Telescope Time Allocation Tools

Project Management and Systems Engineering Plan

Project 688

Draft

PREPARED BY	**ORGANIZATION**
Robert Treacy	NRAO, Project Management Department
VERSION RELEASE BY	**ORGANIZATION**
Bob Treacy, Project Manager	NRAO

APPROVALS	**ORGANIZATION**	**SIGNATURE**
Jeff Kern	NRAO SRDP, Project Director	See SharePoint workflow for approvals
	NRAO SRDP AD	
	NRAO, PMD AD	
Tony Beasley	NRAO Director	

Change Record

VERSION	BY	DATE	REASON
1.0	Treacy, Kern	7/24/2020	Incorporate edits following CoDR, format for release

Table of Contents

1. OVERVIEW

There is long standing interest among users and developers to either significantly modify or replace the existing set of tools that comprise the Telescope Time Allocation Tool suite (TTAT). The focus of the TTAT project is to deliver items 1– 3 in the list below, also represented graphically in Figure 1.

Observatory scientific operations at NRAO may be described by six distinct phases that every observing project goes through:

1. Solicitation, Proposal Creation, Validation, Submission, and Proposal Handling
2. Proposal Review for Technical and Scientific Merit
3. Time Allocation on the Target Instrument
4. Observation Preparation for the Target Instrument
5. Observation Scheduling and Execution on the Target Instrument
6. Data Delivery from the Archive, including Generation of Science Ready Data Products (SRDPs)

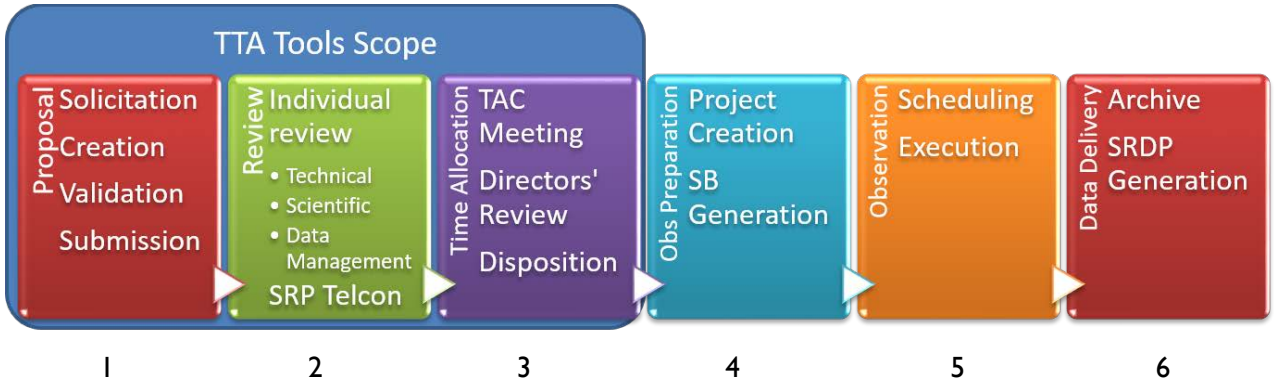

Figure 1 TTA Tool Suite

Functional blocks 1-3 must accommodate all supported instruments (described in section 3.1), where blocks 4-5 are instrument specific. Data delivery from the archive represented in functional block 6 is supported for all instruments although only some instruments support the science quality products of the Science Ready Archive and Operations (SRAO) project. The current TTA Tools design effort needs to accommodate more robust interfaces to Blocks 4-6 to support the SRAO use cases. Implicit requirements from the Observation Preparation, Observations, and Data Delivery blocks need to be recognized and included in the design of the new suite of tools. However, a full redesign of Observation Preparation will need to be performed on a per instrument basis. Therefore, blocks 4, 5, and 6 are formally out of scope for the TTA Tools Project.

This document defines the project management and system engineering processes that will be used throughout the project to deliver a new suite of Telescope Time Allocation Tools.

1.1. Applicable Documents

[AD01] SRDP Program Management Plan 530-SRDP-044-MGMT

[AD02] TTAT Telescope Time Allocation Concept Document 688-TTAT-002-MGMT

[AD03] Telescope Time Allocation Tools Charter 688-TTAT-001-MGMT

1.2. Reference Documents

[RD01] DMSD Software Development Processes V1.1, June 27, 2018
[RD02] TTA Tools Quality Management Plan 688-TTAT-0012-MGMT
[RD03] TTA Tools Execution Plan 688-TTAT-0010-MGMT
[RD04] Telescope Time Allocation (TTA): System Description 688-TTAT-004-MGMT
[RD05] PMD SOP Project Reviews Process PMD00219
[RD06] DMSD Work Management Plan for SRDP

1.3. Acronyms

AD Assistant Director
ALMA Atacama Large Millimeter-Submillimeter Array
AUI Associated Universities Inc.
BI Broader Impact
CASA Common Astronomy Software Applications
CIRADA Canadian Initiative for Radio Astronomy Data Analysis
CIS Computing Information Services
CoDR Conceptual Design Review
DO Director's Office
DSS Dynamic Scheduling System
EDP Enhanced Data Products
FTE Full Time Equivalent
L0 Concept, Use Case, and Stakeholder Level Requirement
L1 System Level Requirement
L2 Subsystem Level Requirement
LOE Level of Effort
MBSE Model Based Systems Engineering
MVP Minimum Viable Product
NRAO National Radio Astronomy Observatory
NSF National Science Foundation
OPT Observation Preparation Tool
PDR Preliminary Design Review
PM Project Management/Manager
PMD Program Management Department
POP Program Operating Plan
QA Quality Assurance
QSU Quarterly Status Update

R&D Research and Development
RACI Responsible Accountable Consulted Informed (matrix/chart)
RID Review Item Discrepancy
RVTM Requirements and Verification Traceability Matrix
SCHED VLBA (and VLBI) observation preparation package
SE Systems Engineering/Engineer
SOW Statement of Work
SRAO Science Ready Archive and Operations
SRDP Science Ready Data Products
SSA Science Support & Archive
SSR Science Support & Research
TPM Technical Performance Measure
TTAT Telescope Time Allocation Tools
VLA Very Large Array
VLASS VLA Sky Survey
VLBA Very Long Baseline Array
VLBI Very Long Baseline Interferometry

2. PROJECT LIFE CYCLE

This project is the culmination of several years' interest in improving the proposal submission and processing tools. An evolutionary approach was taken in 2017 to significantly modify existing tools to address the most egregious issues with the current suite. The evolutionary approach was not accepted by key stakeholders and was abandoned in favor of a replacement. The NRAO Science Support and Research (SSR) department responded by convening a Concept Development Committee with the appointed charge summarized in Section 3.1 This committee established a consensus model of the proposal process which is described by the TTAT Concept Document [AD02]. This project is charged to implement that concept and deliver a supporting suite of tools to be used within operations.

This project is a partnership between the NRAO and the Green Bank Observatory (GBO). NRAO is responsible for the overall project delivery. Within the NRAO the Science Support and Research (SSR) department is responsible for the definition, validation, and user facing documentation for the tool suite. The NRAO Data Management and Software (DMS) department is responsible for the design, implementation, and verification of the tool suite. SSR is accountable for the overall management of the project. GBO is involved in both the science side (through collaboration with the project scientist) and the implementation side (through joint development with the DMS team).

The Life Cycle for the TTAT is anticipated to complete within three stages: Initiation, Implementation, and Divestment. Functional equivalency of existing tools is expected to be delivered by the end of calendar year 2022, and all remaining capability delivered by end of calendar year 2023. Provided that resources are available at the expected level.

Engineering processes will follow the outline provided in the SRDP Program Management Plan [AD01]. Reviews that are referenced throughout this document are to generally follow [RD05] PMD SOP Project Reviews Process, with appropriate scaling to fit project objectives

2.1. Initiation Stage

The initiation stage brings the concept defined by the Concept Development Committee as recorded in the TTA Concept Document [AD02] to an actionable plan for the development of the suite of software tools supporting the TTA processes.

During this phase, the Concept is further elaborated by the Project Scientist in the System Specification [RD04] and a Conceptual Architecture was developed by the Data Management and Software (DMS) Architect. Frequent iteration during the parallel development allows clarification of concepts, refinement of requirements, and alternative approaches to be considered.

Development of the project management plan, preliminary implementation schedule, risk register, and effort estimates based on the System Specification and Conceptual Architecture are also developed during this stage of the project.

This stage ends with the successful review of the Project Concept.

2.2. Implementation Stage

The TTAT Project Office has selected an iterative, phased approach to the implementation of the software suite. We break the development of the new software suite into time boxed phases. The duration of each phase will be agreed at the onset of implementation, when the requirements and scope have been fully elaborated. The phases are defined in the TTA Execution Plan [RD03]. Each phase has specific feature and capability targets. Partial deliveries will be accepted and validated with missing functionality noted and rescheduled as appropriate.

Each phase will go through a series of steps, with an individual responsible for the completion of the step and the transition to the next step. In most cases that individual will be in collaboration with both the owner of the previous and the next step.

1. Requirements Capture (Project Scientist) Detailed requirements suitable for the detailed design and implementation of software to achieve the phases objective will be enumerated. Transition from this step to the next is the acceptance of the System Level (L1) requirements by the DMS Architect (when appropriate a lightweight requirements review may be convened).
2. Logical Architecture (DMS Architect): The DMS Architect, in consultation with the SSA Architect and the TTA Project Scientist, refines the existing architecture in the relevant portions of the system to support the phase objectives.
3. Physical Architecture (SSA Architect): The SSA Architect, in consultation with the DMS Architect, Project Scientist, and Implementation team, refines the design to implementable pieces of the system.
4. Implementation (SSA Lead): Under the direction of the SSA Lead, software is created to achieve the objectives of each phase. The project scientist (and other stakeholder experts) is available to consult and provide frequent iteration during this period.
5. Integration (SSA Lead): The software is integrated and deployed by the SSA team under the direction of the SSA Lead.
6. Verification (DMS Architect): The DMS Architect verifies the system is behaving as designed. If continuous integration and testing are used, this may be a trivial step. This step is completed by the successful outcome of a Test Readiness Review (TRR).

7. Validation (Project Scientist): The Project Scientist is responsible for organizing the formal validation and documentation of each phase of the software development, documenting any variance from the requirements for the phase and any defects to be addressed. This step is complete when the system has successfully completed an Operations Readiness Review (ORR).

In the later stages of the project, the software suite may be deployed for use by Observatory Operations. The ORR Report will clearly state the capability and any noted deficiencies to inform this decision.

Phases may overlap, for instance the Project Scientist might be gathering requirements for phase 3, while the DMS architect is designing the logical architecture for phase 2, and the SSA team is implementing phase 1. The current set of Development phases and associated time estimates is available in [RD03].

In addition to the feature development phases, additional specific phases are focused on integration and reducing accumulated technical debt are included in the execution plan.

2.3. Divestment Stage

Project divestment for the TTA tool suite will occur following delivery of a validated product to the observatory operations teams. Post-delivery, the project team will be dissolved and responsibility for any further improvements or modifications will be incorporated into observatory operations. Detailed plans for the delivery and transition to operations will be developed in conjunction with the operations teams closer to the end of the project. The TTAT Transition Plan (TBD), including support for GBO requirements in operations will define roles, responsibilities, budget, and timeline for completing the transition. Section 17 PROJECT DIVESTMENT AND CLOSEOUT will consolidate details needed for the transition plan until such time a separate document is warranted.

This plan provides the preliminary approach to manage all three project stages. The TTA Tools project office is responsible for updates and maintenance through the Implementation and Divestment stages.

3. SCOPE MANAGEMENT

3.1. Concept Development and Scope Statement

A statement of project scope is itemized in the TTAT Concept [AD02], Section 2, titled *Charge to the Committee.* A summarized list of that charge follows:

- Software is to support VLA, VLBA, HSA, GMVA, and GBT
- Software is to be extensible to the ngVLA
- Look and feel of software should be similar across these different facilities, concepts and lessons from the ALMA interface should be incorporated where possible
- Software must capture observing and processing parameters necessary to satisfy SRDP requirements
- Elements of the Proposal Handling Tool need not follow the ALMA model, but any gains in efficiency through reuse should be explored and leveraged where practical
- Requirements for downstream tools in functional blocks 4-6 of Figure 1 are not in scope, however creating the interface to block 4 is in scope for the project.

3.2. TTAT Scope Management

Scope, system level requirements, and the overall design for TTAT can be nearly fully defined early in the lifecycle. Capability will be delivered to integration and test incrementally in order to assess performance and gather feedback early in development phases. The evolving capabilities of the facilities means that the TTA Tools will need to hit a moving target, however the concept is defined with this in mind and the architecture will support this flexibility.

The Initiation Stage of the TTAT Project will address the system wide conceptual architecture, overall system infrastructure, demonstrate support for all use cases defined in the TTAT Concept Document [AD02], and define project scope in a set of work packages. Many of the work packages are an Implementation Phases. Each Implementation Phase implements specific capabilities and use cases targeted for validation within the phase.

The requirements management process will ensure that the defined scope (and only the defined scope) will be delivered. Progressive delivery dictates continual engagement with a broad set of stakeholders working with the Project Scientist to refine the concept level use cases, assist with decomposition, and validate the decomposed requirements. Requirements are defined and managed on three levels, L0, L1, and L2. These are reported in a Requirements Verification Traceability Matrix (RVTM) which tracks verification and validation of delivered capability. Traceability of requirements to the architecture is maintained through an architecture modelling system. The RVTM is developed and maintained within the the modeling system, serving as the record of authority on which acceptance is based.

L0 - System Concepts - The TTAT Concept Development Committee has compiled a set of use cases, coupled with observatory policies, assumptions, and constraints, all consistent with achieving project objectives resulting in the TTAT System Concepts Document [AD02]. The TTAT System Concepts Document reflects the complete scope for the project period of performance.
L1 - System Level L1 - System Level Requirements are specified by the Project Scientist in the System Specification Document [RD04] and modeled by the DMS Architect during the initiation stage. Refinements or additional L1 requirements will be captured during the first step of each implementation phase to fully specify the detailed functionality to be delivered by the phase.
L2 - Implementation Level Requirements - are broken down from L1 requirements. Requirements at the L2 level inform the development tasks which are implemented and verified within DMS. Decomposition of L1 to L2 requirements is the overall responsibility of the DMS and SSA Software Team.

3.3. TTAT Project Deliverables

A summarized list of deliverable follows:

- Reports to Directors' Offices and other entities as part of the SRDP project as defined under the TTAT project communications plan (in this document as Appendix A: Project Communications Plan).
- Project documentation as defined in the TTAT Project Plan (this document), Schedule, Budget, issue logs, etc.
- An updated Proposal Review Plan documenting the review process and use of the delivered tool suite. This document will include staff size and duties by job category and operational procedures.

- Software tools to support the creation, review, and dispensation of observing proposals from the community.
- A concept for managing interfaces to observation preparation tools (such as the OPT, DSS, and SCHED).
- User Documentation, including a user's guide and documentation of the NRAO review process.

These deliverables are reflected in work packages defined in the TTAT Execution Plan [RD03].

4. SCHEDULE MANAGEMENT

The schedule is built around work packages (primarily the implementation phases), where each includes one or more project level milestones. Progress against project level milestones is the metric against which monthly reports to the NRAO Director's Office are made. Project level tracking aligns with step levels defined within each phase. The project schedule is maintained in a computerized scheduling tool with updates no less than twice a month. Implementation tasks are scheduled and tracked within DMS using the Jira package, in accordance with the DMSD Software Development Processes document [RD01].

5. COST AND RESOURCE MANAGEMENT:

Resources for the TTAT project are primarily matrix managed from other departments across the observatory and thus direct budgetary authority resides in those departments. Effort estimates are associated with each of the Work Packages, and project schedule is derived from the available effort.

Project office costs are currently tracked through the use of the "SRDP" subsidiary, appended to business units from which effort is contributed. Post Conceptual Design Review (CoDR), the TTAT project will have a separate subsidiary to track the project office costs associated with the project, including the effort of additional staff members who will assist the project scientist in refining and validating the software deliverables (Subsystem Scientists).

DMS cost management is described in [RD01].

As a separate AUI observatory, GBO will be responsible for managing its own resources and budget.

6. HUMAN RESOURCE MANAGEMENT

Human resources are managed in accordance with NRAO and AUI policies and rely on the human resources department for all policy and compliance tasks.

There are four roles defined within the TTAT project office:

- Project Director: Accountable for the overall planning, design, and execution of the TTAT Project.
- Project Manager: Responsible for project management and system engineering disciplines used under the TTAT Project. Ensures compliance with Observatory processes and reporting standards.

- Project Scientist: Accountable for leadership of the TTAT Concept Development Committee and development of the overall system concept. Accountable for the definition, and validation of scientific requirements. The Project Scientist assists the Project Director and AD of Science Support and Research in community engagement, and organizes any staff or community training required for acceptance of the new tools.

In addition, the following are not part of the project office, but work closely with the Project Scientist:

- NRAO & GBO Subsystem Scientists: A subject matter expert for each particular subset of the tool suite. Responsible for assisting the Project Scientist with requirements definition and validation.

The structure and responsibilities of DMS personnel involved in the TTAT project are described in [RD06] DMSD Work Management Plan for SRDP.

GBO resources will be allocated based on GBO policies. NRAO will collaborate with GBO to clearly define mutually achievable milestones.

The organizational chart for the TTA Tools Project is shown Figure 2 below:

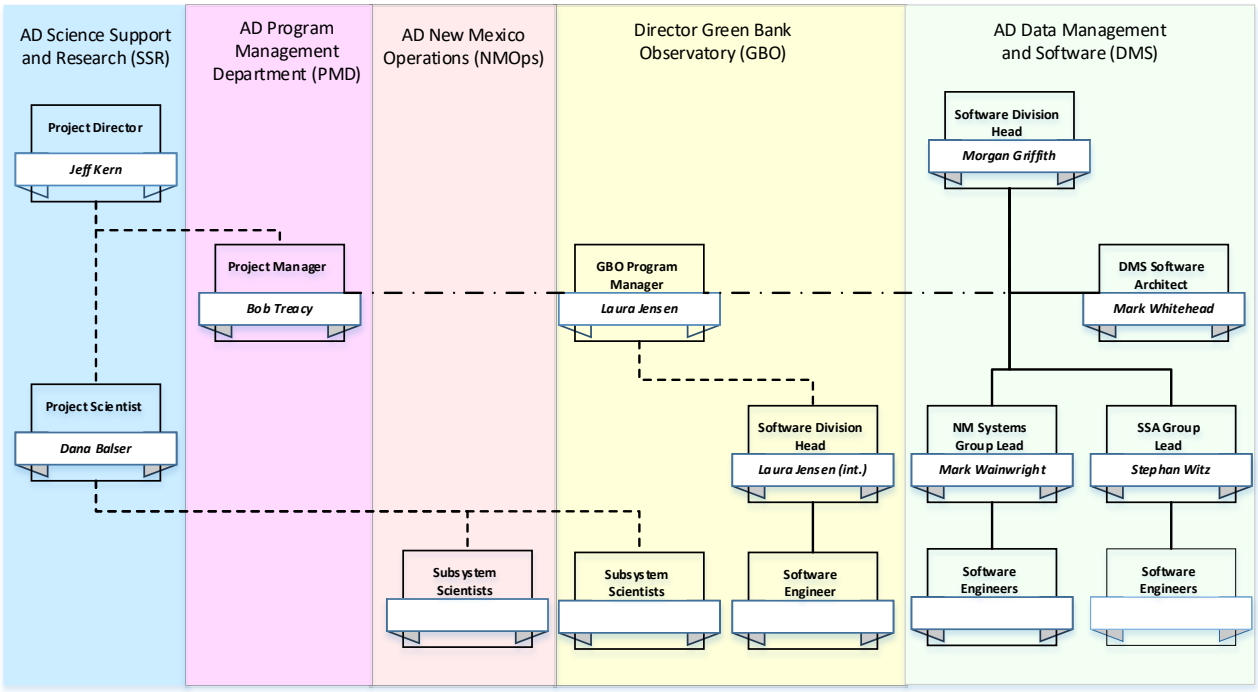

Figure 2 TTA Tools Project Organizational Chart

7. CONTINGENCY

Primary constraints facing the TTAT Project are a fixed resource pool providing in-kind contributions with competing priorities and spend-rate limited departmental budgets. Overall project scope is well defined to replicate the functional equivalency of existing tools and support for new requirements. The overall project schedule is of secondary priority, subject to pressures from competing priorities Typically, best practices for software project management suggest fixed schedule deliverables with a constant emphasis on delivery of the highest priority features. This will require ongoing vigilance by the Project Director and Project Scientist to keep effort focused on the priorities of highest value to the stakeholders. Each software phase described in RD03 will be time boxed and scope will be adjusted to hold schedule, but additional phases may need to be added to recover scope affecting the overall project schedule.

8. THE PROJECT BASELINE

A high-level baseline is given in the TTA Tools Project Charter [AD03]. A preliminary baseline is further developed from provisions in the Project Charter and is reflected in the Scope Statement, the Project Schedule, and the Project Cost Management Plan (TBD following post CoDR Approval). The preliminary baseline is not under change control.

The preliminary baseline is negotiated between key stakeholders for agreement on the scope, schedule, and cost management (i.e. resource commitments). Following such agreement, the baseline documents are approved and constitute the project baseline. This approved baseline is the metric against which project exception reporting is made.

Documents defining the baseline are subject to change control and are identified as follows:

- Scope Baseline – The scope is captured in the TTA Concept Document [AD02], Section 2, titled *Charge to the Committee*. A more detailed description of project scope is the approved version of the TTA Tools Execution Plan [RD03] (approval TBD following CoDR), which includes work package definitions.
- Schedule Baseline – The detailed project schedule is entered into the scheduling tool, then a baseline is set within the tool.
- Cost/Resource Baseline – The project office cost baseline is reflected in the TTA Execution Plan, A significant burden of project cost extends to DMS and Observatory Operations, which provide staffing for development, deployment, and test. Supporting departments are independently responsible to budget resources to meet TTAT project objectives, making this an extremely difficult baseline to set and track. GBO resources will be managed by GBO.

9. CHANGE MANAGEMENT

Change Management within the TTA Tools Project is defined on several levels as follows, consistent with change management across other SRDP Projects:

- Changes to controlled documents which do not impact the project baseline are approved in accordance with the document content. In order to ensure documentation conforms to project standards, all documents shall be approved by the Project Manager. All document changes shall

also be approved by the Project Director. Changes to documents that include scientific authorship or or have implications to scientific requirements (as determined by the Project Director and Project Scientist) shall also be approved by the Project Scientist.

- Changes to documents that define the project baseline that do not alter the approved baseline shall be approved by the Project Manager, Project Director, and the Project Sponsor.
- Changes to documents that define the project baseline where the proposed changes alter the approved baseline shall be approved by the Project Manager, Project Director, and the Project Sponsor and shall subsequently be submitted to the NRAO Change Control Board.

The TTAT Project Office will keep project resources and collaborators (specifically including DMS and GBO) informed of changes to documents that impact their work. Changes to GBO-specific documents and plans will be managed through GBO's Change Control Board in coordination with the TTAT Project Office.

10. QUALITY MANAGEMENT:

The primary deliverable of the TTA Tools project is a suite of software tools supporting the TTA process. The project qualitatively defines software quality as feature completion minus defects discovered in delivered software, minus accrued technical debt. Details for the quality management, processes, and metrics are found in the TTA Tools Quality Management Plan [RD02].

11. COMMUNICATIONS MANAGEMENT

Communications within the TTA Tools Project are currently very simple.. A schedule of SRDP Program level meetings, reports, and stakeholder communication is in AD01, the SRDP Program Plan. Participation of TTA Tools team members in various SRDP Program meetings occurs as needed, and is expected to increase as the project enters the implementation phase. Primary communication between the SRDP project and GBO will be through the SRDP Executive meeting, and inclusion of GBO in the SRDP-DMS meeting. The Project Communications Plan for TTA Tools is in Table 1 of Appendix A: Project Communications Plan. Additional meetings may be considered as the need arises.

12. RISK AND ISSUE MANAGEMENT

TTA Tool risk management follows the process defined in the SRDP Program management Plan [AD01].

Decision making authority for issues within the TTA project resides with the Project Director. For issues arising at interface boundaries with other departments at NRAO or with GBO, the Project Scientist or Project Manager should work with the appropriate Group or Site Lead to develop a consensus response. If agreement cannot be reached at this organizational level, the issue is escalated to the TTA Project Director and either Division Head or Deputy-AD as appropriate. The next step in escalation is to the Assistant Director level with the AD for Science Support and Research representing the SRDP project interests. Final decision authority, if agreement is not reached at the AD level, is the Observatory Director. GBO-specific risks will be reviewed with the GBO Program Manager and escalated to the GBO Site Director as appropriate.

At the discretion of the Project Director and Project Sponsor, risks from the TTA Tool Risk Register may be promoted to the NRAO Observatory Risk Register as part of the Science Support and Research Department or DMS reporting process. The project risks will be reviewed no less than quarterly as part

of the observatory Risk Management process.

TTA Tools Project risk that involves supporting departments will be entered in the SRDP Risk Register for reference and the supporting departments shall be advised to track their risk independently within the Observatory Risk Management process. When assessing risk at the project level, a consideration should be made to escalate to the Observatory Risk Register if the risk is to the project baseline. Triggered risk that could undermine the project baseline must be carried on the Observatory Risk Register in order to draw on any observatory level contingency that may be available.

13. PROCUREMENT MANAGEMENT:

The TTAT Project does not foresee a need for an independent procurement process. Individual computing resources (desktops) will be provisioned following the standard NRAO process. Shared resources needed by the project will be provisioned by the DMS department.

14. STAKEHOLDER MANAGEMENT

TTA Tools Stakeholders have been identified within various groups both internal and external to NRAO as anyone that TTA Tool Project work has the potential to impact. Primary groups include NRAO and GBO Scientists, Data Analysts, management, developers, and Operations Staff; both within VLA, GBO and ALMA. External to NRAO are the NRAO Users Committee, AUI, and of course NSF. A detailed list has been compiled in the TTA Tools Project Stakeholder Register [RD02]. Stakeholder management includes work within the TTA Tools Concept Development and Requirements Committee which serves as a proxy for communicating needs from the User Community to the Project. The Project Scientist is responsible for managing scientific stakeholder input, engaging stakeholders both in the requirements definition and validation steps of each phase. Needs within the stakeholder base inform the Communications Plan in Section 11 of this document, as well as requirements management planning. The primary focus of the Project Communications in Table 1 is internal to NRAO and GBO project resources, however members of the Project Office use every opportunity to socialize the objectives of the TTA Tools Project and manage expectations within the User Community, inform NSF through the Program Operating Plan and QSU reporting, and through EPO. Reporting external to the project is primarily responsibility of the PD and PM.

15. DOCUMENT MANAGEMENT

Project level documents subject to the NRAO approval process will be maintained in the NRAO SharePoint Library under Project 688 TTA Tools. Concept, Stakeholder (L0), and System level requirements (L1) or design documents will also be maintained in SharePoint, although the record of authority for requirements and the design are an integral part of the modeling environment. The technical requirements (L2) will be communicated using the issue tracking system appropriate for the group delivering the implementation (usually Jira). Other communication such as meeting notes, action items, an issue log, a decision log, and other informal living documentation will be in Confluence or other collaboration platform accessible to all project team members and collaborators, as appropriate.

16. BROADER IMPACT

The TTA Tools Project supports Broader Impact (BI) in a number of ways:

- Improvements to the proposal submission and handling will support SRDPs, which opens up use of the instruments to the broader astronomy community.
- The proposal review tools support a double anonymous process where proposal authors and reviewers are anonymous, significantly reducing the opportunity for bias in proposal disposition.
- Including diverse groups in the training and testing phases of the project will promote broader participation in the observatory proposal process.
- We will leverage our RADIAL partnerships to increase the breadth of users prepared to participate in the proposal process.

The Office of Diversity and Inclusion (ODI) is driving BI efforts and awareness across NRAO and the TTA Tools project includes ODI as a project stakeholder.

17. PROJECT DIVESTMENT, TRANSITION, AND CLOSEOUT

TTAT Project activities will eventually transition to the TTAT operations support team within SSR. This transition will begin after the 15th phase of functional development [RD03], when the tool has reached functional equivalency of the existing tools. At that time, increasing capabilities will be developed according to the project plan, but feedback from operations experience will influence the continued development roadmap through the end of the project implementation stage. Once the baseline scope is complete (functional equivalency of existing tools), the TTAT Transition Plan will be executed to manage a phased dissolution of the project team, handover to operations, and transfer of any project team members to pertinent positions that will continue to support TTAT under operations. The TTAT Transition Plan will include a documentation package suitable for defining the design and relevant processes, for maintaining the product, and for training operations staff. The TTAT Transition Plan will conclude when responsibilities of the TTAT project team and all process ownership has been successfully assumed by observatory operations. It is anticipated that continuous enhancement and improvement within operations will occur, but this is out of scope for the project. DMS (or their equivalent) will continue to be accountable for the software maintenance throughout the products' complete lifecycle. A project closeout report shall be submitted to the Project Sponsor and NRAO Director affirming that the TTA Tools Project has met all high-level deliverables. The report shall address the degree to which the project performed against its original plan, budget, schedule and technical parameters and also capture lessons learned.

Appendix A: Project Communications Plan

Note: the following communications plan will be updated as necessary during the project development. Current needs for communication are met within the SRDP Program level meetings and ad hoc meetings between team members.

Project Communications Plan							
Communication Type	**Objective of Communication**	**Medium**	**Frequency**	**Audience or Participants**	**Owner**	**Deliverable**	**Format**
TTA Design Meeting	Project requirements, and design iteration	Face to Face	T: 10:00 F: 9:00	Project Director Project Scientist DMS Architect	PD	Meeting notes	Informal notes

Table 1 Planned periodic meetings and other communication for the TTAT project.