Science Ready Data Products

Cost Management Plan

Project 530

Released

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VERSION RELEASE BY	**ORGANIZATION**
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APPROVALS	ORGANIZATION	SIGNATURE
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Change Record

VERSION	DATE	REASON
1.0	4/16/2018	Released on content in draft Ver .02, 3/23/2018 Approved as part of document set defined in 530-SRDP-033-MGMT SRDP CoDR Package Approval by SharePoint workflow
1.1	5/2/2018	Modified as part of CoDR to reflect concerns about the delivery of science ready standard products from ALMA.
1.2	5/20/2018	Substancial rework based on recommendations from CoDR. Added BOE to appendix and reorganized document to utilize the BOE. 6/20/2018 – Generate PDF for post CoDR Archive

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1. PURPOSE OF DOCUMENT:

This document provides the context for the SRDP project cost. The SRDP project cost is dominated by the staffing costs. As most of the SRDP effort is line managed from other departments within the observatory, this document provides input to the planning processes of the other departments.

2. SCOPE OF BUDGET:

The Science Ready Data Products project has a complex structure, designed both to leverage existing and functioning management structures within the observatory and to minimize the challenges of the final transition to routine operations once the SRDP project reaches the end of its implementation phase.

The result of this structure is that several observatory budget lines contribute to the SRDP project. In particular, this budget plan includes contributions from:

- ICC to cover the cost of the project office.
- CSA-A contributions of scientist and data analyst effort
- CSA-V contributions of scientist and data analyst effort

The SRDP project is internally funded, and is designed to smoothly transition into operations. This means that the project does not have a fixed budget but rather a fixed spend rate. The purpose of this document is to establish a reasonable spend profile for the desired rate of progress of the project.

Included in the spending profile are costs associated with the Science-Ready Data Products Requirements Committee. This committee is charged with defining the draft stakeholder requirements and project priorities. The expected budgetary impact of this committee is small (a few days per year per member after the initial ramp up). For the initial definition of requirements, we anticipate less than 1 FTE week per member (10 FTE weeks total).

This document does not cover the costs incurred by the Data Management and Software Department (DMSD) in support of the science ready data project. These costs are covered as part of the DMS budget process. Explicitly, these are:

- Cost of software implementation (CASA, Pipeline, SSA, etc.) is covered by the software division of the DMSD.
- Cost of system administration support for systems used by the SRDP project, this is within the DMSD Science Information Services (SIS) division.
- Cost of hardware to support the SRDP project (cluster processing systems, Lustre working storage, and archive storage) these are also contained within the DMSD SIS division.

Due to budget exclusions, the Project Manager shall communicate the following information on Risk and Contingency to the managers responsible for departmental budgets as part of the project kickoff.

- The SRDP Project Manager shall tabulate and track project risk in the project risk register. Project level risk will be mitigated under the SRDP Project Office, within the SRDP Project Budget, and under observatory budgeting and risk processes where applicable.
- The SRDP Project leads shall collaborate with Department Managers to identify risk associated with their contributed effort to SRDP. Department managers track and mitigate departmental risk within their departmental budgets.
- Department Managers decide if their risk severity and mitigation costs warrant inclusion in the observatory risk register.

3. REFERENCE PROJECT:

The SRDP project will result in a significant change to the way that the Observatory mediates the interactions of our users and our telescopes. In developing the staffing model, we rely heavily on experience from the first several years of ALMA operations. There are two distinct efforts in ALMA operations, the heuristics development and testing, and the production of data products.

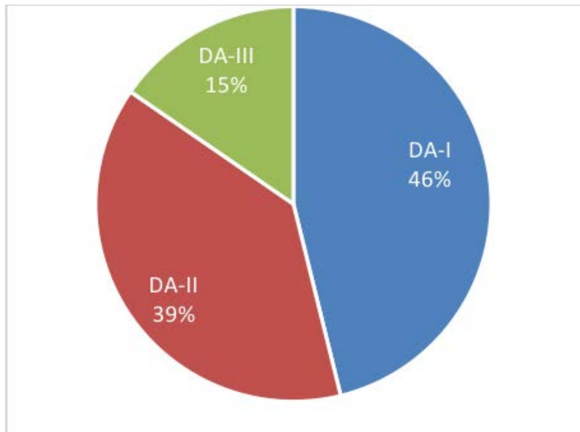

Figure 1: Breakdown of Data Analysts at the NAASC by position.

Heuristic development and testing for ALMA has been led by the NAASC for the past three years. The experience of the team is that it is a very iterative process, with significant effort required by the scientific team to define heuristics, and then perform the extensive testing required to evaluate their efficacy on the data delivered by the telescope. Reliably estimating the effort required for any particular task is difficult, so a level of effort-based process has been used by the NAASC. Although exact allocations of resources fluctuate as other demands intrude, a sustained effort of two to three FTE (of scientist time) has well matched the pace of development from the ALMA pipeline heuristics. An additional FTE of effort comes from fractional allocations of several data analyst who facilitate testing. It should be noted that during peak periods (i.e. prior to each new release) this level of staffing is placed under considerable strain, which should be addressed in the staffing and release planning for SRDP.

Activity	Quantity	Estimated Value
Calibration	Quality Assurance: No Issues	1 FTE-hour
	Quality Assurance: Problematic Data	2 FTE-hour
	Fraction of Problematic Data	26%
Imaging	Quality Assurance: No Issues	1.5 FTE-hour
	Quality Assurance: Problematic Data	2.5 FTE-hour
	Fraction of Problematic Data:	32%

Table 1: Values used based on ALMA Cycle 4 data processing

On the production side, a much more quantitative estimate is available. The data analyst time required for calibration and imaging quality assurance used in the model are summarized in **Error! Reference source not found.**. Because ALMA is still in a period of rapid change, both in the implementation of the pipeline and in process, only the values from reduction performed during cycle 4 are used. These values represent the time spent by Data Analysts (or equivalent), and do not include the time required of an astronomer to do final validation of the products. Anecdotally, a significant fraction of the time required for the various steps is devoted to record keeping and status updates within the ALMA project lifecycle. While it is tempting to discount this from the estimated effort for SRDP, until an automated tracking system has been implemented and shown to be more efficient than the current ALMA process, including this time in the budget for SRDP is the most reasonable assumption.

Data analysts at the NAASC spend approximately 60% of their time working on data processing. The remainder of the time is spent on helpdesk, user support, software testing, and supporting telescope operations. The SRDP staffing model does not attempt to account for the latter effort, as it lies outside the SRDP scope. However, we note that broader allocation of duties to the DAs is useful, both in providing the ability to absorb and manage variations in the required DA effort for data processing and in assisting employee retention through creating engaging positions and careers.

Figure 1shows the fraction of NAASC Data Analysts in each of the three levels of positions. This mix appears to be stable and well matched to the current workload of producing standard data products for ALMA. The staffing model for SRDP assumes the same distribution (actually 15%,40%, 45%). Subsequent experience will lead to review and rebalancing as needed.

Prior to data being delivered to the PI, a final validation of the results is performed by either a senior data analyst or NRAO scientist. The effort estimate for this within the NAASC is approximately 0.5 FTE over suitably long averaging periods (there are of course spikes). This does not include the time spent managing the data reduction team, or other un-related responsibilities.

4. STAFFING MODEL

The SRDP budget consists of three primary activities, project office, heuristics, and operations. Each of these sections is treated separately in the sections below.

4.1. Project Office

The project office is responsible for the execution of the project and consists of four individuals (Project Director, Project Manager, Project Scientist, and Operations Manager. The Project Director, Project Scientist, and Operations Manager roles are funded as part of the SSR Department. The Project Manager role is funded by the NRAO Project Management Office.

4.2. Heuristics Staff

As noted in the discussion of the NAASC effort for the ALMA pipeline, it is difficult to quantify the effort required to develop and validate a particular feature or capability. Instead the resources dedicated to the heuristics team will be tracked as an overall level of effort. The rate at which new capabilities are delivered to the user depends upon the level of effort within the heuristics group, and the level of effort within the corresponding DMS development teams. Although the resource allocations described in the following sections are separated by telescope, the intention is that by the end of the project this will be a single team, and heuristics will primarily be developed and tested in common, with the specialization by telescope only when absolutely necessary. Estimated integrated effort levels based on the tasks defined in the appendix are shown in Table 2.

Task Name	Effort Estimate (FTE -Years)		
	Low	Mid	High
VLA Calibration Pipeline Heuristics	6	8	7
ALMA Calibration Pipeline Heuristics	1.5	3	4.5
VLA Imaging Pipeline Heuristics	4	7	10
ALMA Imaging Pipeline Heuristics	10	12.5	15
Archive Interface	0.5	0.5	1
Quality Assurance	1	2	3
Total	**23**	**32**	**41.5**

Table 2 Integrated effort requirements of SRDP heuristics tasks.

The current level of effort from the NAASC is well matched to the development capabilities of the pipeline team. Above we estimated approximately 4 FTE for heuristic development (3 Scientist, 1 DA), by FY19 the NRAO contributions to ALMA pipeline will all be matrixed into the SRDP project. The role of ALMA Pipeline Project Scientist, responsible for the interface between SRDP and ALMA, will remain outside of the SRDP Project.

The available heuristics effort at the VLA is currently allocated to development and validation of heuristics for the VLA Sky Survey. In fact, an additional 0.6 FTE has been allocated from Science Support to assist in meeting the needs of the VLASS project. After the first epoch of observation the heuristics effort begins to decline (although it never reaches zero) and these resources will be dedicated to development and validation of SRDP for PI observations. The total available effort in the current model (aside from the temporary augmentation for VLASS) is flat, but it is very likely that additional resources will be required to match the desired implementation schedule.

Table 3 summarizes the committed allocated staff over the first few years of the project. As noted above the SRDP project scientist is funded from ICC and does not appear in Table 3. Assuming that the staffing levels continue at the same level for five years the total integrated effort, including the project scientist is 30.75 FTE-Y. Given the relatively high uncertainties in the estimates these numbers are in reasonable agreement.

			SRDP-Heuristics		
Year	VLASS	NAASC	NM-Ops	ALMA	Total
FY18-Q1/2	2.05	3.5	0	0	5.55
FY18-Q3/4	1.45	1.5	0	2	4.95
FY19-Q1/2	1.45	0.25	0	3.25	4.95
FY19-Q3/4	0.45	0.25	1	3.25	4.95
FY20-Q1/2	0.2	0.25	1.25	3.25	4.95
FY20-Q3/4	0.2	0.25	1.25	3.25	4.95

Table 3: Semi-annual staffing for SRDP related heuristics through FY20. The effort is assumed to remain flat from FY20 to the end of the project.

4.3. Operations Staff

Operations staff levels at steady state operations are based on the estimates in the appendix and are summarized in **Error! Reference source not found.**. It is important to note that effort for the VLA Sky Survey and normal ALMA operations are not included. These estimates will be refined as the project progresses, and efficiency improvements are expected to drive the effort required (particularly from the Data Analysts) down over time.

Task	Effort Estimate (FTE)					
	Data Analyst			Astronomer on Duty		
	Low	Mid	High	Low	Mid	High
VLA Standard Calibration	2.3	2.8	4.8	0.25	0.5	0.75
VLA Standard Imaging	2.5	2.75	3.75	0.2	0.35	0.5
VLA Optimized Imaging	0.75	1.5	4.5	0.1	0.1	0.5
VLA Recalibration	0.5	0.5	2.5	-	-	-
ALMA Optimized Imaging	1.45	1.75	3.5	0.125	0.25	0.5
ALMA Recalibration	0.2	0.3	1	-	-	-
Total	7.7	9.6	20	0.7	1.2	2.25

Table 4: Required staffing estimates for SRDP operations.

5. Budget Summary

The SRDP annual spend estimate has been developed using NRAO's estimation worksheet. Neither AUI Management fees nor Enhanced Fees will be applied. A high level budgetary projection based on these rates is summarized below. This is a preliminary estimate based on the best currently available information, but considerable uncertainty remains. No contingency is included in the estimate, and a linear ramp of operations staff is assumed. Note that FY2024 is an estimate of the post project annual cost. This spend rate estimate will be maintained and reviewed on an annual basis prior to the NRAO Budget Summit both for performance in the previous year and to provide updated and more accurate estimates for the coming year.

Summary Budget Table (K$)							Operations
	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024
Salary and Benefits	$634	$1514	$1986	$2191	$2346	$2677	$1111
Travel	$40	$34	$35	$34	$34	$34	-
Indirect Costs	$12	$37	$85	$111	$122	$130	$61
Total	**$715**	**$1632**	**$2132**	**$2347**	**$2511**	**$2861**	**$1172**

Subsidiary accounts have been created to allow accurate tracking of time spent on the SRDP project. DMS will track SRDP related expenditures internally [reference Morgan's Doc here].

6. Appendix: Basis of Estimate

This appendix provides the basis for the estimated cost of the SRDP project. Estimates are presented for two types of tasks:

- Implementation Tasks which have finite duration, for which a total estimated effort and duration are presented. Estimated start and end dates are presented to allow an estimate of the overall staffing profile.
- Operations Tasks are recurring tasks which will become part of the observatory standard operations plan. These tasks are presented with annual effort levels for an assumed steady state operation. The transition to these levels will depend on implementation velocity, community uptake rates, and observatory resource constraints.

6.1. Definitions

Throughout this document the following definitions are used:

- Full Time Equivalent (FTE): Is a rate, the amount of work done by a full-time employee.
- Full Time Equivalent – Year (FTE-Y): The amount of work accomplished by a full-time employee during a year. It is assumed that one FTE-Y is 1700 FTE-hours to account for time taken for meetings and other observatory functions.

6.2. IMPLEMENTATION TASKS:

6.2.1. VLA Calibration Pipeline Implementation

Task Name:	VLA Calibration Pipeline Implementation			Fund Source:	CSA-V
Duration:	3 Years	Start Date:	Q3 FY19	End Date:	Q3 FY22
Description:	Heuristic definition and validation effort required to bring the VLA Pipeline Heuristics to 75% science ready calibration of standard projects at frequencies at S-Band and above				

Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	7 FTE-Y	+/- 1 FTE-Y

Supporting Estimates:

Estimate Reference:	ALMA Calibration Pipeline	Ref:	Pipeline Lead (Kern)
Method:	Analogous Project	Date:	April 16, 2018
Estimate:	7 FTE-Y	Uncertainty:	+/- 1 FTE-Y
Description:	ALMA project development of calibration pipeline took three cycles, with the calibration in use starting in the second cycle. Approximately five members of the scientific staff were dedicated to definition and validation of the pipeline over this period. Similar effort levels per scientist are expected as for ALMA.		
Modifiers:	VLA calibration pipeline already exists (-5 FTE-Y) VLASS Pathfinder experience (-3 FTE-Y) Radio Frequency Interference (+ 2 FTE-Y) Well characterized telescope (- 2 FTE-Y) Greater variance in calibration strategy (handle through prioritized rollout)		

6.2.2. VLA Imaging Pipeline Implementation

Task Name:	VLA Imaging Pipeline Implementation		Fund Source: CSA-V
Duration:	3 Years	Start Date: Q3 FY21	End Date: Q3 FY25
Description:	Heuristic definition and validation effort required to create a VLA Imaging Pipeline suitable for the first standard modes.		

Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	7 FTE-Y	+/- 3 FTE-Y

Supporting Estimates:

Estimate Reference:	ALMA Imaging Pipeline	Ref:	Pipeline Lead (Kern)
Method:	Analogous Project	Date:	April 16, 2018
Estimate:	7 FTE-Y	Uncertainty:	+/- 3 FTE-Y
Description:	The ALMA Imaging Pipeline required two years of development after the calibration pipeline was complete. During this period approximately 3 FTEs were working on the heuristics definition and validation. The ALMA Imaging pipeline is not yet complete, similar effort is expected for at least two more years to increase the output of science ready products.		
Modifiers:	Re-use of ALMA / VLASS Imaging Pipeline (-6 FTE-Y) Wide band imaging (+1 FTE-Y) Wide field imaging (out of initial scope) Multi-Scale imaging – extended objects (+2 FTE-Y) Observing configurations better controlled (-2 FTE-Y)		

6.2.3. ALMA Imaging Pipeline Improvement

Task Name:	ALMA Imaging Pipeline Improvement			Fund Source:	CSA-A
Duration:	5 Years	Start Date:	Q3 FY18	End Date:	Q3 FY23
Description:	Continued heuristic refinement of the ALMA Imaging pipeline to increase breadth of covered modes and quality of products.				

Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	12.5 FTE-Y	+/- 2.5 FTE-Y

Supporting Estimates:

Estimate Reference:	ALMA Software Support Team	Ref:	NAASC Org Chart
Method:	Analogous Project	Date:	April 16, 2018
Estimate:	2.5 FTE	Uncertainty:	+/- 0.5 FTE
Description:	The ALMA software support team has been filling this role to date. Approximately 2.5 FTE are required to continue advancing this effort at the current rate.		
Modifiers:	None		

6.2.4. *ALMA Calibration Pipeline Improvement*

Task Name:	ALMA Calibration Pipeline Improvement		Fund Source: CSA-A
Duration:	3 Years	Start Date: Q3 FY18	End Date: Q3 FY21
Description:	Continued heuristic refinement of the ALMA Imaging pipeline to increase breadth of covered modes and quality of products.		

Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	3 FTE-Y	+/- 1.5 FTE-Y

Supporting Estimates:

Estimate Reference:	ALMA Software Support Team	Ref:	NAASC Org Chart
Method:	Analogous Project	Date:	April 16, 2018
Estimate:	1 FTE	Uncertainty:	+/- 0.5 FTE
Description:	The ALMA software support team has been filling this role to date. Approximately 1 FTE is required to continue advancing this effort at the current rate.		
Modifiers:	None		

6.2.5. Archive Interface Definition and Test

Task Name:	Archive Interface			Fund Source:	ICC
Duration:	5 Years	Start Date:	Q4 FY18	End Date:	Q4 FY23
Description:	Scientific effort required to define and test the Archive Interface.				

Estimate Date	Estimate Cost	Estimate Uncertainty
June 1, 2018	0.5 FTE-Y	+ 0.5 FTE-Y

Supporting Estimates:

Estimate Reference:	Institutional Knowledge	Ref:	
Method:	Engineering Estimate	Date:	June 1, 2018
Estimate:	0.1 FTE	Uncertainty:	+ 0.1 FTE
Description:	The Archive Interface already has a well-developed Functional Requirements document. Minimal effort from scientists will be required to continue to develop and test this interface.		
Modifiers:	None		

6.2.6. Product Quality Assurance Definition

Task Name:	Product Quality Assurance Definition			Fund Source:	CSA-A
Duration:	2 Years	Start Date:	Q4 FY18	End Date:	Q4 FY21
Description:	Scientist effort required to establish consensus metrics for product quality and validate their use in the pipelines.				

Estimate Date	Estimate Cost	Estimate Uncertainty
June 1, 2018	2 FTE-Y	1.0 FTE-Y

Supporting Estimates:

Estimate Reference:		Ref:	
Method:	Expert Judgement	Date:	June 1, 2018
Estimate:	1 FTE	Uncertainty:	0.5 FTE
Description:	This is a research topic to define and develop a QA approach. Very uncertain, will need to refine as the project progresses.		
Modifiers:			

6.3. OPERATIONS TASKS:

6.3.1. VLA Standard Calibration – Data Analyst

Task Name:	VLA Standard Calibration – Data Analyst	Fund Source:	CSA-V
Description:	Data analyst effort required to perform QA on VLA standard observations. This is the estimate for steady state operations.		

Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	2 FTE	+2 / -0.5 FTE
June 1, 2018	2.8 FTE	+2 / -0.5 FTE

Supporting Estimates:

Estimate Reference:	VLA Sky Survey Operations Plan	Ref:	Ops Plan: v. 0.3
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	2.25 FTE	Uncertainty:	2 FTE
Description:	• VLA Sky Survey estimates 2 hours for 80% of data sets, 8 hours for 20% problematic data sets. Net 3.2 hours per data set. • VLA Operations executes approximately 3000 observations per year.		
Modifiers:	• Assume efficiency increase in QA of 2 by time of routine operations. • Assume 80% of projects are SRDP compliant.		

Estimate Reference:	ALMA Pipeline Operations	Ref:	Ubach e-mail 3/31/17
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	1.8 FTE	Uncertainty:	1 FTE
Description:	• ALMA operations requires 1 hours for 74% of data sets, 2 hours for 26% problematic data sets. Net 1.26 hours per data set. • VLA Operations executes approximately 3000 observations per year.		
Modifiers:	• Assume 80% of projects are SRDP compliant.		

Estimate Reference:	VLA Sky Survey Operations Epoch 1.1	Ref:	Chandler e-mail: 3/23/18
Method:	Parametric Estimate	Date:	June 1, 2018
Estimate:	3.8 FTE	Uncertainty:	+2 / -0.5 FTE
Description:	• VLA Sky Survey Epoch 1.1 actual values 4 hours for 100% of data sets • VLA Operations executes approximately 3000 observations per year.		
Modifiers:	• Assume efficiency increase in QA of 1.5 by time of routine operations. • Assume 80% of projects are SRDP compliant.		

6.3.2. VLA Standard Calibration – Astronomer on Duty

Task Name:	VLA Standard Calibration – Astronomer on Duty	Fund Source:	CSA-V
Description:	Effort required to troubleshoot, provide final QA acceptance of VLA Standard Imaging products. This is time of a scientist or senior DA.		

Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	0.5 FTE	+/- 0.25 FTE

Supporting Estimates:

Estimate Reference:	VLA Sky Survey Operations Plan	Ref:	VLASS Ops Plan: v. 0.3
Method:	Analogous Project	Date:	April 16, 2018
Estimate:	0.6 FTE	Uncertainty:	+/- 0.3 FTE
Description:	VLA Sky Survey 16 hours per week to advise DAs on diagnosing and fixing issues in the pipeline.		
Modifiers:			

Estimate Reference:	ALMA Operations	Ref:	
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	0.5 FTE	Uncertainty:	+/- 0.25 FTE
Description:	• ALMA Operations estimates 0.25 hours per OUS is required from either an Astronomer or a senior DA. • VLA Operations executes approximately 3000 observations per year.		
Modifiers:	• VLA data may contain more erroneous data, RFI, or other artifacts to that require corrections. (increase estimate by 1.5) • Assume 80% of projects are SRDP compliant.		

6.3.3. VLA Standard Imaging – Data Analyst

Task Name:	VLA Standard Imaging – Data Analyst	Fund Source:	CSA-V
Description:	Data analyst effort required in steady state to support QA of standard imaging		

Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	2.5 FTE	+1.5 / -0.25 FTE
June 1, 2018	2.75 FTE	+1/ -0.25 FTE

Supporting Estimates:

Estimate Reference:	VLA Sky Survey Operations Plan	Ref:	VLASS Ops Plan: v. 0.3
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	2.25 FTE	Uncertainty:	+2 / -0.25 FTE
Description:	• VLASS Estimates 4 hours for 80% of images, 16 hours for 20% problematic images. 6.4 hours on average • VLA Operations produces 3000 observations per year		
Modifiers:	• Assume projects take 25% of the time as VLASS because there are many fewer images to QA • Assume 80% of projects are SRDP compliant.		

Estimate Reference:	ALMA Operations	Ref:	Ubach e-mail 3/31/17
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	2.75 FTE	Uncertainty:	+1 / -0.25 FTE
Description:	• ALMA requires 1.5 hours for 68% of OUSs, 2.5 hours for 32% problematic images. Average is 1.82 hours per project • VLA Operations produces 3000 observations per year		
Modifiers:	• Assume 80% of projects are SRDP compliant.		

Estimate Reference:	VLA Sky Survey Operations Epoch 1.1	Ref:	Chandler e-mail: 3/23/18
Method:	Parametric Estimate	Date:	June 1, 2018
Estimate:	2.8 FTE	Uncertainty:	+1 / -0.25 FTE
Description:	• VLASS operations reports 0 hours for 50% of images, 2 hours for 50% problematic images. 1 hour on average. • VLA Operations produces 3000 observations per year		
Modifiers:	• Assume no auto-accepted images so 100% of projects take 2 hours • Assume 80% of projects are SRDP compliant.		

6.3.4. VLA Standard Imaging – Astronomer on Duty

Task Name:	VLA Standard Imaging – Astronomer on Duty	Fund Source: CSA-V
Description:	Effort required to troubleshoot, provide final QA acceptance of VLA Standard Imaging products. This is time of a scientist or senior DA.	

Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	0.35 FTE	+/- 0.15 FTE

Supporting Estimates:

Estimate Reference:	ALMA Operations	Ref:	
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	0.35 FTE	Uncertainty:	+/- 0.15 FTE
Description:	• ALMA Operations reports 0.25 hours per OUS • VLA Operations produces 3000 observations per year		
Modifiers:	• Assume 80% of projects are SRDP compliant.		

6.3.5. VLA Optimized Imaging – Data Analyst

Task Name: VLA Optimized Imaging – Data Analyst		Fund Source: CSA-V
Description: Effort required from Data Analysts to support the QA of optimized imaging of VLA data.		
Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	1.5 FTE	+3 / - .75 FTE
Supporting Estimates:		

Estimate Reference:	Expert Estimate	Ref:	
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	1.5 FTE	Uncertainty:	+3 / - .75 FTE
Description:	• Assume 2 hours for easy project, 4 hours for problematic (25%-75% split) • Assume 700 Optimized Images per year (~2 per day)		
Modifiers:	• High uncertainty on optimized image use.		

6.3.6. VLA Optimized Imaging – Astronomer on Duty

Task Name:	VLA Optimized Imaging – Astronomer on Duty	Fund Source:	CSA-V
Description:	Effort required from Scientific Staff to support the QA for optimized imaging of VLA data sets.		

Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	0.1 FTE	+ 0.4 FTE

Supporting Estimates:

Estimate Reference:	ALMA Operations	Ref:	
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	0.1 FTE	Uncertainty:	+ 0.4 FTE
Description:	• ALMA Operations reports 0.25 hours per OUS • Assume 700 Optimized Images per year (~2 per day)		
Modifiers:	High uncertainty on optimized image use.		

6.3.7. VLA Recalibration QA Effort

Task Name:	VLA Recalibration QA Effort	Fund Source:	CSA-V
Description:	Data Analyst effort required to perform QA on VLA Recalibration use cases. Note that we assume this are sufficiently routine to not require substantial scientist effort.		

Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	0.3 FTE	+1.5 FTE
June 4, 2018	0.5 FTE	+2 FTE

Supporting Estimates:

Estimate Reference:	VLA Sky Survey Operations Plan	Ref:	VLASS Ops Plan: v. 0.3
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	0.5 FTE	Uncertainty:	2 FTE
Description:	• VLA Sky Survey estimates 2 hours for 80% of data sets, 8 hours for 20% problematic data sets. Net 3.2 hours per data set. • VLA Operations executes approximately 3000 observations per year.		
Modifiers:	• Assume 10% of projects request recalibration (Very high uncertainty)		

Estimate Reference:	ALMA Pipeline Operations	Ref:	Ubach e-mail 3/31/17
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	0.25 FTE	Uncertainty:	1 FTE
Description:	• ALMA operations requires 1 hours for 74% of data sets, 2 hours for 26% problematic data sets. Net 1.26 hours per data set. • VLA Operations executes approximately 3000 observations per year.		
Modifiers:	• Assume 10% of projects request recalibration (Very high uncertainty)		

Estimate Reference:	VLA Sky Survey Operations Epoch 1.1	Ref:	Chandler e-mail: 3/23/18
Method:	Parametric Estimate	Date:	June 1, 2018
Estimate:	0.75 FTE	Uncertainty:	+3 FTE
Description:	• VLA Sky Survey Epoch 1.1 actual values 4 hours for 100% of data sets • VLA Operations executes approximately 3000 observations per year.		
Modifiers:	• Assume 10% of projects request recalibration (Very high uncertainty)		

6.3.8. ALMA Optimized Imaging QA: Data Analyst

Task Name:	ALMA Optimized Imaging QA: Data Analyst	Fund Source: CSA-A
Description:	Data analyst effort required for QA of optimized imaging of ALMA projects.	
Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	1.75 FTE	+1.75 / -0.3 FTE

Supporting Estimates:

Estimate Reference:	ALMA Operations	Ref:	Ubach e-mail 3/31/17
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	1.75 FTE	Uncertainty:	1.75 FTE
Description:	• ALMA Operations requires 1.5 hours for 68% of OUSs, 2.5 hours for 32% problematic images. Average is 1.82 hours per project • North America PIs receive approximately 1600 OUS per year		
Modifiers:	• Assume 100% of projects request an optimized image • Highly Uncertain: request rate and images per project		

6.3.9. ALMA Optimized Imaging QA: Astronomer on Duty

Task Name: ALMA Optimized Imaging QA: Astronomer on Duty		Fund Source: CSA-A
Description: Scientific staff effort required for QA of optimized imaging of ALMA projects.		
Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	0.25 FTE / year	+0.25 / -0.125 FTE / year

Supporting Estimates:

Estimate Reference:	ALMA Operations	Ref:	
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	0.25 FTE / year	Uncertainty:	+0.25 / -0.125 FTE / year
Description:	• ALMA Operations reports 0.25 hours per OUS • North America PIs receive approximately 1600 OUS per year		
Modifiers:	• Assume 100% of projects request an optimized image • Highly Uncertain: request rate and images per project		

6.3.10. ALMA Recalibration QA: Data Analyst

Task Name:	ALMA Recalibration QA: Data Analyst	Fund Source:	CSA-A
Description:	Data Analyst effort required to perform QA on VLA Recalibration use cases. Note that we assume this are sufficiently routine to not require substantial scientist effort.		

Estimate Date	Estimate Cost	Estimate Uncertainty
April 16, 2018	0.33 FTE	+ 0.66 / -0.25 FTE

Supporting Estimates:

Estimate Reference:	ALMA Operations	Ref:	Ubach e-mail 3/31/17
Method:	Parametric Estimate	Date:	April 16, 2018
Estimate:	0.33 FTE	Uncertainty:	+ 0.66 / -0.25 FTE
Description:	• ALMA operations requires 1 hours for 74% of data sets, 2 hours for 26% problematic data sets. Net 1.26 hours per data set. • North America PIs receive approximately 1600 OUS per year		
Modifiers:	• Assume 25% of projects request a recalibration (Very high uncertainty)		