

A “challenge problem” approach to training a new generation of experts in arms control

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Abstract

How do we recruit, train, and empower the next generation of arms control specialists? As LANL’s Program Director for Nuclear Nonproliferation and Security and one of a few subject matter experts at LANL with actual experience working with Russian counterparts on arms control (NDR and MKS, respectively), we have spent a lot of time and energy over the past few years trying to answer this important question.

We have tried several approaches, including creating wiki pages, archiving key documents and developing new course material. All these efforts are important and worth doing, but they haven’t proved very successful as a vehicle to truly engage the next generation.

In fall 2020, we tried a new approach. We carefully selected a group of five early-to-mid career staff from across our Laboratory who we had the skills and interest to work in nuclear arms control. We provided them with the same classified briefing we had given to senior U.S. government officials several months earlier about new START. We then challenged the group to make as much progress as they could in a 3-month period in addressing several carefully chosen, real-world arms control questions. This “challenge problem” approach is based the premise that addressing real-world problems is a more motivating and effective way to learn than reading papers and attending lectures, and initial results are promising.

This paper will briefly describe our experience in the hope that it may be useful to our colleagues with similar workforce challenges.

Introduction

National interest in arms control problems ebbs and flows based on many factors. Tracking with that ebb and flow are the numbers of staff familiar with the technical problems and the larger history. We are now entering a period of increased interest after many years of not-so-much interest and need to reinvigorate staff who have worked in this area before and replenish the numbers of staff at all levels who know something about arms control problems.

We are offering this paper because we doubt we are the only organization in this position. We also think our experience can generalize to other topics where the support varies so the pipeline for capable staff needs to be rebuilt periodically.

Prior Efforts

The need to create arms control expertise is not a new problem though we have changed how we think about it. For several years, experienced staff have retired or moved on to new opportunities and there were not broad opportunities to bring newcomers into the field. We focused on maintaining a knowledge base that could be used later when interest ramped back up. These included:

- Wiki – The goal here is to create a hyperlinked set of discussions and relevant references as a resource for anyone working on the technical side of arms control. The hope is to develop a reference that fills the gap between policy and history materials and technical papers that do not relate specifically to arms control problems. ####Reference####
- Archives – Partially in support of the wiki and partially to avoid losing relevant materials, an effort has been underway to collect, digitize, and catalogue the papers, notes, and other materials from LANL staff previously involved in arms control.
- Mentoring – The Arms Control, Treaty Verification, and Disarmament Subcommittee has developed a mentoring program linking experienced arms control staff to new comers in the field. [1] LANL has participated in this effort, but there is a barrier to entry in that mentees already have some interest in arms control.

None of these really took off within LANL. LANL is supporting these in the broader community and refer those interested to an INMM presentation this year.

- An Introduction To Arms Control At The Intersection Of Policy And Technology. Selected Topics From The ACTVD Arms Control Primer [2]

As interest in arms control began ramping up gain, solving this problem became more urgent. We know we need to

- Give staff a chance to learn more about the technical aspects of arms control
- Add to LANL’s pool of technical experts with some familiarity with the problems
- Prepare for future opportunities in this area
- Generate new ideas and connections

In the fall of 2020, we tried a new approach, which we are calling a “challenge problem” approach that more directly address what we needed.

The “Challenge Problem” approach

The idea behind a “Challenge Problem” is to define an interesting problem, the “Challenge” and minimize barriers to entry for people to try and solve the problem. The first part makes the effort relevant to the real world, so is more engaging than reading papers to create a wiki or an archive. The second part avoids the issue that getting a proposal funded to develop a new idea is easier if you already have a track record in the field.

The DARPA Red Balloon Challenge is a good example. In 2009, DARPA posed a problem, on a given day find 10 red balloons that will appear in various locations across the United States. The challenge was focused on creating new ideas for how communications interact with the internet and social networking. As a model for us, it showed how posing a new question to those who may or may not have considered it before, intentionally limiting the amount of time available and letting people engage a “fun” puzzle, can lead to new engagement and new ideas. [3]

Cohort 1 was composed of staff relatively early in their careers. None were brand new to LANL, but all were new to arms control. This allowed us to draw on their existing expertise, but add to it to begin creating a new generation of expertise.

Cohort 2 was composed of staff who had significant program responsibilities, such as program managers or the leads for larger projects. This also allowed us to draw on their existing expertise

while adding to the pool of potential arms control expertise and incorporating their pre-existing skills in thinking about what a sponsor needs.

We used the same initial approach with both groups. We provided a briefing on the basics of arms control, an overview of the history of arms control, the larger problem frame work, and current problems. We gave both groups the same (classified) briefings on-site based on prior presentations we've provided very senior USG officials who came to LANL in the past few years to learn about AC for real world mission needs. In addition, they were sent reading materials and some additional special speakers were scheduled.

We then suggested several realistic, real-world questions for the group to focus on, similar to

- How can we determine presence or absence of high explosive?
- How can we evaluate monitoring scenarios?
- How do we count number of warheads in a container?

along with a number of other topics that have been previously identified as incompletely solved.

The expectation was not that either cohort would come up with a brand new approach during this brief exercise, rather it was to provide a vehicle for diving in and learning. The use of real, unsolved questions provided a framework and motivation for exploring a range of solutions, bounded by time and budget. Each cohort was given an end date at which point they gave a final presentation to a range of line and program managers.

Results

Cohort 1 was assembled just as the winter surge in pandemic numbers started so while it was possible to have some meetings on site, they were limited in how much they could meet directly and how deep into classified topics they could go. The work they were able to complete centered around the question: "How can we distinguish between one and multiple warheads on a missile without revealing sensitive information?" They completed a literature review and discussions to identify past work and possible options. They then did their own overview of solutions and down selected to a couple of options informed by a systems engineering methodology.

One tweak to our direction to Cohort 2 based on Cohort 1's experience was to think a bit more about new ideas which could lead to new proposals. That was to help push things a bit beyond what has been done already. The work done by Cohort 2 was similar to that by the earlier group, but they were able to identify and do some initial modeling on a possible new approach to warhead verification.

More important than the technical output of either Cohort was the feedback from the participant. All participants expressed appreciation for the opportunity. It was clear based on their presentations and later discussions that all participants gained better understanding of the problem space in general and an appreciation for some of the constraints arms control brings to measurements. These included:

- Understanding the difficulty of balancing the need to protect sensitive information and the need to get a sufficient signature to confirm a declaration.
- The limits of novel technologies. For example, measurements that took too long or exposed the weapon to previously unconsidered conditions may not be usable.

- Counting weapons pose significantly different problems than counting delivery vehicles.

In both cases, as line and program managers with experience in this area, we were impressed by what was generated given the relatively short timelines. While it is still too early to know who from the groups will participate in deeper efforts in arms control, we are continuing to engage them with workshop opportunities and proposal development.

Conclusions, Recommendations, and Future Plans

There are some things we would change based on our experience with the first two cohorts.

- We need to consider team balance in areas of expertise. These cohorts were radiation detector focused. This made it difficult in each case for a non-radiation expert to contribute. In the future, we will consider centering about other areas of expertise.
- While COVID limitations were beyond our control, the first cohort was heavily constrained by limits on meeting in person and in secure facilities. The second cohort was less constrained, but still unable to work as closely together as would be ideal. In the future, we expect staff will be able to do more getting together to talk through ideas.
- We intentionally constrained the amount of time available in order to limit the demands we were making on already busy staff. However, a common theme once interest was piqued was a desire for more time to study the history of research on specific problems and past measurement systems, classified and unclassified. We are addressing this in part by bringing participants in on current workshops so they can be part of discussions of where things are now and why.
- More forward thinking background material and proposals, as opposed to focusing on past (expired) treaties, were requested. We are providing new speakers who can address more current perspectives though to some extent forward thinking will have to be guesswork.
- It would be useful if the participants had more information on nuclear weapons themselves. A basics of nuclear weapons will be considered both for new cohorts and for past participants to help their understanding.

Compared to our other efforts, this was a resounding success. Both cohorts remained engaged through the end of the defined tasking and provided good out briefs on their results and experience. Staff involved in the effort both provided positive feedback about the experience and have been willing to participate in follow-on efforts. This meets our original objective of getting a new generation of LANL staff involved in arms control and gives us a basis on which to continue building momentum.

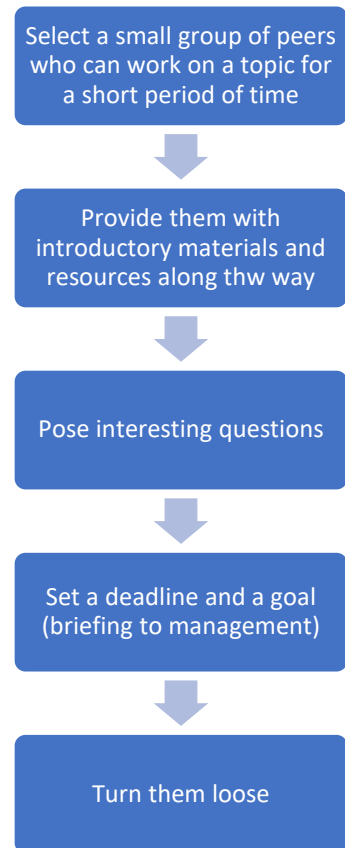


Figure 1 summarizes our process that we hope to continue to use with new cohorts. One option is to bring together another group of early career radiation detection focused staff. Another is to look at experts from a different area, such as seismology and related detonation detection experts who could look at a different set of

Figure 1 Arms Control Challenge Process

problems. This would allow other parts of LANL to be better engaged. We are also planning on sessions with the first two cohorts to brainstorm ideas that can feed a proposal development process. Long term success of the effort will be demonstrated by continued engagement and the development of new arms control tools by LANL staff.

References

- [1] K. Jenkins, J. Benz, M. Decroix and M. Smith, "Training the next generation of experts through the INMM Arms Control, Treaty Verification, and Disarmament (ACTVD) Pilot Mentorship Program," in *Proceedings of the Institute of Nuclear Materials Management Annual Meeting*, Palm Desert, CA, 2019.
- [2] J. Benz and G. Flynn, " An Introduction To Arms Control At The Intersection Of Policy And Technology. Selected Topics From The ACTVD Arms Control Primer," in *INMM & ESARDA Joint Annual Meeting*, Online, 2021.
- [3] Defense Advanced Research Projects Agency, "Red Balloon Challenge," Defense Advanced Research Projects Agency, [Online]. Available: <https://www.darpa.mil/about-us/timeline/network-challenge><https://www.darpa.mil/about-us/timeline/network-challenge>. [Accessed 27 July 2021].

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