Innovating science communication: the structure supporting ATLAS Education & Outreach

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On behalf of the ATLAS Experiment

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Abstract

The ATLAS Education & Outreach project has, over the years, developed a strong reputation for supporting innovation. Animated event displays, musical CDs, 3d movies, 3-storey murals, photo books, data sonifications, multi-media art installations, pub slams, masterclasses, documentaries, pop-up books, LEGO® models, and virtual visits are among the many diverse methods being exploited to communicate to the world the goals and accomplishments of the ATLAS Experiment at CERN.

This variety of creativity and innovation does not pop out of a vacuum. It requires underlying motivation by the collaboration to communicate with the public; freedom and encouragement to do so in a creative manner; and a support structure for developing, implementing and promoting these activities.

The ATLAS Outreach project has built this support structure on a well-defined communication plan, high-quality content, and effective delivery platforms. Most importantly, implementation of the program has been based on the effective engagement of the participating institutes and other key partners, not only to leverage modest human resources and funding, but also to take advantage of the rich imagination and inspiration of a diverse, global human collaboration. We present our current plan, on-going activities, and a few more fun innovations for the future.

Keywords: ATLAS, LHC, CERN, Physics, Communication, Outreach, Education, and Innovation

1. Introduction

Communication is both central and essential to the scientific process. The size, scope and worldwide impact of scientific experiments, such as those at the Large Hadron Collider (LHC) at CERN [1], require that it go beyond the dissemination of results between peers. Rather, key results need to be clearly communicated to non-specialized audiences, including those providing funding for the projects and those most affected by the results (often the general public).

Fig 1 provides a rough illustration of the flow of information through an experiment and on to three major target audiences (the science community, the public, and the decision makers who provide support for the experiments). The concepts conveyed by this figure are not meant to take away from the social and ethical obligation of scientists to communicate results to the world at large, but to underscore the pragmatic need for communication to leverage support for science, in the form of ideas (from others in the science community, such as theorists) and resources (provided by the public via decision makers in governments and other funding agencies).

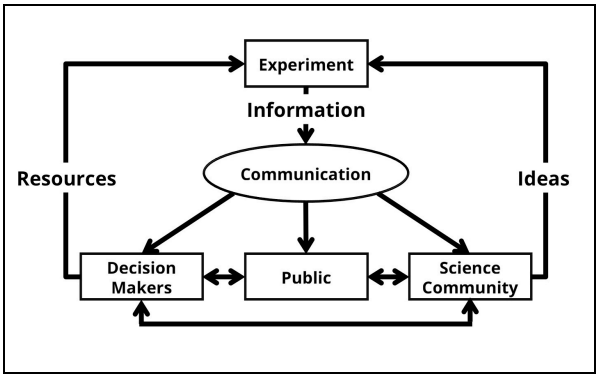

Fig 1. Simplified communication flow diagram for a major scientific experiment.

This document describes the structure developed and employed by the ATLAS [2] Education & Outreach Project, including strategy, platforms, content development and activities, designed to foster effective communication to the Decision Makers and Public. Interestingly, it does so by employing the more conventional method aimed at communicating to the Science Community: conference proceedings.

2. Strategy

2.1. Goal

The primary goal of the ATLAS Education & Outreach Project [3] is to communicate the goals and accomplishments of the ATLAS physics programme to the public. These goals are perhaps best summarized in the following broad mission statement: ATLAS is a particle physics experiment designed to explore the basic building blocks and fundamental forces of nature in order to advance our understanding of the world around us.

2.2. Target Audiences & Communication Objectives

The ATLAS Education & Outreach project defines communication objectives for the following primary target audiences: General Public, Policy Makers in Science & Technology, Students & Teachers.

By **General Public**, we are referring to, well, everyone. There are arguments for focusing efforts on the more "science attentive" public: less need for simplistic explanations, or less need to convince them of the value of our work, for example. However, there are also compelling sociological arguments for making the added effort to bring people of all levels of education and interest on board. In addition, the ever-increasing usage of social media by both the public and the press mean that content targeting the general public has a much larger exposure, due to the inherent feedback mechanisms of the platforms.

The primary communication objective for the general public is to develop an understanding and appreciation of ATLAS, and the field of particle physics, and to convey the necessity of fundamental research for society. There are two key educational messages here: the importance of the scientific process for the development of society, as a whole, and the role of ATLAS in this process. Note that this does not imply depth to the educational aspects of our work, but the fostering of an appreciation that what we are doing is worthwhile and important to society.

The target audience **Policy Makers in Science & Technology** includes participants in government agencies and industry who help to make decisions and define policy for their country or organization concerning support for particle physics and science, in general. This includes heads of states, members of parliament or congress, funding agency members, and high-level representatives of a company or industry that supports (or could support) our field.

Here, the primary objective, beyond informing supporters and funding providers with a report of accomplishments, is to communicate the impact of our research on society. This reaffirmation of the medium and long-term benefits of the financial investment has the goal of sustaining and increasing support for ATLAS and particle physics, in general.

Students & Teachers are the most common target audience addressed by the Education & Outreach program. They make up the vast majority of CERN visitors, and are the primary target of events and activities organized at the member institutes. For the most part, these are students in secondary science classes, aged between 15 and 18. However, there exist programs that present the key concepts of particle physics to primary school students (typically age 8 and above) [4] and some support, generally in the form of guided visits and presentations, is also provided for undergraduate university students [5] and high school teachers [6] attending the programmes at CERN.

The primary objective for targeting students and teachers goes beyond the recruitment and training of the next generation of scientists and science educators. Efforts are made not only to educate the students, but also to convey the excitement of discovery and to foster a deeper appreciation of the

scientific method by witnessing its application first-hand in leading-edge research. In addition, the importance and success of worldwide collaboration is an important lesson for students, many of whom have rarely travelled outside of their home regions or countries. Overall, one clear objective is to instil and reinforce these values in the students and teachers with the hope of influencing the future leadership of our society.

2.3. Themes and Messages

In order to effectively achieve the communication objectives described above, the programmes developed by the ATLAS Education & Outreach project are built on three primary themes: Physics, Collaboration, and Technology.

The **Physics** theme focuses on the major questions facing particle physics, today. These are typically presented in the context of the Standard Model and might employ other models under consideration that go beyond. Questions can include:

- What are the basic building blocks of nature?
- What are the forces that describe their interactions?
- What the "dark matter" that appears to make up much of the mass of galaxies?
- Why does it appear that antimatter has disappeared while matter remains?
- Why is gravity so weak compared to the other three known forces?
- Could there be extra spatial dimensions?
- What was the early universe like in the time before protons and neutrons came into being?
- How do fundamental particles attain mass?

These questions are fundamental and understandable by all of the target audiences, regardless of the level of education or expertise. By posing them early in the conversation, audience questions about the motivation for our work are laid to rest and a firm foundation is built for describing how it is we go about trying to address the questions.

This leads to the theme of **Collaboration**. Here the focus is on the common motivation for scientists from all corners of the globe to seek answers to the fundamental questions facing mankind. The primary communication task is to describe the worldwide effort required to construct, run, and maintain the experiment. Emphasis is put on the commonality of goals, contrasted with the diversity of nationalities, and on the advantages of working in such a culturally rich environment. In addition, it is common to present the fact that around 80-90% of the collaboration actively contributes from their home institutes, often far from CERN, participating in the decision-making, as well the running of the experiment.

The theme of **Technology** covers all aspects of the experiment, including the development, running and maintenance of detector components, the trigger and computing systems, including the LHC Computing Grid, and the physics analysis environment. The LHC accelerator complex is included to provide context.

Although the focus of the program theme remains squarely on the development and usage of leading edge technology to find answers to the major physics questions, clearly a lot can be shared concerning the direct application of the technology to other domains of human interest. Descriptions of the application of innovative technology in fields, such as medicine, communication, computing, and other high-tech industries, help to emphasise the near-term advantages of supporting fundamental research without taking away from its long-term goals.

3. Communication Platforms

3.1. Introduction

The themes and messages described above are implemented by the ATLAS Education & Outreach project using a variety of communication platforms, content and activities. The primary platforms include an online presence (public web pages and social media), a local presence (visitor centre), and support for activities hosted by colleagues at or near their home institutes (books, brochures, posters, models, multimedia material, etc.).

All platforms and content rely on common text, images, and a well-defined visual identity, to convey the messages in a clear and coherent manner. Each project is expected to target at least one of the specified audiences and deliver key messages in a manner approved by the collaboration. This section provides brief descriptions of the various platforms and the audiences they address.

3.2. Public Web Pages

The ATLAS Public Web site is the primary hub of the online platforms. The content is organized into three major sections:

- **Discover:** static material describing the physics, collaboration, and the technology of the ATLAS Experiment;

- **Resources:** material targeted at the primary target audiences, including multimedia, applications, written material, links to activities and games, and instructions for organizing visits;
- **Updates:** dynamic news items, features, physics briefings, blogs, virtual visit pages, and any material that is frequently added or updated.

The public web pages act as a central home, in that other platforms are often used to direct the public here. All material on these pages is meant to be representative of the collaboration and is thus passed through a well-established editing and approval procedure.

The web pages were recently redesigned and ported to the Drupal™ [7] content management system. They should be online and public at the time of publication of these proceedings.

3.3. Social Media

Social Media has surpassed nearly all other ATLAS platforms in visibility and engagement with target audiences. This echoes the results of academic research in the field of communication over the past several years, since the development and rapid expansion of the usage of Web 2.0 tools for communication on the world stage [8]. Outreach uses social media as an important and effective means to reach a wide, diverse audience, both directly and via the media.

Platforms: ATLAS maintains several platforms, in order to engage different audiences with a variety of communication strategies:

- **Twitter:** Tweets are sent to announce updates on the ATLAS Web Pages, related web pages, and external articles featuring ATLAS, the LHC, and relevant items on particle physics. It is also used to retweet CERN items and to engage conversation with target audiences. [9]
- **Facebook:** Facebook entries are made for similar items as Twitter, but using images and video to attract and retain audiences. It also hosts occasional photo essays on ATLAS-related topics. [10]
- **Google+:** Currently Google+ content exactly echoes that of Facebook. Google+ is also used for the hosting of Hangouts. [11]
- **YouTube:** Hosts videos selected from the ATLAS collection on CDS. [12]

Strategy: Current usage follows typical strategies developed and employed by science communication specialists and academics [13], albeit with a heavier emphasis on announcement over engagement. This is primarily due to limited resources and can be modified. The CERN Social Media guidelines [14] are respected and specific Guidelines for ATLAS are currently being drafted. Monitoring and analysis of usage statistics is done using local and 3rd party tools, such as HootSuite® [15], Socialbakers [16], and Google Analytics [17].

3.4. ATLAS Visitor Centre

The ATLAS Visitor Centre (AVC) [18] is a museum-type exhibit located in the ATLAS complex at collision point 1 of the LHC. It features a direct view into the ATLAS control room, through a large glass wall, and contains presentation material for guided visits, as well as hands-on material for non-guided visits. There is also a viewing facility for a ten-minute 3d movie describing the ATLAS experiment.

Currently, public visits to the AVC are always guided. This is driven by demand (around 50,000 visitors in 2013), and by safety and security requirements. Experience has also shown that guided visits are a far more effective means for describing the experiment and delivering the key communication messages. Not only is the communication enhanced by the personal nature of the engagement, but it also provides the possibility for the guide to listen to the concerns of the visitors, and to clarify any potential misunderstandings.

Guides: The majority of visits are guided by official CERN Guides trained and coordinated by the CERN Visits Service (CERN DG EDU). ATLAS physicists participate as both official CERN guides or as ATLAS-trained guides.

CERN Protocol coordinates official VIP Visits, with relevant ATLAS members acting as guides. VIPs might be invited directly by collaboration members due to special circumstances. In these cases, a dedicated member of the Outreach team organizes the visits.

3.5. Underground Visits

Underground Visits take place during LHC shutdowns. They comprise a 45-minute tour 80m below ground to a viewing platform of the detector. Along the way visitors view images of the construction of the detector, pass by facilities housing data acquisition and trigger electronics, as well as services for the detector components. A guide is

always with the group, wearing a dosimeter to monitor exposure to residual radiation, following safety protocol, describing the facilities, and answering questions. Underground Visits often begin or end by visits to the AVC to complement the experience and to provide more opportunity for interaction with the group.

Dedicated support is provided for the organisation of underground visits by members of the media, including journalists, photographers, and videographers. National media visits [19], which take place during long shutdowns of the LHC, require the identification of appropriate interviewees and guides. This is done in coordination with the CERN Press Office. Other special events that can require outreach support include the visits of special interest groups, special student groups, artists, musicians, etc. These are handled on a case-by-case basis.

Guides: Guides receive safety training from ATLAS and must be certified to serve. Outreach provides educational and communication guidelines and training, on request, as with other visit guides.

3.6. Virtual Visits

ATLAS Virtual Visits [20] take place in the AVC, using a combination of videoconferencing, webcast and recording equipment installed for this purpose. The visits are designed to give participants (typically classrooms or public events) a visit experience similar to being at CERN. Guides give informal descriptions of the LHC physics program, the accelerator, the detector and the collaboration, and then field questions from the visitors.

The Virtual Visit programme began in 2011 and has grown significantly in the subsequent years. It has reached audiences in classrooms and events on seven continents (including visits from the IceCube South Pole Neutrino Observatory [22]), targeting an audience that is challenged to make the trip to CERN for geographical, economical, or social reasons.

ATLAS Education & Outreach runs the virtual visit program, communicating with the participants, reserving times for the visits and for preceding tests, identifying operators and guides, developing the web site, editing and embedding the recorded video, and publicizing the events, when public, on social media. Technical support is provided by IT, as needed. Recordings of previous visits can be seen on the Virtual Visit home page [21].

Operators: CERN IT helps to train a number of operators to run the visits, ensuring correct running of the equipment and compliance with the CERN rules for broadcast and recording. This frees the guides to focus on interaction with the audience and to deliver the physics messages in a clear and effective manner.

Guides: Anyone in the collaboration can be a virtual visit guide. Depending on the event, guides might be chosen by the participants or event organizers due to their affiliation with a relevant institute or based on language skills. Guides from other experiments or other parts of CERN might also be invited to talk, depending on the occasion. No formal training is required, although a set of recommended guidelines is available and shadow visits are also recommended.

3.7. Local Events

Events hosted at CERN or in the surrounding region are most commonly organised centrally in coordination with the CERN DG Communications and Outreach groups. Examples are Open Days, Researcher Night, Dans le peau d'un chercheur, and Anniversary activities.

ATLAS Education & Outreach serves to recruit and organise volunteers, define an educational program, prepare material (posters, videos, games, etc.), set up logistics, and provide publicity on the public web pages and social media. The activities are planned with Technical Coordination and Safety, as well as with the central CERN organizers.

3.8. External Events

Collaboration members frequently host or participate in special events designed to engage the public at their home institute or another host venue. ATLAS Education & Outreach supports these events through the development of material, translation of existing material, hosting of Virtual Visits, and publicity on the public web pages and/or social media platforms.

3.9. Masterclasses

Masterclasses [23] target students (typically aged 15-18, but ranging from elementary school through university) with specialised particle physics events featuring real ATLAS data. They encourage students by letting them be physicists for a day and allow an excellent opportunity for interaction between the students and members of the collaboration.

Physicists from a significant number of ATLAS Institutes host masterclasses with students at

neighbouring schools or during special events. Most participate in national or international programs, such as those organised by IPPOG [24], and the classes are often coupled with Virtual Visits and/or a videoconference connection with other participants.

ATLAS Education & Outreach participates by providing masterclass teachers, organising Virtual Visits, helping to secure data, and with the development of tools used to analyse the data. Outreach also provides publicity via news articles and social media. Finally, through participation in IPPOG working groups, the outreach coordination helps to develop strategy for future development.

4. Content Development & Activities

4.1. Introduction

Content supporting the platforms described above is developed using common themes and messages, by following writing style guidelines, and by reusing written and visual material, whenever possible. This assures coherence across the platforms and simplifies development and maintenance. A graphic charter, including colour scheme, fonts, and logo, is employed to create and maintain a recognisable visual identity for ATLAS.

4.2. News Articles

The ATLAS Education & Outreach Team reports periodically on the goals and accomplishments of the experiment. Content includes:

- **Reports** on recent activities, such as new physics results, conference presentations, technological advancements, human achievements, etc.
- **Features** on major milestones, key physics topics, summaries of accomplishments, expectations for new exploration, etc.

The news articles are published in a dedicated section on the public web pages, then publicised on social media, at a roughly weekly frequency.

4.3. Physics Briefings

Physics briefings are periodic write-ups summarizing recent physics results (publications or conference presentations). The topic choice is typically proposed by a physics convener, physics coordinator, member of management or outreach coordinator. The idea is to summarize the publication in 2-3 paragraphs, supported by 1-2 images, in a voice that is as general as possible.

Briefings are published on the public web pages in a similar manner as the news articles, and are also advertised via social media. The frequency of publication varies; several will be written during a major conference, for example, timed to be published concurrent to the presentations of new results.

4.4. ATLAS Blogs

Short article or story written by a collaboration member about their experiences on ATLAS. It is meant to be written in a personal voice and to describe some aspect of life working on a particle physics experiment (hardware, software, analysis, etc.). Some of the original blogs were about taking shifts in the control room. Others have been about physics analysis, detector work during shut down, or reflections on the meaning behind recent results or potential discovery.

The blogs are published on the public web pages, alongside news and briefings, and are also advertised on the social media. The frequency of publication depends on success in the recruitment of writers from the collaboration.

4.5. Brochures

ATLAS brochures are designed to describe the various aspects of the experiment to the public. Current brochures are: General Experiment, Physics, Detector, Software & Computing, and Direct Applications.

Brochures are present in the ATLAS Visitor Centre, at events hosted at CERN or at member institutes, and are available for download on the public web pages in a variety of languages.

4.6. Multimedia

Multimedia material is developed for a variety of uses and platforms, including the public web pages, social media and visitor centre. It is also developed at the request of collaboration members for usage in public talks and events, local and remote events. The material is designed in cooperation with an expert from the collaboration, with the help of CERN services or other professionals. Multimedia material includes: Photos, Videos, Animations, Event Displays, Plots, and Mixed Media.

The material is made to be general enough to serve the collaboration on multiple platforms and employs the graphic charter as described above.

4.7. Merchandise

ATLAS Education & Outreach develops and maintains a variety of merchandise (books, clothing, 3d event viewers, pens, cards, etc.) to disseminate information about the experiment either on its own or in support of public events. The material is typically conceived by Outreach and designed in partnership with a professional designer. On occasion, collaboration members might propose designs, perhaps as part of a competition, but the final look must comply with the ATLAS graphic charter before implementation.

5. Organisation

5.1. Introduction

The complete ATLAS Education & Outreach team includes all 3000 members of the collaboration, many of whom contribute actively by hosting local exhibitions, events or public talks, giving interviews to local media, translating public documents, acting as guides for visits or virtual visits, writing blogs, and engaging the public by sharing their enthusiasm for science and the physics of the LHC. The **core team** described below is primarily engaged in developing platforms, content and strategy to facilitate these activities.

5.2. Coordination

There are two ATLAS Education & Outreach Coordinators, each elected to a **two-year term** by the Collaboration Board in a similar manner to other Coordinators serving the collaboration (e.g. Physics, Computing, Trigger, etc.). Re-election requires a 2/3 vote. The terms "leap frog" each other, providing an overlap of one year, to ensure continuity of the programme.

5.3. Groups

The ATLAS Education & Outreach Project is organised in groups, each of which is led by a convener who is responsible for the group's activities and for coordinating with other groups and partners. The current group organisation is designed to cover development and maintenance of the platforms, content and activities described above: Written Content, Multimedia, Public Web Pages, Social Media, and Visits.

Conveners of the various groups, as well as most of the participants, are members of the collaboration. Most typically contribute between 10-20% of their time, as a service contribution to the collaboration. Service credits can be awarded for operators and convenors, as a means to reward institutes for their contributions to the core work.

5.4. Communication Expertise

ATLAS Education & Outreach profits from the participation of experts in writing and communication in the core team. Access to such expertise is essential for the development of strategy and implementation of a communication plan. Other expertise required by the project includes event management, exhibition design, and multimedia development. Limited resources require finding an appropriate balance of in house talent and external partnerships.

5.5. Speakers Committee

As with every major project on the experiment, there is an ATLAS Outreach Speakers' Committee. The role of the committee is to solicit opportunities for official talks, announce the talks to the collaboration, develop authorship policy, select speakers, and review material (like these proceedings) presented on behalf of the collaboration.

6. Summary

The ATLAS Education & Outreach project has developed a firm, structured basis, which has allowed it to implement a significant number of highly visible and successful outreach activities. This basis is a communication strategy that defines clear goals, target audiences, and messages that resonate with those audiences, through the development of themes describing the goals and accomplishments of the experiment.

The project organisation is designed to solicit, increase, and complement the active participation of its collaboration members by providing the communication platforms and material needed to support their efforts.

The past few years have seen a remarkable surge in the size and scope of audiences turning their

attention to the activities of our field. Efforts in the coming years will focus on using the structure and tools that are in place to continue to expand and educate this audience, communicating the importance of fundamental research, and recruiting the scientists and science supporters of tomorrow.

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References

[1] CERN is the European Laboratory for Particle Physics in Geneva, Switzerland, http://cern.ch.
[2] ATLAS is an international particle physics experiment located at one of four collision points of the Large Hadron Collider at CERN, http://atlas.ch.
[3] The ATLAS Education & Outreach Project, http://atlas-outreach.web.cern.ch.
[4] CERN's "Dans le Peau d'un Chercheur" programme is focused on introducing physics to local primary school students, http://danslapeaudunchercheur.web.cern.ch.
[5] The CERN Summer Student Programme targets undergraduate students typically in their 3rd year of university studies, http://home.web.cern.ch/students-educators/summer-student-programme.
[6] The CERN teacher programmes target secondary school physics teachers from around the world, http://home.web.cern.ch/students-educators/teacher-programmes.
[7] Drupal™ is an Open Source Content Management System, https://www.drupal.org.
[8] V. Polonski, "The evolution of social networking sites: the rise of content-centric platforms which favour the perpetual present", London School of Economics and Political Science, http://blogs.lse.ac.uk/impactofsocialsciences/2014/01/15/the-evolution-of-social-network-sites-in-2014.
[9] Twitter: https://twitter.com/ATLASexperiment.
[10] Facebook: https://www.facebook.com/ATLASexperiment.
[11] Google+: https://plus.google.com/+ATLASExperiment.
[12] YouTube: http://www.youtube.com/TheATLASExperiment.
[13] A few example social media strategies for the sciences: http://www.elsevier.com/connect/how-to-use-social-media-for-science.
[14] CERN Social Media Guidelines: https://cern.ch/security/rules/en/social-media.shtml.
[15] Hootsuite®: http://www.hootsuite.com.
[16] Socialbakers: http://www.socialbakers.com.
[17] Google Analytics: http://www.google.com/analytics.
[18] ATLAS Visitor Centre: http://www.atlas.ch/atlas_tour.
[19] CERN National Media Visits: http://press.web.cern.ch/press-visits-over-long-shutdown-lhc.
[20] ATLAS Virtual Visits: Bringing the World into the ATLAS Control Room, S. Goldfarb, *Itnl. Conference on Computing in High Energy and Nuclear Physics*, May 2012, New York, NY, USA.
[21] ATLAS Virtual Visits: http://cern.ch/atlas-virtual-visits.
[22] IceCube Neutrino Observatory: http://icecube.wisc.edu.
[23] ATLAS International Masterclasses: http://atlas.physicsmasterclasses.org/en/index.htm.
[24] IPPOG is the International Particle Physics Outreach Group: http://ippog.web.cern.ch.