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State of the Research Environment – 2013

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Abstract

This report describes the condition of the research environment at Sandia National Laboratories and outlines key environment improvement activities undertaken by the Office of the Chief Technology Officer and the Sandia Research Leadership Team during fiscal year 2013. The report also outlines Lab-level objectives related to the research environment for fiscal year 2014.

Acknowledgments

Many Sandians have contributed to the production of this report. We would like to thank Leslie Phinney for her contributions to assessing and improving the research environment at Sandia and providing her perspectives for this report. We also thank all of the members of the Research Leadership Team who accepted Leslie's recommendations and actively worked, and continue to work, to create a better research environment for Sandians. Finally, we thank the CTO Office team for their support and contributions, including Ben Cook, Richard Macklin, Sheri Martinez, Pete Atherton, and Chris Miller.

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Executive Summary

This report describes the condition of the research environment at Sandia National Laboratories and outlines key environment improvement activities undertaken by the Office of the Chief Technology Officer (CTO Office) and the Sandia Research Leadership Team (RLT) during fiscal year 2013 (FY13). The report also outlines Lab-level objectives related to the research environment for FY14.

Six elements provide the framework for gauging the condition of Sandia's research ecosystem: (1) the types of research we pursue, (2) line of sight to Laboratory objectives, (3) talent attraction and retention, (4) work structure, (5) policies/procedures, and (6) facilities/equipment. As FY13 ended, the CTO Office looked across the research enterprise using each of these elements to evaluate state of health and found the condition of the research environment to be *Good*, with room for improvement.

FY13 Actions and Outcomes

Throughout FY13, the CTO Office and the RLT undertook a series of activities to improve the research environment. These activities included defining the ideal research environment, identifying areas for improvement in the existing environment, and obtaining personal commitments from the RLT to implement improvement activities. The table below summarizes each of these activities and organizes them by the six elements of the research environment.

Elements	Actions
Research	• Created of Exploratory Express LDRD • Launched Research Challenge information sessions and associated workshops, colloquia, distinguished lecture series, and similar events • Developed Research Quality Standards
Line of Sight	• Expanded LDRD information sessions to include research strategy • Launched Research Challenge information sessions and associated workshops • Included staff in strategic planning by Research Foundations and Research Challenges • Communicated regularly and intentionally with management and staff about research strategy and research conducted in each center • Emphasized and rewarded professional society engagement, publications, patents, awards, etc. during performance reviews • Conducted CTO tours of centers and research foundation activities
Talent	• Mentored staff and managers • Named three new Sandia Fellows • Created a joint hire agreement between Sandia and University of New Mexico

Elements	Actions
	• Increased nominations for professional society fellowships, national awards, etc. • Sponsored activities that brought students (K-20) to Sandia
Work Structure	• Engaged on time charging policy • Developed Research Challenges that will increase synergy and alignment among projects
Policies/Procedures	• Engaged on the time charging policy • Engaged on the definition and implementation of DOE Conference Rules
Facilities/Equipment	• Piloted workspace enhancement for increased staff interactions at CERL

RLT members and the CTO Office reported general success at gathering people together, increasing staff understanding of Laboratory priorities, engaging staff in research strategy development, and nominating managers and staff for external recognition and awards.

FY14 Priorities

Sandia strongly acknowledges the importance of the research environment to the accomplishment of world-class research by including it as one of the three goals of the Research Strategy. Further underscoring its importance are Lab-level milestones that focus on specific areas in need of improvement. In FY14, two Lab-level goals with associated milestones and deliverables specifically address elements of the research environment. These priority areas under Sandia Strategic Objective 4 (SO-4) "Excel in the practice of engineering" are:

- SO-4, Goal 2 - Enhance our engineering environment
  - Milestone 4.2.3: Deploy and socialize the Research Quality Standards
    - Deliverable 4.2.3.1: Distribute the Research Quality Standards to all employees in declared research centers
    - Deliverable 4.2.3.2: Execute a laboratory communication strategy and provide web tools via the CTO website
    - Deliverable 4.2.3.3: Develop linkage to the Nuclear Weapons (NW) Realize Product Procedure and Defense Systems & Assessments (DSA) Mission Assurance frameworks

- SO-4, Goal 3 - Enhance our competencies through external engagement
  - Milestone 4.3.1: Enhance collaborations with academia, government, industry, and professional societies
    - Deliverable 4.3.1.1: Deploy "external award" tools and track
    - Deliverable 4.3.1.2: Assess the current UNM joint hire process and result and develop lessons learned for future implementation

        - Deliverable 4.3.1.3: Implement new partnership tools

    - Milestone 4.3.3: Take actions to improve Sandia's research environment
        - Deliverable 4.3.3.1: Assess implementation of the RLT research environment commitments
        - Deliverable 4.3.3.2: Benchmark how other corporate R&D leaders maintain the health and vibrancy of their research environment
        - Deliverable 4.3.3.3: Increase delivery of high impact publications

It is our intention to report on the results of the FY14 SO-4 milestones and deliverables and associated RLT and CTO Office actions in next year's FY14 State of the Research Environment report.

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1. Background

The research environment has long been an area of interest and concern at Sandia National Laboratories. Physicist Dick Claassen is credited with beginning Sandia's research enterprise in the late 1950's. In his report describing the characteristics and guidelines for a research organization at the Lab, Claassen wrote, "I believe that we must establish a proper atmosphere – one which is conducive to effective research work." [1]

That "atmosphere" – or today what we call the research environment – consists of a variety of elements. At Sandia, we organize these elements into (1) the types of research we pursue, (2) line of sight to Laboratory objectives, (3) attraction and retention of talent, (4) work structure, (5) policies/ procedures, and (6) facilities/equipment. These elements, with the stated goal to "steward and nurture a vibrant, problem-rich research environment," appear in Sandia's Research Strategy.

Although acknowledged as an important element of the research enterprise throughout Sandia's history, the research environment has not consistently received the attention it deserves. It is often relegated to the "important but not urgent" when operational or administrative issues demand attention.

In 2013, following several studies conducted over 10 years that had similar findings and observations, the Research Leadership Team (RLT)[2] committed to personal actions to improve the research environment. The Office of the Chief Technology Officer (CTO Office) also committed to a set of actions, one of which was to produce this report annually. Our goals for this report are to increase awareness of this important topic, communicate actions taken over the course of each FY to improve the research environment, and to provide a set of measures to document the evolution of research environment quality over time.

The following pages assess the condition of Sandia's research environment and outline the key environment improvement activities undertaken by the RLT and the CTO Office during FY13. We also outline FY14 Lab-level objectives related to the research environment that provide direction for subsequent activities by the RLT and CTO Office.

[1] R.S. Claassen, *Presentation to M.J. Kelley Describing Plans for Fundamental Research at Sandia*, pp. 6-7, 31 May 1957, Collection #7, 1100 History of Research (F. L. Vook) Solid State Science, Sandia National Laboratories Corporate Archives.

[2] RLT membership consists of the CTO, the Deputy CTO, Directors of Research Centers, and Strategic Management Unit (SMU) Director Representatives. Additional "at large" representatives from the research community and CTO Office are invited by the CTO. Research Centers are defined as those with a significant percentage of work dedicated to some aspect of research, or the work has a significant impact on the research community as determined by the CTO. (https://cto.sandia.gov/rlt.html - Sandia Restricted Network)

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2. State of the Research Environment

One of the goals in Sandia's Research Strategy is to "steward and nurture a vibrant, problem-rich research environment."[3] We parse this goal into six elements: (1) the types of research we pursue, (2) line of sight to Laboratory objectives, (3) attraction and retention of talent, (4) work structure, (5) policies/ procedures, and (6) facilities/equipment. This framework provides a simple but adequate way of gauging the condition of our research ecosystem.

As FY13 ended, we looked across the research enterprise using each of these elements as a lens through which we evaluated state of health. In aggregate, we found the condition of the research environment to be *Good*, with room for improvement.

Admittedly, measures did not accompany our appraisal in this first year of our assessment. Though we recognize their value, we have not yet reached consensus on the appropriate measures to track. A priority of the CTO Office in FY14 is to identify and begin tracking primary indicators of the state of the research environment.

2.1 The Six Elements

A summary of the state of each element in the research environment follows. We also note areas for attention and improvement.

- **Research** – Numerous reviews by Sandia's external advisory boards provide ample independent evidence that we are pursuing compelling and challenging national security solutions through our research. Our research portfolio also consists of a balanced mix of projects that span the full R&D (research and development) lifecycle (fundamental through applied research). An area that warrants some attention is improving awareness of and appreciation for the different drivers and value systems that are inherent in each part of that lifecycle. For example, fundamental research focuses on understanding all aspects of phenomena whereas applied research focuses on a particular problem or application. These drivers have very different value systems.

  Attention to improving Sandia's publication rates (e.g., journal articles), with emphasis on those that report Laboratory Directed Research and Development (LDRD) results, is also necessary. We found that Sandia's LDRD-related publication rates are unacceptably low, especially when compared to the other NNSA (National Nuclear Security Administration) laboratories.[4] Publishing results, with commensurate intellectual property protection, is a required product of research. In addition to open journals for unclassified work, venues for classified publication exist. Sandians should better utilize both.

- **Line of Sight** – Throughout FY13, we sought to articulate Laboratory strategic objectives and research challenges more effectively such that researchers could better connect their

[3] Appendix A: Sandia Research Strategy – Goal 3 outlines this goal in detail.
[4] Per publications and LDRD funding averages reported in Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and Sandia National Laboratories LDRD Annual reports FY10-FY12. http://tri-lab.lanl.gov.

work to Sandia's larger national security missions. However, much work remains to help our researchers understand the Laboratory's strategic directions and the importance of research to delivering on our mission commitments.

- **Talent** – The Laboratory continues to attract highly skilled talent as evidenced by the number of new employees added to our ranks and the rigorous criteria we use for candidate selection. In his 2013 State of the Labs address, Labs Director and President Paul Hommert noted that 30% of current Sandians have been at the Laboratory less than four years. (This large influx of new employees stemmed largely from an unprecedented number of retirements due to changes in Sandia's pension plan and health benefits.)

  Overall, talent retention continues to be extremely high, particularly when compared with industry. Attrition at Sandia has averaged <2% over the past five years (sans retirements and dismissals). However, there are isolated pockets where we have lost top researchers to industry because of salary competition. Leaders have observed that in recent years it has become more challenging to attract top talent to the Laboratory in certain fields. For example, in the computing and information sciences.

  Active external engagement with peers, though highly valued at the Laboratory, was inhibited in FY13 due to Department of Energy (DOE) rules on conference attendance.[5,6] These conference constraints and their implementation cast an enormous dark cloud over the research environment at Sandia and the rest of the DOE national laboratory system. Detrimental effects of these restraints will likely manifest themselves for a long time into the future.

- **Work structure** – Engagement by the CTO and Sandia's management team on a new time charging policy for "time compression"[7] minimized negative consequences to Sandia's work structure (also see "policies/procedures" below). Early versions of the policy had the potential to impose severe restrictions on time charging for professional development activities, especially professional society engagement and some types of proposal writing and reviewing.

  Sandia researchers often complain about insufficient autonomy and discretionary time for uninterrupted, focused thought. The Laboratory's workload for the B-61 Life Extension Program and the national fiscal environment make it difficult to address these complaints in a visible and meaningful way. However, the identification and maturation of focused Research Challenges provide an opportunity to attract external visibility and increased funding (internal and external) in more focused areas. Over time, we expect that researchers engaged in these Research Challenges will see that the suites of projects they are working on better align with each other, enabling more continuity in their work.

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[5] Daniel B. Poneman, *Updated Guidance on Conference-Related Activities and Spending*, DOE Secretarial Memo, December 6, 2012, www.directives.doe.gov/references/Conference-Related_Activities_and_Spending/view.
[6] *GC Guidance on Conducting and Participating in Conferences (Reissued 7-5-12)*, www.doe.gov/sites/prod/files /GC%20Conference%20Guidance.pdf.
[7] "Time compression" is the practice of proportionally allocating all time expended by an employee across all benefiting projects in order to follow the principle of fair treatment to all customers.

In some research centers, an additional factor that detracts from staff's ability to focus is high and possibly increasing fractionalization of work – each researcher working on many unrelated projects at a small level of charging. Implementation of the Research Challenges and realization of the Labs' vision of multiple core sponsors who invest in our capability base will help over time. However, the reduced level of NW funding for early stage research results in increased support by multiple small programs from other sources, further adding to fractionalization. It is unclear at present how best to address this issue in the near term.

- **Policies/procedures** – The CTO and several other members of Sandia's management team engaged vigorously in discussions about the implementation of a new time charging policy for exempt staff. This engagement minimized the potential detrimental effects time compression will have on the research environment over the coming months and years. In addition, the CTO Office noted inconsistent implementation of one Sandia policy/procedure in FY13. We found that while corporate policy/procedure allows reimbursement for professional society dues and professional development time,[8] line organizations do not implement it consistently. In FY14, this warrants attention to uncover the reasons for the inconsistencies and to identify potential solutions.

- **Facilities/equipment** – Sandia researchers, in general, have access to state-of-the-art facilities and equipment to accomplish their work. These facilities and equipment are sometimes located at other institutions since in many cases it is neither fiscally prudent nor essential to build certain facilities or acquire equipment that staff can access elsewhere. Nothing came to the attention of the CTO Office during FY13 to indicate that current administrative and operational policies/procedures unduly hinder access for our researchers. However, a small number of Sandia facilities have aged considerably and require much-needed upgrades. Continued attention to and advocacy for the highest priority capital improvements are vital to the research environment.

2.2 Research/Researcher Accomplishments

The six elements outlined above combine to create an environment where research can thrive at the Laboratory. Abundant awards, society fellowships, peer-reviewed research publications, etc. illustrate the acumen of our highly skilled workforce and the leading edge research they conduct. It is impossible to list all of these accomplishments here, but we offer a few representative highlights from FY13 below.

Awards and Recognition

A number of Sandians received awards and recognition from professional societies and other organizations, including:

- Three American Physical Society Fellows
- Two American Ceramic Society Fellows

[8] Sandia Corporate Procedure FIN100.1.PAY.8 "Obtain Company-Paid Employee and Corporate Professional Memberships, Licenses, and Certifications."

- One Institute of Electrical and Electronics Engineers Fellow
- One American Institute of Aeronautics and Astronautics Fellow
- One American Chemical Society Fellow
- Three 2013 Black Engineer of the Year awards
- One 2013 Asian American Engineer of the Year award
- One 2013 Hispanic Engineer National Achievement Award
- Four R&D 100 Awards

Scholarly Publications and Covers

Peer-reviewed research publications in top journals illustrate the quality and leading edge nature of the research conducted at Sandia. Again, it is impossible to list all of these accomplishments here, but we offer a few representative highlights from FY13 below.

- A report titled "Direct Measurements of Conformer-Dependent Reactivity of the Criegee Intermediate CH_3CHOO" appeared in *Science*.[9]
- "Three-Dimensional Mapping of Quantum Wells in a GaN/InGaN Core-Shell Nanowire Light-Emitting Diode Array" appeared in *Nano Letters*.[10]
- Two papers related to an LDRD project on "tunable metamaterials for agile filtering in the infrared" appeared in *Applied Physics Letters*.[11,12]
- A silicon chip fabricated in the Microsystems and Engineering Applications (MESA) facility appeared on the cover of *Science.*[13]
- *The Journal of Chemical Physics* featured "Large-scale molecular dynamics simulations of evaporation-induced nanoparticle assembly" on its cover.[14]
- "Self-assembly in a mixed polymer brush with inhomogeneous grafting density composition" appeared as the cover story in *Soft Matter*.[15]
- *ACS Macro Letters* featured an article titled "Atomistic Simulations Predict a Surprising Variety of Morphologies" on the cover.[16]

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[9] Craig A. Taatjes, Oliver Welz, Arkke J. Eskola, John D. Savee, Adam M. Scheer, Dudley E. Shallcross, Brandon Rotavera, Edmond P.F. Lee, John M. Dyke, Daniel K. W. Mok, David L. Osborn, Carl J. Percival, *Direct Measurements of Conformer-Dependent Reactivity of the Criegee Intermediate CH_3CHOO*, Science, 12 April 2013, Volume 340, Number 6129, DOI: 10.1126/science.1234689.

[10] James R. Riley, Sonal Padalkar, Qiming Lee, Ping Lu, Daniel D. Koleske, Jonathan J. Wierer, George T. Wang, Lincoln J. Lauhon, *Three-Dimensional Mapping of Quantum Wells in a GaN/InGaN Core-Shell Nanowire Light-Emitting Diode Array*, Nano Letters, 6 August 2013, 13 (9), DOI: 10.1021/nl4021045.

[11] Sheng Liu, Jon F. Ihlefeld, Jason Dominguez, Edward F. Gonzales, John Eric Bower, D. Bruce Burckel, Michael B. Sinclair, Igal Brener, *Realization of tellurium-based all dielectric optical metamaterials using a multi-cycle deposition-etch process*, Applied Physics Letters, 102, 161905 (2013), DOI: 10.1063/1.4803019.

[12] Burton Neuner, Chihhui Wu, Gregory Ten Eyck, Michael Sinclair, Igal Brener, Gennady Shvets, *Efficient infrared thermal emitters based on low-albedo polaritonic meta-surfaces*, Applied Physics Letters, 102, 211111 (2013), DOI: 10.1063/1.4808086.

[13] *Science*, 8 March 2013, Vol. 339.

[14] Shengfeng Cheng, Gary S. Grest, *Molecular dynamics simulations of evaporation-induced nanoparticle assembly*, The Journal of Chemical Physics, February 2013, Volume 138, Issue 6, DOI: 10.1063/1.4789807.

[15] Su-Mi Hur, Amalie L. Frischknecht, Dale L. Huber, Glenn H. Fredrickson, *Self-assembly in a mixed polymer brush with inhomogeneous grafting density composition*, Soft Matter, 2013, 9, DOI: 10.1039/C3SM50173F.

[16] Dan S. Bolintineanu, Mark J. Stevens, Amalie L. Frischknecht, *Atomistic Simulations Predict a Surprising Variety of Morphologies in Precise Ionomers*, ACS Macro Letters, 2013, 2 (3), DOI: 10.1021/mz300611n.

3. FY13 Research Environment Improvement Activities

Recognizing that we were "contemplating" research environment issues without taking visible and consequential steps for improvement, the RLT and the CTO Office committed to taking actions that were neither discrete nor temporary. Combined, these actions represent a holistic effort toward improvement. Further, a long-term goal is that these activities will help develop a mindset where unflagging and deliberate attention to the research environment is an integral part of all Sandia's endeavors.

3.1 Defining the Ideal Research Environment

First on the list was to define what an ideal research environment at Sandia would look like. The RLT referenced Daniel Pink's intrinsic motivation framework and set out to describe an environment that kept these motivators in mind. Pink argues that purpose, mastery and autonomy are the most powerful motivators in complex work activities (as opposed to rewards and punishments). [17,18] He describes these motivators as:

- Purpose – a yearning to do what we do in the service of something larger than ourselves,
- Mastery – the desire to get better and better at something that matters, and
- Autonomy – the urge to direct our own lives.

With this framework in hand, the CTO Office and a sub-team within RLT sought input from early career researchers and senior scientists and engineers to develop a suitable description. RLT adopted the resulting *Ideal Sandia National Laboratories Research Environment* description on December 14, 2012.[19] This description sets a high bar for the environment the RLT would like to nurture. To reflect this intent further, we modified goal three of Sandia's Research Strategy objectives to include much of the same language.

3.2 Identifying Areas for Attention

After describing the environment that we wanted to nurture, our next task was to identify specific areas that warranted RLT attention and action. Accordingly, the CTO Office commissioned an analysis of the current environment,[20] including a review of several studies and surveys conducted over 10 years that examined different aspects of the workplace.[21,22,23,24]

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[17] Daniel H. Pink, *Drive: The Surprising Truth About What Motivates Us*, Riverhead Books, New York, NY, 2009.
[18] Dan Pink, *The puzzle of motivation*, TEDGlobal 2009, http://www.ted.com/talks/dan_pink_on_motivation.html.
[19] Appendix B: Ideal Sandia National Laboratories Research Environment provides additional detail.
[20] Leslie M. Phinney, *Improving Sandia National Laboratories' Research Environment*, Sandia Report, May 2013, SAND2013-4206.
[21] Gretchen B. Jordan, Devon Streit, J. Stephen Binkley, *Assessing and Improving the Effectiveness of National Research Laboratories*, IEEE Trans. on Engineering Management, Vol. 50, pp. 228-235, 2003.
[22] Gretchen B. Jordan, *What Matters to R&D Workers*, Research Technology Management, pp. 23-32, May-June 2005.
[23] Lani M. Sanders, Michael Gregson, Kim Edson, Linda Houston, Dean Jones, Mark Ladd, Joan Luciano, Chuck Maheras, Linda Nozick, Thor D. Osborn, Ruby Pai, Lori Parrott, Margie Tatro, Jessica G. Turnley, Tommy Woodall, *Executive Synopsis: Leveraging Our Strengths Towards an Ever More Engaging Environment: A Systems Study of Engagement and Retention*, Sandia Report, December 2011, SAND2011-9330.

The CTO Office analysis found that these earlier studies and surveys reached similar conclusions. Sandians were consistently saying that they desired:

- Improved line of sight between daily work and Sandia's national security missions,
- More career growth and development opportunities,
- Increased time to focus, and
- Better understanding of research and mission strategies.

Using these persistent themes and Daniel Pink's framework described above, the CTO Office report recommended three areas for attention by RLT members:

- Improving line of sight to Lab objectives,
- Promoting the prestige of learning, and
- Facilitating improved appreciation for the different drivers and value systems that are inherent in each part of the R&D lifecycle (from fundamental research to mission delivery).

At a meeting held on March 20, 2013, RLT members chose to focus their FY13 efforts on promoting the prestige of learning. The CTO Office had already embarked on improving line of sight with a series of information sessions about the Research Strategy. The RLT deferred attention to the third recommendation to a future focus.

The RLT committed to reporting annually on its members' personal actions to demonstrate the value placed on continuous learning at the March 20 meeting. The commitment included, but was not limited to, continued professional development, attending Sandia seminars and talks, and nominating staff and managers for appropriate professional recognition. RLT members also committed to setting the same expectations for their direct reports and cascading them down through their organizations, as well as appropriately rewarding the behaviors they collectively want to encourage.

During the same meeting, the CTO Office committed to identifying and reporting any negative effects caused by certain corporate policies and procedures. The CTO Office also agreed to release an annual "State of the Research Environment" report to increase awareness about this important topic.

3.3 Actions Taken and Outcomes Observed

RLT Actions

Following six months of active engagement, RLT members gave a report of their actions at a meeting on October 31, 2013. During the roundtable discussion, each member offered examples of actions they took to set expectations, establish rewards, personally demonstrate the behaviors expected of everyone in their organization, and directly promote the prestige of learning. In summary, the RLT reported that they:

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[24] Jim Danneskiold, *We Heard Your Voice: Sandia Leadership Implements Measures to Address Concerns Raised in LM Voice Employee Survey*, Sandia Lab News, pp. 1, 4, February 8, 2013.

- Included overviews of the research strategy during information sessions about the FY14 LDRD investment area calls to increase line of sight to the Labs' priorities.
- Communicated more intentionally and more often with management and staff (at All Hands and small group meetings, via newsletters, etc.) about research strategy and research conducted in their centers. These communication avenues also presented opportunities to recognize staff who had received awards, fellowships, papers published in high impact journals, etc.
- Included more staff in Research Foundation and Research Challenge strategy discussions to increase their engagement and provide line of sight to Laboratory objectives.
- Sponsored or hosted colloquia, distinguished lecture series, and similar events that the RLT member attended with the expectation of attendance by members of his/her management team.
- Engaged in more opportunities to nominate staff and managers for national and international recognition, such as professional society fellowships and awards.
- Emphasized and rewarded professional society engagement, publications, patents, awards, etc. during performance reviews.
- Mentored staff and managers in ways that promote the management of careers and searched out ways to help staff whose work is deeply classified to stay visible in the external research community.
- Sponsored a joint hire agreement between Sandia and the University of New Mexico (UNM) to enhance collaborations.
- Sponsored activities that brought students (at all levels, K-20) to Sandia to familiarize them with science and work in a national security laboratory setting.
- Invited the CTO to tour a center or set of research foundation activities and hear selected staff discuss their research.
- Reconfigured workspaces in the Cyber Engineering Research Laboratory (CERL) to promote collaboration and foster serendipitous interactions amongst staff.

RLT Action Outcomes

In general, RLT members reported that both staff and management responded positively to their increased focus on "promoting the prestige of learning." They were successful at gathering people together, increasing staff understanding of Laboratory priorities, engaging staff in research strategy development, and nominating managers and staff for external recognition and awards. All RLT members reported that they intend to do more of the same in FY14.

One area identified by the RLT for improvement was to increase the degree of technical engagement of first-level managers with staff. It appears that managers are increasingly distanced from the technical work conducted in their departments. Obtaining a better understanding of the root cause of the decrease in first-level manager technical engagement should be a priority for the coming year. In addition, RLT members expressed a general desire for more recognition events including possibly creating "Lifetime Achievement" awards that recognize service to the Labs as well as technical achievement.

CTO Office Actions

During the same meeting, the CTO Office reported on engagement in Lab-level activities to improve the research environment. In summary, the CTO Office reported that we:

- Hosted a series of lunchtime Research Challenge information sessions to provide line of sight to Laboratory objectives, and supported associated Research Challenge workshops to engage staff in activities that will position Sandia for the future.
- Initiated the Exploratory Express Investment Area within the LDRD program to stimulate excitement in the research community and promote trailblazing within this discretionary research portfolio.
- Engaged in numerous dialogues regarding DOE conference attendance rules and a new time charging policy on "time compression" to improve interpretation and guidance, reduce complexity and the time associated with adhering to the rules, and to minimize other potential detrimental effects on the research environment.
- Launched the development of Research Quality Standards to clarify expectations of researchers for research quality.
- Led the identification and promotion of three new Sandia Fellows to serve as ambassadors, talent magnets, and mentors to staff.

Another action taken by the CTO Office, but not reported on in the October RLT meeting, was engagement in Washington, D.C. on the importance of LDRD to the NNSA laboratories. In the third quarter of FY13, language was introduced to the House of Representatives version of the FY14 appropriation to limit the LDRD program to 4.5% of the labs' costing rather than the 8% that had been in effect for nearly a decade. The CTO briefed House Energy & Water Committee staffers to highlight the impact and importance of the LDRD program and the potential detriments such a drastic cut would have on mission delivery. In addition, the CTO Office prepared responses and communications materials for the Sandia Field Office and NNSA/HQ.

CTO Office Action Outcomes

Anecdotal evidence combined with attendance numbers indicated that the Research Challenge information sessions and associated workshops served to engage staff in these important activities and generated excitement. Nearly all of the information sessions filled an auditorium that has capacity for >100 occupants and the workshops attracted an average of 84 researchers each from across the Laboratory.

Implementation of small, fast-turnaround, high-risk Exploratory Express LDRD projects resulted in >60 novel project ideas submitted by the end of FY13, of which eleven were funded. Example projects underway include imaging neutrons to enable neutrino detection, using a graphene field-effect transistor to detect and identify gamma rays at room temperature, and mimicking the blood-brain barrier using a novel microfluidic chip architecture.

Reports to the RLT stated that Sandia's involvement in the DOE Conference Attendance Policy implementation process reduced approval/denial notification times by two weeks. In addition,

the Labs' engagement resulted in updated requirements and guidance from DOE, which relaxed some aspects of the conference attendance rules.

In general, it remains too early to measure the impact of engagement on the time charging policy. It is also too early to measure the impact of the appointment of the new Sandia Fellows; however, they are actively participating on the RLT and on the Research Challenge teams. The expertise that the Lab Fellows bring with them will help shape Sandia's science and engineering enterprise well into the future.

The Research Quality Standards document comprises 50 case studies covering all phases of research. These standards help researchers avoid common problems that could harm their reputations and careers, serve as an aid when mentoring and advising new researchers, and provide assurance to our customers that Sandia research is of the highest integrity. Deployment and socialization of this document will occur in FY14.

Table 1 organizes all of the RLT and CTO Office activities according to the six elements of the research environment.

Elements	Actions
Research	• Created of Exploratory Express LDRD • Launched Research Challenge information sessions and associated workshops, colloquia, distinguished lecture series, and similar events • Developed Research Quality Standards
Line of Sight	• Expanded LDRD information sessions to include research strategy • Launched Research Challenge information sessions and associated workshops • Included staff in strategic planning by Research Foundations and Research Challenges • Communicated regularly and intentionally with management and staff about research strategy and research conducted in each center • Emphasized and rewarded professional society engagement, publications, patents, awards, etc. during performance reviews • Conducted CTO tours of centers and research foundation activities
Talent	• Mentored staff and managers • Named three new Sandia Fellows • Created a joint hire agreement between Sandia and University of New Mexico • Increased nominations for professional society fellowships, national awards, etc. • Sponsored activities that brought students (K-20) to Sandia
Work Structure	• Engaged on time charging policy

Elements	Actions
	• Developed Research Challenges that will increase synergy and alignment among projects
Policies/Procedures	• Engaged on the time charging policy • Engaged on the definition and implementation of DOE Conference Rules
Facilities/Equipment	• Piloted workspace enhancement for increased staff interactions at CERL

Table 1: FY13 Research Environment Improvement Actions

Other Research Environment Actions

Other actions undertaken at Sandia that preserve and improve the research environment also deserve mention in this report. First is the personal engagement of Paul Hommert, Sandia President and Labs Director, to communicate the importance of LDRD to stakeholders in Washington, D.C. This engagement has helped congressional staff and our sponsors understand that severe reductions in the program will have debilitating consequences across the national security enterprise.

Rewarding activities in intellectual property, royalties, and technology transfer highlights the value that Sandia places on intellectual property and deploying innovations. The annual Innovation and Intellectual Property Celebration honored 140 Sandians for their innovative achievements and delivery of technical solutions. In addition, the FY13 deployment of Sandia's new Royalty Sharing Program resulted in Sandians receiving over 350 patent filing/issuance awards and over 120 public good innovator awards. Some centers provided additional financial rewards for intellectual property creation.

Another action that will enhance the research environment is the CTO-sponsored Post-Doctoral Professional Development Program (PD2P) Distinguished Mentorship Award. This award, presented to technical advisors and managers who are excellent mentors to postdocs, was bestowed for the first time at the 2013 PD2P Poster Session in December.

The *Sandia Research* magazine debuted in January 2013, further emphasizing the importance of research at Sandia. Published quarterly, *Sandia Research* has an external audience composed largely of non-scientists in industry, government and academia. The stories showcase Sandia's unique capabilities and people, how our work advances the frontiers of science, and the impact of research on our mission.

Finally, the Art and Science of Science and Technology Forum and Roundtable, hosted at Sandia June 5-7, 2013, initiated a dialogue about a new way of approaching the practice of research.[25] While particular follow-on activities have yet to be identified, the Roundtable began a discussion about how to identify science that can be applied to improving how research is done, and to identify ways in which Sandia can apply such knowledge to our own processes.

[25] *Art and Science of Science and Technology: Proceedings of the Forum and Roundtable,* June 5-7, 2013,Sandia National Laboratories, Albuquerque, NM, Harvard Kennedy School, Belfer Center for Science and International Affairs, http://belfercenter.ksg.harvard.edu/publication/23766/art_and_science_of_science_and_technology.html.

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4. FY14 Priorities

As mentioned in the Background section of this report, the research environment has long been an area of interest and concern at Sandia. We underscore its importance to the accomplishment of world-class research by including it as one of the three goals of the Research Strategy, and further emphasize it by creating Lab-level milestones that focus on specific areas we want to improve.

In FY14, two Lab-level goals with associated milestones and deliverables specifically address elements of the research environment. These priority areas under Sandia Strategic Objective 4 (SO-4) "Excel in the practice of engineering" are:

- SO-4, Goal 2 - Enhance our engineering environment
  - Milestone 4.2.3: Deploy and socialize the Research Quality Standards
    - Deliverable 4.2.3.1: Distribute the Research Quality Standards to all employees in declared research centers
    - Deliverable 4.2.3.2: Execute a laboratory communication strategy and provide web tools via the CTO website
    - Deliverable 4.2.3.3: Develop linkage to the Nuclear Weapons (NW) Realize Product Procedure and Defense Systems & Assessments (DSA) Mission Assurance frameworks

- SO-4, Goal 3 - Enhance our competencies through external engagement
  - Milestone 4.3.1: Enhance collaborations with academia, government, industry, and professional societies
    - Deliverable 4.3.1.1: Deploy "external award" tools and track
    - Deliverable 4.3.1.2: Assess the current UNM joint hire process and result and develop lesson learned for future implementation
    - Deliverable 4.3.1.3: Implement new partnership tools

  - Milestone 4.3.3: Take actions to improve Sandia's research environment
    - Deliverable 4.3.3.1: Assess implementation of the RLT research environment commitments
    - Deliverable 4.3.3.2: Benchmark how other corporate R&D leaders maintain the health and vibrancy of their research environment
    - Deliverable 4.3.3.3: Increase delivery of high impact publications

In addition to these Lab-level goals, RLT members reaffirmed their commitment to "promoting the prestige of learning" in FY14 and continuing to implement their FY13 activities.

The CTO Office pledged to uncover the reasons for the inconsistencies in implementation of the Sandia policy/procedure allowing reimbursement of professional society dues and professional development time and to identify potential solutions. In addition, the CTO Office committed to identify and track chief indicators of the state of the research environment; to align the FY15 LDRD program with Lab strategy and priorities; and to develop a Lab-level understanding of the roles, responsibilities, accountabilities, and authorities (R2A2) of Lab Fellows and Senior

Scientists/Engineers. Finally, the CTO Office received and accepted a suggestion to monitor the effect of the rollout of Engineered Safety on the research environment.

It is our intention to report on the results of the FY14 SO-4 milestones and deliverables and associated RLT and CTO Office actions in the FY14 State of the Research Environment report.

Appendix A: Sandia Research Strategy – Goal Three

Steward and nurture a vibrant, problem-rich research environment that is a fundamental element of the Laboratories' mission success.

Vision: Sandia has an ideal research environment in which highly skilled scientific and engineering talent thrive and work together to solve compelling and challenging national security problems.

Sub-Goals

- Research. Pursue compelling and challenging national security research and create mechanisms that allow staff to move easily across the spectrum of fundamental, developmental, applied, classified, and open research.
- Line of Sight. Communicate Sandia's strategic research directions and the role of research in successfully meeting mission commitments in a way in which all Sandians can crisply explain the importance of their work and why Sandia is the right place to do it.
- Talent. Attract and nurture a highly skilled, diverse technical workforce that is actively engaged at the leading edge of science and engineering and actively collaborating with researchers from academia, government, and industry.
- Work structure. Advocate for a work structure where sufficient autonomy and discretionary time are available for uninterrupted, focused thought on challenging research problems.
- Policies/Procedures. Advocate for consistent implementation of policies and procedures that address Sandia's operational and administrative needs but are also empowering, supportive, streamlined and logical. Encourage a culture where consideration of the research environment is a routine part of decision-making.
- Facilities/Equipment. Maintain access to state-of-the-art facilities and equipment for staff and, where possible, configure the workplace to enhance scheduled and serendipitous interactions among staff.

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Appendix B: Ideal Sandia National Laboratories Research Environment

Ideal Sandia National Laboratories Research Environment
(Written by L. Napolitano and subteam, and adopted by RLT on 12/14/12)

- **Important work**
  Researchers are pursuing work that enables the mission and advances the frontiers of science and engineering. They can crisply explain the importance of the work and why Sandia is the right place to do it. They engage in fundamental, developmental, applied, classified, and open work, and move easily across the spectrum of research activities. Strategic directions have been identified and disseminated through efficient two way communication. Sandia National Laboratories (SNL) partners effectively with external entities including other governmental organizations, industry, and universities.
- **High quality people**
  SNL recruits and retains an outstanding and diverse workforce. Hiring is from a wide-ranging talent pool, including foreign nationals, maintaining a world class workforce. Student interns and graduates from highly ranked university programs eagerly seek Sandia positions, contribute to solving important national problems, and enhance their careers by working at Sandia. Sandians build extensive networks with collegial coworkers with expertise across the breadth of disciplines at SNL. Sandians maintain awareness of and engagement with leading edge advances in their fields occurring externally, as well as internally, to SNL. Collaborating with national and international experts from industry, government, and universities is encouraged and straightforward. Visitors from academia, industry, and government/FFRDCs choose to spend sabbaticals at SNL. Sandians' participation and leadership are highly visible at national and international scientific and engineering meetings.
- **Time to focus**
  The number of projects for an individual Sandian is such that he or she is able to focus on them without feeling too fractionated. Sufficient autonomy and discretionary time are available for uninterrupted, focused thought on challenging research problems. Mechanisms are in place that enable the pursuit of new research ideas in a timely fashion. Researchers are able to spend the majority of their time on research. Administrative systems are streamlined, logical, and consistent so that they can be completed without undue time and effort.
- **State-of-the art facilities and support**
  SNL builds and maintains state-of-the-art facilities and equipment in selected areas that enable world class research. Managers are technically current and versed in Sandia mission challenges so that they can understand and guide research consistent with current and emerging national needs. SNL management has a clear strategy for supporting research and communicates it consistently.
- **Growth and development opportunities**
  Staff and postdocs are mentored assiduously and expected to take advantage of a wide range of available opportunities for professional growth. Sandians are able to grow and develop professionally through attendance at national and international conferences and meetings, publishing, participation in the leadership of professional societies, and project assignments that demonstrate and further individual expertise. Staff are broadly curious about the work and mission of Sandia and are encouraged to explore and engage in the breadth of work at

SNL. Sandians participate in internal and external rotational assignments that present career growth opportunities and have clear reinsertion plans. Staff take advantage of sabbaticals and entrepreneurial leaves in order to gain new and valuable expertise and perspectives.

- **Empowering work environment**
  The work environment and policies are perceived as empowering and supportive. All staff feel welcomed, valued, and heard, not only for their abilities, but also for their unique qualities and perspectives. Expectations and policies are communicated clearly and consistently leading to understanding and perceived fairness. Agility and managed risk taking are encouraged and rewarded. Researchers are expected to be creative and pursue new ideas. Intellectual property management practices facilitate innovation and agility. Sandians have sufficient autonomy to accomplish their assignments in their own way within a broad set of unambiguous expectations. Interactions within diverse and technically similar teams are both collegial and self-critical fostering the highest quality research.
- **Integration of work and operations**
  Operational issues such as safety and security are effectively integrated into every activity at the Laboratory. The flow of work is logical and efficient, so that only value-added steps remain. Sandians take ownership for both the conduct and output of the work.
- **The workplace**
  The workplace is configured to enhance interactions among staff, both scheduled and serendipitous. It is forward-leaning, replete with the newest tools, but sufficiently flexible to enable continued productivity with established technology. Information technology is leading edge so that interaction is equally easy for all, independent of physical proximity. Sandians develop and nurture broad networks across the laboratory and interact frequently to explore and refine new ideas. Sandians know that they can pursue innovative ideas in a timely fashion.

Nomenclature

CERL	Cyber Engineering Research Laboratory
CTO	Chief Technology Officer
CTO Office	Office of the Chief Technology Officer
DOE	Department of Energy
DSA	Defense Systems & Assessments
FY	Fiscal Year
LDRD	Laboratory Directed Research and Development
MLT	Mission Leadership Team
NNSA	National Nuclear Security Administration
NW	Nuclear Weapons
PD2P	Post-Doctoral Professional Development Program
R&D	Research and Development
R2A2	Roles, Responsibilities, Accountabilities, and Authorities
RLT	Research Leadership Team
SMU	Strategic Management Unit
SNL	Sandia National Laboratories
SO-4	Strategic Objective 4
UNM	University of New Mexico

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