SKA Operations Concepts

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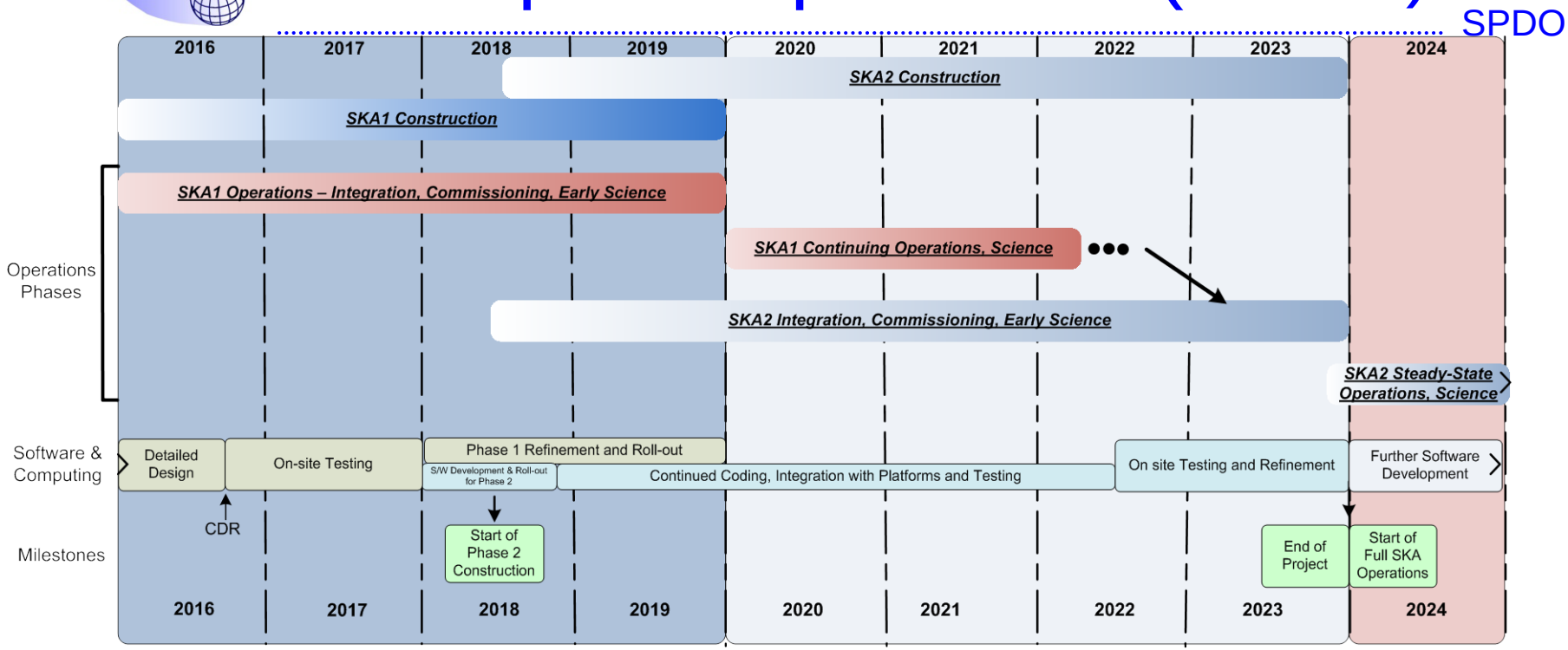
Operations Document

- Purposes:
  - provide working definition of top-level SKA operations,
  - describe development of operations
    - construction of SKA1 to steady-state operations of SKA2,
  - describe useful operational concepts,
  - brief working operations scenarios.
- Next steps: Produce a full set of operational requirements.
  - Representative descriptions in the document will change.
  - Use lower level analysis to provide exemplary guidance.
- Emphasis on the technical aspects
  - administrative and organisational structures must support the technical requirements.
- Detail cannot be provided at this stage,
  - Detailed areas can be explored but not committed,
  - analysis of a full set of operational requirements will eventually yield detail.

Scope of Operations

- Planning:
  - all activities leading to the definition of the capital project plan and the operations plan.
  - project definition, system engineering and design. Preparatory and Pre-Construction phases of the project schedule
- Construction:
  - Everything defined to be in the capital project plan.
  - Capital items or services procured by contract or agreement with a supplier.
  - Acceptance procedures:
    - Formal acceptance sign-off => operations domain.
    - no longer included as part of construction
    - Risk is transferred from supplier to the SKA Organisation.

Scope of Operations (cont'd)



- Operations includes:
  - All activities not defined as planning or construction activities.
  - Integration of supplied components, sub-systems or services into the system.
  - Using the telescope: planning and carrying out the science.
  - Because the SKA can be operated and used for science while it being constructed, the operations phase is in parallel with construction.
  - Software is a separate case. It goes from planning to operations. No construction.

Operational Locations Concept

- Global Headquarters
  - Location to be defined.
  - Top level policy direction: science, administration, strategy.
- Regional Science Centres
  - Location of principal users
  - Coordinate participation in science programmes
  - User development & support
- Host Country Headquarters
- Supercomputer Centre
- Site Operations & Maintenance Centre
  - Near SKA core
  - Base for technical staff required at or near core site
- Near-site accommodation complex (if present).
  - If site operations staff require nearby short-term accommodation.
- Note these centres are logically separated by function, but some could be physically co-located.

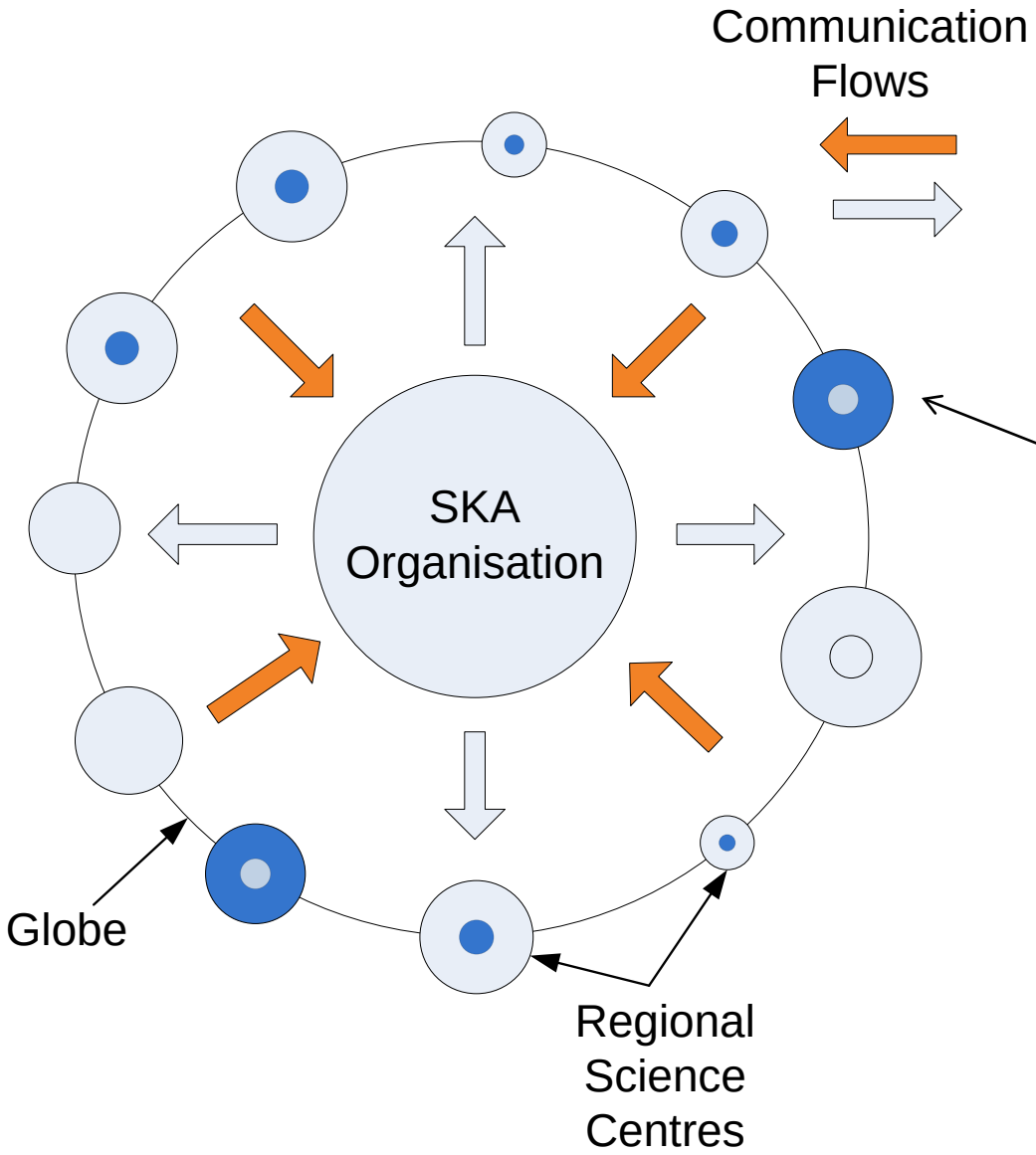
Operations at Global Headquarters

- Top-level management,
- Long-term policy direction,
- Financial oversight,
- Relationship with funding organisations,
- Legal affairs,
- Contracting and procurement,
- Other global business affairs,
- Mandating and managing technical standards,
- Top-level scientific direction,
- Final proposal evaluation.

Operations at Regional Science Centres

- Science backbone of the SKA.
  - Generating proposals
  - Organising large survey projects
  - Science analysis
  - publications
- Also expected to contribute to:
  - production of software,
  - algorithms,
  - deep analysis of performance,
    - modelling of key parts of the system.
- Note: probably also involved in technical planning and construction.
  - Work package contractors.

Short Programmes (PI Proposals)



Some Regional Science Centres concentrate on PI-driven observations – handle logistics, proposal ranking, and aggregate them into large schedulable chunks (resembling surveys)

Operations at Host Country Headquarters

SPDO

- Manages:
  - operations at the telescope site,
  - physical infrastructure and computer at the supercomputing centre,
  - maintenance of all the facilities in the Host Country,
  - near-site accommodation (if present).
- Carries out:
  - Short/medium term scheduling of the telescope and data processing,
  - programming and operation of the supercomputing centre,
  - system configuration management,
  - host country business operations
    - fiscal, accounting,
    - procurement, contracts,
    - human resources,
    - managing the shipment of goods (import and export),
    - local transportation vehicles and equipment,
    - environmental matters,
    - host country legal.

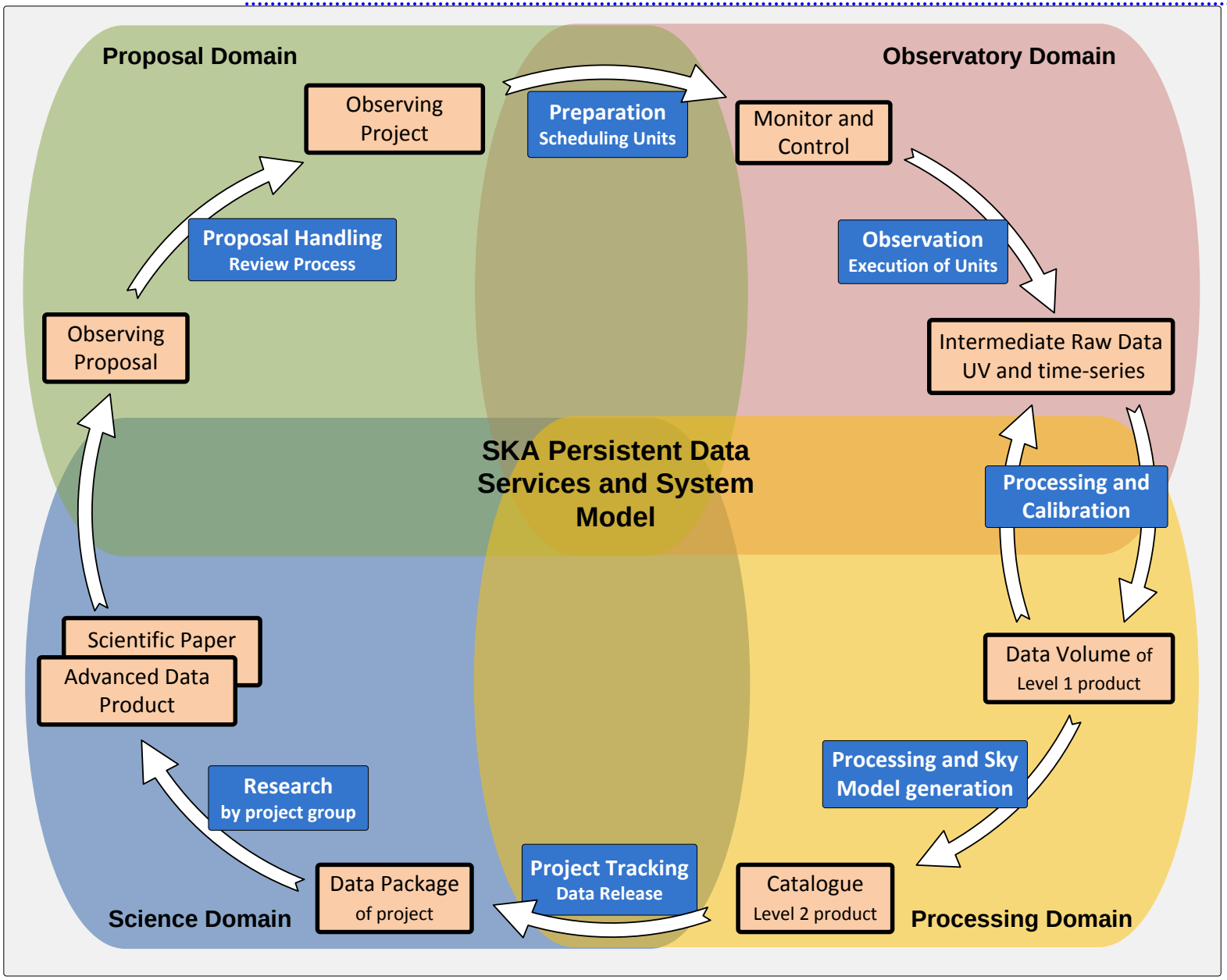
Operations at the Site Operations Centre

SPDO

- Site Operations: see document: “Initial Model for Maintenance & Operations Staffing”
  - Coordinate all site activities from a safety perspective,
  - Track the operational status of all telescope components,
  - Liaise with and track the activities of the Maintenance Group,
  - Communicate status and activity reports to the Site Country Headquarters,
  - Carry out the short-term schedule for the telescope, including all its sub-arrays.
- Maintenance:
  - Carry out planned and unplanned maintenance,
    - Telescope equipment on site and infrastructure,
    - Largest component of site staff – estimated to be a few hundred people (SKA2).
- Managing maintenance:
  - maintain a good up-to-date collective picture of the state of the system,
  - information from all sources to diagnose problems,
  - plan the most effective use of staff to carry out repairs,
  - liaise with senior management when necessary to develop policy direction,
  - liaise with the Configuration Management Group on spares and system status.

Science Operations – from Proposal to Paper

SPDO



Adapted from PEP and ESO (Quinn et al.)

Persistence Services and System Model

- System Model:
  - contains the state of the system,
  - evolves with time (must be known at all times),
- Stored and served to users and processes.
  - accessible to
    - all phases of data/science processing,
    - maintenance and operations staff,
    - schedulers.
- Contains (as examples):
  - model sky (calibration),
  - historical calibration database,
  - other databases – environment, equipment operating temps, etc.
  - model of atmospheric and ionospheric effects,
  - configuration state of the system,
    - from the configuration management system.
  - performance models of critical sub-systems (dish pointing, ADCs, etc.)

Software Development & Operations

- Most challenging aspects of the system design/development.
- Development begins before 2016:
  - Some aspects part of operations post 2016 (see operations schedule)
  - Construction:
    - aspects associated with the functioning of the telescope, such as M&C.
  - Operations:
    - data reduction software such as imaging and pulsar data processing.
    - Software associated with integration and continuous evaluation.

Institutional Roles: Science Ops & S/W Development

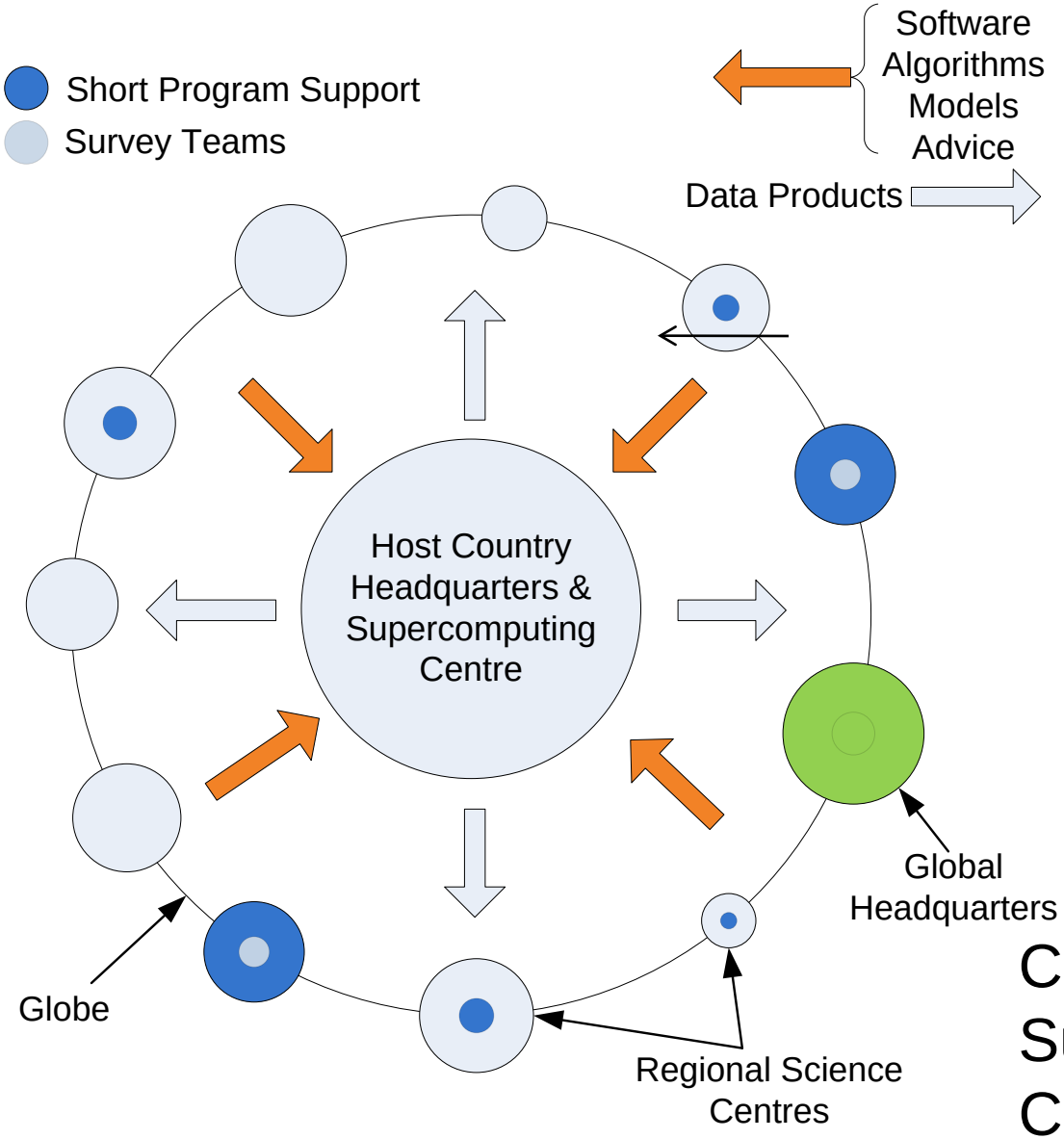
- Assumptions:
  - volume of raw data is too large to be distributed globally,
  - supercomputer system, located in the host country, will be used to carry out many of the data reduction procedures.
  - data products (smaller than raw data or even images) will be distributed to the regional science centres around the world.
  - data products also archived at the supercomputer centre.

- Roles/responsibilities of SKA Organisation:
  - Software related to operating the telescope,
  - Software related to basic data processing,
    - responsible for generating the required data products.
  - Software development in either of the above areas,
  - Quality assurance, backup, archiving, maintaining system databases, etc.,
  - Quality assurance of all software running at the supercomputing centre,
  - Software developed under contract.

Institutional Roles: Science & S/W (cont'd)

- Roles/responsibilities of Regional Science Centres:
  - Science data processing S/W (beyond "basic"):
    - S/W of direct interest to science being done at the centre.
    - may have to run on the supercomputer,
      - generate specialised data products, for example for a large survey, from raw data.
    - S/W verified at the supercomputing centre as "non-interfering" (standards compliant)
    - SKA Organisation not responsible for quality control, documentation or outcomes.
  - Contributing algorithms and methods:
    - e.g. S/W or partially completed code.
    - Of general interest or enhances telescope performance.
  - Contract software development for SKA Organisation.

S/W & Data Flow: Concept Framework



Code Integration at Supercomputing Centre.

Status of Operations Planning

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- Requirements analysis has begun in general:
  - No special emphasis on operations yet.
  - Some of the concepts in the current may be modified or abandoned if they cannot fit requirements.
- Have carried out early estimates of some operational needs, particularly site operations and maintenance.
- No official policy yet formulated on mix of large survey projects and smaller PI-driven short programmes.
  - Key science comprises entirely large programmes.
  - Both types of programmes will likely be supported.

End