

LEADERSHIP THROUGH COLLABORATION AND HARMONY: HOW TO LEAD WITHOUT FORMAL AUTHORITY

There is a growing tendency in business to recognize that pooling the ideas, resources, commitment and efforts of many is more effective than relying on the few best individuals. Here, we look at how the ATLAS collaboration at CERN – the European nuclear research center in Geneva – managed the world’s largest ever physics experiment over almost 20 years. By examining how the collaboration turned traditional leadership and project management on its head, we gain new insights into how leaders and managers can benefit from a collaborative model for implementing complex, large-scale projects.

On October 21, 2008, a new era of physics began. Swiss President Pascal Couchepin and French Prime Minister François Fillon were joined at CERN by science ministers from CERN’s member states and others to inaugurate the Large Hadron Collider (LHC) – the world’s largest “atom smasher.” By that time, about 7,000 scientists – more than half of the world’s particle physicists – were involved in the LHC project. The collider consists of a 27-km ringlike underground tunnel, straddling the border between Switzerland and France. It accelerates particles known as protons through its tunnel in opposite directions at close to the speed of light. It then forces head-on collisions inside one of the four so-called detectors located around the LHC. By analyzing the resulting debris and understanding these collisions, physicists hope to learn about the basic forces that have shaped our universe since the Big Bang and been

the foundation for the emergence of life itself.

The ATLAS detector (see **Figure 1**) is the largest, most complex scientific device ever built. It is about half the size of Notre Dame cathedral in Paris and weighs around 7,000 tonnes – as much as the Eiffel Tower. It sits in a 10-story cavern 90 meters under the ground. It handles data rates roughly equivalent to the transmission of 20 simultaneous telephone conversations by every person on Earth, and the error margin of the measurements it performs has to be less than a hundredth of a millimeter.

It took the collaboration of 169 research institutions and national agencies from 37 countries and 2,500 scientists almost 20 years to imagine, design, fund, build, install and go operational with the ATLAS detector. How did such a diverse collaboration, spread across the globe, manage to produce such incredible results?



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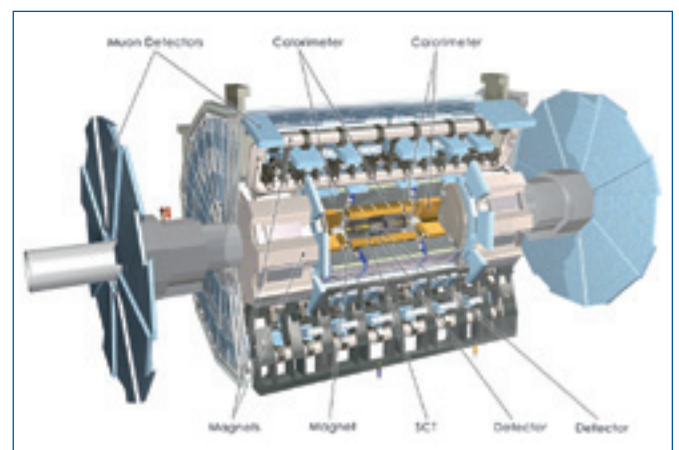


Figure 1 – ATLAS detector, Source: CERN

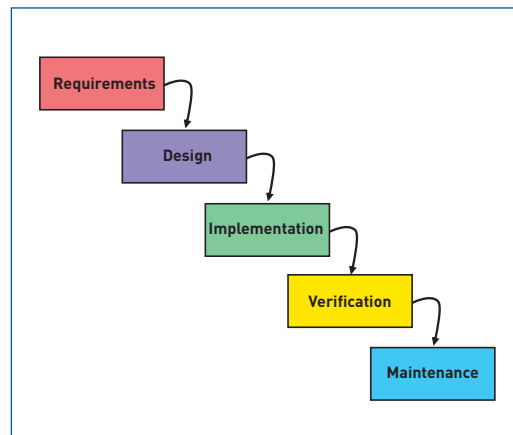


Figure 2 – The waterfall model

Breaking the Mold: Leading through Stewardship

Traditional project management uses variations of the so-called waterfall model (see **Figure 2**), in which each phase is dealt with in detail and completed before the project “flows” onto the next. However, with ATLAS, because of the complexity of building a unique instrument for which the technology did not yet exist, the waterfall approach was not possible. Above all, finding the right person to orchestrate the whole process was essential.

When Carlo Rubbia, winner of the Nobel Prize for Physics, became director-general of CERN in 1989, he launched the ambitious new LHC project. Peter Jenni was selected as “spokesperson” for the development of the ATLAS particle detector by the scientists collaborating on the project. Jenni had no authority beyond that granted to him by the people who would work with him. Still, he is recognized as the indisputable leader of the project, the man who kept it on track and ensured the ATLAS collaboration got the best out of its members. Those who know him can testify that he has little in common with a strong, top-down leader. To quote Markus Nordberg, resource coordinator at ATLAS:

Peter is a very good example of a person who quietly brings everybody together, doesn't rock the boat, wants to make sure that everybody feels that they are part of the process. He knows how to encourage people through gentle guidance.

The ATLAS management team's leadership style was more about stewardship – encouraging participation and ideas rather than dictating and directing project evolution. Funds were allocated to ideas so that they could build momentum and grow. New ideas and initiatives were always encouraged, since creativity arose out of debate and the pooling of knowledge. And each step of the project evolution demanded innovative solutions that were not known in advance. Because the members trusted and respected one another's abilities, everyone was encouraged to help resolve problems. Management's role was more about channeling the creativity and deliberations of the collaboration members. Sir Chris Llewellyn Smith, director-general of CERN from 1994 to 1998, describes the managerial challenges:

The LHC was built because the scientific community in Europe wanted it. So there was no problem in getting people to join in building the detectors. The problems were finding the resources, preventing the community from becoming too ambitious and bankrupting the whole thing, and then the managerial issue of a very multinational environment.

Building Consensus and Harmony

The 169 research institutions and 37 national funding agencies primarily financed their own national scientists. If a member of the collaboration walked away from the project, ATLAS would lose the funds linked to that person. Fortunately, this never happened, even though the ATLAS collaboration was a new experience for these highly reputed scientists who were “stars” in physics both in their own national institutions and globally. Roger Cashmore, director of research for the CERN collider program, chairman of the Resource Review Board and later deputy director-general of CERN, notes:

Ultimately, decisions had to be taken on consensus; you had to keep everybody, with an enormous diversity of skills, on board because it was technically very difficult. I don't think one could have built ATLAS or any of the other detectors without that camaraderie and commitment. You could not have done it with a top-down management system.

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Consensus building around the evolution of ATLAS was not a given; it had to be guided. To maintain harmony in the collaboration, there could be technological compromises as long as they did not affect the quality. Both process efficiency and cost efficiency might be sacrificed, but they were less important than getting a decision that would not jeopardize the functioning of the collaboration or the machine. The fact that the community as a whole voted on the winning solutions – one member, one vote – helped consensus building.

Being Open and Inclusive

Fundamentally, participants and project coordinators accepted that the collective wisdom of the collaboration was far greater than that of any one individual. Failing to propose what the collaboration judged to be the best solution did not reflect negatively on the capacity of the team. The team and its members would certainly be able to contribute later in the process. And ATLAS management always made room for the “losing” side. Those scientists whose solutions were not retained were always offered opportunities to contribute to the chosen solution.

Regular meetings – open to all – facilitated the openness and knowledge sharing. In 2007, for example, it is estimated that there were over 3,000 meetings in ATLAS. All recorded contributions, roughly 30,000, were made available to anyone to download ahead of time. Hans Hoffmann, the ATLAS technical coordinator, describes how it works:

When you walk into a problem you broadcast it around the collaboration and somebody comes up with the right idea. You then perfect it. If you don't openly share, within the collaboration at least, it doesn't work! So the schedule of meetings where you bring people together to discuss and which you repeat over and over again never stops. It's a culture of being completely open, where you don't go for intellectual property or for acknowledgment for yourself; everyone feels the importance of the ultimate goal. In such collaboration, results count. Everything is discussed. If people don't work out, they are soon no longer invited to participate in experiments. There is no hiding!

Postponing Decision Making to Manage Risks

A golden rule in the evolution of the project was: Don't rush decision making. Why? Because the highly uncertain technological environment required careful risk management. Traditionally, during the design phase, project teams attempt to identify all future risks and look for measures to reduce or mitigate them. This view is based on the logic that the future can be predicted with some certainty and that unforeseen events are the exception rather than the norm. The ATLAS management team had an entirely opposite view on risk; their way of looking at managing risk was simply to avoid it. Markus Nordberg explains:

Yes, the process is slow, it is consensus-driven. The whole point, however, is that you leave the decision ... to the last possible moment – that way you reduce uncertainty. That is the only way. You have to leave the possibility of reducing uncertainty, rather than fixing the risks.

Enabling Project Leaders to Collaborate with Discipline

To start with, ATLAS was a loose coalition of people, but once the strategic decisions had been made, there was a need for more structure. As a result, a more traditional project discipline emerged to guide the project from build to installation (see **Figure 3**).

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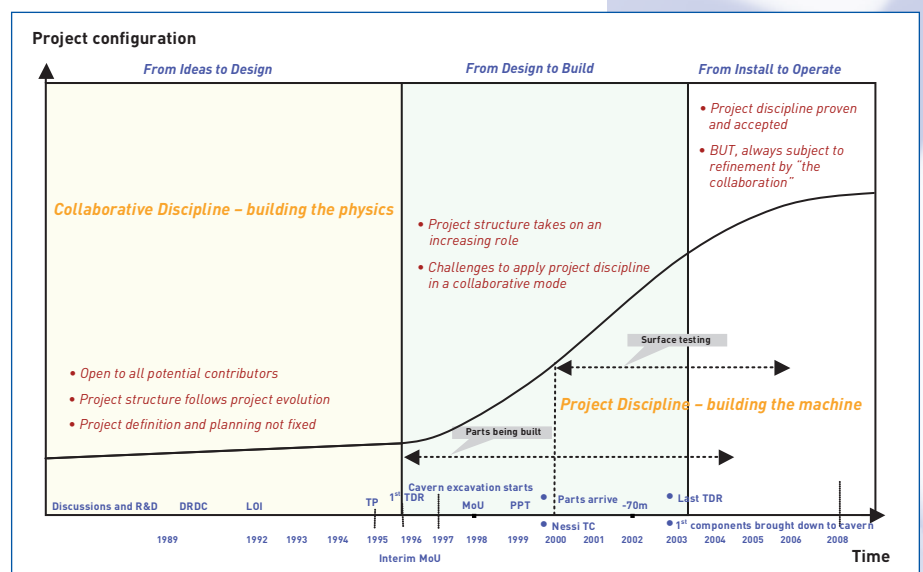


Figure 3 – Interaction between collaboration discipline and project discipline

CERN's role was to provide the legal structure and oversight processes to channel and realize the best ideas. When project leaders felt the best ideas were maturing, they required that these be encapsulated in specific documents, starting with a letter of intent. Various other documents formalized the evolution of the project, including a memorandum of understanding and technical design reports, which described in detail what the ATLAS detector would look like. The central ATLAS executive team also started organizing itself into a more formal structure. It also identified the four major building blocks, or sub-systems, that would constitute the detector and further divided them into sub-elements. As Cashmore notes:

Over those years a cultural shift developed. Work became increasingly project oriented to keep track of how money was spent. You had to make good arguments and have priorities to secure enough money for what was really needed.

From 2000, as the major components of the detector started to arrive in Geneva, the interaction between collaboration and project discipline began to change. The ATLAS management team faced strong pressure to justify the use of the funds and to ensure the components arrived on time. The complexity of the collaboration was not reduced, however. For example, one of the sub-systems was built in 14 different locations worldwide, so a monthly progress report was instituted to keep track. Finally, in 2003, the cavern was ready after six years. As Marzio Nessi, technical coordinator for ATLAS and a member of the management team explains:

All parts assembled in the cavern had first been assembled and tested on the surface as far as possible. We kept the engineering teams who had built the parts throughout the process. Still, every time we brought something down we encountered problems, whether it was with the magnets or any other part. The full detector was only finally installed in 2008.

Lessons for Business

With ATLAS now operational, the scientists involved can concentrate on the research that will expand our knowledge of the fundamental laws that govern nature and the universe. Key to the ATLAS collaboration was the capacity of all involved to work for one another and go beyond personal recognition. Apparent inefficiencies and loose processes in fact enabled harmony and compromises, which were never allowed to jeopardize the quality. Authority came out of respect from peers and was never used to coerce. Leadership meant stewardship. Perhaps these are lessons that business can apply to managing projects with high uncertainty, complexity and risk.

*For a more detailed understanding of the evolution of the collaboration, see the IMD case study by Donald A. Marchand and Philippe Margery, *The ATLAS and LHC Collaborations at CERN: Exploring the Big Bang*, IMD-3-2015, 2009.*

For further reading:

The ATLAS website: <http://www.atlas.ch/>

The CERN website: <http://public.web.cern.ch/public/>

The Large Hadron Collider (LHC) and ATLAS Experiment Virtual Reality (VR) photographic panoramas: <http://www.petermccready.com/portfolio/05061601.html>

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