DOI: 10.18727/0722-6691/5258

Redesigning the ALMA User Experience from End to End

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In the middle of the COVID-19 pandemic and while the ALMA antennas were still powered down, ALMA launched a global initiative to Redesign the User eXperience (RedUX). The RedUX Working Group (WG) interviewed ALMA users worldwide, equally spread amongst the three regions (North America, East Asia and Europe) between November 2020 and May 2021. The discussions that took place at the RedUX interviews were distilled and concrete suggestions for improvements were passed by the RedUX WG to individual teams responsible for ALMA software components, WGs or regions, as well as to the ALMA Integrated Science Operations Team.

Redesigning the User eXperience (RedUX)

Based on insights gained by previous interactions with the global Atacama Large Millimeter/submillimeter Array (ALMA) user community, such as the ALMA end-to-end user experience survey conducted in late 2019 and early 2020, ALMA launched RedUX to further improve the ALMA user experience. RedUX adopted a wide, holistic approach by conducting a series of individual interviews, the goals being to make the use of ALMA an exciting, educational and productive experience for all users and to help increase the scientific output of the facility. The RedUX Working Group (WG) issued a call for volunteers willing to be interviewed on their past, present and prospective experience with ALMA, published in the ALMA newsletters of the three regions between 15 September and 1 October 2020. Although the total number of interviews carried out (69 in total) is very small compared to the total number of ALMA users worldwide (more than 10 000 registered ALMA users at the time of writing), they spanned all levels of career stage and interferometry expertise as well as scientific profile and interests. The users were spread geographically amongst the three regions and were interviewed by the respective WG representative. The ALMA user journey was split into phases and steps (see Figure 1) and every individual touchpoint was addressed. The individual interviews approached the ALMA user experience from various angles simultaneously collecting feedback on all touchpoints of the user experience.

This feedback was translated into concrete suggestions, passed by the RedUX WG for implementation to the teams responsible for ALMA software components and WGs and to the ALMA Integrated Science Operations Team (Zwaan et al., 2021). Some of these suggestions, accompanied by actions under consideration globally within ALMA or locally in Europe, are presented below.

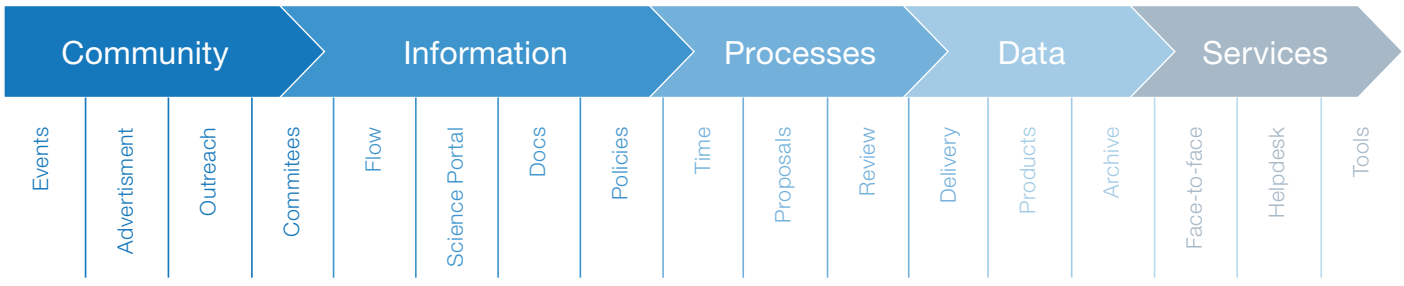
Example advances in selected ALMA subsystems

The ALMA Science Portal has undergone a major change of its look and feel, in light of many of the recommendations made by the RedUX WG following the users' feedback. Figure 2 shows the new main page, with a modern layout. The content of the Science Portal has also been reorganised; information has been regrouped and it is now easier to find and access.

The ALMA Science Archive interface is another user-facing subsystem that is implementing changes in line with the feedback received from ALMA users. Small requests, such as additional metadata on the interface, have already been scheduled for implementation. As several of the items on the feedback list were already in planning, the RedUX feedback was also taken into account in prioritising future implementations.

The Snooping Project Interface (SnooPI[1]), the ALMA Observing Tool, and the Helpdesk also attracted feedback from RedUX, some of which has already been

Figure 1. The ALMA user journey map.



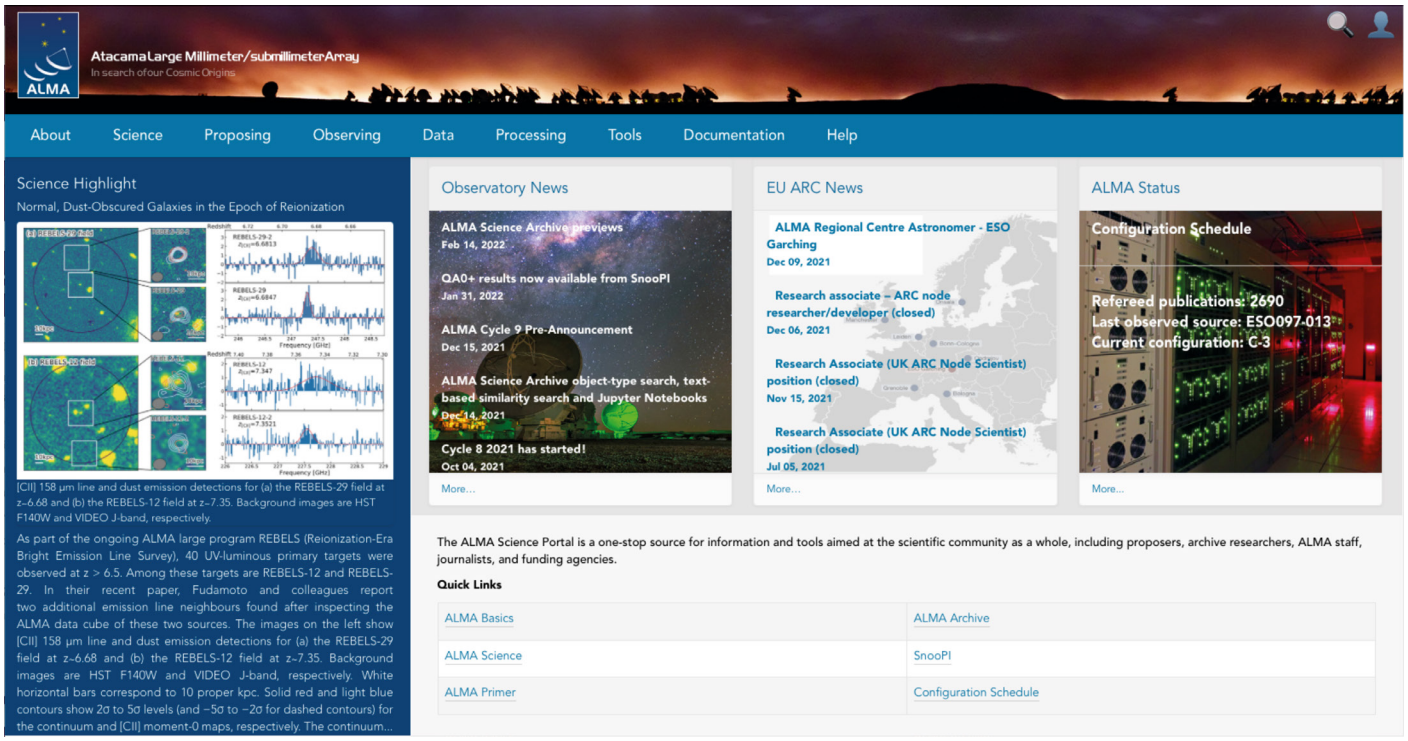


Figure 2. The revamped ALMA Science Portal, with a modern look and feel and a reorganised content.

implemented. Examples of implementations within SnooPI include the possibility to export the calibrator data for each Scheduling Block (SB) in a table format and the sorting of SBs based on properties such as band, array, execution etc.

Improving the ALMA user experience

Thanks to the discussions with the users, many good ideas for improvements in the end-to-end ALMA user experience emerged that were brought forward to the Integrated Science Operations Team. They range from improvements in communication between the project and the community to ways of maximising the use of the ALMA deliverables to user support services and everything in between. Below we summarise some of these ideas, which will be leading future ALMA developments in user support matters.

Communication

As RedUX took place in the middle of the COVID-19 pandemic, the way ALMA responded to the pandemic and the resulting working conditions were major topics of discussion at the interviews. Most users felt that the cancellation of the ALMA Cycle 8 Call for Proposals was the right decision, made in a timely manner and communicated promptly and clearly to the community. Nevertheless, more timely and centralised information dissemination would be appreciated, accompanied by the reasoning behind every decision — in particular, but not solely, in times of crisis. Furthermore, it was felt that more real-time information would be helpful to keep the community up to date and to allow for better planning on the part of the users. Regular and frequent news on upcoming and future capabilities as well as development activities is something the community is eagerly waiting for and the prompt communication of newly found problems that directly affect the users, such as issues with the data or the reduction software, would be much appreciated. As a response to these concerns, ALMA is now looking into ways of improving the information flow towards the community.

One way to engage the ALMA community is through surveys like the ones that were performed from the start of ALMA operations up to and including Cycle 6. These surveys aimed to learn from the users about the quality of the services provided to the community but evolved over time from general queries about all the services to more targeted queries on specific services and tools, following significant developments in those services or tools. The possibility of running focused surveys and regularly publicising the results and follow-up actions is being evaluated. That would allow users to be aware of where the pressure for future developments lies and of the actions taken by the project to accommodate users' needs. For clarity, the provenance and purpose of all ALMA-related surveys will have to be unequivocally identifiable, whether they originate from within the project or from, for example, external committees.

ALMA deliverables

Most of the interviewees re-image the products that are delivered to them. The reasons for doing so include (but are not limited to) the need for parameter optimisation to match their scientific needs or more advanced reduction such as self-calibration or data combination. Many users are worried that less

seasoned colleagues are perhaps not aware of the fact that ALMA products can often be improved beyond what the quality assurance process is delivering. This is the case, for instance, for dynamic-range-limited images. Archival researchers in particular, who are used to science-ready data from facilities operating at other wavelengths, may not be fully aware of this aspect of ALMA deliverables. To better guide users, the option of additional training and documentation is being explored, to ensure that they understand the potential need for reprocessing.

The Common Astronomy Software Application (CASA) is the package used by the majority of ALMA users for data reduction and analysis and, inevitably, it was discussed in depth in the interviews. Users reported difficulties following the development of the various CASA versions, updates and bug fixes, and also difficulties with maintaining various CASA versions on their computers. Multiple versioning was also reported to potentially result in poor referee reports, as referees are not always aware of the CASA and pipeline version a data set should be using. Remote, centralised, user-initiated data processing would circumvent the need for users to keep up with CASA versioning. It would also be useful to users who do not have direct access to powerful computers, as was the case for many scientists working under non-optimal conditions during the pandemic. As a result, such a service would further promote archival science. As ALMA and CASA mature, issues affecting proprietary and archival data are being identified. An automatic and regular reprocessing of the contents of the ALMA archive, as done by other large facilities, would ensure that the contents of the ALMA archive were always up to the most up-to-date standards. Reprocessing could be implemented as an alternative to, or in parallel with, user-initiated processing.

User-support services

Face-to-face support is the most valued user-support service offered by the ALMA Regional Centres (ARCs) and it is the one that ensures that the array can be accessible to all users, even those with no expertise in interferometry. Nevertheless, many users still report not being fully aware of the suite of support services offered by the ARCs. Furthermore, some users, and in particular the less experienced ones, may not recognise the need for face-to-face support or may not know how to phrase their needs, both things that prevent them from requesting support. The ARCs are exploring avenues to improve the advertising of the available support services. Furthermore, as expertise spreads in the ALMA user community the need for basic face-to-face support is shifting towards supporting less experienced users. At the same time, there is an increasing need for more specialised support such as working with visibilities, imaging of mosaic data, self-calibration and data combination. The ARCs quickly reacted to the pandemic and adapted their services by offering virtual support, thereby opening new possibilities for interactions with the community. And while it is universally accepted that nothing can replace the value of in-person interactions, virtual support facilitates the logistics and adds flexibility in the user support practices.

Perhaps one of the most striking outcomes of RedUX is the degree to which the user community relies on the project to increase expertise in the community. ALMA's goal from the start was to be a telescope for all astronomers and, thanks to the success of the user support structure that has been put in place in the ARCs, this goal has become a reality. Nevertheless, users would like to get more out of the support services, especially in terms of training and scientific community build-up. To this end, events targeting specific audiences, events covering a wider range of topics, and cross-regional events are all being looked at. The demand for ALMA-specific interferometry schools was clearly articulated in all three regions. There is also a huge demand for tutorials and educational material at all levels and, in addition to new material that will be produced as a response to this demand, an effort will be made to better organise and centralise the scattered material already available. Finally, ALMA users would like to see the project facilitate connections amongst the members of the community, especially in times of crisis. This can be achieved via dedicated communication channels, virtual get-togethers, short topical talks with time for discussion, online forums and suchlike.

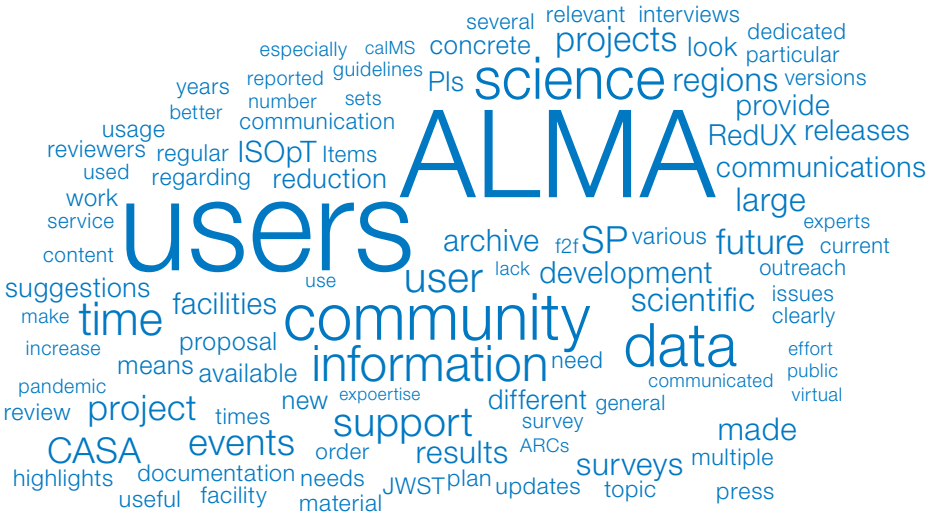


Figure 3. Word cloud summarising the recommendations brought by the RedUX WG to the ALMA Integrated Science Operations Team.

To address all the above, a comprehensive list of recommendations was brought to the ALMA Integrated Science Operations Team. While providing the full list is outside the scope of this article, a word cloud summarising the recommendations is presented in Figure 3, with science, data, communications, development and support being concepts featuring prominently there.

Follow-up of RedUX recommendations in Europe

The ARCs are the interfaces between the ALMA project and their respective user communities. The user-support services provided to these communities are adjusted to the circumstances and needs of each of the regions and, although similar in essence, may differ in implementation. As a result, much of the feedback received from the users and, subsequently, many of the recommendations presented by the RedUX WG, in particular on topics related to the growth of the user base and the strengthening of the expertise in submillimetre interferometry in the community, were region-specific and may be handled by each of the ARCs individually. These efforts will be coordinated amongst the regions, to ensure a uniform implementation of new and improved user support practices across the project.

The European ARC is heavily involved in observatory support processes like Quality Assurance (Petry et al., 2021) and Extension and Optimisation of Capabilities (Maud et al., 2021). Nevertheless, user support remains one of its major roles. All users with the European ARC as their "preferred ARC" in their ALMA user profile are provided with support by the European ARC network. The user-support tasks are shared amongst the ESO ARC in Garching and the seven ARC nodes located in Bologna (Italy), Bonn/Cologne (Germany), Grenoble (France), Leiden (the Netherlands), Manchester (UK), Ondrejov/Prague (Czech Republic) and Onsala (Sweden). For a description of the European ARC network see Hatziminaoglou et al. (2015).

A number of actions are already taking place in Europe as an immediate response to the feedback received via RedUX, some of which are presented below.

- The network put together a WG composed of staff from the European ARC network, dedicated to raising awareness amongst European ALMA users about the support and services offered by the network to the ALMA community. The WG meets regularly and discusses strategies to increase the visibility of the nodes in their communities, to improve the transfer of ALMA expertise knowledge from the nodes to the European community, to strengthen the role of the network in building and maintaining the European ALMA community and to continuously engage this community to use ALMA and its new observing modes for their science.
- In the interviews with European users it became obvious that the structure of ALMA and also the role and composition of the oversight committees were unclear, as was the way to provide feedback to the project. To address these uncertainties, an article was published in the ESO Messenger to clarify ALMA's organisational structure, to advertise the European Science Advisory Committee and to indicate the various ways in which users can provide feedback to the project (Zwaan et al., 2021).
- A new series of monthly talks, named ALMA recounts of Cosmic Conundrums[2], was established in December 2021. Each talk focuses on a major question in modern astrophysics. Each invited speaker — one per talk and an expert in the field — describes the context of the question they were asked to address and then focuses on the ALMA contribution to the field, past and future. In addition to illustrating the major scientific advances made thanks to the power of ALMA, the talks are also intended for astronomers who have not yet used ALMA for their science.
- ALMA and interferometry are often perceived, especially by non-experts, as mysterious or complicated. ALMA experts from the European ARC network prepared a series of three-minute videos[3], under the title "ALMA explained", to present basic ALMA and interferometry principles in a simple but scientifically robust manner. The videos target astronomy students and early-career scientists not acquainted with ALMA or the principles of interferometry and were released via the network's webpages[4] and YouTube channel[5]. The collection is being continuously updated with new additions.
- The European ARC Newsletter[6] has been restructured following user feedback and is now published on a monthly basis. Other than announcements of general interest, it features short polls that aim to solicit immediate feedback from the community and highlights of ALMA results led by astronomers with European affiliations.
- Following requests from almost all the European users who were interviewed, the first ALMA school is now being prepared by the European ARC network, with the support of the OPTICON-RadioNet Pilot[7] and with a target date sometime in autumn 2023.
- New European ARC network webpages are in the making. The pages will be repurposed and converted into a useful inventory for all European user support matters.

Conclusions

RedUX user feedback included issues that were already known to the project but also some that had either gone unnoticed so far or whose importance may have been underestimated. Overall users agreed that there is a general ALMA community feeling; there are, however, large fluctuations within this general statement. Depending on their geographic location, the relation of their institute or group to ALMA and the level of expertise and involvement of their immediate surroundings in ALMA, users may feel varying degrees of connection to the project. The ARCs will intensify their efforts to engage with their communities and to further advertise their services to accommodate the changing needs of the ALMA user base. At the same time, ALMA is looking into ways of improving information flow and of opening more communication channels with the community.

RedUX showcased how users see ALMA not just as a facility but as a project leading the users through their science. The requests for more training and training material, for topical workshops and for coordination to establish links amongst members of the community clearly demonstrate that the community relies heavily on the ALMA project to increase user expertise, to expand the user base and to even establish new collaborations that will allow for an even better use of the facility. The ARCs are ceaselessly adapting their services to accommodate these needs, to expand the user base, to

continuously train new generations of interferometrists and to strengthen expertise in the community, keeping ALMA at the forefront of astronomical research.

The facility will remain the primary instrument for an important fraction of current ALMA users worldwide for the foreseeable future, with the potential to produce ground-breaking science. By ensuring a continuous collaboration between the project and the user community, ALMA's scientific output can be enhanced and will remain prominent in the astronomical landscape even in the era of upcoming facilities like the James Webb Space Telescope and ESO's Extremely Large Telescope.

Acknowledgements

We would like to thank all the ALMA users and prospective users who participated in RedUX and for the enjoyable and insightful interviews we had with them.

References

Hatziminaoglou, E. et al. 2015, The Messenger, 162, 24
Maud, L. et al. 2021, The Messenger, 183, 13
Petry, D. et al. 2021, The Messenger, 181, 16
Zwaan, M. A. et al. 2021, The Messenger, 184, 16

Links

[1] SnooPI: https://almascience.eso.org/observing/snoopi
[2] ALMA recounts of Cosmic Conundrums: https://www.eso.org/sci/facilities/alma/arc/alma_recounts.html
[3] European ARC videos: https://www.eso.org/sci/facilities/alma/arc/ALMA_explained_videos.html
[4] European ARC webpages: https://www.eso.org/sci/facilities/alma/arc.html
[5] European ARC YouTube channel: https://www.youtube.com/channel/UCXsYQxxTSF-o23UP7HU_jYQ
[6] European ARC Newsletter: https://www.eso.org/sci/facilities/alma/news/arc-newsletter.html
[7] OPTICON-RadioNet Pilot: http://www.orp-h2020.eu

A very bright and large point dominates the top half of this picture of the sky above ESO's Very Large Telescope (VLT) on Cerro Paranal in Chile's Atacama Desert. But if you take a closer look, you will notice it is not just one point but two, very close to each other. What you see is in fact a conjunction of Jupiter and Saturn.

F. Char/ESO