Toward a Management Plan for the ALMA Project

Expanded ALMA Executive Committee
(Draft 19 October 2001)

Summary
The E-AEC recommends that the management structure developed previously for the bilateral ALMA Project also be used as the basis for planning for the trilateral project. This structure is built around the concept of Integrated Product Teams (IPT) that assures an equal representation of all the Executives in the management and execution of the tasks necessary to construct ALMA. The tasks of the IPTs are developed around a set of work packages that are developed by, and administered by, the ALMA International Project Office (IPO). The IPO serves as the ALMA "customer", setting specifications, task values and acceptance criteria; the Executives serve as "vendors" working under agreed "sole source, fixed price" contracts. These concepts are illustrated.

Five questions are presented to the ACC/E-ACC the answers to which are needed to develop further and implement the Management Plan for the construction phase of the ALMA Project.

1. Management Principles for the ALMA Project

The E-AEC has reviewed the potential applicability to the trilateral project of the ALMA Management Plan that was developed for the bilateral project; we believe that an adequate framework exists which can be adapted with little modification to serve effectively the needs of the trilateral project. In particular, the same principles that informed the bilateral management plan should also serve successfully to guide the trilateral plan. Specifically:

- The construction, commissioning and operation of ALMA will be governed by an international Agreement between the two or three *Parties*, the NSF acting for North American organizations involved, ESO acting for European organizations involved, and, potentially, NAOJ acting for Japanese organizations involved;
- The Parties will establish an ALMA Board as the supervisory and regulatory body for the Project; the ALMA Board is not a legal entity;
- The Parties will each appoint an *Executive* empowered to act on behalf of the Party to carry out the tasks required to construct and operate ALMA; the Executives are legal entities. Funding for the Project will be provided by the Parties to their respective Executive;
- The Parties will establish new institutions for ALMA only if absolutely necessary;
- The Parties will make equal value contributions. To the maximum extent possible the Parties will share the ALMA work equitably and receive equal intellectual and economic benefit from their ALMA participation;

- The ALMA Board will establish an International Project Office (IPO) to provide the central focus for the management and control of the Project. The Board will select the personnel for the IPO by international search;
- The ALMA Board will establish standing Management and Science Advisory Committees for the ALMA Project;
- The Executives will each establish a *Project Office* with a project Manager and the project management structure they regard as necessary to manage their assigned ALMA tasks;
- The Executives' project management, acting together, will establish the project Work Breakdown Structure (WBS) and divide the WBS tasks such that tasks of approximately equal value and equal risk are assigned to each Executive;

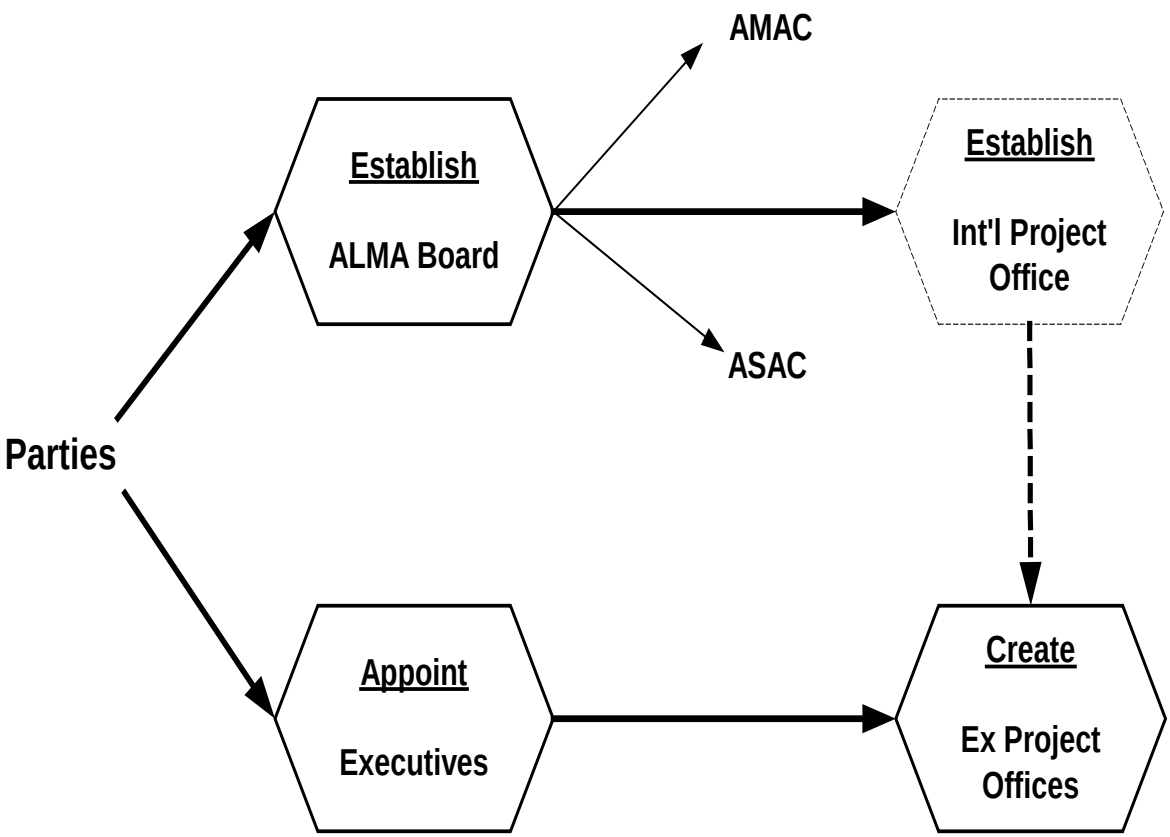
2. An Implementation of the Management Principles for the ALMA Project

The entities that create the ALMA Project, in the terminology used above, are the *Parties,* either two or three. The Parties are the entities that provide funding for the project. The Parties have two initial responsibilities: (1) to establish jointly, and by agreement, an oversight body for the Project, the *ALMA Board*; and (2) independently to appoint an *Executive Agency,* or *Executive*, to manage the project tasks and responsibilities that are agreed to become the purview of each Party. The ALMA Board is not a legal entity, but the Executives are legal entities (i.e. they can enter into contracts, employ staff, etc). In order to carry out their ALMA functions each of the Executives will create an *ALMA Project Office* and secure for that office the staff and resources necessary for the performance of the ALMA tasks assigned to that Executive. The ALMA Board, on the other hand, has the responsibility to establish an International Project Office (IPO) that will manage the ALMA Project. The IPO will carry out its management function by specifying the scope, schedule and tasks of the Project and then coordinating the efforts of the Executives to provide the necessary deliverables.

Figure 1, on the next page, illustrates the development of this management structure. The development begins on the left with the Parties establishing the ALMA Board and appointing Executives. Subsequently, the Executives create their respective Project Offices. The ALMA Board establishes the International Project Office and appoints the ALMA Science Advisory Committee (ASAC) and the ALMA Management Advisory Committee (AMAC).

Presently, the ALMA Coordinating Committee (ACC) functions as the ALMA Board for the Design and Development phase of the Project. The Parties have each appointed an Executive; the AMAC and ASAC are appointed and functioning bodies. Only the International Project Office remains to be established, a task that is the responsibility of the ALMA Board. In Figure 1 the IPO is drawn with a dashed line to highlight the fact that it does not yet exist.

Fig. 1 ***Development of the ALMA Project Management Structure***



The management structure needed for either the bilateral or the trilateral ALMA Project must be one capable of assuring that the usual project goals of cost, performance and schedule compliance are achieved. But in addition, the *guiding principles* make it clear that it must also be one in which the work can be done by the Executive Agencies making use of the staff and resources of those Executives. The principle that no new institution is to be established as an organizational entity for ALMA means that the project must be organized so that the work is managed and coordinated jointly but resources are allocated separately. It is a significant challenge to create a management structure that satisfies all these requirements. The nature of the ALMA Project as the production of a set of tightly integrated instrumentation assemblies makes it impossible to separate the project into two or three independent parts that can be simply controlled by two or three global interface documents; a tightly integrated management is necessary for a tightly integrated project.

As a solution to this problem, we recommend that the management structure for the ALMA Project be based on the concept of Integrated Product Teams (IPTs). We believe this concept will be effective for either the bilateral or the trilateral project. The essence of the IPT concept is the recognition that usually the level-1 WBS tasks will be shared between the two (or three) Executives; for this reason the leadership for those level-1 tasks will also be shared. The IPT is that shared leadership. Each IPT consists of all those individuals who are assigned by one or another of the Executives with significant responsibility for subtasks within a given level-1 WBS task. The IPT staff will not be co-located; each individual works within the infrastructure of his or her Executive. The leadership of each IPT is provided by the Executives' respective task leaders. One of these persons will be identified as the IPT Leader and the other(s) will serve as the IPT Deputy Leader(s). The intent is that these individuals will normally resolve by consensus any technical issues that arise within the IPT.

The IPT Leader and the Deputies are vested with the responsibility to assign, coordinate and monitor subtasks as specified by the ALMA WBS. In practice, this means that each of these individuals is responsible for completing the assigned subtasks within the existing infrastructure of, and using the resources provided by, their respective Executives.

The IPT management structure is a powerful method of organizing work carried out across geographic, institutional, and professional boundaries. It allows work packages assigned to different organizations utilizing different skill sets to be effectively coordinated. It is proposed to adopt the IPT model within the ALMA Project to achieve the following goals:

- Provide a single point of integrative responsibility for each major work package. A single individual, the IPT Leader, will be identified for each IPT. This Leader will be responsible for assuring that the various work packages, when completed, will meet the project schedule and the performance specifications.

- Provide common, coordinated, management of the IPT and the work groups within the Executives. The IPT Leader and the Deputies are themselves the work managers for the Executives. Common management provides the link between the project coordination function and the means to accomplish the work within the Executives.
- Make decisions at the lowest level in the organization where sufficient knowledge is available. The organizational and technical complexity of the ALMA Project makes it impossible for all significant decisions to be deliberated project-wide. Instead, responsibility will be delegated to the IPTs and will carry with it authority to make decisions within that particular IPT. This has the benefit of empowering all those individuals who have responsibility for ALMA tasks and subtasks.

The Management IPT differs functionally from the other IPTs. The composition of the Management IPT is the Project Managers from the Executives, just as is the case for the other IPTs with their managers. However, the Leader of the Management IPT is not selected from among the Executives' Project Managers, instead it is the ALMA Project Manager who is on the staff of the IPO. Within the Management IPT the Project Managers from each of the Executives will function as deputies to the ALMA Project Manager. The individual Project Managers from each of the Executives report to their respective Executive; the ALMA Project Manager, as part of the IPO staff, reports to the ALMA Board.

The ALMA Project Management implementation, structured around effort being the responsibility of the Executives but organized as IPTs, is illustrated in Figure 2. By focusing on the right side of this diagram, one can see that the ALMA Project has a traditional hierarchical management structure. In particular, the ALMA Board serves the function of a board of directors, the IPO functions as the project management, and the IPTs function as task managers. The unusual aspect of the management structure proposed for ALMA (shown in Figure 2) is the execution of tasks, or shares of tasks, at the Executives. Figure 2 is an illustration of ***management structure***; the functional structure proposed for the ALMA Project is shown schematically on Figure 3.

Functionally, Figure 3, the ALMA Management is structured along the lines of a general contractor with the IPO serving as that general contractor. Specifically, the IPO provides to the Executives a detailed definition of the ALMA system structured as a set of *work packages*. The Executives each agree to perform those work packages as *fixed price, sole-source, contracts*. The IPO then monitors those contracts and coordinates the interaction among the work package deliverables. However, it is not the intention that the IPO funds those contracts. Instead, the Executives receive their funding directly from their respective Parties and the Parties in turn receive project credit for the "value" of the contracts (i.e. the work packages) as agreed with the IPO.

Fig 2. ***ALMA Project Management: Construction Phase***

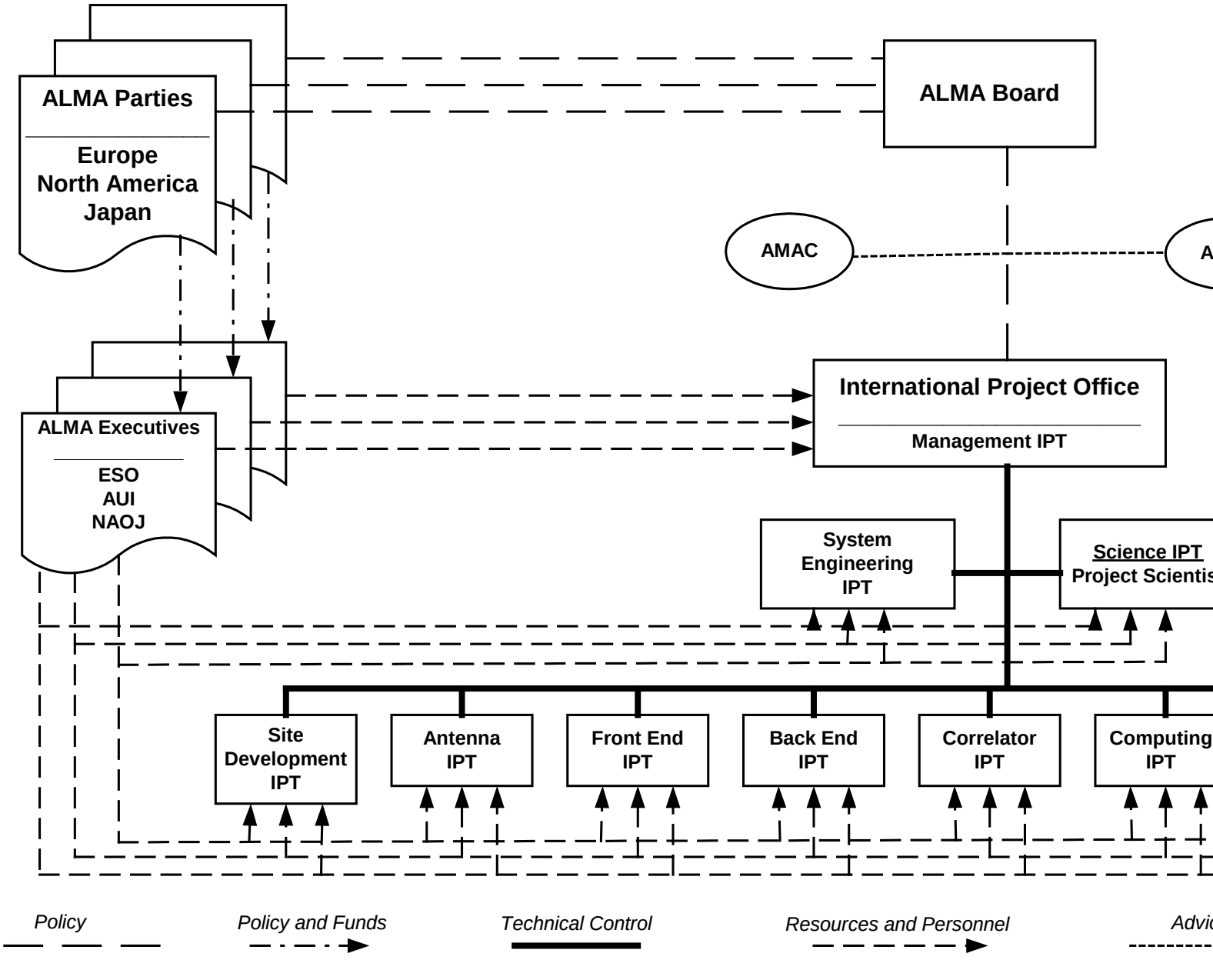
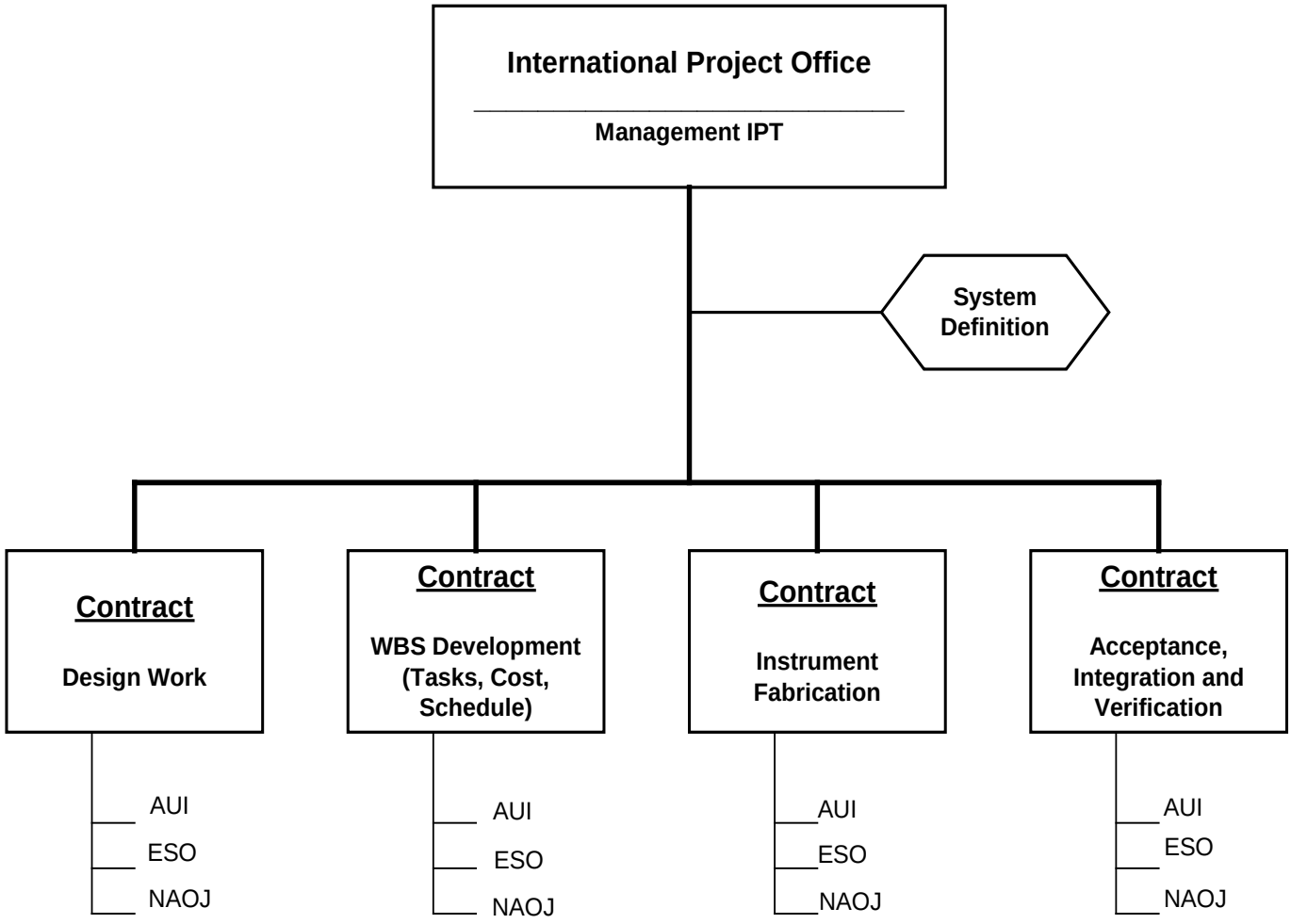


Fig. 3 **Functional Outline of ALMA Project Management**



3. Role of the International Project Office

Whether thought of functionally as the ALMA "General Contractor", or thought of structurally as the ALMA Central Management, the International Project Office is the focal point for implementation of the proposed ALMA Management Plan. Specifically, the IPO is responsible for (1) the Project scope, detailed specification of the ALMA system that satisfies that scope, and the Project schedule; (2) the Project budget and costs, and (3) it is the entity accountable to the scientists and funding agencies (the "Parties") for successful execution of the Project.

Project Scope, System and Schedule**:** The IPO will**:**

- Establish and maintain the scope of the project. This is done through a negotiation involving the scientists on one hand (the ASAC), and the ALMA Board on the other. It is a tradeoff between prioritized science goals and costs.
- Set the specifications for the ALMA system. Work packages will be developed to those specifications that will enable the IPO to negotiate with the Executives for completion of those work packages to a particular cost or "value". The IPO will serve as the ALMA "customer"; the Executives are "vendors".
- Establish and maintain the Project WBS and Schedule. This is the core of the management task for ALMA. It is the WBS and schedule that ties the efforts of the Executives together.
- Establish and control the configuration. This means enforcing strict adherence to the WBS. Where the WBS must be changed, those changes have to be managed centrally. It is the IPO that controls the change process and manages the consequences of a change.
- Define, maintain and enforce Interface Control—indispensable for a project done by many institutions working cooperatively. The IPO is the entity responsible for the ICDs.

Costs: The IPO will:

- Provide an impartial, and consistent, determination of the costs. This applies both to the cost of the baseline project and the cost of any additions or proposed alternatives. This prevents the Executives from being their own arbiter of costs.
- Negotiate an adjustment of "valued" cost estimates in the face of experience where necessary. This is to handle the case where, for some external reason, the cost of a particular task increases substantially above the value previously fixed for it (e.g. the chip makers form a cartel and dramatically raise prices). Such an event will have consequences for all Executives, not just the one with the task facing such an increase. An equitable adjustment will need to be negotiated.
- Serve as "scorekeeper" to assure that the valued contributions of each Executive remains on a par with those of the others. This is to handle the case where the action, or inaction, of one Executive causes a cost increase for the other. An example would be the failure of one Executive to deliver a subassembly to the other Executive on

schedule causing the second Executive to idle some part of his workforce. The IPO will assess and tabulate those consequences for future settlement.

Accountability**:** The IPO will:

- Establish and enforce acceptance criteria for delivered hardware and software from the two Executives.
- Be accountable to the ALMA Board for management of the Project. This includes accountability for the actions of the Executives.
- Be accountable to the scientists for proper execution of the project in achieving its science goals. The ASAC advises and reviews the IPO with their reports going to the ALMA Board

4. Composition of the IPO

We recommend that the IPO be composed of the following professional staff all of whom report exclusively to the ALMA Board:

- Project Director
- Project Manager
- Project System Engineer

In addition, the IPO will need a scheduler to be responsible for the WBS and the necessary reporting. Administrative staff will provide supporting functions. The staff of the IPO should be co-located. The professional composition noted here is identical to that listed in the draft of the ALMA Agreement with the single exception of the Project System Engineer. We believe this individual is needed to set system specifications, ICD standards and acceptance criteria—all this work to be done in consultation with the System Engineering IPT.

With approval of the ALMA Board, each member of the IPO will be employed by one of the Executives.

5. Questions for the ACC and E-ACC

a. Is the Management structure as described here an appropriate basis for developing the ALMA Management Plan for the construction phase of the project, either for the bilateral or the trilateral project?

b. Does the IPT structure adequately satisfy the requirements of the Executives and make for an appropriate sharing of responsibility?

c. If the IPT structure is approved, the E-AEC recommends that the ACC/E-ACC approve the following individuals as the initial IPT Leaders and Deputy Leaders:

WBS Level-1 Task	Leader	Deputy Leader	Deputy Leader
Management	R. Brown	R. Kurz	M. Ishiguro
Site Development	D. Hofstadt	S. Radford	S. Sakamoto
Antennas	J. Kingsley	T. Andersen	? Ukita
Front End	W. Wild	J. Payne	? Sekimoto
Back End	R. Sramek	A. Baudry	? Iguchi
Correlator	J. Webber	A. Baudry	? Okamura
Computing/SW	B. Glendenning	G. Raffi	K-I Morita
System Eng/Int	G-H. Tan	P. Gray	Y. Chikada
Science	S. Guilloteau	A. Wootten	T. Hasegawa

d. Does the ACC/E-ACC agree that the professional staff proposed for the IPO is appropriate for the needs of the IPO?

e. The IPO is the focus of the proposed management structure for the construction phase of the ALMA Project. Because the IPO does not yet exist, but the need for its functionality is immediately critical to the successful execution of the Project, what measures can be taken to compensate for the "missing IPO" between now and the time the IPO is established and operational?