislation.

Furthermore, the national labour law can have a major impact on the staffing conditions. The example of ESRF shows the constraints of this model in for example the area of staffing: the French labour law had implications for a 24/7 operational model. Furthermore, scientific staff are often temporarily employed by a research project and this might not fit in a labour law model where there is a strict regulation on the term of labour contracts.

#### *Treaty with a national legal entity*

This combination is mainly focussed on the strengths of both models; the weaknesses of both models can be overcome by the combination of both models. Whereas the treaty model can be rigid in the operational phase, the national legal entity is flexible in its organisational structure.

The lengthy procedure to establish a treaty is a weakness of this combination model causing a delay in the start of construction and operation. It could serve SKA very well but it is not consistent with the SKA timeline because it is not realistic to establish a treaty within four years.

The example of ESRF shows that the national legal entity was able to develop their own best practice for a tender procedure (due to agreement on a treaty level) and at the same time create a flexible operational model of the national legal entity. ESRF is guaranteed a robust collaboration at a high political level as well as long-term commitment, and yet its internal structure of the operational organisation is not rigid.

The example of X-fell, in a very first phase of construction, shows the start of with a national legal entity with the aim to expand the governance with a treaty. In this case the host state took a lead in the process of preparation and establishment of the entity.

*Agreement (with/without handling agent)*

The main drawback is the lack of legal personality. Once agreed upon, an agreement is a quick start-up process with legally binding agreements between the parties. In the Gemini case the dominant partner (NSF) is acting as a handling agent.

For reasons of domestic legislation AURA is operating the Gemini facility instead of NSF. In SKA the appointment of the handling agent will be more complicated because it is not foreseen that one of the participants shall dominate in terms of the size of contribution or in another way. Furthermore, SKA shall have more than 19 participants and consequently the decision-making process will be more complicated.

The ALMA organisation is also an interesting example of the Agreement model. The organisation made a quick start and has a phased design similar to that of SKA. The major drawback in the ALMA organisation is the missing link of central authority. This was caused by the sovereignty of the participating members. At the same time this sovereignty made a smooth start possible because there were no extended negotiations on the decision-making process, contribution and the transfer of authority and responsibility. The missing central authority can lame the progress and have an impact on the operational model.

From these two cases we learn that in the Agreement model special attention should be given to the decision making process as well as to the representation of the collaboration. Given the fact of the high number of participants this model bears risks when applied to SKA.

*Memorandum of understanding*

The Memorandum of Understanding has different meanings in different countries. This collaboration model does not provide a legal personality. Here it is used as an example of a non-legally binding collaboration for a common purpose. Parties act to their best endeavour. It is a legally light (fast) way to organise collaboration and is acceptable to most parties/governments because the parties are not legally binded and liable but obliged to act to their best endeavour.

Even so, the four LHC experiments at CERN are set up in a MOU form (all over construction budget approximately 900 million EURO). This is not common in view of the size of the budget and the duration of the project, 10 to 15 years, but it serves the purpose. The example of the Atlas experiment at CERN, anchored in a robust organisation, shows that it can work in practice for large-scale facilities with a and a long duration. However, the duration of Atlas and the other three experiments for the LHC are strongly connected with the LHC. The LHC is a CERN project. CERN's status as a long-standing international organisation serves as a "safeguard" for the investment and will ensure success and commitment for Atlas and LHC. Whereas Atlas is embedded and depending on the LHC project of CERN the SKA is different because SKA is an independent project as such and is not anchored in another organisation or project.

## II.2. Preferred model?

From the aforementioned comparison we conclude that the treaty-based model seems to include a maximum support for the SKA requirements.

Due to the high level of commitment at a governmental level, the international organisation is robust from the perspective of SKA's lifetime, an expected 50 years. Therefore the SKA organisation should have a design that lasts this long and allows for the different phases of construction, operation and decommissioning.

The international organisation will provide SKA with a large degree of autonomy. No one can foresee how global and national politics shall develop over the next 50 years. So the independent status enables SKA to act "regardless" of changes in governments, legal systems and domestic policies. Of course SKA, just as other international organisations, will have to agree its policy with all the participants in order to be provided with a budget. The budget can be fully spend on the SKA research infrastructure as an international organisation will be granted with the tax exemptions on VAT and excise duties.

The initial investments will also be safeguarded by the immunity of the site and offices. The procedures of settlement of disputes are decided by the SKA organisation rather than the domestic jurisdiction of the host country. For the site and office the inviolability of the premises can be created.

The SKA organisation will be able to design its own staffing conditions and customise it to a 24/7 operational model, with its own payment scale according to competitive standards and temporary contracts in line with common practice for science projects.

SKA staff can acquire a diplomatic status and will therefore be free to travel all over the world. Visiting staff and users will not be subject to national immigration laws this will be an advantage as scientists are global inhabitants. The diplomatic status might cause problems for the partners of the staff regarding employment outside the SKA organisation.

Protecting the site over such an extended area from intruders will be a formidable challenge. No other existing facility has such an extended area spanning more than one country. Moreover as an international organisation SKA will not easily be drawn into local national conflicts.

One of the weaknesses in the treaty model is the rigid structure caused by the fact that amendments of the treaty are subject to parliamentary approval. This can be overcome at the start when paid attention to by drawing up and negotiating the design of the treaty document. The treaty document should be as lean as possible and contain only high-level items: for example, all the operational issues can be arranged on a lower level for example leaving it to the decision general director of the facility.

However, a drawback and main weakness of the treaty model is the burden it places on the negotiation process and therefore causing a lengthy procedure. From this perspective SKA is comparable to other research infrastructures and it is realistic to expect that the negotiation and ratification processes will be as lengthy as these have been with other organisations.

ITER is the most recent example (established 2006) and is perceived as a quick start up. From final design to the intergovernmental agreement took 5 years.

Referring to the current SKA timeline it is not realistic, even in the most optimistic estimate, to expect the ratification of a treaty within four years. The SKA timeline foresees the start of the initial construction in 2015.

Besides that we have found from our discussions that the political support in Europe to set up an international organisation just for SKA cannot be taken for granted. Also should be taken into account that there are already existing international organisations with an research mission in astronomy, more specifically ESO with a mission in ground based astronomy in the southern hemisphere.

### **II.3. Alternatives to consider**

We need to take the weaknesses stated so far into account and investigate whether these can be overcome by other models, a combination of models or the use of other existing organisations. We will focus on the models which can be set up in a shorter period of time and will involve the maximum of the requirements of the SKA Organisation.

Our focus will be on models which are less complicated to negotiate (less subjects of negotiation, package deals) or models which do not need to be ratified by parliament, without immunities and privileges. In doing this we will identify the main risks for SKA.

Other models like an Agreement or Memorandum of Understanding will not provide a legal personality for the SKA Organisation. This means that SKA Organisation as such will not have authority to act in all the territories where SKA is active. In the case of an Agreement it is possible to overcome this objection by appointing a national or international handling agent. As learned from the analysed examples in the long term, this model can pose a threat to the robustness of the organisation because it can be complicated to establish central authority.

An Memorandum of Understanding is not a vehicle commonly used for long-term commitments. In general MoU's have a short-term duration of approximately 5 years. An MOU can serve as a viable step up to another legal model and provide governance for an interim period. The collaboration is structured and focused on the purpose. The higher the political level of the participants the stronger the collaboration will be because of the political prestige (best endeavour) and political credibility.

As previously mentioned, the ERIC model cannot serve the global SKA organisation because its nature is not consistent with the aim of SKA to constitute an international collaboration with a globally balanced participation and contribution/budget. However, ERIC could provide a robust body to group European participants in global SKA.

The national legal entity provides legal capacity. Under the condition that the domestic legal system is acceptable for all participants this model might suit most of the requirements of SKA although this depends on domestic legislation.

To ensure attention for the SKA Organization and SKA interest the entity should therefore be established within the domestic legislation of a SKA participating state whereby the opportunities of the bilateral host state agreements with the SKA entity should be taken into account.

The state of statutory seat should have a robust legal system and sustainable political climate according to our current knowledge. No one can foresee how global politics shall develop over a period of 50 years. Nevertheless, in this model SKA will not be autonomous and so it will have less authority to design its own procedures due to the regulation of the national legal system. The staff regulation and conditions will be subject to the national legal system of labour law and immigration law. But also the procurement procedures will be regulated by the domestic legislation. For example if the the juste retour rules are conditional for the SKA procurement procedure the national legal entity can not be established in a member state of the European Union because the EU Tender regulation will then apply. The EU Tender regulation is based on the principle of fair competition and will classify “juste retour” as unfair. These aspects of course will all have an impact on the operation model.

Another option could be, in order to be able to benefit from the strengths and opportunities of an international organisation, that the SKA project will be supported or hosted by another international organisation or is assisted in the start up process. A lengthy procedure would then be avoided. Possible drawbacks are that the organisation concerned is not sufficiently suited to the purpose of SKA or that the focus of the organisation will not be dedicated to SKA. Whether such an option is feasible will also depend on the willingness of the hosting organisation.

Even then, negotiation processes will be necessary and because of the state level of negotiation this will take some time and maybe lead even to an amendment of the treaty of the hosting international organisation.

We conclude that alternatives to a treaty model for SKA project are feasible. We need further to investigate what the boundary conditions are for SKA and the alternative models.

### **CHAPTER III: NEXT STEPS WP4**

Our second deliverable will be to provide viable options for the SKA legal framework and governance. In order to realise this deliverable we will start the discussion within PrepSKA by providing “straw man” documents on models of a legal framework. We shall also provide a list of topics intended as a “skeleton” for the governance and a draft SKA Implementation Agreement and the governance in order to discuss the priority, timing and commonly shared acceptability of the issues in alignment with the discussion within the Agencies SKA Group.

The planning of the final design and site selection of SKA might cause delays in the realisation of SKA. The negotiation of the final Implementation Agreement for SKA will include the host state bid/agreement and therefore depends on the site selection and the final design of the telescope. Only then can a realistic consideration of the risks of the different legal models be made and a decision taken as to which legal form will be most appropriate.

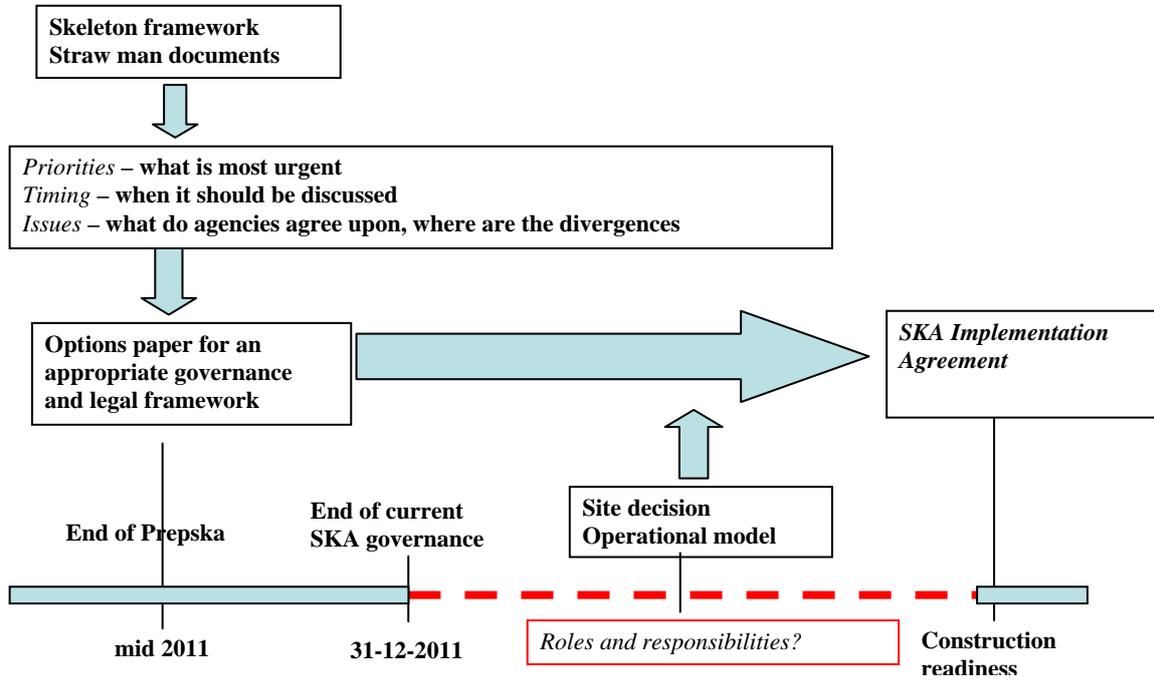
The EC grant is extended for the PrepSKA consortium and will now end by December 2011 although most of the activities of the policy Work Packages will receive only funding until April 2011. Work Package 2 and Work Package 7 requires more time to finish the activities. The current SSEC and SPDO agreements will also end by 31 December 2011.

As the following figure illustrates, there is a need for a decision-making body for the period when the current arrangements of the SSEC and PrepSKA come close to an end while at the same time decisions on site and design are scheduled according to the current SKA timeline as shown by table 17. planning.

The issues of provisional governance need urgent attention. It is not just a case of finding a means of global collaboration but also a need to find interim funding. The legal form should be lean and designed for the interim purpose, but with the capability of natural growth towards the SKA Implementation Agreement with the required legal framework and governance model for a fully operational SKA.

In our future work we will focus on the start-up process of the existing organisations and we will perform a cross-sectoral risk analysis with the other policy Work Packages of SKA in order to develop viable options for the organisation of SKA.

Table 17. Planning



**LIST OF ABBREVIATIONS AND DEFINITIONS**

Treaty, Convention	Different headings used for legally binding intergovernmental agreements subject to parliamentary consent (ratification)
MoU	Memorandum of Understanding, used as legally non binding agreement on a collaboration for a common purpose
Agreement	Legally binding set of arrangements between parties
Handling agent	Appointed representative based on mandate of parties
ERIC	European Research Infrastructure Consortium
EC	European Commission
EU Treaty	Treaty of European Union (1993)
ESFRI	European Strategy Forum for Research Infrastructures
ASG	Agencies SKA Group
SKA	Square Kilometre Array Telescope
SSEC	Science and Engineering Committee of the SKA Collaboration
SPDO	SKA Project Development Office
PrepSKA	Preparatory Phase Study of Square Kilometre Array Telescope
WP	Work Package
OWG	Operations Working Group of the SKA Collaboration
RFI	Radio Frequency Interference

**Research Infrastructures**

ESO	European Space Observatory, 1960 Chile and 1962 Germany.
ESA	European Space Agency, 1975 France.
AAT	Anglo-Australian Telescope, 2002 Australia.
SALT	Southern African Large Telescope, 2005 South Africa.
GEMINI	The Gemini Observatory; 2007 Hawaii.
ALMA	Atacama Large Millimeter Array Project (ALMA), 2002 Chile.
HST	Hubble Space Telescope, 1977 USA .
Pierre Auger Observatory	MoU based collaboration, studying ultra-high energy cosmic rays, 1992 Argentina.
CERN	Centre for European Nuclear Research, 1954 Swiss.
ATLAS	Experiment at the Large Hadron Collider at CERN, 1992 Swiss and France.
ESRF	European Synchrotron Research Facility, 1988 France.
EMBL	The European Molecular Biology Laboratory, 1978 Germany.
DLS	Diamond Light Source, 2003 United Kingdom.
XFEL	X-ray Free Electron Laser, 2009, in preparatory phase Germany.
INTELSAT	International consortium that owns and manages a constellation of communications satellites, 1971 Bermuda.
ITER	International Fusion Energy Organization, 2007 France.
ILC	International Linear Collider, in preparatory phase.

## **REFERENCES AND APPLICABLE DOCUMENTS**

### **Organisations**

- Legal documents: treaty, agreements, MOU, statutes of several infrastructures as there is CERN, ILC, ITER, ESRF, Gemini, ALMA, ESO, AAT, SALT, ATLAS, EMBL, DLS, X-FEL, ESA, Pierre Auger, ILL, ESS
- Report ESFRI, Workshop Legal Forms of research infrastructures of pan-European interest (2006)
- Preparatory Phase Projects: Prace, Aurora Borealis, Clarin, Elixir
- Documents provided via the Sinapse-website of the EC

### **SKA documentation**

1. Statement of common intent on IPR amongst Parties to MoU-2000
2. Request for Proposals for Siting the SKA
3. Memo 80 - Industry Liaison Models and Policies
4. Memo 84 - Report of the SKA Operations Working Group
5. Memo 94 - Spectrum Protection Criteria for the Square Kilometre Array
6. Memo 96 - SKA Infrastructure Development
7. Memo 100 - Preliminary specifications of the Square Kilometre Array
8. International Collaboration Agreement for the SKA (Square Kilometre Array) Program
9. Memorandum of Agreement to establish the SKA Program Development Office
10. Memo 101 - Very Large Array (VLA) completion report
11. Memo 102 - Lessons Learned From Other Large Scientific Facilities - Report of the SKA Operations Working Group
12. Status of Pathfinder Telescopes and Design Studies

## **ANNEX I: Current SKA Organisation**

### **The current organisation of the SKA project**

The current organisation has several actors from the science community and funding agencies (funding bodies). The SKA is a bottom-up project, there is a strong commitment of the science community. The current organisational agreements are for a limited scope and duration. This will be the starting point from which the future SKA organisation will evolve.

#### ***International Collaboration Agreement (1 January 2008-31 December 2011)***

According to the International Collaboration Agreement for SKA the collaborating research institutes agree to advance the SKA project as a joint international endeavour through technology development and system design towards construction of SKA.

**SSEC** is the governing body for this collaboration and is therefore committed to the aforementioned objectives. SSEC appoints the director of SPDO.

The 50 research institutes (originated from 19 countries) involved in SKA have organised themselves in three regional groups, namely:

European SKA consortium, US SKA consortium and the-Rest-of-the-World Group (Australian SKA Coordination Committee, Canadian SKA Consortium, National Research Foundation, National Astronomical Observatories of the Chinese Academy of Sciences and National Centre for Radio Astrophysics). The overall purpose is to provide a framework in which the realisation of SKA can be pursued.

Main responsibilities of **SSEC** are:

1. Provide scientific and technical guidance for the SKA project
2. Determine the membership of the collaboration
3. Be the primary forum for interactions and decisions on scientific and technical matters for SKA among the partners
4. Represent SKA to the regional and national funding agencies

#### ***SPDO Memorandum of Agreement (1 January 2008-31 December 2011)***

This is the framework to internationalise the technology development and design for SKA and develop a costed system design. The director of SPDO is appointed by SSEC and will report to the SSEC.

Main responsibilities of **SPDO** are:

1. Coordinating the global activities of the SKA project in terms of engineering, science and site
2. Evaluation, operations, telescope, simulations and public outreach
3. Providing the secretariat of SSEC
4. Developing a costed design for SKA
5. Undertaking site characterisation studies in Australia and Southern Africa with regional partners

***PrepSKA project (April 2008- 31 December 2011)***

PrepSKA is designed as a collaboration project between science institutes and funding partners, all together 20 parties. The collaborating international parties have formally agreed on the establishment of a PrepSKA Consortium, a condition to receive the grant from the EC, based on the PrepSKA proposal. This provides the opportunity for funding agencies, governmental bodies and scientists to work together towards the realisation of SKA.

According to the PrepSKA Consortium Agreement the PrepSKA Board consists of all 20 parties, namely 9 global funding partners/agencies: STFC, NWO, CNRS, INAF, IT, CSIRO, DIISR, NRF, NRC, and 11 scientific partners. In addition to this there are two affiliated funding agencies: NSF, Vetenschapsradet and the SPDO. The aim of the PrepSKA Consortium is to deliver an Implementation Plan for the construction of SKA. This plan will be the basis of a funding proposal to governments or agencies when seeking funding for the construction of SKA.

***Agencies SKA Group (Terms of Reference, February 2009)***

This is a group of funding bodies and others sharing an aim to realise the Square Kilometre Array (SKA) as a global project and which previously met as an SKA Informal Funding Agencies Group (IFAG). As technical and policy efforts continue under the coordinating efforts of the PrepSKA project and the SKA Science and Engineering Committee (SSEC) it is recognised that a more formal body, with the ability to make recommendations on threshold issues to governmental bodies, is necessary. Where appropriate, this body should be empowered to address, and where required, recommend alternative frameworks for making decisions. A new Agencies SKA Group (ASG) has been established with the following aims and scope.

The overall aims of the ASG are to:

1. Deliver a non-binding Joint Agreement on the Implementation of SKA, with emphasis on Phase 1 and 2, to coincide with the conclusion of PrepSKA in 2011/2012;
2. Achieve sufficient consensus and provide decisions and recommendations on key policy areas of the SKA project, where appropriate. Where this is not possible, to recommend an appropriate framework for such decisions; and to
3. Prepare the groundwork for the subsequent establishment of a formally-constituted SKA Steering Group at an appropriate time.

**ANNEX II: The Square Kilometre Array Fact Sheet SKA Program Development**  
**Office Version 2.1, 13 November 2009**

**What is the SKA?**

- The SKA is a revolutionary radio telescope, with up to 1 square kilometre of collecting area providing up to 50 times the sensitivity and 10 000 times the survey speed of the best current-day telescopes.
- It is a global project in which astronomers, engineers and industry from more than 50 institutes in 19 countries are participating in the scientific and technical design of the telescope through development programs, design studies, and pathfinder telescopes.
- The SKA will give astronomers insight into the formation of the first stars and galaxies after the Big Bang, how galaxies have evolved since then, and what is the likely future of the cosmos itself. And, if history serves as a guide, it will answer many, as yet, unformulated questions.

**What will it look like?**

- The SKA will employ antenna systems to cover the frequency range from 70 MHz to 10 GHz. Fifty percent of the total sensor collecting area will be concentrated in the core region, 15-20 km across, with the remainder in outlier stations at distances of up to at least 3000 km to provide very detailed images of the cosmic objects.
- In the higher part of the frequency band, the sensors will comprise up to 3000 dishes each of about 15m diameter and carrying low noise innovative feed and receiving systems in their focal planes. In the lower part of the band, the sensors will be fields of aperture array tiles, with no moving parts, able to observe a number of large areas of the sky simultaneously.
- Signals received by the sensors will be transferred to a central signal processing system and high performance computer by optical fibre links carrying up to 160 Gbits/sec per sensor.
- The special purpose central processing system will extract as much as 1 Peta-byte of astronomical data every 20 seconds, so that exascale computing and Exabyte data storage will be required.
- A sophisticated data archive and distribution system will provide access to the data by astronomers and physicists anywhere in the world.

### **Where will it be located?**

- Two candidate locations are under consideration: Australasia and Southern Africa.
- In Australasia, the core region would be in Western Australia with remote stations stretching across Australia to New Zealand. In Southern Africa, the core would be in Northern Cape Province in South Africa with remote stations in seven neighbouring countries including Madagascar and Mauritius.
- The core region in either location will have to accommodate up to three sub-cores, each approximately 5 km in diameter - one for the dishes, one for sparse aperture array dipoles, and one for dense aperture array tiles.
- Major site selection criteria include the current and future radio quietness of the sites, and the infrastructure capital and operations costs including power. Ongoing site characterisation includes measurement of the current radio-quietness of the core regions and representative remote stations, as well as measurement or modelling of tropospheric and ionospheric stability.

### **Timeline and cost**

- *Timeline:* five stages of development of the SKA are foreseen:
  - 2008-2012 Preparatory Phase in which the system design and cost are determined, and the site decision and initial construction funds are ratified by the participating governments
  - 2013-2014 Detailed design, production engineering and tooling
  - 2015-2018 Initial construction (10%), commissioning, acceptance, integration and first science. Ratification by governments of funds for the full SKA.
  - 2019-2022 Completion of construction, commissioning, acceptance, integration, and shared-risk science
  - 2023 science operations
- *Cost.* The target cost for the SKA is 1.5 billion Euros (2007).