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# DMS Work Management Plan for SRDP

| PREPARED BY | ORGANIZATION | DATE |
|---|---|---|
| Morgan Griffith | NRAO - DMS | 4/13/2018 |

## Change Record

| VERSION | DATE | REASON |
|---|---|---|
| 0.1 | 3/22/2018 | Initial Draft |
| 1.0 | 4/13/2018 | Incorporating feedback from internal reviewers<br>Approved by M. Griffith and B. Glendenning through NRAO Workflow |
| 1.1 | 6/27/2018 | Updates to Communications, Deployment and Operations, Budget, per recommendations from CoDR. Added a Testing description to the Design and Integration section. |
| 2.0 | 3/20/2020 | Updates based on learnings from SRAO, inclusion of VLASS and TTA Tools projects. |

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# 1 INTRODUCTION

## 1.1 Purpose

This document describes the process for managing the priority of the Science Ready Data Products (SRDP) effort across the Data Management and Software Department (DMSD) in the context of all of the priorities that DMSD needs to address. It introduces the management, design, and integration processes necessary for large cross-DMS projects such as SRDP. The primary focus is on software development, but it also applies to cases where Scientific Information Services (SIS) is involved.

The scope of SRDP includes Science Ready Archive and Operations (SRAO), the VLA Sky Survey (VLASS), and the Telescope Time Allocation tools (TTA) projects.

## 1.2 Change Management

Changes to this document must be approved by the DMSD Software Division Head and subsequently distributed to all members of the DMSD Software Leads team.

## 1.3 Document Structure

After the introduction, a definition of roles used in the document is provided, followed by an overview of the management of overall work priorities. The design and integration process specific to projects which cross DMS group boundaries is outlined. A section outlining governance and communication for SRDP follows, along with an estimate of the budget for SRDP. The group priority setting process is described in Appendix A.

Additional information on the detailed management of the software development work, including procedures for tracking feature development, bug fixes, and research projects, can be found in "DMSD Software Development Processes" [RD01].

## 1.4 References

[RD01] Rafael Hiriart, Morgan Griffith, "DMS Software Development Processes"
[RD02] Robert Treacy, "SRDP System Engineering Management Plan"
[RD03] Mark Whitehead, "TTA Tools Conceptual Architecture"

## 1.5 Abbreviations and Acronyms

**Table 1: Abbreviations**

| Acronym | Definition |
|---|---|
| AD | Assistant Director |
| ALMA | Atacama Large Millimeter-submillimeter Array |
| CASA | Common Astronomy Software Applications |
| CIO | Chief Information Officer |
| DMS | Data Management and Software |
| DMSD | Data Management and Software Department |
| DSO | Division of Science Operations - ALMA |

| Acronym | Definition |
|---|---|
| FTE | Full-Time Equivalent |
| HTC | High Throughput Computing |
| ICC | Internal Common Cost |
| JIRA | An issue tracking system, from Atlassian |
| L0 | Level 0, or Stakeholder Requirement |
| L1 | Level 1, or System Requirement |
| L2 | Level 2, or System Element Requirement |
| M&C | Monitor & Control |
| MVP | Minimum Viable Product |
| NRAO | National Radio Astronomy Observatory |
| POP | Program Operating Plan |
| RVTM | Requirements Verification and Traceability Matrix |
| SEMP | System Engineering Management Plan |
| SIS | Scientific Information Services |
| SRAO | Science Ready Archive and Operations |
| SRDP | Science Ready Data Products |
| SSA | Science Support and Archive |
| SSR | Science Support and Research |
| TTA | Telescope Time Allocation |
| VLA | Very Large Array |
| VLASS | VLA Sky Survey |
| VLBA | Very Long Baseline Array |

# 2 ROLES

The following roles are defined. While in some cases these roles correspond to positions, the design and integration teams are staffed from the development groups as described in Sections 5.1 and 5.2..

Architect – Assemble appropriate resources from science stakeholders and DMS groups for design exercises, lead the design/estimation process, help to define System Element tests, develop the conceptual architecture, lead elaboration of logical and physical architecture.

Group Leads – Responsible for delivery of work assigned to their group, participate in design process and/or allocate resources for the design/planning and integration. The DMS groups which are responsible for SRDP delivery are described in the Section 7 (Resources and Budget). The SSA Group Lead (or designate) will act as act as the integration lead, bring all the technical parts together from the various development efforts across the groups, assemble them into a working system, lead testing, identify issues and drive resolution.

Design Team members – Under the direction of the Architect, consider the work which is requested, the long-term plan (SRDP roadmap); as a team consider options for delivery, converge on a solution (architecture decomposition and modification, interface definitions), provide estimates of time required to develop capabilities, implement and test them. Provide feedback on whether the requested work packages are realistic in the requested timeframe, and if not, suggestions on options/modifications that could be accomplished.

Integration Team members – Integrate the deliverables as a system, conduct integration and verification testing.

DMS Software Head – Work with stakeholders and architect to align requested work to resources, and if necessary, adjust work request to available time/resources; work with management and stakeholders to resolve priority conflicts and project issues; track and report DMS progress, responsible for the delivery of the DMS work.

Developers – Participate in design and integration roles as needed, both within group and across groups; develop and deliver software and unit tests, conduct unit tests, contribute to regression test suite.

SRDP Validation Lead – Work in partnership with the DMS team and SRDP staff to validate the system, i.e. ensure that it meets the needs of the users. Individual SRDP projects may have their own validation lead.

# 3 DOCUMENTS

The following documents will be used in managing the work:

SRDP Architecture – Describes the components of the system, relationships between them, and interfaces. This will be maintained in the Cameo tool.

DMS Shared Project File – Provides high level tracking of high priority DMS efforts, such as POP goals and Observatory priorities, such as SRDP.

DMS SRDP Schedule – Tracks design, development, and testing activities across DMS for SRDP. This will be coordinated with the overall SRDP project schedule managed by the SRDP Program.

JIRA – Used in the day-to-day management of the work, tracks individual work items from backlog through development, verification, and validation. Also used by the DMS groups in the planning meetings.

SRDP Issue List – Tracks status on SRDP issues, with references to action items in JIRA.

DMS Risk Register – Lists risks and potential actions for each DMS group and across DMS; high risks are also transferred to the Observatory Risk Register.

DMS Technical Debt Register – Captures tradeoffs encountered when making implementation decisions that incur potential future work in order to meet an urgent current need. Supported by a discussion of the cost and necessity of the future work vs. the benefit (or cost avoidance) of an earlier partial solution.

# 4 PLANNING AND PRIORITIZATION

Observatory priorities are managed at the Department level, involving stakeholders from all the relevant departments, and when appropriate, the Observatory Director. The Long Range Plan spans the upcoming five years and is updated yearly. Yearly priorities are set in the annual Budget Summit and documented in the Program Operating Plan (POP). The large projects, such as SRDP, provide input based on what they plan to accomplish. SRDP is the agreed top Observatory priority with the exception of telescope operations (which has little overlap in personnel).

As the work is accepted into DMS, the high-level deliverables are tracked and inserted as planning priorities for the individual groups. For projects which span groups, conceptual architecture is developed in a "Design and Integration" step. In addition to creating the architecture, this defines where (i.e. in which group(s)) the responsibilities land, what could be accomplished in a particular timeframe, and provides an integration framework across the groups as the work is completed. Work items are tracked in the groups at a more granular level in JIRA.

Each group follows a planning process where work priorities are set with input from the DMS priorities and Science/Operations (described in more detail in Appendix A). The groups have formal planning meetings on a regular basis including their Science/Operations stakeholders and DMS management. The Observatory priorities and agreed-upon project work, defined in the Design and Integration step, serve as input to the planning process. They are introduced as high priorities and noted in the discussions. When conflicts are found in priorities, DMS management has the responsibility to work out the conflicts with the help of its Science and Operations stakeholders, either at the division level, or through escalation to the department level. Many of the same stakeholders and management personnel attend the various group planning meetings, so conflicts can be resolved efficiently. The result is agreement on the work to be done in the time period and allocation of resources.

The Planning and Prioritization process for DMS is supported by a roadmapping technique which helps integrate ideas and requests from different timeframes, with the intent of 1) aligning work with DMS and Observatory priorities and goals, and 2) identifying potential conflicts between teams' plans and working to resolve them. It provides structure to bridge the gap between the shorter-term work planning goals and the Long Range Plan, and a place to analyze and balance the requests of DMS stakeholders.

Figure 1 shows the framework for setting priorities and illustrates how the processes relate to one another. Appendix A describes the group prioritization process in more detail.

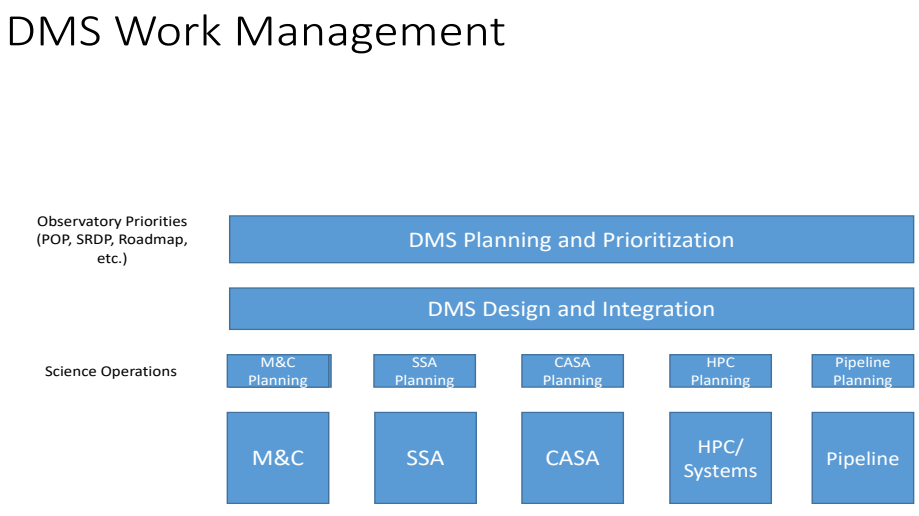


Figure 1: DMS Work Management.

The DMS development and delivery effort available for SRDP is guided by the DMS budget estimates, provided in Section 7.

# 5 SRDP DEVELOPMENT PROCESS

Figure 2 shows the SRDP Development Cycle in the larger context of the Software Development Process. This follows the model commonly referred to as the "V" diagram in the Systems Engineering context. The outputs of the conceptual architecture development allow the definition of work packages and estimates, which are inputs into the prioritization process described in Section 4.

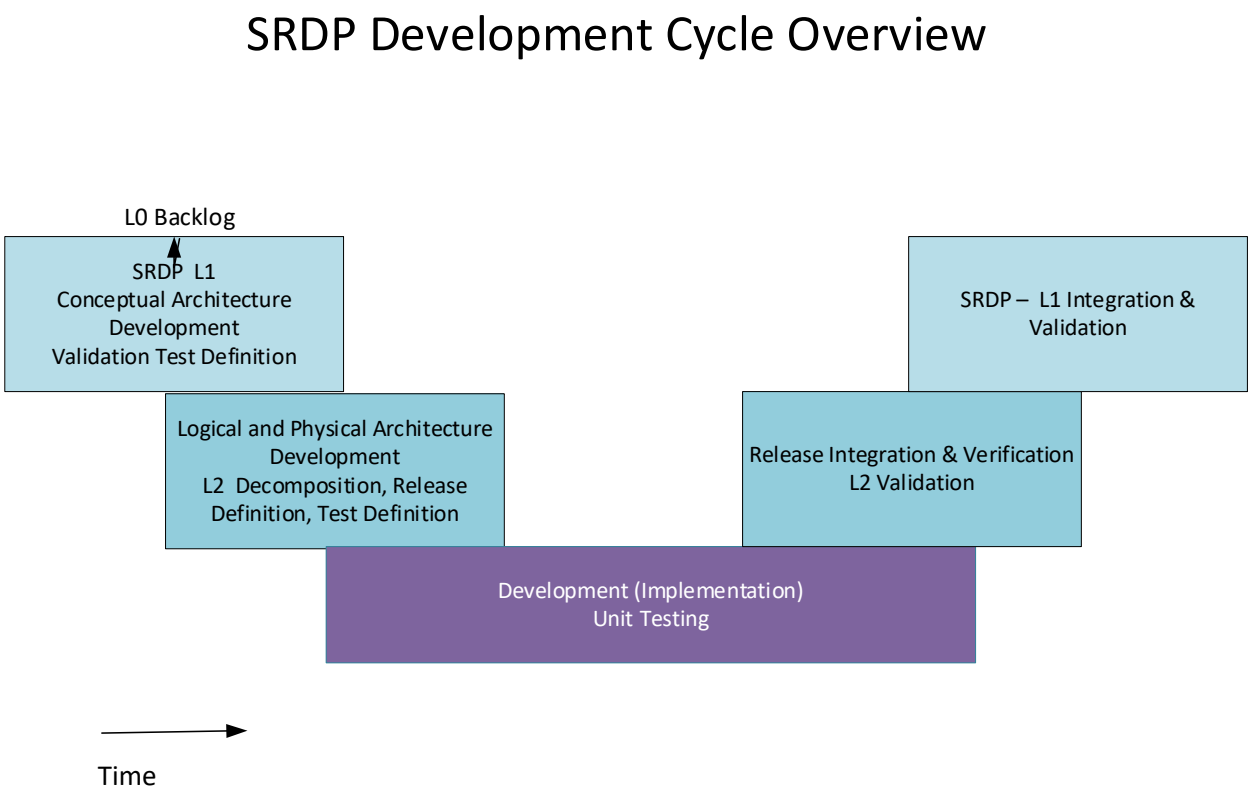


Figure 2 : SRDP Development Cycle.

Note that the different projects in the SRDP program will follow the general approach describe below, but there are differences due to their individual histories and requirements. The relatively well-defined scope of the TTA Tools project has allowed development of an overarching conceptual architecture, and plans to deliver work packages in phases, elaborating the logical and physical architectures with each phase. SRAO and VLASS anticipate the need to include a higher proportion of changing or developing requirements, so the up-front conceptual architecture is continually developed in rolling waves, and then further elaborated.

## 5.1 Architecture, Design and Development

Cross-DMS projects and programs, such as SRDP, require interaction across the DMS groups and the systems they support. An architecture/design process such as described in the TTA Tools Conceptual

Architecture [RD03] will be used to break down high-level requirements into lower level ones for implementation by the DMS groups. Figure 3 illustrates the relationships between architectural development (conceptual, logical, and physical) and other key processes and deliverables.

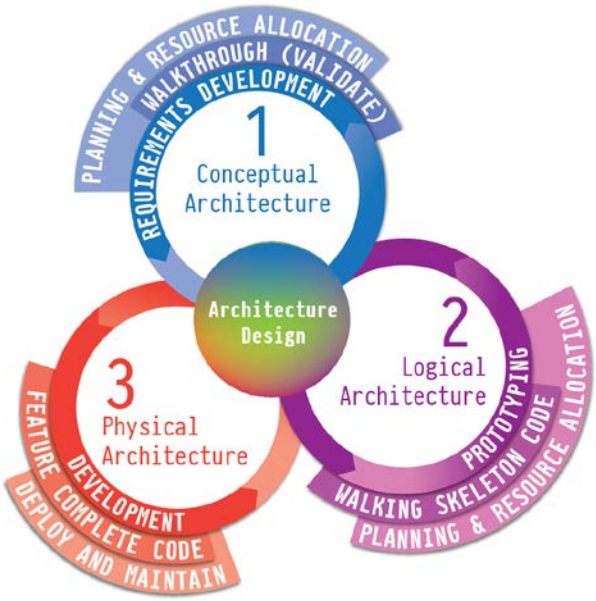


Figure 3: Planned iterative phases emphasizing how architecture development is paired with prototyping and coding as development progresses. Graphic by Reid Givens.

The design process will reference an SRDP project's conceptual architecture, developed by the DMS Architect, initially based on the overall stakeholder requirements. The architecture will outline the major components of SRDP and the interfaces between the components, and will be updated as the high level requirements are broken down over time.

As referenced in the SRDP System Engineering Management Plan (SEMP) [RD02], three levels of requirements are envisioned, L0 (Stakeholder), L1 (System), and L2 (System Element).

*Stakeholder Requirements* provide an overall concept of the system, including software, hardware, manual processes, workflows, i.e., how all the parts work together. The DMS Architect will work together with the science stakeholders as a team to develop stakeholder requirements that are useful for system development. The stakeholders are responsible for defining the requirements and the DMS architect is responsible for putting them into a useful form.

*System Requirements (L1)* are the first decomposition into systems that need to be delivered. This is the input to DMS development. Architectural development will be iterative as illustrated in Figure 3, determining the following things:

1) A breakdown of how the requirements map to the different DMS delivery groups and subsystems.
2) Clarification of what needs to be delivered, with the goal of having an agreed understanding between the SRDP requirement providers and the development staff. These are the *System Element Requirements (L2)*, and are the responsibility of the group lead(s)

3) Estimates of the effort required to deliver working code that conforms to the physical level architectural design, meets the System Element requirements and a timeline for delivery. Constraints of availability of resources (effort, expertise of particular people) will be taken into account. Breakdown of the System Element requirements should be done to the extent needed to assemble reliable estimates.
4) The tests needed for verification of the System Element Requirements.
5) Updates to the architecture.

Notes:

- These steps do not necessarily happen in sequence, as refinement may change assumptions that require another iteration.
- The overall work package estimate needs to include reasonable integration time, testing, verification, and validation activities.
- The estimated budget for SRDP will be used as guidance as to how much work can be accepted for the project in a specific timeframe.
- Analysis should be done during the design process to identify overlapping work which will benefit SRDP and other stakeholders/projects.
- Prototyping will be used to prove the practicality of concept explored during architectural development. The "walking skeleton" model will be used when possible, creating early working "end-to-end" prototypes, and then adding capability to the skeleton to develop the working system.
- The design process will look ahead to future iterations to include work that would need to be done in the current one to support delivery of a future capability.
- With the assumption that capabilities will be delivered in iterations within designated time boundaries, judgements will need to be made based on estimates of which development items are likely to fit in the designated time, and which should be deferred to a later iteration.

The design portion of the iterations are also time-boxed, as described in the SEMP [RD02], in order to provide a stable list of tasks to be delivered in each iteration. This list will describe the Minimum Viable Product (MVP) and will include all the "must have" requirements and the work to deliver them.

Previously unknown requirements discovered during the design process or derived from a research project (see below) will be added to the list of SRDP requirements in the Requirements Verification and Traceability Matrix (RVTM) and in other documents as appropriate. [1]

### *5.1.1 Research Projects*

System Element Requirements may not always be straightforward to define, i.e. there may be uncertainty as to what is required or as to whether a particular method will yield a solution. In these situations, an iterative development approach (Research Projects, discussed in RD01) will be used, involving participation of both the SRDP stakeholders and the developers. There are specific constraints on this type of requirement definition:

1) The solution needs to fit within the overall design of the system, as defined by the conceptual architecture and the individual subsystem architecture.
2) Effort for iteration is time-boxed.

[1] L0 requirements will be added to the Stakeholder Requirements document. L1 requirements will be added to the System Requirements document for a future cycle. L2 requirements will be added to JIRA and tracked, along with any further decomposition.

3) The end result will include tests for success which can be used for verification/validation.

The research project may result in a final solution (rather than a set of requirements for further development), but even in that case the end result should include tests.

## 5.2 Integration

An increased need for an integration team arises in projects, such as SRDP, that cross group boundaries. These teams will be organized by pulling resources from the development groups, under the control of the SSA Group Lead.

The scope of integration ranges from components within a subsystem that need to work together, through subsystems which need to work with each other through their defined interfaces, and on to integration at the SRDP level where the DMS software, hardware, and SRDP processes all need to mesh in order to deliver the required functionality. This is shown in Figure 2as both Release Integration (L2/System Element level) and SRDP Integration (L1/System level).

As the requirements are broken down in the requirements decomposition and design processes, the DMS Architect iterates requirements and elaborates the architecture[2]. The architect also contributes to the integration test plan, specifying the test suite that will be used to verify the System Element Requirements. He/she can also specify architecture validation tests, such as scalability and performance tests, etc. The integration team is responsible for executing the tests.

The System Element Requirements are passed to the group managers, who work with their groups to convert them into tasks needed to deliver the required functionality. The architect is involved in a consultative and reviewer mode, and ensures a consistent architecture across the groups. He/she can also be involved in performing prototyping to check that things will work properly. On the other hand, it is important to leave detailed design to the groups, so they "own" their system.

As development (implementation) work ends, each group works on their own integration and unit tests, integrating new features into their individual subsystems (System Elements) and verifying the System Element requirements.

DMS Software Division Head, with guidance from DMS Software Architect and group leads, will assemble integration teams appropriate to projects. For SRDP projects, integration will primarily reside in the SSA group, led by the SSA Group Lead, and will involve resources from the development groups as appropriate. The group lead will define the necessary test platform and further elaborate the integration tests. The purpose of the integration team is to bring together the features and functionality from the System Elements to ensure they work as a System. For example, for a re-calibration use case, the Archive, Workflow Manager, and Pipeline would all potentially deliver new functionality. The integration team would use the integration tests to determine whether all the components performed as a system and to validate that the use case was delivered as specified. Features are considered as “delivered” only when the project integration tests pass successfully.

A subset of tests designated by the integration team will be automated and incorporated into a regression test suite. Developers will create requirements-based automated tests to be included in verification and also as components of integration testing.

[2] The DMS Architect is part of the Requirements Committee and is involved in requirements decomposition.

When the integration tests pass, then the DMS-delivered system is ready for validation.

In addition to validation, the next level (L1) also may include integration work, in this case between the delivered system and other teams' deliverables, such as operations processes. Testing and integration with operations processes will be done by the Validation Lead, with participation and assistance from the DMS integration team. JIRA ticketing and weekly follow-up at the DMS-SRDP team meeting will serve as a vehicle for communication and issue resolution.

## 5.3 Testing

The following provides additional details of the overall testing process and defines responsibilities for specific testing areas.

As part of conceptual architecture development, the stakeholders, the Validation Lead, and the DMS Architect will define tests to validate the conceptual system model. These can be used later as system validation tests on the delivered system, and are derived from the L0/L1 requirements.

The DMS Architect, SSA Architect, and development team mebers create verification tests, which are executed as part of verification and are derived from the L2 requirements. Many of these are unit tests, defined during the design of the logical and physical architecture. Some of these will be integration tests, as they will pull together parts across subsystems and from within subsystems. A portion will be manual, as they will combine systems and processes that need to be done by people. They should all be tied to the requirements through the RVTM.

A portion of the tests will be automated as appropriate to facilitate comprehensive testing and to provide regression.

When a test fails, the cause of that failure should be considered. In most cases a coding error will need to be fixed, but in some, the test may be outdated and need to be replaced with a different test or eliminated from the testing suite.

The SSA Group Lead will coordinate the work of the integration team and, along with guidance from the architecture, will provide continuity across work packages and time.

# 6 COMMUNICATIONS AND GOVERNANCE

Progress on high-level deliverables, i.e. POP goals, SRDP L1 deliverables, are tracked bi-weekly by the DMS Head of Software. Lower level tracking is done at the group level by the Group Leads and through the JIRA ticketing system. Issues are escalated both within DMS and as needed to the project (SRDP) level.

A cross-DMS SRDP schedule will be maintained by the DMS Head of Software to track design, development, and testing activities. It will be reviewed as a standing agenda item in the weekly DMS-SRDP coordination meetings.

SRDP-related communications within DMS and between DMS and the Project are outlined below.

## 6.1 Communications

The following are regular meetings regarding DMS and SRDP, and their cadence:

**Table 1: Meeting and Communication Schedule**

| Meeting | Cadence | Participants | Purpose |
|---|---|---|---|
| DMS/SRDP coordination | Weekly | DMS Head of Software SIS CIO DMS Architect SRDP Program Director SRDP Project Manager SRDP Scientist SRDP Operations Manager DMS Group Leads | Discuss progress, status, and future plans; coordinate work that crosses boundaries or that is jointly done; review and address issues and risks. |
| DMS Leads | Bi-weekly | DMS Head of Software DMS Architect Group Leads | Discuss L2 progress and issues; plan design and integration activities and resources. |
| Staff | As needed | DMS Head of Software DMS Staff | Information on the Project will be shared by DMS Head of Software either in the bi-weekly Leads meeting or as needed more broadly to the software development division. |
| SRDP Executive Management | Weekly, if needed | SSR Department Head DMS Department Head DMS Head of Software SIS CIO SRDP Program Director SRDP Project Manager | Provide updates, discuss issues and risks, planning. |

## 6.2 Issues

Issues will be escalated as needed from the Group Leads up through DMS Head of Software, and to the SRDP Project Manager. DMS issues for SRDP will be tracked on an SRDP issue list, with any associated actions tracked in JIRA. Issues rising to the SRDP level will be tracked in the SRDP issue log.

## 6.3 Risks

Risks will be tracked on the DMS Risk Register, either on the individual group pages or, in the case of cross-group risks, on an "SRDP" page, and escalated to the Observatory Risk Register if they cross the threshold for "High" risks. New or changed risks will be discussed at the DMS/SRDP Weekly Meeting.

## 6.4 Changes to Architecture

The architecture will be updated by the design teams as the Stakeholder Requirements are broken down into System Requirements and beyond. When a conflict arises between a proposed implementation and the architecture, this may indicate a missing or incomplete requirement. The architect will work with the group lead(s) and developer(s) to resolve the conflict, and as needed, update the architecture and/or requirements documents, and test procedures.

In the case of the TTA Tools project, the DMS Architect and the SSA Architect will collaborate throughout the logical and physical phases to guide implementation.

## 6.5 Deployment and Operations

SIS is responsible for the internal deployment of software. The software team will bundle releases in an appropriate format and provide release instructions. SIS will deploy the software across the sites, in coordination with SSR as needed. Standard version control and configuration management software enables automation of this capability.

The configuration of each deployment (versions, dependencies) will be kept and managed to allow redeployment of the current version of the system for operational recovery, and to provide the ability to back out to the previous version in case of issues with a new deployment.

Bugs found in operational software will follow the standard process described in RD01.

Further Operations responsibilities and procedures will be defined as the Operations Manager role is filled and Operations begins to ramp up.

## 6.6 Process Improvement

At the conclusion of each development cycle (either rolling wave or phase) this work management plan will be reviewed to capture best practices and potential improvements. This will be led by the SRDP Program Manager and will include the project participants. Updates will be made to the processes and this document.

# 7 RESOURCES AND BUDGET

The resources for the DMS portion of SRDP will be drawn from existing DMS Groups. Their responsibilities and scope are:

- ICC (Management) – Overall oversight and management of the project.
- M&C (Monitor and Control) – Monitoring and control of the telescopes, including taking the data and providing it for downstream processing and archiving.
- SSA (Science Support and Archive) – User facing software: proposal and observing setup tools, workflow manager, helpdesk, and the archive; integration.
- CASA (Common Astronomy Software Applications) – data reduction software.
- Pipeline – Automated data reduction, based on CASA.
- HTC/Systems (High Throughput Computing) – Computing throughput, performance, and capacity
- DMS Architect – Overall architecture and design.

Table 3 below provides both the initial estimates of the dedicated effort per group/role needed to deliver SRDP, and an indication of the impact on the group (related FTE) based on the number individuals which will need to be involved in some capacity. For example, for CASA, approximately 3.5 FTE will need to be dedicated to SRDP work, and that effort will be spread across 10-11 group members who be involved in SRDP-related activities. These estimates are very initial, i.e. pre-operations concepts, and will have to be significantly revised as we gain experience with the project and operations.

**Table 2: DMS Project SRDP Budget (FTE's)**

| | FY20 | FY21 | FY22 | Number of team members involved |
|---|---|---|---|---|
| **ICC** | 0.3 | 0.3 | 0.3 | 2 |
| **M&C** | 0.2 | 0.2 | 0.2 | 1 |
| **SSA** | 5.0[3] | 5.0 | 5.0 | 9 |
| **CASA/Pipeline** | 3.5 | 3.5 | 3.5 | 11 |
| **HPC/Systems** | 0.25 | 0.25 | 0.25 | 2 |
| **Architect** | 0.5 | 0.5 | 0.5 | 2 |
| **Sum** | 9.75 | 9.75 | 9.75 | 27 |

The DMS commitment of resources to SRDP is significant. Of the approximately 50 people available, over half will be involved in the program. Since ongoing maintenance and support work (including software bug fixes) occupies about 50% of the available effort, the 9.75 FTE's represent approximately 20% of the total effort and 40% of the available project effort. For the SSA group, who is the most involved in SRDP delivery, this represents roughly 70% of their available project effort.

The strategy for the SIS (hardware) budget is to manage the SRDP requirements as part of the overall hardware capabilities budget, i.e. ramp up slowly, so we don't shock the system. Certain large proposals or commensal surveys may request resources outside of this envelope and will need to be handled on a case-by-case basis. Contingency for external processing, such as AWS, XSEDE, or other high-throughput computing centers, is included in the overall budget, and alternatively could be negotiated as part of evaluating large proposals.

[3] Contingent on hiring of additional resources.

# 8 APPENDIX A: GROUP PRIORITY SETTING PROCESS

## 8.1 Nomenclature:

A *capability* is a very broad Observatory ability. These are used to define in broad-brush strokes directions the Observatory wants to go, for example, at a "5 year plan" level. Examples would include: new observing modes, adding pipelined data reduction, enabling VO for our users, etc.

Capabilities are decomposed into *features* which is the normal level used in the semi-annual planning cycle and for progress tracking. Examples would include support for some particular device in an observing mode, adding or significantly revamping a data processing task, etc.

Features are described by *requirements***.** The requirements are used to make sure that the provider and the client agree in detail about what the feature should provide, and tests derived from them will typically be used to check that the feature is satisfactory for its acceptance testing.

## 8.2 Process outline

1. Under the Observatory Strategic Planning umbrella, DMSD senior management will maintain a plan of software/SIS capabilities vs. time ("5 year plan"). The priorities will flow from overall Observatory strategic decisions (i.e., SSR and the telescopes), with the role of DMSD management to ensure that the plan is feasible for an assumed technical environment, schedule, and budget.
2. Any internal stakeholder may suggest a feature for development. They are responsible for providing enough detail (normally via requirements) that the effort and impact required to develop it can be estimated. These features will normally be sent to SSR Science User Support Division concerned (VLA/VLBA, ALMA) for collection and first prioritization, although they should also send a copy to the software/SIS group leads for information and a preliminary effort evaluation.
    a) The staff member who has defined new requirements should be available for detailed analysis and follow up/clarifications with the developers, including user acceptance testing of the features they have proposed.
3. External stakeholders can similarly propose features for development, but they should work through a defined internal advocate (e.g., CASA requests should come through the project scientists).
4. Group leaders have to understand proposed features well enough to estimate their impact/work. If more details (requirements) are needed for an estimate, these will have to be better defined by the proposer. Senior DMSD management will need to be kept informed.
5. Features that are well enough understood are put into the feature backlog by the leader of the involved group(s). This is work that is well enough understood to be developed but not currently scheduled. Further interaction on requirements will need to happen at analysis/design time.
6. Priority setting process. Every six months the Science User Support Groups will provide to DMSD their consolidated list of new features with enough level of requirements for an evaluation of effort. Based on the list of features from the Observatory priorities as well as the development priorities of the Science support groups (and with some weeks of time to prepare) the lead of each group will put together a 12 month strawman features development plan based on his or her understanding of the priorities for his group, with a sufficient set-aside for normal support, testing, commissioning support, etc. Features proposed for development should be prioritized and the cutoff line (likely to be developed, possible to be developed) clearly delineated. These strawman plans will be presented and discussed in the following meetings:
    a) System (largely M&C) software and operations SIS groups will meet with a group defined

by the site Assistant Director (AD) plus DMSD senior management. The list of priorities is the responsibility of the site AD or ALMA DSO lead.

b) CASA will meet with the CASA Stakeholders Committee, and the CASA based pipelines will meet with ALMA DSO and VLA staff (probably separately) and DMSD senior management. The final list of priorities is the responsibility of DMSD.
c) SSA will meet with the SSR and DMSD senior management. The final list of priorities is the responsibility of DMSD.
d) The other groups will similarly meet with representatives of their user communities and DMSD management, with the final list of priorities (which at this stage will have become development and deployment priorities) being the responsibility of DMSD. We consider that AIPS and Obit are in a maintenance phase (and with very limited resources) and therefore should not be subject to this process.

7. Plan finalization meetings. After the priority setting meetings DMSD will organize a meeting at the "coordination group" (Deputy AD+) level laying out the priorities for each group, compatibility with the capabilities ("5 year") plan, and remaining issues that need to be resolved by the Director's Office. In addition performance against plan for the just concluded cycle will be presented. For the meeting closest to the start of the fiscal year, DMSD management will also provide a detailed (group level) budget.
8. Unplanned features. Site ADs have the right to change the priorities of the System/Operations groups within their allocated resources, although DMSD must be kept informed. All other requested changes are at the discretion of DMSD, and preference will be given to holding items for the next planning cycle. It is understood that occasionally urgent things will arise so this will not always be possible.
9. Acceptance of new features is the responsibility of the customer (usually SSR or the telescope). At a minimum the feature should undergo a user test, and acceptance is implicitly granted after a successful user test. User tests should be scheduled immediately after the completion of development, as developers will typically need to be involved to resolve issues with recently developed features before proceeding to new features.
10. Software maintenance. Bug fixing and problem investigation is an expected activity of all groups, for which time should be allocated (and subtracted from the total effort foreseen for development work). The amount of this time will be based on experience and previous metrics, and can be prioritized formally or informally depending on the preference of the customers. Software maintenance work exceeding the allocated time will be considered unplanned features.