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Shaping Collaboration 2006: *Action Items for the LHC*

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Abstract. *Shaping Collaboration 2006* [1] was a workshop held in Geneva, on December 11-13, 2006, to examine the status and future of collaborative tool technology and its usage for large global scientific collaborations, such as those of the CERN LHC [2]. The workshop brought together some of the leading experts in the field of collaborative tools (WACE 2006) [3] with physicists and developers of the LHC collaborations and HENP (High-Energy and Nuclear Physics). We highlight important presentations and key discussions held during the workshop, then focus on a large and aggressive set of goals and specific action items targeted at institutes from all levels of the LHC organization. This list of action items, assembled during a panel discussion at the close of the LHC sessions, includes recommendations for the LHC Users, their Universities, Project Managers, Spokespersons, National Funding Agencies and Host Laboratories. We present this list, along with suggestions for priorities in addressing the immediate and long-term needs of HENP.

1. Introduction

The scope and complexity of the LHC projects, combined with the size and geographical spread of the collaborations building and maintaining those projects, present formidable challenges to the best of communication technology. It is thus natural for the LHC community to seek guidance from experts in the field of collaborative tools and, equally, for those very experts to embrace the challenge of finding solutions to the complex problems to be faced. The *Shaping Collaboration 2006* workshop provided a forum for interaction between the two groups and also paved the way for the development of working partnerships in the various aspects of the field.

The usage of collaborative tools is certainly not new to the HENP community. For the past half-century, accelerators and their associated experiments attained a size too large to be constructed and maintained by single institutes. Researchers, many of whom are attached to universities and have teaching constraints, are required to travel to host laboratories to install, run and maintain their detectors. As a result, the usage of communication tools, such as audio and video conferencing, e-mail, chat, etc. have become essential for the field. It is not surprising, under these circumstances, that a now commonly pervasive medium, the World-Wide Web, was invented at CERN [4]. It was a natural response to the distributed nature of a field that relies on close communication and access to data and documentation.

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It is also natural to expect a premier laboratory, such as CERN, now hosting four of the most important scientific experiments ever conceived, to act as a hot spot for the development of tools benefiting from this achievement. How can the birthplace of the World-Wide Web not make every effort to remain at the forefront of the collaborative tool field, especially given the demands of these collaborations and its access to outstanding brainpower and infrastructure? Yet, only a few years previous, a report prepared by representatives of the LHC collaborations and members of CERN-IT found that only a very minimal effort was being made to maintain aging equipment at the laboratory and that no coherent effort was underway to develop tools or infrastructure to support the expected needs of the LHC [5].

In the past two years, with new leadership in place, and increasing support from CERN IT and management, significant improvements have been seen. Yet, at the time of *Shaping Collaboration 2006*, it remained unclear whether a sufficient effort would be made to scale up in time for LHC start up, nor whether the plans would benefit significantly from important advancements in the field. It is under these conditions that some of the key promoters of collaborative tool technology in HENP came together with the experts from WACE to plan the conference.

This document provides a brief summary of the talks and discussions that were held at the workshop. Other details can be found in the Conference Summary, prepared by the organizing committee (listed in section 2.2). That summary, which also includes a collection of selected slides from presentations made during the conference, can be found on the Shaping Collaboration 2006 web site at [1]. It concludes with a list of action items prepared during a panel discussion held at the close of the LHC portion of the workshop.

2. Conference Overview

2.1. Conference Goals

The goals of *Shaping Collaboration 2006*, as stated by the Organizing Committee at its inception were "… to focus on exploring how collaborative tools could meet the urgent needs of global science projects, in particular those of the CERN LHC, to provide essential means of communication between each member of their large and geographically diverse communities."

"The conference would bring together representatives of the LHC user community with experts in collaborative tool technologies to inform the latter individuals of LHC needs, and to teach the LHC community of the state of the art in collaborative tools and of innovations currently under development."

It is our opinion that the conference met and exceeded these stated goals. Not only were the communities brought together to share information and ideas, the event presented an informal atmosphere, conducive to discussion, and fostering of clear and candid interaction among the participants. Abstract ideas were debated, but the primary focus was on identifying concrete action that could be taken to improve the situation at CERN and at the home institutes, in order to prepare quickly for the needs of the LHC. A summary of these "Action Items" is presented in Section **Error! Reference source not found.**. They synthesize a multi-prong approach to address all levels of the organizational hierarchy, from users and developers, to key management and funding providers.

2.2. Organizing Committee

The program was established by an Organizing Committee, who consulted widely with experts concerning the topics of the conference. Members of the Organizing Committee included:

- R. Eisberg (DESY IT)
- P. Galvez (California Institute of Technology)
- S. Goldfarb (University of Michigan)
- J. Herr (University of Michigan)
- E. Hofer (University of Michigan, School of Information)

- T. Kawamoto (ICEPP, University of Tokyo)
- H. Neal (University of Michigan, Chair)
- H. Newman (California Institute of Technology)
- M. Storr (CERN DSU/ED)

Prof. Homer Neal chaired the organizational meetings for the first 1.5 days of the conference, focusing on HENP issues. Dr. Erik Hofer, along with a separate organizing committee from WACE, established the program for the second 1.5 days, which was a traditional WACE workshop.

2.3. Attendees and Speakers

There were approximately 100 conference participants, including registered attendees, as well as those opting to attend remotely through audio or video conferencing. The list of speakers included individuals from Germany, Italy, U.K., Japan, Korea, CERN and the US. They came from universities, research institutes, laboratories and private industry. A complete list of speakers is presented, along with the program agenda, in Section 3.

3. Program Summary

The following is an outline of the agenda of the HENP portion of the workshop program. Sessions are described, including brief summaries of the presentations and of major issues raised and discussed. Slides and web-based synchronized videos of the presentations are available via links on the conference web site [1]. We highly recommend viewing the presentations directly, to view and hear audio from the actual speaker, as well as commentary and exchanges with the audience.

3.1. Session1: Introduction/Keynote

Prof. Homer A. Neal (University of Michigan) chaired the session. It featured a welcoming statement from Jos Engelen, the CERN Deputy Director General for Science. Dr. Engelen described the challenges to be faced by CERN, as the host laboratory for the LHC, in the coming years and welcomed any input from the workshop that could help to address these challenges. He also agreed to communicate these recommendations to the Director General and to the appropriate management.

Douglas van Houweling, founding president and CEO of Internet2, then delivered the keynote presentation for the workshop, describing the current status and future plans for Internet2 and emphasizing the importance of network resource management, for communication and data transfer during the coming years.

3.2. Session 2: Reflections on the Development of the Web

Mick Storr (CERN DSU) chaired the session. He spoke on behalf of Robert Cailliau, one of the founding fathers of the World-Wide Web, who was unable to attend due to personal reasons. The presentation, called "Reflections on the Development of the Web: The Goal of Scientific Collaboration," provided an extensive and fascinating overview of the Web, its history, and its usage for scientific collaboration. The talk emphasized the importance of the Web as infrastructure for communication tools designed for large, global collaborations, such as the LHC experiments. It also provided insight for expected future developments.

3.3. Session 3: The Human Component of Collaboration

Reinhard Eisberg (DESY IT) chaired the session, which addressed important sociological aspects of large-scale collaboration. Presentations included "Intergroup Protocols and Human Collaboration," by Deb Agarwal (Lawrence Berkeley National Lab), "Theory of Remote Scientific Collaboration," by Erik Hofer (University of Michigan School of Information), and "Collaboration in Context - Capturing and Utilizing Context to Support Collaborative Knowledge Building," by Martin Wessner (Fraunhofer Institute). For much of the HENP audience, this session represented a first exposure to the theories underlying the field of Collaboration Science, and there was a great deal of interest in comparisons to issues faced by the LHC collaborations.

3.4. Session 4: Deployment Experiences / Remote Control Room

Steven Goldfarb (University of Michigan) chaired the session, which addressed previous experiences and current plans for the deployment of remote collaboration systems. Talks included a remote presentation "Beyond HENP - Experiences from UK eScience," by Andy Parker (Cambridge eScience Centre), "CMS Plans for Centres," by Lucas Taylor (Northeastern University), and "Plans for the USCMS Remote Operations Center," by Erik Gottschalk (Fermi National Lab). LHC participants were particularly interested to learn of the experience gained from the eScience initiatives, as well as to get a first glimpse of the complex technical issues facing CMS, as it constructs remote centres for monitoring the detector in real time.

3.5. Session 5: Views from the LHC

Mick Storr (CERN DSU) chaired the session, which focused on the specific issues facing the LHC community, as well as some preliminary plans to address those issues in the coming years. The talks included "An Overview of the ATLAS Experiment and the Role of Collaborative Tools in Scientific Discovery," by Steinar Stapnes (CERN), Deputy Spokesperson for the ATLAS Collaboration, "Collaborative Tools in a Grid Environment," by Rick Cavanaugh (University of Florida), "RTAG 12: An Assessment of the Collaborative Tool Needs of the LHC," by Steven Goldfarb (University of Michigan), and "Collaborative Tool Plans at CERN," by Tim Smith (CERN).

It is important to note that Tim Smith is the group leader of the CERN IT UDS group charged with installing and maintaining the collaborative tools to be used by CERN-based members of the LHC collaborations. His presentation mixed optimism concerning the plans to address issues raised by RTAG 12 and the collaborations with the realities of limited dedicated CERN resources. This sparked important discussion concerning the need to apply pressure on both CERN and the collaborations to increase funding in support of collaborative tools.

3.6. Session 6: Geography Matters

Tatsuo Kawamoto (ICEPP, Tokyo) chaired this session, addressing needs specific to collaboration members located at long distances (many time zones) from the host laboratory and those with limited resources for communication infrastructure. Talks included "The Impact of Distance and Time in Large Scientific Collaborations," by Hiroshi Sakamoto (ICEPP, Tokyo), and "The Importance of Collaborative Tools in Developing Countries," by Airong Luo (University of Michigan School of Information).

3.7. Session 7: Maximizing Returns on National Investments

Prof. Homer A. Neal (University of Michigan) chaired the session, which featured a presentation from the head of the recently formed Office of Cyberinfrastructure of the U.S. National Science Foundation, and a subsequent discussion focused on identifying potential funding sources for collaborative tool research, development, and implementation. The presentation was "Maximizing Returns on National Investments," by Dan Atkins (Head, U.S. NSF Office of CyberInfrastructure), and it emphasized the importance of collaborative tools as a means to extract the most from the U.S. LHC investments.

3.8. Session 8: Collaborative Tools, Education & Training

Mick Storr (CERN DSU) chaired the session, which discussed the various communication tools used for public education and training. Dr. Storr has been deeply involved in the organization of the Academic and Technical Training programs at CERN and has been an advocate of the usage of tools, such as web lecture archives and remote teaching facilities. The session featured the presentation "Collaborative Tools, Education and Training," by Joseph Hardin (Sakai Project), which discussed tools in use in a university environment and their potential application to the LHC.

3.9. Session 9: State of the Art

Philippe Galvez (California Institute of Technology) chaired the session, which focused on the latest developments in collaborative tool technology. Talks included "Enabling Virtual Organizations (EVO)," by Philippe Galvez, "Web Lecture Archiving, Robotic Tracking Systems, and the Lecture Object," by Jeremy Herr (University of Michigan), "MVL: A Tool to Support Maintaining, Optimizing, and Trouble Shooting Accelerator Components from Off-Site," by Roberto Pugliese (Elettra, Trieste), and "ConferenceXP: Shaping the Future of Collaboration," by Todd Needham (Microsoft Research).

3.10. Session 10: A Vision for the Future

Harvey Newman (California Institute of Technology) chaired the final session of the LHC program, presenting several views, general and specific, of the possibilities that lie ahead for the development and usage of collaborative tools for the LHC and beyond. The presentations made were "A Vision of Collaboration at the High Energy Frontier in the LHC Era," by Harvey Newman, "Using OpenGL and 3D to Manage Large Numbers of Video Conferencing Streams," by Pavel Farkas (California Institute of Technology), "Collaborative Tools and the Management of Large Experiments," by Markus Nordberg (CERN), and "Grid Enabled Collaborative Tools for Scientific Research," by Charles Severance (University of Michigan, Sakai).

One should note that Markus Nordberg is the Resource Coordinator for ATLAS. That he volunteered to give a presentation on collaborative tools in the context of managing one of the LHC experiments is admirable and displays an increasing interest on the part of these collaborations to explore new means to handle the growing complexity of the problems being faced.

4. The Panel Discussion: Action Items for the LHC

4.1. The Discussion

The LHC program agenda was concluded with a wrap-up session, chaired by Prof, Homer A. Neal, featuring a panel discussion with the purpose of summarizing the key issues identified during the workshop and preparing a list of action items to address those issues. The panel comprised Markus Nordberg, Harvey Newman, and Steven Goldfarb, representing a broad spectrum of LHC users, management, and collaborative tool developers.

In the following section, we present the laundry list of issues identified by the panel and by active participation by the audience. Each major bullet represents a key issue or question raised during the conference. The minor bullets that follow propose potential answers or means to arrive at solutions to the issues. We chose to leave the output in the exact form it took during the discussion, as we believe it captures the essence of a very important moment of lucidity that can only be found during workshops of this sort, where the key players have been locked together in substantive discussion over a significant amount of time.

4.2. The Action Items

The following list of action items was determined by the panel to represent the highest priority issues facing the LHC:

In terms of collaborative tool usage:

- **What should the LHC users and their universities do to prepare themselves for LHC data taking and analysis?**
  - Propagate the culture of collaboration within groups.
  - Train group members to utilize collaborative tools.
  - Become familiar with the collaborative tool systems CERN has deployed and plans to deploy.
  - Review and determine how to configure rooms for effective collaboration.
  - Initiate desktop conferencing, and pervasive use of collaborative tools as needed.

  - Seek cost proposals; assemble costing options.
  - Consult with national project offices about best practices.
  - Engage university administration in discussions about the importance of cost sharing for collaborative tools.
- **What should LHC project managers do?**
  - Collect information about best practices within the national environment.
  - Assign special responsibilities within the national LHC structure (e.g., Tier-2 sites).
  - Attach collaborative tool training sessions to Grid (and other) meetings.
  - Share widely the experiences of challenges faced by remote colleagues.
- **What are the spokespersons' responsibilities?**
  - Make sure that remote collaboration is possible and supported
- **What should national funding agencies do?**
  - Recognize the importance of supporting collaborative tools for its research groups; recognize the critical nature of collaborative tools for success of the LHC program.
  - Eliminate policies that restrict funding for collaborative tools
  - Support interdisciplinary efforts to develop a coordinated approach to generate collaborative environment for HENP research.
- **What should the host laboratory do?**
  - Provide necessary local facilities to support laboratory meetings and interconnectivity.
  - Modernize network connections.
  - Show users best practices and equipment information.
  - Establish "standards" for use.
  - Support laboratory structures that seek user input and advice.
- **What funding models should be used for collaborative tool hardware and staff support?**
  - Given that experiments have become proactive in supporting collaborative tools, an approach for cost sharing with the Lab should be pursued; all entities are short of funds and a shared effort should be pursued.
  - Team account charges for specific services should be implemented.
  - Experiments must be prepared to provide funds for critical short-term needs, until such time as long-term plans may be put in place. This is particularly important now in the first year of LHC running.
- **What are some notable takeaways?**
  - Many interesting r/d projects were reported (e.g., EVO developments, GECSR´, etc.
  - HENP should pursue collaboration with other communities (fusion energy community, ILC, etc.).
- **What areas should be given the highest priorities for future R/D?**
  - Integration;
  - Robustness & Ease of Use;
  - Security;
  - Pervasiveness.
- **How would one form a multi-disciplinary effort to pursue the collaborative tool needs of the LHC experiments?**
  - Agency sponsored workshop; Goal to develop vision.
  - Focus on CyberInfrastructure proposal development.
- **How can industry and the HENP community become better connected in terms of meeting the HENP collaborative tool needs?**
  - Motivate industry to partner in developments that serve large distributed organizations such as those in HENP.
  - Define pilot projects with industry with service level agreements.
  - Involve industry experts in the planned agency workshops.

5. Conclusions

The laundry list of action items in Section 4.2 provides the sharpest set of conclusions that could possibly come from the workshop. It presents a clear and succinct list of work to be done by all members of the collaborations, the HENP community, the collaborative tool research community, and the funding agencies. The generation of this list, as well as the very positive interactions held between these groups, rendered the workshop a success, from our point of view.

Now that more than a year has past since the event, however, one can also find optimism in the important progress that has taken place in preparation for LHC start up. CERN has increased both manpower and infrastructure resources, through partnerships with both ATLAS and CMS, in the form of Service Level Agreements. Audio and video conferencing facilities are being constructed in all major LHC meeting rooms, and the CERN IT developers have made a significant effort to train LHC users in the operation of the tools provided.

Even with this progress, however, it is important that we continue to address all of the issues that remain. Collaborative tools need to be recognized as an essential aspect, of growing importance, for HENP and all large, globally distributed scientific endeavours. Future planning, scale of effort, and funding must reflect this fact or we risk to waste important national and international investments in science resources.

6. References

[1] Shaping Collaboration 2006 was a conference on collaborative tool developments and policy for the LHC and for large, global science projects, in general. A summary description of the conference, agenda, and attached materials, including video archives of presentations can be found at http://cern.ch/ShapingCollab2006.

[2] The LHC is the Large Hadron Collider under construction at CERN, the European Laboratory for Particle Physics, in Geneva Switzerland. The collaborations include ALICE, ATLAS, CMS, and LHCb. More information can be found at http://www.cern.ch.

[3] WACE is the Workshop on Advanced Collaborative Environments, an annual workshop on collaborative tool theory, research, and technology: http://www-unix.mcs.anl.gov/wace.

[4] T. Berners-Lee, "Information Management: A Proposal" (1989): http://www.w3.org/History/1989/proposal.html.

[5] S. Goldfarb, et al., "Report of the LHC Computing Grid Project RTAG 12: Collaborative Tools," CERN-LCG-PEB-2005-07: http://cern.ch/muondoc/rtag12/Report/RTAG12-Report.doc.

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