



ALMA BOARD

ALMA EDM Document	AEDM 2018-061-O
Distribution	Ordinary Session

Subject: Proposal for the Revised Principles of the ALMA Development Program – **Technical Readiness**

AUTHOR(S): AMT

Purpose of Document: To provide the ALMA Board with a proposal for the revision of the Principles of the ALMA Development Program

Status: To be approved by written Procedure, pursuant Art. 11 of the Board's Rules of Procedure

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1. Introduction

1.1. Purpose

This document identifies the guiding principles of the ALMA Development Program. The detailed implementation of the ALMA Development Program will be defined in the ALMA Development Program Implementation Plan [RD03], which shall be prepared and released by the AMT and approved by the Director's Council.

1.2. Scope of this Document

This document is applicable to all ALMA Development Projects and Studies as identified in this document. This document supersedes AEDM 2011-023-O (Rev2) Principles for the ALMA Development Program.

1.3. Applicable documents

Appl.	Document Title	ALMA Doc. Number
[AD01]	ALMA Trilateral Agreement – Agreement concerning the Operations of the ALMA by NSF, ESO and NINS dated 15 December 2015	
[AD02]	ALMA Management Agreement – Management Agreement concerning the Operations of the ALMA by AUI, ESO and NAOJ [draft]	
[AD03]	ALMA Principles of Operations	ALMA-10.00.00.00-0020-A-PLA [draft]
[AD04]	ALMA Maintenance Principles	AEDM 2014-027-O (ALMA-02.00.00.01-0003-A-PLA)
[AD05]	ALMA Warranty Policy	AEDM 2014-026-O (ALMA-10.00.00.00-0016-A-PLA)
[AD06]	ALMA Management Team Charter	ALMA-10.00.00.00-0035-A-GEN

1.4. Reference documents

Appl.	Document Title	ALMA Doc. Number
[RD01]	ALMA Operations Management Plan	ALMA-10.00.00.00-034-A-GEN
[RD02]	ALMA Maintenance Management Plan	ALMA-02.00.00.01-0006-A-PLA
[RD03]	ALMA Development Projects Implementation Plan	ALMA-10.04.00.00-0025-A-PLA

1.5. Acronyms and Definitions

- ALMA Board: [AD01]
- ALMA Director: [AD01,AD02]
- Executive Directors: [AD01,AD02]
- Directors Council (DC): [AD01,AD02]
- ALMA Management Team (AMT): The team of representatives from the Executives and the JAO that is tasked with overall management coordination of ALMA [AD02, RD03].
- ALMA Integrated Teams (IXTs): Teams composed of representatives from the three Executives [AD01, AD02] and the JAO that are tasked with coordinating activities regarding specific operational aspects throughout ALMA [AD03 and AD06]. These include Science, Science Operations, Computing, Engineering and Education and Public Outreach, referred to as IST, ISOpT, ICT, IET and IEPOT, respectively [RD01].
- ALMA Science Advisory Committee (ASAC): [AD01].
- Projects (as defined in Section 3.2).
- Studies (as defined in Section 3.2).

2. Background and Motivation

Continuing hardware and software developments and infrastructure enhancements are essential to maintain ALMA as the state-of-the-art and world leading facility for millimeter/submillimeter astronomy over the course of its projected life of 30+ years. These should enable new, improved or extended capabilities and greater efficiency. In particular, the rapid progress of electronic technology should make new hardware components and subsystems offering improved performance and higher reliability available for insertion into ALMA throughout the project lifetime. Equally important, advances in software and computing will offer improved performance and reliability that translate into more capabilities for scientific research and reduced costs of operation. Infrastructure enhancements may also result in qualitative or quantitative increases in the scientific capability of ALMA.

3. The ALMA Development Program

3.1. Science Vision

The ALMA Development Program must be driven by science. Its major and ultimate goal is to enhance the scientific capability of ALMA.

The ALMA Development Program consists of a single, coherent vision containing any or all of the following:

- science themes to explore;
- preferred directions for capability enhancements to examine; and
- specific areas of improvement identified by the ALMA partnership.

3.2. Development Projects and Studies

The ALMA Development Program will comprise **Projects** and **Studies**.

- a) **Projects** focus on the delivery of tangible improvements to ALMA for a particular aim with defined deliverables to ALMA. They will either be full-scale or small-scale and are, depending on their size, subject to different approval processes.

Full-scale Projects are those with estimated overall costs of more than 250 kEUR, 250 kUSD or 30 MJPY; Small-Scale Projects are those with estimated costs below or equal to the above amount. The DC shall agree on a method to regularly index these amounts.

Projects to be submitted for approval shall first demonstrate technical readiness. This technical readiness may be achieved by a preliminary design Project.

Costs of Projects shall include all personnel, material, hardware and software costs, including costs for assembly, delivery, integration, verification, commissioning and warranty, unless specifically waived by the ALMA Board. Operations costs after commissioning and science verification and considering the warranty period for Projects [AD05] are assumed to be part of the costs of normal Operations according to the ALMA Principles of Operations.

- b) **Studies** are aimed at facilitating or assessing the viability of possible Projects, including assessments of opportunities for collaboration among the Executives. They may consist of research and development that may lead to tangible improvements to ALMA, consistent with the scientific priorities identified in the overall science vision.

3.3. Scope

The ALMA Development Program shall:

- a) Achieve its goal of enhanced scientific capabilities by means of:
- Delivery of new equipment or capabilities,
 - Improvement, enhancement or increased availability of existing equipment or capabilities,
 - Reduced costs or risks for Operations, or
 - Improved efficiency.
- b) Consider hardware and software developments and infrastructure enhancements apt to achieve the aim of the ALMA Development Program;
- c) Be coordinated across the three Executives and the JAO to accomplish a joint and concerted ALMA Development Program;
- d) Involve the scientific and technical communities as well as industries throughout the ALMA partnership;

- e) Be implemented by the Executives in coordination with the JAO with funds made available by the ALMA Parties; and
- f) Respect regional differences in so far as they do not invalidate other principles.

The results of the ALMA Development Program shall be part of the ALMA Project and as such become available to all ALMA users. The ALMA Trilateral Agreement [AD01] governs legal ownership of the results of the ALMA Development Program.

3.4. Contributions and Costs

1. The contributions to the ALMA Development Program:

- a) Should be funded at a level that allows for an efficient and effective Development Program while not derogating resources for Operations;
- b) Shall be based on real costs and be included in the ALMA Budget as approved by the Board. The ALMA Budget contains two specific funding lines, for the Development Program: one for Projects (DEV) and one for Studies (OFF-002);
- c) For each Executive, DEV funding shall reflect the Shares of Contribution [AD01] according to the budget process as agreed by the Parties and the ALMA Board;
- d) OFF-002 shall include an annual Budget to be approved by the Board, according to the budget process as agreed by the Parties and the ALMA Board, and to be balanced reflecting the Shares of Contribution [AD01], as indicated in article 13.2 of the ALMA Management Agreement [AD02];
- e) An Executive may spend in excess of the OFF-002 Budget amount approved by the Board on Studies at its discretion;
- f) Contributions to Studies beyond the aforementioned OFF-002 budget amount are neither subject to balance nor to the Budget approval processes of the ALMA Board. However, the activities resulting from this additional spending shall be reported to the Board for information. In any case, such contributions will not alter the shares of Observing Time;
- g) Development Projects and Studies may also include contributions (financial or otherwise) from parties other than the Executives as a means of ensuring or augmenting the resources available for the Development Program;

2. Development Projects and Studies may have contributions from more than one Executive and the JAO.

3. Executives may, according to the rules applicable to them, include contributions from participation by other institutions. In the case of ESO, this may include the offer of Guaranteed Observing Time (GTO) from the ESO share of Observing Time to the institutions contributing to the Project. Any such arrangement requires prior written consent of the other Parties in accord with the ALMA Trilateral Agreement [AD01].

4. Proposals for additional contributions to the ALMA Development Program, from third parties (e.g. other institutions) shall be handled by the Parties and the Board in accord with the ALMA Trilateral Agreement.

3.5. Timescale

The ALMA Development Program shall cover a five-year period outlining schedules for approved projects as well as timelines for future projects and/or solicitation for community input, including an additional fifteen-year outlook. It shall be reviewed biannually by the ALMA Board following the initial approval process.

4. Approval process

4.1. Science Vision

The ALMA Director, with input from the AMT and the IST and in coordination with the ASAC, develops and maintains the vision and overall direction of the ALMA Development Program and proposes it to the ALMA Board for approval every three years.

4.2. Projects to be approved as part of the ALMA Development Program

- a) Shall be based on proposals from the Executives, following respective Executives' processes;
- b) Shall be reviewed and/or evaluated and/or recommended regionally through the relevant Executives' processes;
- c) Shall be submitted by the Executives to the AMT;
- d) Shall be evaluated by the AMT together with the JAO Observatory Scientist and the JAO Observatory System Engineer, involving the IXTs in the evaluation as appropriate. The evaluation shall:
 - Assess the science case and its relevance for the vision and aims of the ALMA Development Program;
 - Include an Operational Impact Assessment that estimates the total life-cycle cost of the Project (reduction or increase) including operation, maintenance and decommissioning, and telescope time (AD04 and AD05);
 - Include a Technical Readiness Assessment that determines if a given project is technically feasible;
 - Consider development capabilities in the individual regions so that ALMA enhancements and renewal can be sustained in the long-term;
 - Target completion of the evaluation process within six (6) months after submittal of the complete proposal documentation.

The set of Projects with suggested prioritization shall then be recommended by the AMT together with the JAO Observatory Scientist and the JAO Observatory System Engineer to the ALMA Director.

Full-scale Projects shall be submitted with the advice from the ASAC by the ALMA Director to the ALMA Board for approval.

Small Projects shall be approved by the ALMA Director after consulting with the ASAC.

The approval of a Project shall include approval of the overall costs of the Project for the purpose of balancing Party contributions to the ALMA Development Program.

The ALMA Director shall regularly inform the ASAC and the ALMA Board about the set and status of approved Projects.

The administration of requirement assessments for ALMA Development projects is the responsibility of the AMT. This responsibility includes ensuring that approval procedures

are followed, that process and review decisions are timely, and that issues arising are resolved transparently and expeditiously.

4.3. Studies

The IST shall coordinate the scope of Studies to be executed by the Executives.

Studies may be initiated, approved, and executed entirely by the Executive who funds the Study, provided no ALMA observing time or shared resources are required for the Study's execution. If such resources are required, a plan must be presented to the AMT for approval by the relevant IST member. It shall be the funding Executive's responsibility to ensure that approval for ALMA time/resources is obtained before proceeding with the study.

The relevant Executive shall inform the AMT and the ASAC about the approved Studies.

5. Program Implementation

5.1. General

The ALMA Development Program shall be implemented by the Executives in coordination with the JAO. The AMT together with the JAO Observatory Scientist and the JAO Observatory System Engineer shall coordinate the relevant activities across the Executives and the JAO. Each Executive will manage Projects and Studies according to their own rules, apply their own contract and procurement and oversight practices, and manage expenditure as required by their own rules.

Collaborations among the Executives in conducting Projects or Studies and collaborations among and within each Executive's region and across the regions shall be encouraged.

Details shall be defined in the ALMA Development Program Implementation Plan [RD03].

5.2. Projects

1. The Executives, in possible collaboration with other institutions they may choose, carry out or oversee Projects within their respective regions. They shall be responsible to integrate the result of the Project into ALMA in collaboration with the JAO.

Cost and schedule control and corrective actions relating to individual Projects shall be the responsibility of the Executive(s) carrying out the Project.

2. The Projects that are part of the implementation of the ALMA Development Program:

- a. Shall follow consistent processes regardless of type, i.e., hardware, software and infrastructure.

- b. Shall include integration into the ALMA system, verification and commissioning up to delivery to Science Operations
- c. Shall be subject to an acceptance review by the JAO with involvement of the Executives. The acceptance criteria for each Project shall be approved by the AMT.
- d. Shall be subject to relevant gate reviews as defined in the ALMA Development Program Implementation Plan [RD03].

The Executive(s) carrying out the Project shall keep the AMT informed about the progress of the Project and report any issues, in particular actual or expected major cost overruns, schedule delays or inability to meet specifications.

5.3. Studies

Studies shall be implemented according to the respective Executive's own processes and rules.

The outcome of the Studies shall be made available to the other Executives, the ASAC and the JAO through internal ALMA document. Confidentiality obligations might apply, if considered necessary by the Executive carrying out the Study.

6. Roles and Responsibilities

- *The ALMA Board* approves the overall vision for the ALMA Development Program and approves full-scale projects.
- *The Executives* manage and administer the design and construction of approved Projects up to and including handover to Science Operations, in possible collaboration with other institutions they may chose through processes that may vary from Executive to Executive. They initiate and carry out Studies.
- *The ALMA Director* owns the overall vision and direction of the ALMA Development Program. He/she also recommends full-scale projects, brought forward by the Executives, for approval to the ALMA Board. He/she also approves small projects upon recommendation by the AMT.
- *The AMT* is responsible for coordinating the implementation of the overall vision of the ALMA Development Program, managing the assessment of proposals for full-scale and small projects, and for overseeing their execution, once approved. This oversight includes reviewing the schedules and reports on progress, potentially recommending changes to the project in the event of considerable deviations from the approved deliverables, costs or schedule. The AMT is the final approval authority for Studies that require dedicated ALMA time to execute.
- *The ASAC* advises the ALMA Board and the ALMA Director in the development of the overall visions and during the approval process for full-scale and small projects.

- *The IST* is responsible for interfacing with the scientific community to gauge interest and raise potential avenues of development for consideration in the vision. It is also responsible for coordinating the regional proposal processes to include relevant information regarding the overall vision and/or specific avenues of development.

7. Project Proposal Requirements

Proposals for Projects of the ALMA Development Program shall:

- a) Include a detailed science case;
- b) Contain a detailed Project plan that will include, among other items, a schedule, deliverables, and overall costs;
- c) Contain preliminary integration, verification and commissioning plans including telescope time;
- d) Include an estimate of overall costs of the Project, covering all personnel, material, hardware and software costs, including costs for assembly, delivery, integration, verification and commissioning.
- e) Address the impact on the scientific capability and/or operational performance of ALMA, including an estimate of the operation and maintenance costs after verification and commissioning.
- f) Identify the participating institutions, if any.

Further details shall be defined in the ALMA Development Projects Implementation Plan [RD03].