The European ALMA Regional Centre: a model of user support

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ABSTRACT

The ALMA Regional Centres (ARCs) form the interface between the ALMA observatory and the user community from the proposal preparation stage to the delivery of data and their subsequent analysis. The ARCs provide critical services to both the ALMA operations in Chile and to the user community. These services were split by the ALMA project into core and additional services. The core services are financed by the ALMA operations budget and are critical to the successful operation of ALMA. They are contractual obligations and must be delivered to the ALMA project. The additional services are not funded by the ALMA project and are not contractual obligations, but are critical to achieve ALMA full scientific potential.

In Europe a distributed network of ARC nodes (with ESO being the central ARC) has been set up at the following seven locations: Bologna, Bonn-Cologne, Grenoble, Leiden, Manchester, Ondrejov, Onsala. These ARC nodes are working together with the central node at ESO and provide both core and additional services to the ALMA user community.

This paper presents the European ARC, and how it operates in Europe to support the ALMA community. This model, although complex in nature, is turning into a very successful one, providing a service to the scientific community that so far has been highly appreciated. The ARC could become a reference support model in an age where very large collaborations are required to build large facilities, and support is needed for geographically and culturally diverse communities.

Keywords: submillimetre - millimetre facilities, Instrumentation: interferometry, Observatory operations, User support

1. INTRODUCTION

ALMA science operations is provided by the Joint ALMA Observatory (JAO) in Chile, and the three ALMA Regional Centres (ARCs) located in each ALMA region – Europe, North America and East Asia. The primary function of the JAO is to operate and maintain the array at the Array Operations Site (AOS) and the Operations Support Facility (OSF). JAO is responsible for the observations, the array calibration, the first check of the quality assurance of the data, the operations of the Santiago (SCO) archives, while the interface between ALMA and the astronomical community is provided by the three partners through the ARCs. The ARCs have their main headquarters at NAOJ in Mitaka, Japan, for the East Asian partner, at ESO in Garching, Germany, for the European partner, and at NRAO in Charlottesville, USA, for the North American partner.

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Each of the ARCs supports its users from the proposal preparation stage to the data delivery and subsequent analysis, operates a helpdesk, a mirror archive (a replica of the one at the SCO), and provides face-to-face support for data reduction. Each ARC may also provide additional, enhanced services as deemed desirable by the managing Executive. In addition, the three ARCs support the ALMA Observatory by contributing to the duties at the OSF during observations (i.e. astronomer on duty shifts), helping in commissioning and scientific optimization activities and during the proposal review process. By structure, the ARCs provide critical services to both the ALMA operations in Chile and to the user community.

Because of the complexity of ALMA science operations, very close communication and coordination between the JAO and the ARCs is required. This remains the main challenge of this set-up, as we will describe in this paper. More complete information about the ALMA project and the ARCs can be found at ALMA Science portal: http://almascience.org/ and in particular the guides to the three ARCS at http://almascience.org/documents-and-tools).

ALMA science operations has been already described at past SPIE publications (Andreani and Zwaan, 2008; Nyman et al., 2010; Lundgren et al., 2012). We defer the interested reader to these papers for a description of the ALMA Operations model.

1.1 Current status of operations

ALMA has been performing scientific observations since September 2011 in the form of proposal-based "Early Science Projects", in addition to regular commissioning and science verification activities. The Cycle 2 observing period, starting on the 1st of June 2014, will schedule scientific projects with ALMA more advanced capabilities with respect to previous cycles. Presently the observatory is completing Cycle 1; the Cycle 2 observing period will be starting soon, with more capabilites. The capabilities of ALMA are steadily expanding within each Cycle and we currently expect that the ALMA baseline project will be completed and entered in Full Science Operations by 2015 (see Nyman et al., this SPIE).

2. THE EUROPEAN ALMA REGIONAL CENTRE

In addition to supporting the scientific use of ALMA by their respective communities, the ARC structure of the three ALMA partners also provide assistance to the Chilean community and open sky projects. The primary aim of each ARC is to help maximise ALMA's scientific return for its users, and to optimise the use of our most precious resource, observing time. The deliverables of the ARCs are among the key performance indicators at the core of any assessment of scientific productivity of an Observatory.

Because the European ARC has more nodes than its partner ARCs in North America (NA) and Japan (EA) (EU: 7, NA: 3, EA: 3), the coordination of the scientific support is more complicated. Besides the central European ARC at ESO, ARC nodes exist at the following locations: Bologna (Italy), Bonn/Cologne (Germany), Grenoble (France), Leiden (The Netherlands), Manchester (UK), Ondrejov (Czech Republic) and Onsala (Sweden). Within the European ARC astronomers can find everything relevant to ALMA.

Each ARC node is staffed with scientists providing a range of experience in interferometry, (sub-)mm observing and ALMA data reduction and interpretation. The staff at the ESO ARC and the ARC nodes work together to provide optimal support to users during the complete lifetime of a project from proposal preparation, preparation of the scheduling blocks (SBs), delivery of the calibrated science products to the users, and, if required, additional data reduction support. Furthermore, the ARC nodes can give advice regarding observing strategies and can help with ALMA archival research. The ARC network organises community days, tutorials and workshops throughout Europe to reach out to the community and to train users in proposal preparation and data reduction. The nodes reach out to the local public as well by giving public outreach talks in various languages.

However, the roles that the central ARC and the nodes fulfill are very different. All face-to-face support, one of the core functions of the ALMA project, takes place exclusively at the ARC nodes.

The specific distribution of the tasks among the central ARC and the nodes is arranged internally, so that (ideally) the

user perceives the ARC as a unified structure. At the same time, users seek direct help from experts close to their home institute, and work together with them to extract the full potential of the ALMA data.
All initial contacts between the user and the ARC staff happen through the ALMA Helpdesk. The ARC staff may answer the user's question immediately, refer to documentation, or forward the query to an expert within the ARC network. The ARC may advise that face-to-face help is required, or the users may request face-to-face support.

The different roles of the ESO ARC and the ARC nodes are outlined below, but the main aim of the European ARC is to work and act in synergy as a single entity, in the sense of sharing the same models for operations and user support.

2.1 The role of the central ARC at ESO

The main tasks of the central ARC, of direct relevance to ALMA users, are:

- Phase I operations: distribution of the call for proposals to prospective European ALMA users, preparation of documentation and tools relevant for each Call, assistance in coordinating the refereeing process and in assessing the technical feasibility of the proposals.
- Phase II operations: assisting users with the preparation of the technical details required to schedule and execute the proposed observations, and validation of Phase II material.
- Checking the data quality before delivery.
- Data product support: delivery of the final raw and pipeline-reduced data to the PIs.
- Archive operations: the ESO ARC node holds a complete synchronised copy of the ALMA archive.
- Running the ALMA Helpdesk.
- Community development and outreach.
- Contributing to the development of the Observing Tool, the pipeline, the archive and the data reduction package.
- Support the Observatory during observations, commissioning and optimisation of capabilities.

2.2 The role of the ARC nodes

User support with proposal preparation by means of face-to-face meetings, dedicated workshops and through ALMA Helpdesk is provided by the ARC nodes. In particular,

- Phase I: expert advice on the technical aspects of a proposal, training in the use of ALMA specific tools.
- Phase II operations: one-on-one advice by a contact scientist for each ALMA project.
- Face-to-face help with data reduction, including expert support in data processing for specialised observing techniques.
- Help in archival research, including assistance to users of the ALMA archive in identifying and using the data products suitable for their scientific projects, and through the ALMA helpdeska .
- Community preparation through lectures, tutorials, targeted trainings, University courses, workshop, seminars.
- Close interaction with the community and regular updates on ALMA (Community Days and other events, newsletter, webpages).
- Development of special methods and tools to optimise observation preparation and the scientific return of ALMA data.
- Local public outreach (in various languages).

3. CURRENT OPERATIONS WORKFLOW

The ARCs has to adapt their operations model, from the original form written in the ALMA operations plan, to the continuous changes both at JAO and the ALMA partners. The ARCs are taking more and more active role in supporting the observatory during the optimisation of capability tasks, and the observing sessions.

In the meantime, the ARCs have a central role in checking the data quality before delivery. This quality control will be done soon by the ALMA Pipeline, which contains checks to ensure that the data products reach the desired sensitivity and meet other criteria. However, the Pipeline is still under a test phase. In Europe the quality control activity is currently a shared duty between the central ARC and ARC nodes, performed by ARC staff using standard scripts, and such semi-manual checks will continue to be important while new observing modes are being introduced, even with an operational pipeline.

The European ARC has invested a lot of effort in establishing a good communication flow, which is key to share the same/similar expertise and knowledge, which constitutes the basis of a uniform and highly qualified user support.
Communication within the network of ESO and ARC nodes involves teleconferences, shared wikis, periodic face-to-face meetings and an annual all-hands meeting. Resources are shared as required, e.g. community events at any node usually involve person-power and materials from other nodes. Staff exchanges, such as for science leave at another node, also take place.

3.1 Inherent challenges and strengths

The distributed ARC structure established in Europe poses numerous challenges. Each node operates under a slightly different mandate and local structure, yet tasks, responsibilities and timelines must be harmonised and synchronised throughout the network. Another major challenge lies in the ARC nodes being separated from the central interface to the array. As a consequence, activities at the different nodes may not be optimally aligned with ALMA developments elsewhere and there is the risk that the ARC nodes feel detached from the Observatory and not an integral part of the ALMA project. Diverse mandates and funding situations bear the possibility of a node dropping out and/or not serving the community as expected. The ARC model is totally new in Europe's astronomy landscape, and it still needs the awareness from the user basis and the funding agencies.

On the other hand, everyone recognises the big advantage to have the ARC nodes close to the users' home bases, catering exactly to the specific needs and preferences of the local communities. The network's diversity in combination with good communication spawns new ideas and intense discussions on operational models, optimizing processes and adjusting current policies.

We are presently witnessing that this model, although complex in nature, is turning into a very successful one, providing a service to the scientific community which has been so far highly appreciated.
The direct face-to-face user support in the local communities would be compromised if we were to change to a centralised ARC model, and that conversely, the overall quality and breadth of user support could be diminished if the coordinating role of ESO were to be reduced.

3.2 Limited but successful experience

The ALMA advisory boards recognised and appreciated the key role of the ARCs: “The ARCs are proving to be a real asset, with their support generally recognised as excellent."
Users’ feedback has been so far extremely positive. The European scientific engagement has been overwhelming in that Europe by now has produced the largest share in submitted proposals, and in the number of ALMA science papers.

We believe the key factors for this success lie in that:
1. A large fraction of the active community are not just consumers, but actively participating in the project. This increases their expertise, their motivation, the esteem for the project and it makes them effective “ambassadors” of the ALMA project.
2. ALMA has been extensively advertised through well-organised community events.
3. Users appreciate direct help from well-known experts close to their home institute, and are glad to work together with them to prepare proposals and extract the full potential of the ALMA data.
4. User training close to home and adjusted to the local communities preferences.

4. FUTURE EVOLUTION

The European ARC network is aiming at developing in the direction of a virtual/distributed institute. The ability to develop, deliver, and support enhanced services across the network will critically depend on the ability of a well-integrated ARC node network to function as a single distributed team.

Here we discuss some possible scenarios.

4.1 Scientific support

As ALMA observations become more standardised, and experience in the community with ALMA data grows, the user support at the nodes will shift from direct assistance with technical and/or practical aspects, to pushing the ALMA capabilities to the limit; supporting large, data intensive projects; supporting archival research; and enabling advanced scientific analysis. We therefore foresee an evolution of the user support currently provided by the ARC nodes to a more science-oriented support, whereby users will benefit from the proximity to the staff at the regional node and exploit their scientific expertise, in addition to their technical support, to improve their scientific output. The model of user support (face-to-face), deemed very successful by users, advisory committees and funding agencies alike, will not change the content of the support, however, it will adapt to the new needs.
At the same time, new users and newly developed ALMA capabilities will continue to require 'basic' user support.
To accommodate the needs of an increasingly demanding ALMA user community, the ARC nodes work towards strengthening their areas of (unique) expertise, focusing on issues such as polarimetry, (mm-)VLBI, solar observations, or the enhancements of synergies between ALMA and other facilities each of the ARC nodes is actively supporting.
The expertise areas each ARC node is specialising in depend on the demands of the ty they are supporting as well as their mandates, and due to the distributed expertise within the ARC nodes network, this development is expected to also strengthen the ties among the various nodes.

4.2 Towards centres of unique expertise

ALMA users can obtain the same level of high quality user support from every node. At the same time, local expertise and demand by local communities will lead to the development of unique expertise areas at each of the nodes that benefit the entire network and draw a global audience. Subtle aspects of ALMA observations, specialized modes of ALMA operations, and levels of data processing that go beyond what most users require, necessitate support for a distributed community. The ARC node network is closely coordinating the development of these expertise areas to ensure global coverage, avoid overlap, and stimulate inter-node collaborations.
The ARC nodes will focus their work to enhance their expertise by developing added functionality for ALMA, such as new algorithms, archival research, meta-analysis of the calibration.

4.3 Participation in development studies and new technologies

When ALMA moves beyond its initial phase, information flow will become bi-directional. While at first, most information flows from the project to the users, as time progresses, input from the users back to the project becomes important. This includes studies that are part of the ALMA Development Plan, proposed for by the community and delivering new hardware and software that enhance ALMA's performance. The ARC nodes play an important role in promoting participation of their communities in these projects, and often are part of these projects when they match the expertise areas mentioned above.

5. CHALLENGES

Challenges and strategies to keep this model alive are addressed in this session.

5.1 Communication

Information exchange is the key to making a structure like the ARC node network function well. The information flow is critical and if interrupted this set-up may break down. The European ARC has tried to cope with this challenge in the way described above (section 3), but, although efficient, this set-up is not exempted from potential risks. The major one consists in misunderstanding. We believe that a way to cope with this is to tackle problems as soon as they show up, their immediate identification helps to address solutions, which should be implemented as soon as possible.
A good communication flow highlights areas of risks and proposals and/or backup solutions need to be addressed immediately for each potential risk.

5.2 Retain expertise

The ARC nodes have been a great asset in attracting young people who want to get close to the ALMA project but still pursue a career in science. However, one of the most challenging issues is to retain the experts, people who are trained in operating the facility, who understand its technical aspects, and who provide user support and who know how to exploit the observing modes to get the best science from the array. Funding on a short term basis and with unsecure future scares people and at most the good ones leave the project for better prospects. In addition scientific institutes have difficulties in competing with the market and its salaries. Another aspect of this is that often the institutes hosting the centres do not have the possibility to offer extended contracts and people after a few years *have* to leave.
We started discussing within the European network the possibility to cope with these problems, allowing possible exchange of staff among the ARC nodes.

5.3 Flexible user support model

The ARC nodes network is a vibrant, ever-evolving structure, that has to first and foremost accommodate the needs of the ALMA astronomical community. However, the needs and mandates of each individual node may differ and the network has to allow for an individual evolution within the global network evolution, while maintaining its fully integrated structure, common goals and modus operandi. This can only be achieved by allowing for flexibility and the integration of new concepts, while maintaining open all communication channels.

As more and more nodes act as general support centres supporting not only ALMA but other facilities as well, the scope of the networks' function will inevitably be widened, incorporating, at the same time, new expertise and new facilities, and new synergies will emerge.

5.4 Keep the network changing but integrated

The weakness as well as the strength of this network lies in its inhomogeneous structure, as each node has partly different organisation, funding, constraints, community size, and -perhaps more importantly- mandate from its funding agencies. However, we believe that, although challenging, the difference and differentiation make this structure strong as long as anyone is able to accept it and cope with it.
Difference in culture and framework help the development of new ideas, increases the flexibility, brings a new concept of users' support, and widens the scope of this network, for instance by including new facilities, and new expertise.

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