2017 LARGE FACILITIES WORKSHOP REPORT

National Science Foundation

May 1 - 3, 2017
LIGO Livingston & Baton Rouge, LA

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1 Introduction

1.1 Purpose & Intended Audience

The Large Facilities Workshop (LFW) is an annual event hosted by NSF's Large Facilities Office (LFO). The workshop is a collaborative forum for NSF's Large Facilities community intended to provide participants with continuous learning and information sharing opportunities. Desired outcomes to advance the NSF mission of scientific research at Large Facilities include:

- Sharing knowledge and experience with best practices and common challenges that arise for both NSF and its Large Facilities.
- Discussing new initiatives and engaging the Large Facilities community for input.
- Demonstrating project management, operations, and business-related tools and techniques.
- Expanding our community of practice and connecting colleagues from large complex scientific facilities to share information, experience, and expertise.

If you have a role in the development, planning, construction, or operation of large complex scientific facilities, then this workshop is for you. Content will target the following kinds of professionals:

- Facility and Operations managers
- Property and maintenance managers
- Cooperative agreement and contracting officers
- Business professionals
- Project managers, estimators, schedulers, and controllers
- Principal Investigators and scientists
- Engineers and construction managers
- Policy and oversight stewards

The workshop format and content is also structured to allow attendees and speakers to earn credit towards maintaining various professional certifications in the form of continuous learning points. Workshop attendees and speakers may earn credits towards various certifications, such as AACE International's Cost Estimating Professional or Earned Value Professional, state Professional Engineering License, Project Management Institute's Project Management Professional, and Federal Acquisition Certifications for Program and Project Managers and Contracting Officer's Technical Representative.

1.2 Format

The agenda and presentations from the workshop are included in Appendices A and D and available on the 2017 NSF LFW website. The list of participants and an overview of the range of participants are included in Appendix B and Section 3.

The agenda was structured to provide a diverse selection of relevant topics for the Large Facilities community along two dedicated tracks, a "Continuous Learning Track" and a "Business Practices Track." Various approaches for information sharing were used, with plenary presentations plus break-out sessions featuring presentations, panels, and roundtable discussions. The workshop was also structured to present NSF's evolving oversight approach at a high level, followed by more detailed discussions of key elements. Requirements from the *American Innovation and Competitiveness Act 2017* and the recently revised Large Facilities Manual (NSF 17-066, March 2017) were discussed. An update was provided on progress towards implementing recommendations from the *National Academy of Public Administration (NAPA) Panel Report on NSF's Use of Cooperative Agreements to Support Large Scale Investment in Research* and the *Report of the Subcommittee on NAPA Implementation* of NSF's Business and Operations Advisory Committee. The workshop strived to include topics applicable to all facility life cycle stages, with a majority of sessions focused on operating facilities. Speakers were encouraged to present and elicit "Best Practices" and "Actionable Recommendations" which were captured by dedicated note takers and compiled herein. The session "Idea Exchange Open Forum for Award Recipients" also provided an opportunity for facilities to engage each other and freely share ideas in order to provide critical feedback to NSF to improve future workshops and large facility efforts.

1.3 Location

The Laser Interferometer Gravitational-Wave Observatory (LIGO) in Livingston, LA graciously offered to hold the 2017 Large Facilities Workshop. The workshop took place at LIGO Livingston and in Baton Rouge, LA. The workshop was centered around an in-depth, behind-the-scenes tour of LIGO during their regular Tuesday morning window to conduct routine maintenance on the Advanced LIGO detector and facility. Workshop sessions on Monday May 1st and Wednesday May 3rd were held at the Renaissance Baton Rouge Hotel. Tuesday May 2nd included morning tours and afternoon workshop sessions at the LIGO Livingston site. Please see the LIGO Livingston website and NSF press release for more information on their facility and recent discovery.

The workshop is held every year, with even year workshops in the Washington, DC area and odd year workshops in the field at a Large Facility.

2 Presentation Highlights

This section provides very brief summaries of the presentations, including their purpose, main points, and any major discussions. Any key takeaways from interactive discussions that can be characterized as "Best Practices" or "Actionable Recommendations" are also noted. Where possible, organizations responsible for following up on any actions are also identified. This section is intended to summarize and supplement the detailed, expert slide presentations included in Appendix D and available on the 2017 NSF LFW website, not transcribe all comments and discussions. More detailed but rough notes on the various viewpoints expressed during the discussions are available and may be requested from LFO. These notes will be used by LFO to help inform the Action Recommendations.

2.1 Monday May 1, 2017

Evolving NSF Oversight & Other Developments

Speaker: Matt Hawkins, Head, Large Facilities Office (LFO), NSF

Description: LFO provided an overview of the past year's activities, status of projects in design and construction, and framed the workshop break-out session discussions. Ongoing activities include implementing the American Innovation and Competitiveness Act (AICA) and recommendations from the National Academy of Public Administration (NAPA) Panel Report on NSF Use of Cooperative Agreements to Support Large Scale Investment in Research. NSF clarified that the AICA requirements will be applied in a reasonable, appropriate way going forward. NSF has strategically implemented AICA requirements for facilities already in design and construction. Generally speaking, current Recipients with design and construction awards where the project is less than 75% complete have been brought into compliance. For active operations award (i.e. 3 years into a 5 year award) no additional actions are required for annual funding increments; these will be based on the last proposal submission and standard NSF review. However, future audit requirements based on annual risk assessments or award end date will apply. NSF will exercise judgement when considering each case, particularly where there is flexibility. All future proposals and subsequent awards must be in full compliance.

High Performance Teams on Science Projects: Successful Strategies and Lessons for Building an Engaged and Talented Team

Speaker: Ed Hoffman, CEO, Knowledge Engagement LLC; former NASA Chief Knowledge Officer and Director, NASA Academy; Executive in Residence, Columbia University School of Professional Studies

Description: The last decade has witnessed an unprecedented acceleration of change in technologies, organization approaches, and human perspective. These changes have reshaped the nature of the organization and placed a premium on accelerated learning and workforce engagement. Management of science projects has unique challenges and opportunities beyond the technical aspects. Ed Hoffman shared his NASA experiences and discussed in what manner performance best happens at the team level.

Best Practices:

- Identification and management of social risks in addition to technical and business risks.
- Successful projects and organizations can discuss mistakes, mishaps, and failures – they use such difficult experiences to get better.

- Successful teams succeed in four dimensions: helping people grow, inclusion and relating with people, thinking and creating new ideas, and providing clear direction.
- Talent development is dependent on four areas: ability, attitude, assignments, and alliances.
- Sharing of knowledge through different types of venues and media.
- Lessons Learned programs should focus on the workforce benefit and minimize burden.

Antarctic Infrastructure Modernization for Science (AIMS)

Speaker: Brandon Neahusan, Project Manager, AIMS, Leidos
Description: An overview of the diverse NSF science missions and infrastructure improvements underway in the Antarctic, with a focus on the AIMS project which is progressing through NSF's Design Stage Reviews.

Best Practices:

- Consider facility operational flow early to provide a more efficient layout and savings in operations time and costs that can be put towards more science.
- Engage your science user community early to ensure the facility will meet their needs.

Federal Budget Outlook (Working Lunch)

Speaker: Beth Blue, Program Analyst, NSF-BD
Description: The NSF Budget Division provided an overview of the federal budget process and an update on the current budget outlook for FY 2017 and FY 2018.

The Role of International Collaborations for Large Research Facilities

Speaker: Mangala Sharma, Program Director, NSF-OISE
Description: The NSF Office of International Science and Engineering (OISE) facilitated an interactive discussion on the international dimensions of large research facilities, including identifying and managing partnerships. NSF emphasized the goal of sharing common challenges and good practices to build effective institutional partnerships throughout the lifetime of research facilities.

Best Practices:

- Share common challenges and good practices to help build effective institutional partnerships, reduce barriers, and improve efficiencies in international partnerships for research facilities.

Business Systems Reviews (BSR) Hot Topics – Coordination of Administrative Business Reviews Across the NSF Large Facility Portfolio

Speakers: Roland Roberts, Program Director, National Ecological Observatory Network (NEON), Operations, NSF-BIO;
Florence Rabanal, Large Facilities Advisor, NSF-LFO
Anna-Lee Misiano, Grant & Agreement Specialist, NSF-DACS

Description: Discussed updates to the NSF process for identification and sequencing of administrative business reviews across the Large Facility Portfolio. The session primarily focused on NSF's strategy for identifying and managing risks associated with these large investments. NSF noted that they coordinate their respective plans as much as is possible with the Office of the Inspector General to avoid duplication, but their respective decisions on what assessments will be conducted are made independently.

Best Practices:

- Use portfolio risk assessment, a single coordinated process, to consolidate individual risk assessments, inform decision making and planning, and provide most effective and efficient oversight while meeting all requirements.

Actionable Recommendations (ARs):

1. Provide training on NSF's large facility oversight process/requirements and reviews, for new Recipients and for changes.
2. Better coordinate and communicate oversight reviews and standards, consolidating data calls and sharing review plans with Recipients, so that the necessary oversight can be done more effectively and efficiently for all parties while minimizing the administrative burden on Recipients.

MREFC Process from a Facility Perspective

Speakers: Demian Bailey, Regional Class Research Vessel (RCRV), Project Manager, Oregon State University (OSU);
Rita Pittmann, Planning & Controls Manager, Leidos

Description: Managers described their experience going through the Major Research Equipment and Facilities Construction (MREFC) review process for the RCRV and AIMS projects. The projects shared best practices and lessons learned, for the benefit of organizations that might go through the process in the future, and recommended process improvements to NSF.

Best Practices:

- In lieu of existing experience, the most important resource will be the Large Facilities Manual.
- Contact other programs/projects who have used the process.
- Engage stakeholders early, especially science/grantee community.
- Work with the NSF Program Officer, LFO Liaison, and Contracting Officer or Grants/Agreements Officer to understand the MREFC stage-gate review process, especially:
    - Organizations involved, including who makes what recommendations and decisions,
    - Evaluation criteria,
    - Timeline,
    - Information requirements and deadlines for read ahead packages,
    - Expect additional questions and clarifications from different review organizations that will require responses, including additional information, calculations, presentations, etc.
    - Leave enough time for internal reviews before providing information.
- If you have questions regarding the LFM, ask LFO as they can provide clarifications and identify flexibilities.

- Pay particular attention to timelines and provide sufficient time to meet and balance the following:
    - NSF requirements and reviews,
    - Congressional budget request cycles, including lag between budget request and award and potential complications like delays and continuing resolutions,
    - Subcontracting process
- The risk register is a living document, be prepared to routinely update the register and recalculate contingency.
- MREFC process is flexible with regards to facility/recipient management structures.
- Let the requirements drive the design and let the requirements-driven design drive the budget formulation.
- Recognize that NSF has prioritized the success of the project – they want you to succeed.
- Don't ask for direction. Use your team and propose solutions that work for the project, don't bring problems (NSF prefers to make decisions or give consent anyway rather than give direction, typically).
- The project is better off because of the various reviews, outside panels and consultants ("painful but worthwhile").
- Business Systems Reviews (BSRs) can be impetus to improve wider university/organization business practices – gives the project leverage to help effect broader positive change.
- Stay ahead of evolving oversight and new developments and requirements.
- Don't underestimate the depth of project management requirements that NSF will want to see. As the project becomes more real, oversite and expectations grow for reporting and documentation.
- If you are an academic or used to being on a tight budget, think bigger. Don't try to do everything yourself, e.g., hire a project controls specialist early, hire a risk manager and contract out aspects of the project for which you don't have the expertise. Do it right.
- Read and follow the LFM closely and structure the entire project around it.
- Make choices based on what's best for the project in the long run… not what's easy or convenient in the short term.
- Align your Project Execution Plan (PEP) directly with the LFM, your Business Systems section of the PEP with the BSR functional areas to facilitate the BSR, align your Project Reporting section of your PEP with the ANSI EVM Criteria to facilitate your EVM verification.
- Assume positive intent. NSF wants to see your program succeed as much or even more than you do. They have a different set of demands that trickle down. Be open to their direction… but think critically about it and push back where warranted, but do your homework.
- Air your dirty laundry. Bring up sticky issues early and often. Even (or especially) those that you think NSF won't want to hear.
- Don't underestimate the importance of quality budget formulations and contingency development and use. These are the most import aspects of building a program that can withstand scrutiny.
- Keep a "beginner's mind". Avoid preconceived ideas and assuming you have all the answers.

Actionable Recommendations:

1. Provide training on NSF's large facility oversight process/requirements and reviews, for new Recipients and for changes. (Repeat of AR 1 from BSR Session)

Roundtable – Masters Forum – Creating a Successful Lessons Learned Approach: People, Process, Culture

Facilitators: Ed Hoffman, CEO, Knowledge Engagement LLC; former NASA Chief Knowledge Officer and Director, NASA Academy; Executive in Residence, Columbia University School of Professional Studies; Rebecca Yasky, Large Facilities Advisor, NSF-LFO

Description: Knowledge capability is based on experience, learning and relevance. Successful organizations create strategies and methods that encourage practitioners to share their lessons in a variety of ways. Participants shared their lessons with colleagues and provided input to NSF on the implementation of a lessons learned program for large facilities. This session connected practitioners, reflection, sharing, and stories to enhance commitment to lessons learned.

Best Practices:

- Share lessons learned through stories to provide context.
- Establish different venues for practitioners to tell stories.
- Make reporting of lessons learned a routine part of your process, e.g., as part of annual reviews.
- Lessons learned reporting should include actions taken and their impact.

Actionable Recommendations (numbering continued from above):

3. Take into consideration input from an informal Recipient working group to enhance and engage our communities of practice.
4. Consider holding "Town Hall" type of discussions with Recipients and prepare Lessons Learned reports based on the feedback received (and share feedback with Recipients).
5. Consider leveraging the existing panel review process, annual reviews, and annual reports to collect and document lessons learned.
6. Consider developing a curriculum around lessons learned to facilitate the initiation process especially as it relates to business process.
7. Allow Recipients time at annual workshops to meet and share experience. Share all feedback with all Recipients, e.g., via report on blog or Recipient Community website.
8. Create a forum for people from our large facilities community to work together and share ideas among each other, e.g., a wiki blog for NSF users.

Cyberinfrastructure Investments & Opportunities

Speaker: Bill Miller, Science Advisor, NSF-CISE

Description: NSF provided an overview of cyber infrastructure initiatives and developments that will be discussed in depth at future cyberinfrastructure workshops.

Evolution of EVM and the Future

Speaker: Wayne Abba, President of College of Performance Management

Description: Earned Value Management (EVM) is a project management technique for measuring performance in an objective manner and providing early warning indicators of cost and schedule overruns and underruns. Wayne Abba shared the history of EVM including a "Tale of Two Aircraft" and gave a look into the future for performance management including recently enacted legislation.

Best Practices:

- Early adoption of an EVM system into a project leads to better project outcomes.
- Consider EVM as a management tool rather than a reporting tool.
- EVM is an integrated discipline, bringing together the three project elements of technical, cost, and schedule, and needs participation by many disciplines including systems engineering, scheduling, cost estimating, risk management, procurement, and project management.
- Project management and EVM can be effectively applied across industries, and is not specific to a given industry.
- Project managers should openly address and incorporate contingency during project cost estimation and project planning (already used by NSF).
- Make project management a discipline and a business tool rather than a personality-driven exercise.
- Ensure adequate early planning in order to obtain reliable EVM reporting as soon as practicable.
- A project needs to invest in training its practitioners on EVM for EVM to be most effective.
- Timely generation of labor cost data using labor hours can facilitate providing management with more prompt EVM data than might be available than waiting for data generated the accounting system.
- Using EVM for effective project management can enhance NSF credibility with the ultimate effect of increasing budgetary support for projects and more science.

2.2 Tuesday May 2, 2017

Education & Public Outreach (Working Lunch)

***Speaker*:** William Katzman, EPO Manager, LIGO Livingston Observatory (LLO)
***Description*:** An overview of LIGO education and public outreach activities was provided, emphasizing the benefits of local community engagement through the Science Education Center, university partnerships, and docents. Described how recent Louisiana State and Southern University graduates were at the helms of both LIGO detectors as the wave was detected.

LIGO Science & Technology

Speaker: Joe Giaime, Head, LIGO Livingston Observatory (LLO)
Description: An overview of LIGO scientific instrumentation and technological innovations was provided, highlighting extraordinary seismic isolation, mirror suspension, and noise reduction techniques that were developed.

Modern Methods of Schedule Risk Analysis

Speaker: David Hulett, Hulett & Associates, LLC
Description: Early methods of quantifying risk analysis using Monte Carlo simulation placed probability distributions directly on activity durations. Developments in the last 10 years have allowed us to model risks much more specifically and intelligently. New methods for analyzing the impact of risk on a project's schedule were introduced, including (1) distinguish uncertainty and project-specific risks, (2) apply risks to multiple activities (or categories of activities), (3) apply risks in series and in parallel, (4) model how duration correlation occurs, and (5) prioritize risks for focused risk mitigation.

Best Practices:

- When performing risk analysis, consider whether there exists an inter-relationship between project risks. For example, a risk of in climate weather has a correlated risk of workplace accidents if ice or muddy conditions result.
- When performing risk identification, perform one on one, confidential interviews to ensure Unknown Knowns (Known but unspoken) risks are not left out of the risk register due to reluctance for staff to speak freely.
- Look for "common causes" of uncertainty that exist in multiple risks and try to mitigate those separately.

Facility Operations & Maintenance Roundtable

***Facilitators*:** Richard Oram, Operations Manager, LIGO Livingston Observatory (LLO);
Nigel Sharp, Program Director, NSF-MPS

***Description*:**

LLO presented some aspects of operation and maintenance of a gravity wave observatory then others shared challenges and best practices that are commonly faced by large facility operators.

Best Practices:

- Have an environmental threat plan and fit in with what the community does.
- Include foreseeable preventive maintenance costs and upgrade requirements when planning budgets and communicate these to your Program Officer. Tactics include:
    - Develop an Asset Condition Report evaluating the remaining life of civil infrastructure and estimating the cost of significant replacement or refurbishment to be scheduled.
    - Develop a Facility Condition Index (FCI), a standard used to indicate the condition of an asset or assets, use the ratio of the cost of requirements divided by the current replacement value (CRV) of the asset.
    - Develop a Property Life Cycle Maintenance Plan peer reviewed and vetted by maintenance professionals from a similar large science facility annually.
    - Include Lifecycle Maintenance as a dedicated Work Breakdown Structure element in you annual work plan.
    - Utilize Computer Maintenance Management Systems preventive and corrective maintenance.
    - If possible, group specific activities into discrete fiscal years so they can be accomplished in the same year funding cycle.
- Important to provide detailed basis of estimates when making a supplemental request for additional funding to address large unexpected repairs and maintenance.
- Keep uptime and downtime metrics (% of time facility is operating/observing) and track causes of downtime to identify and prioritize issues that could be addressed to maximize science.
- Initiatives established during construction project management can provide a firm foundation for operations and maintenance, e.g., change control, documentation, issue tracking, etc.
- Use advisory committees for effective communications with user community and to build community consensus.
- Develop and use a communications plan to identify which stakeholder community (project staff, facility management, funding agencies, external user community, etc.) needs to be informed for different types of communications. For example, new discovery press releases would probably go to all stakeholder communities whereas disruption to science operations would probably only go to project staff, facility management, and funding agency liaisons.
- Hold regular meetings with facility scientific staff, operations staff, and IT staff to exchange issues, concerns, ideas, and problems so solutions are not developed in a vacuum.

Practical Guidance to Strengthen Facility Estimates

***Facilitators*:** Jason Lee, Assistant Director, Applied Research and Methods, US Government Accountability Office (GAO)
Kevin Porter, Large Facilities Advisor, NSF-LFO
Erik Nylund, Crowe Horwath / Kforce Government Solutions (CH/KGS)
***Description*:** NSF discussed new cost estimating and analysis requirements from the American Innovation and Competitiveness Act and how they are supported by the Large Facilities Manual and GAO Cost Estimating and Assessment Guide. NSF and GAO led an interactive discussion emphasizing the applicability of the GAO Cost Guide and importance of Cost Estimating Plans (CEPs) and the Basis of Estimate (BOE) for both Construction estimates and Operations and Maintenance estimates. GAO and CH/KGS both discussed recent examples of good CEPs and BOEs from AIMS and NEON.

Best Practices:

- Operations and maintenance (O&M) and design and construction organizations must ensure practices for estimating and managing costs follow the best practices in the GAO Cost Guide.
- Follow Large Facilities Manual (LFM) Section 4.2 to ensure all of the correct information and detail is included in the cost estimate up front – this will provide higher quality estimate and reduce time to award.
- Early development of a solid Cost Estimating Plan (CEP) will help ensure all best practices are followed and a high quality estimate is provided on time.
- A well-documented and detailed Basis of Estimate (BOE) is absolutely critical for justifying any funding request.
- Consult industry and other quality standards for best practices in developing CEPs and BOEs, e.g. AACE International Recommended Practices.
- Use of a "quality standard" as though cost estimate will be subject to third party review and such that third party can replicate.
- Have clear linkages, via Work Breakdown Structure (WBS), between BOE supporting information, associated calculations and rolled-up costs.
- Have thorough and well-documented assumptions for cost drivers, cost estimating methods, and data sources.
- Use an integrated cost model which includes build up from lowest to highest levels of the WBS.
- Provide well-supported cost escalations and indirect/fringe/overhead rates.
- Sufficiently document risk and sensitivity analyses and discussion of cost estimate limitations.
- For O&M proposals, CEP and BOE can be tailored to your facility, e.g., by establishing appropriate WBS elements and combining the CEP and BOE with the work plan.
- During Operations Stage, consider potential need for contingency for major upgrade, refurbishment, and construction efforts (must still comply with Uniform Guidance and LFM).
- Recognize appropriate uses of Allowances in the BOE.

2.3 Wednesday May 3, 2017

Large Facility Innovations & Technology Transfers Discussion

Speaker: Matt Hawkins, Head, NSF-LFO

Description: All NSF programs support NSF's mission "*to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense*." This type of support is a primary driver of the U.S. economy. NSF's Research Infrastructure also plays a key role in driving the U.S. innovation ecosystem by creating new (or enhanced) technologies and processes in order to meet the scientific objectives and advance human knowledge. Innovation can happen at every life-cycle stage, but it happens most readily during design, construction and operations. NSF and its Recipients have always been (and should remain) focused primarily on the science outcomes that our Research Infrastructure supports. However, as facilities costs rise in an era of challenging budgets, it may be advantageous to better articulate these innovative aspects in the "Broader Impacts" of major facility proposals. To best achieve this, and more broadly support NSF's mission, cataloging and quantifying these successes in a more formal and routine way may be beneficial. This session focused on sharing examples of innovative activities driven by NSF-funded Research Infrastructure and discussing ways in which NSF can work with major facility Recipients to better describe the benefits on U.S. innovation and the economy. Many NSF award Recipients in attendance shared excellent, illustrative examples of innovative activities conducted in-house or in close partnership with the private sector.

Best Practices:

- Include information regarding innovative technologies and processes developed as part of Design, Construction or Operations in annual reports to NSF.
- Routinely post information regarding innovative technologies and processes (including partnerships with the private sector) on program websites using main headers that include the word "Innovation" so that NSF's Office of Legislative and Public Affairs and easily locate using a simple web search.

Actionable Recommendations (numbering continued from above):

9. Investigate the ability to informally use NSF's Business R&D and Innovation Survey (BRDIS) with the academic institutions and non-profits that operate NSF's major facilities.

Management Fee to Fee

Speaker: Jeff Lupis, Division Director, Division of Acquisitions and Cooperative Support (DACS), NSF

Description: NSF provided an overview of the proposed new fee policy for large facilities. NSF developed and implemented its current fee policy in response to the OIG and Congressional concerns and to address the NAPA recommendations. NSF found that certain expenses could not be effectively met through indirect cost or contingency and eliminating these expenses would place our large facility awardees at a significant disadvantage. However, there are very few policies regarding fee on assistance awards elsewhere in the government, so NSF had to develop and implement its own policy on fee that included appropriate negotiating and oversight of fee. NSF will adopt fee-types consistent with those typically provided in government contracting, with additional guidelines to awardees including examples of inappropriate uses of fee. NSF is revising procedures and will provide additional outreach and address timing for roll out of the new policy.

Distributed Networks & Facilities Roundtable

Facilitator: Rob Hengst, Large Facilities Advisor, NSF-LFO

Description: NSF and Recipient personnel involved in distributed networks and facilities held roundtable discussions. Roundtable members each briefly shared their experiences on topics pertaining to distributed facilities such as centralized procurement, cyber infrastructure, site facilities maintenance, personnel/staffing, parts/storage, etc.

Performance Metrics –Strategy and Experience at the Department of Energy (DOE)

Speaker: Ben Brown, Senior Science and Technology Advisor, Office of the Deputy Director for Science Programs, DOE

Description: The DOE Office of Science discussed their recently-implemented strategy to collect user statistics across 27 operating facilities, including the practical challenges and the broad benefits envisioned for stakeholders. Led by the Federal sponsors and collaborating and listening to the experts on the ground, DOE was able to develop a database of users to help understand how science is done and how it is evolving, and develop metrics to be used to support its budget requests for facility sustainment and improvement.

Best Practices:

- Collecting user metrics can help to:
    - understand how science is done and how it is evolving,
    - understand and articulate the spectrum of user activity, including the types of institutions and users involved, and the capabilities and outputs of facilities,
    - improve transparency for facilities and stewards,
    - visualize the vast network of connections between facilities and the geographic distribution of remote and international users, and
    - support budget requests for facility sustainment and improvement
- Telling the whole story is challenging, carefully understand and develop ways to encompass the complex institutional relationships and heterogeneous portfolio of science.
- Any system of collecting facility performance metrics should strike a balance between creating a system for rigorous, historical, and sortable corporate user statistics while providing flexibility to facilities and stewards.
- Having different systems for funding grantee proposals and facility operations can make data collection challenging.
- Avoid unfunded mandates and logistical nightmares for facilities – collecting the data is supposed to be helpful.

Idea Exchange Open Forum for Award Recipients

Facilitator: Tim Cockerill, Director of Center Programs, Texas Advanced Computing Center, The University of Texas at Austin

Description: This session for award Recipients offered an opportunity for the large facilities to share ideas amongst themselves with a goal of providing critical feedback to NSF in the form of reasonable, actionable, documented recommendations. Actionable Recommendations (ARs) developed by the group were provided to NSF during the open Workshop Debrief in the afternoon and are summarized in Section 4.

Overall, Recipients were very pleased with the opportunity to openly discuss issues among themselves and provide input to NSF.

Incurred Cost Audits & Data Collection Tool

Speaker: Eddie Whitehurst, Deputy Branch Chief, DACS-Cooperative Support Branch (CSB), NSF
Description: CSB provided background and context on new requirements for incurred cost audits and the Large Facilities Data Collection Tool. CSB emphasized that the tool is intended to collect cost information in a consistent manner to facilitate potential audits. Any questions and concerns, including comments on functionality of the Excel tool, should be brought to the cognizant Grants and Agreements Officer. NSF noted that they coordinate their respective plans as much as is possible with the Office of the Inspector General to avoid duplication, but their respective decisions on what assessments will be conducted are made independently. Multiple Recipients noted there appears to be duplication of audits and oftentimes the third party auditors have different standards and are not familiar with the Uniform Guidance or funding construction of a facilities via a Cooperative Agreement, causing an avoidable burden upon the limited facilities resources. Most of these problems should now be eliminated with the introduction of the standardized data collection tool and the fact that the OIG no longer contracts with the Defense Contract Audit Agency (DCAA) to perform audits. In the past, DCAA was requiring Recipients to place all information into a specific format.

Actionable Recommendations:

2. Better coordinate and communicate oversight reviews and standards, consolidating data calls and sharing review plans with Recipients, so that the necessary oversight can be done more effectively and efficiently for all parties while minimizing the administrative burden on Recipients. (Repeat of AR 2 from BSR Session)

Cybersecurity & CTSC (Working Lunch)

Speaker: James Marsteller, Information Security Officer, Pittsburgh Supercomputing Center
Description: This session provided an overview of the Center of Trustworthy Scientific Cyberinfrastructure (CTSC), including CTSC mission, past work with large facilities, key resources and events of interest to large facilities.

Science Done by a Global Community

Speaker: Gabriela Gonzalez, former Spokesperson, LIGO Scientific Collaboration
Description: The talk focused on the main astrophysical results in gravitational wave astronomy generated by the work done by the LIGO Scientific Collaboration.

Best Practices:

- Consider using an open, self-governing, international collaboration with member agreements describing scientific, not financial, commitments. While atypical, it has been very successful for the LIGO Scientific Collaboration.

Uniform Guidance Procurement Standards

Speakers: Eddie Whitehurst, Deputy Branch Chief, DACS-Cooperative Support Branch (CSB), NSF
Description: CSB provided an overview of requirements from 2 CFR 200 Uniform Guidance 200.317-326 Procurement Standards. NSF noted that the Proposal and Award Policies and Procedures Guide will be updated to include the new micro purchase threshold of $10,000 set forth in the AICA. Subsequent to the session, OMB issued a one year grace period for the procurement standards, with an implementation date of December 26, 2017.

NSF Earned Value Management System Verifications

Speakers: Rebecca Yasky, Large Facilities Advisor, NSF-LFO
Description: NSF now utilizes an applied process for the compliance evaluation review (CER) and acceptance of a Recipient's earned value management (EVM) systems. A project-focused EVMS acceptance permits the use of other project and business review results and focuses the CER on the EVM specific processes.

Best Practices:

- Projects should implement EVM systems during the Preliminary Design Stages so that the project teams have experience using the EVMS before construction and the EVMS will be ready for NSF's verification during the Final Design Stage.

Workshop Debrief - Open Forum & Actionable Recommendations from Idea Exchange

Facilitator: Kevin Porter, Large Facilities Advisor, NSF-LFO
Description: NSF held open forum for workshop attendees to provide direct feedback and recommendations for future improvements and topics. Actionable Recommendations AR developed during the Idea Exchange Open Forum for Award Recipients were discussed with NSF and are summarized in Section 4.

2.4 Actionable Recommendations – Topical Sessions

Summary of ARs captured above, and consolidated below, related to "Large Facility Oversight & Initiatives (O&I)":

1. Provide training on NSF's large facility oversight process/requirements and reviews, for new Recipients and for changes.
2. Better coordinate and communicate oversight reviews and standards, consolidating data calls and sharing review plans with Recipients, so that the necessary oversight can be done more effectively and efficiently for all parties while minimizing the administrative burden on Recipients.
3. Take into consideration input from an informal Recipient working group to enhance and engage our communities of practice.
4. Consider holding "Town Hall" type of discussions with Recipients and prepare Lessons Learned reports based on the feedback received (and share feedback with Recipients).
5. Consider leveraging the existing panel review process, annual reviews, and annual reports to collect and document lessons learned.
6. Consider developing a curriculum around lessons learned to facilitate the initiation process especially as it relates to business process.
7. Allow Recipients time at annual workshops to meet and share experience. Share all feedback with all Recipients, e.g., via report on blog or Recipient Community website.
8. Create a forum for people from our large facilities community to work together and share ideas among each other, e.g., a wiki blog for NSF users.
9. Investigate the ability to informally use NSF's Business R&D and Innovation Survey (BRDIS) with the academic institutions and non-profits that operate NSF's major facilities.

3 Participant Summary Data

Appendix B contains a list of the 137 registered workshop participants. NSF's Large Facilities were well represented. Participation by other federal agencies and organizations to build our community of practice was not as large as the 2016 workshop in Washington, DC. A cross section of different professionals were represented. Overall attendance exceeded expectations.

Professions by Organization

	Recipients	NSF	Other	TOTAL
Business Professionals	28	7	1	36
Operations Managers	13	5		18
Project Managers	14	6	9	29
Executives	24	7	7	38
Scientists, Engineers	8	2		10
Other	3	1	2	6
TOTAL	90	28	19	137

NSF Large Facility Award Recipient Participation

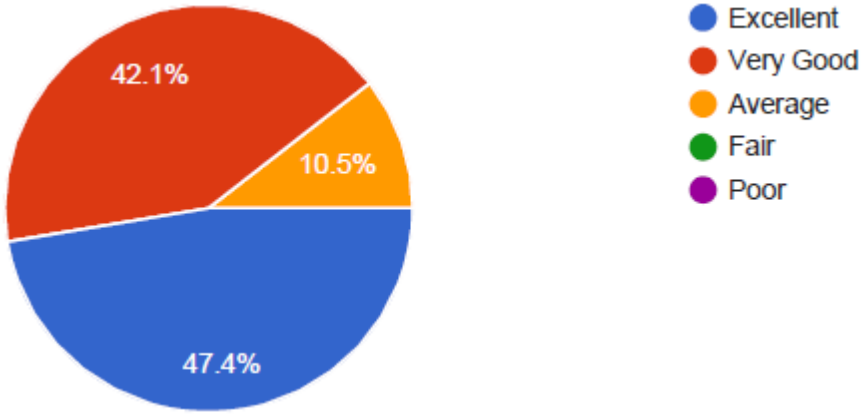
United States Antarctic Program / Antarctic Infrastructure Modernization for Science	USAP / AIMS	2
Arecibo Observatory	AO	1
Academic Research Fleet / Regional Class Research Vessel	ARF / RCRV	4
Cornell High Energy Synchrotron Source	CHESS	5
Green Bank Observatory	GBO	1
Gemini Observatory	Gemini	4
IceCube Neutrino Observatory	ICNO	1
International Ocean Discovery Program (JOIDES Resolution)	IODP	2
Long Baseline Observatory	LBO	0
Large Hadron Collider	LHC	3
Laser Interferometer Gravitational-wave Observatory	LIGO	5
Large Synoptic Survey Telescope	LSST	2
National Center for Atmospheric Research	NCAR	2
Natural Hazards Engineering Research Infrastructure	NHERI	14
National Ecological Observatory Network	NEON	7
National Geophysical Observatory for Geoscience	NGEO	6
National High Magnetic Field Laboratory	NHMFL	3
National Optical Astronomy Observatory	NOAO	0
National Radio Astronomy Observatory	NRAO	4
National Superconducting Cyclotron Laboratory	NSCL	1
National Solar Observatory / Daniel K. Inouye Solar Telescope	NSO / DKIST	6
Ocean Observatories Initiative	OOI	0
Association of Universities for Research in Astronomy	AURA	5
Associated Universities Incorporated	AUI	3
Supercomputing Centers		9

4 Survey, Idea Exchange, and Workshop Debrief – Summary of Results & Actionable Recommendations

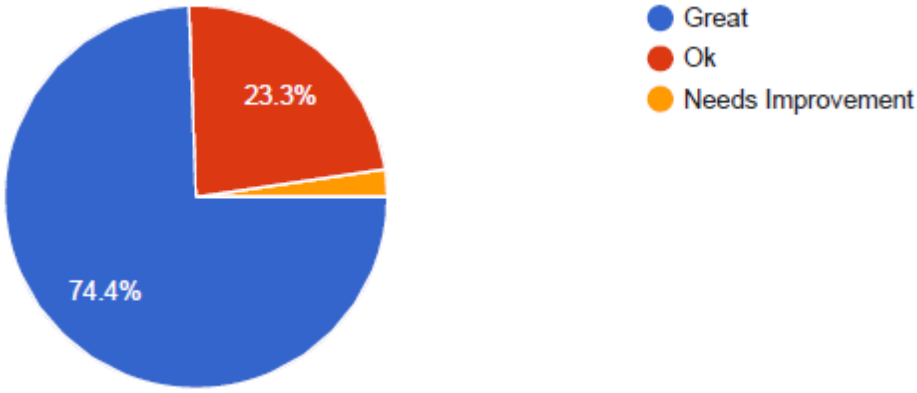
Feedback on the workshop was requested both online each day and in person at the end of the three days. All data from online survey results is included in Appendix C. Some key takeaways are summarized below and will be addressed to continuously improve future workshops. The Idea Exchange and Workshop Debrief sessions were also used to solicit feedback and the Actionable Recommendations summarized below.

4.1 Key Survey Results

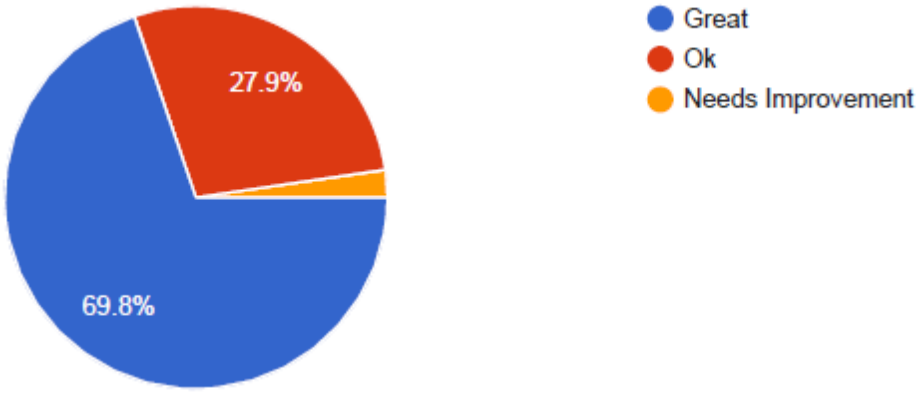
Overall, how would you rate this entire workshop?
19 responses



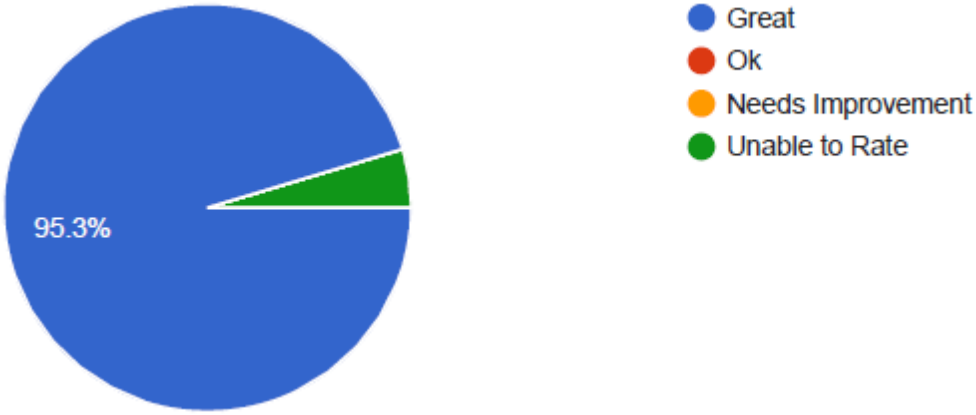
Overall workshop planning and communications by NSF?
43 responses



The purpose and intended audience of the workshop?
43 responses



Tour
43 responses



4.2 Consolidated Actionable Recommendations – Topical Sessions, Idea Exchange, Workshop Debrief, and Survey

Large Facility Oversight & Initiatives (O&I):

1. Provide training on NSF's large facility oversight process/requirements and reviews, for new Recipients and for changes.
2. Better coordinate and communicate oversight reviews and standards, consolidating data calls and sharing review plans with Recipients, so that the necessary oversight can be done more effectively and efficiently for all parties while minimizing the administrative burden on Recipients.
3. Take into consideration input from an informal Recipient working group to enhance and engage our communities of practice.
4. Consider holding "Town Hall" type of discussions with Recipients and prepare Lessons Learned reports based on the feedback received (and share feedback with Recipients).
5. Consider leveraging the existing panel review process, annual reviews, and annual reports to collect and document lessons learned.
6. Consider developing a curriculum around lessons learned to facilitate the initiation process especially as it relates to business process.
7. Allow Recipients time at annual workshops to meet and share experience. Share all feedback with all Recipients, e.g., via report on blog or Recipient Community website.
8. Create a forum for people from our large facilities community to work together and share ideas among each other, e.g., a wiki blog for NSF users.
9. Investigate the ability to informally use NSF's Business R&D and Innovation Survey (BRDIS) with the academic institutions and non-profits that operate NSF's major facilities.
10. Provide a simple planning tool/figure depicting the large facility oversight process/requirements throughout the facility lifecycle.
11. Facilitate facility-to-facility communications, so Recipients can better engage with each other, share outcomes and lessons learned.
12. Better engage the user community, e.g., obtain and leverage science community feedback to improve operations, facilitate access to potential user pool, determine if user names could be made available publically if user opts in.

General Workshop Planning & Agenda (P&A):

1. Earlier development and communication of information. For example:
    a. Workshop dates.
    b. Agenda and establish annual topics.
    c. More substantive descriptions of sessions.
    d. Clearer goals and objectives for sessions and identification of sessions seeking input
    e. Goal of identifying Best Practices and Actionable Recommendations and the presence of a dedicated note taker in each session to record key points.
2. Need broader input and attendance. For example:
    a. Include Recipients in agenda development, e.g., via telecom, survey, take into consideration input from an informal Recipient working group to enhance and engage our communities of practice.
    b. Develop ways to more broadly solicit input for future topics.

c. Involve the user community in the workshop, e.g., via user led discussions telling NSF and Recipients what they need.
d. Encourage NSF Program Officer attendance to the workshop.

3. Identify ways to better engage participants and facilitate discussions. For example:
    a. Use professional facilitators.
    b. Working sessions with interactive problem sharing and solutions throughout workshop, deliberation amongst panelists.
    c. Create more opportunities for organic discussions and networking, e.g., longer breaks, more open or lightly structures sessions, additional small breakout rooms, an early meet and greet, facilitate dinner groups.
    d. Introduce NSF staff in attendance.

Specific Workshop Topics & Speakers (T&S):

1. Consider the following topics/sessions/structure for future workshops:
    a. More topics for scientists and users (e.g., user scheduling, user engagement – how to recruit, engage, and support user).
    b. Have candid and constructive dialogue on lessons learned from past problems encountered on NSF large facilities construction and operations, e.g., a session specifically on NEON, structured reviews of selected programs, root cause analysis training and application.
    c. Reduce NSF communications footprint. If policy or oversight updates from NSF are needed, consolidate into one session.
    d. Add basic information session/orientations for people new to the NSF large facilities community. Information could include NSF mission and organization, how proposal process works, NSF oversight activities, list of key documents such as LFM and BSR guide.
    e. Need sessions better organized to facilitate cross facility sharing at different levels or types of operations - directors, administration staff, education and outreach, etc. (e.g., see how the NSF Engineering Research Center organizes their annual meetings).
    f. Accounting for property, plant, and equipment (PP&E) in closeout of major construction projects, e.g., via a panel of actual facilities.
    g. How to improve communications/collaboration with NSF.
    h. Diversity in the Science Community.
    i. "Walking tightrope between science and politics."
    j. Hands-on estimating.
    k. Motivational TED-type talks for scientist and managers on successes and failures from experienced outside speakers.
    l. Science presentations.

Workshop Logistics (Registration, Hotel, Meeting Rooms, etc):

Many detailed and helpful comments were provided on workshop logistics and are included in the Appendix C survey results. These planning details were separately consolidated and prioritized and will be considered internally and discussed with workshop logistics contractor(s).

5 Overall Conclusions & Actionable Recommendations

Overall the workshop was successful and provided a constructive and collaborative environment for NSF's Large Facilities and other partners. New initiatives were highlighted and the rich interactive discussions will help with continuous improvement. Many "Best Practices" were shared with the community. Many "Actionable Recommendations" were identified as summarized below and will be considered by NSF and the Recipient community. NSF continued to improve the Large Facility community of practice. Feedback of the overall workshop was collected and will help improve future workshops.

NSF will track and communicate follow-up actions taken for the Actionable Recommendations above by using a tracking table like that depicted below.

Actionable Recommendation Tracking Table:

Type
O&I Large Facility Oversight & Initiatives
P&A General Workshop Planning & Agenda
T&S Specific Workshop Topics & Speakers

Type	Number	Actionable Recommendation	Owner	Organization	Action	Due Date
O&I	1	Provide training on NSF's large facility oversight process/requirements and reviews, for new Recipients and for changes.				
O&I	2	Better coordinate and communicate oversight reviews and standards, consolidating data calls and sharing review plans with Recipients, so that the necessary oversight can be done more effectively and efficiently for all parties while minimizing the administrative burden on Recipients.				
O&I	3	Take into consideration input from an informal Recipient working group to enhance and engage our communities of practice.				
O&I	4	Consider holding "Town Hall" type of discussions with Recipients and prepare Lessons Learned reports based on the feedback received (and share feedback with Recipients).				
O&I	5	Consider leveraging the existing panel review process, annual reviews, and annual reports to collect and document lessons learned.				
O&I	6	Consider developing a curriculum around lessons learned to facilitate the initiation process especially as it relates to business process.				
O&I	7	Allow Recipients time at annual workshops to meet and share experience. Share all feedback with all Recipients, e.g., via report on blog or Recipient Community website.				
O&I	8	Create a forum for people from our large facilities community to work together and share ideas among each other, e.g., a wiki blog for NSF users.				
O&I	9	Investigate the ability to informally use NSF's Business R&D and Innovation Survey (BRDIS) with the academic institutions and non-profits that operate NSF's major facilities.				
O&I	10	Provide a simple planning tool/figure depicting the large facility oversight process/requirements throughout the facility lifecycle.				
O&I	11	Facilitate facility-to-facility communications, so Recipients can better engage with each other, share outcomes and lessons learned.				
O&I	12	Better engage the user community, e.g., obtain and leverage science community feedback to improve operations, facilitate access to potential user pool, determine if user names could be made available publically if user opts in.				

Type	Number	Actionable Recommendation	Owner	Organization	Action	Date
P&A	**1**	Earlier development and communication of information. For example: a. Workshop dates. b. Agenda and establish annual topics. c. More substantive descriptions of sessions. d. Clearer goals and objectives for sessions and identification of sessions seeking input e. Goal of identifying Best Practices and Actionable Recommendations and the presence of a dedicated note taker in each session to record key points.				
P&A	**2**	Need broader input and attendance. For example: a. Include Recipients in agenda development, e.g., via telecom, survey, take into consideration input from an informal Recipient working group to enhance and engage our communities of practice. b. Develop ways to more broadly solicit input for future topics. c. Involve the user community in the workshop, e.g., via user led discussions telling NSF and Recipients what they need. d. Encourage NSF Program Officer attendance to the workshop.				
P&A	**3**	Identify ways to better engage participants and facilitate discussions. For example: a. Use professional facilitators. b. Working sessions with interactive problem sharing and solutions throughout workshop, deliberation amongst panelists. c. Create more opportunities for organic discussions and networking, e.g., longer breaks, more open or lightly structures sessions, additional small breakout rooms, an early meet and greet, facilitate dinner groups. d. Introduce NSF staff in attendance.				

Type	Number	Actionable Recommendation	Owner	Organization	Action	Date
T&S	**1**	Consider the following topics/sessions/structure for future workshops: a. More topics for scientists and users (e.g., user scheduling, user engagement – how to recruit, engage, and support user). b. Have candid and constructive dialogue on lessons learned from past problems encountered on NSF large facilities construction and operations, e.g., a session specifically on NEON, structured reviews of selected programs, root cause analysis training and application. c. Reduce NSF communications footprint. If policy or oversight updates from NSF are needed, consolidate into one session. d. Add basic information session/orientations for people new to the NSF large facilities community. Information could include NSF mission and organization, how proposal process works, NSF oversight activities, list of key documents such as LFM and BSR guide. e. Need sessions better organized to facilitate cross facility sharing at different levels or types of operations - directors, administration staff, education and outreach, etc. (e.g., see how the NSF Engineering Research Center organizes their annual meetings). f. Accounting for property, plant, and equipment (PP&E) in closeout of major construction projects, e.g., via a panel of actual facilities. g. How to improve communications/collaboration with NSF. h. Diversity in the Science Community. i. "Walking tightrope between science and politics." j. Hands-on estimating. k. Motivational TED-type talks for scientist and managers on successes and failures from experienced outside speakers. l. Science presentations.				

Appendix A: Agenda

National Science Foundation
2017 Large Facilities Workshop
LIGO Livingston & Baton Rouge, LA
Monday, May 1 – Wednesday, May 3

Agenda

Monday, May 1	**Renaissance Baton Rouge Hotel**
7:00 – 8:00 AM	**Registration, Light Refreshments**
8:00 – 9:00 AM	**Evolving NSF Oversight & Other Developments** ***Speaker***: Matt Hawkins, Head, Large Facilities Office (LFO), NSF ***Description***: NSF will provide an overview of the past year's activities and frame the break-out session discussions. Activities include implementing the American Innovation and Competitiveness Act and recommendations from the National Academy of Public Administration (NAPA) Panel Report on NSF Use of Cooperative Agreements to Support Large Scale Investment in Research.
9:00 – 10:30 AM	**High Performance Teams on Science Projects: Successful Strategies and Lessons for Building an Engaged and Talented Team** ***Speaker***: Ed Hoffman, CEO, Knowledge Engagement LLC; former NASA Chief Knowledge Officer and Director, NASA Academy; Executive in Residence, Columbia University School of Professional Studies ***Description***: The last decade has witnessed an unprecedented acceleration of change in technologies, organization approaches, and human perspective. These changes have reshaped the nature of the organization and placed a premium on accelerated learning and workforce engagement. Management of science projects has unique challenges and opportunities beyond the technical aspects. Ed Hoffman will share his NASA experiences and discuss in what manner performance happens at the team level.
10:30 – 11:00 AM	**Break**
11:00 – 12:00 PM	**Antarctic Infrastructure Modernization for Science (AIMS)** ***Speaker***: Brandon Neahusan, Project Manager, AIMS, Leidos ***Description***: An overview of the diverse NSF science missions and infrastructure improvements underway in the Antarctic, with a focus on the AIMS project which is progressing through NSF's Major Research Equipment and Facility Construction (MREFC) process.
12:00 – 1:00 PM	**Federal Budget Outlook (Working Lunch)** ***Speaker***: Beth Blue, Program Analyst, NSF-BD ***Description***: The NSF Budget Division (BD) will provide an overview of the federal budget process and an update on the current budget outlook for FY 2017 and FY 2018.

1:00 – 2:00 PM **The Role of International Collaborations for Large Research Facilities**

Speaker: Mangala Sharma, Program Director, NSF-OISE

Description: The NSF Office of International Science and Engineering (OISE) will facilitate an interactive discussion on the international dimensions of large research facilities, including identifying and managing partnerships. The goal is to share common challenges and good practices to build effective institutional partnerships throughout the lifetime of research facilities.

Business Systems Reviews (BSR) Hot Topics – Coordination of Administrative Business Reviews Across the NSF Large Facility Portfolio

Speakers: Roland Roberts, Program Director, National Ecological Observatory Network (NEON), Operations, NSF-BIO;
Florence Rabanal, Large Facilities Advisor, NSF-LFO

Description: NSF will discuss updates to the NSF process for identification and sequencing of administrative business reviews across the Large Facility Portfolio. It is primarily focused on NSF's strategy for identifying and managing risks associated with these large investments.

2:00 – 2:20 PM **Break**

2:20 – 4:00 PM **MREFC Process from a Facility Perspective**

Speakers: Demian Bailey, Regional Class Research Vessel (RCRV), Project Manager, Oregon State University (OSU);
Rita Pittmann, Planning & Controls Manager, Leidos

Description: Managers will describe their experience going through the MREFC review process for the RCRV and AIMS projects. The projects will share lessons learned, for the benefit of organizations that might go through the process in the future, and recommend process improvements to NSF.

Roundtable – Masters Forum – Creating a Successful Lessons Learned Approach: People, Process, Culture

Facilitators: Ed Hoffman, CEO, Knowledge Engagement LLC; former NASA Chief Knowledge Officer and Director, NASA Academy; Executive in Residence, Columbia University School of Professional Studies;
Rebecca Yasky, Large Facilities Advisor, NSF-LFO

Description: Knowledge capability is based on experience, learning and relevance. Successful organizations create strategies and methods that encourage practitioners to share their lessons in a variety of ways. We will provide space for participants to share their lessons with colleagues and provide input to NSF on the implementation of a lessons learned program for large facilities. This session will connect practitioners, reflection, sharing, and stories to enhance commitment to lessons learned.

4:00 – 4:20 PM **Break**

4:20 – 5:00 PM **Cyberinfrastructure Investments & Opportunities**

Speaker: Bill Miller, Science Advisor, NSF-CISE

Description: An overview of cyber infrastructure initiatives and developments that will be discussed in depth at the NSF Cyberinfrastructure for Facilities Workshop.

Evolution of EVM and the Future
Speaker: Wayne Abba, President of College of Performance Management
Description: Earned Value Management (EVM) is a project management technique for measuring performance in an objective manner and providing early warning indicators of cost and schedule overruns and underruns. Wayne Abba will share the history of EVM including a "Tale of Two Aircraft" and give a look into the future for performance management including recently enacted legislation.

6:00 – 8:00 PM **Reception (Optional), Renaissance Baton Rouge Hotel**

Tuesday, May 2	LIGO Livingston Observatory
7:00 – 8:00 AM	**Registration, Light Refreshments (Renaissance Baton Rouge Hotel)**
8:00 – 9:00 AM	**Buses - Renaissance Baton Rouge Hotel to LIGO**
9:00 – 9:15 AM	**LIGO Welcome** ***Speaker***: Albert Lazzarini, LIGO Deputy Director
9:15 – 11:40 AM	**Observatory Tours**
11:40 – 12:00 PM	**Break**
12:00 – 1:00 PM	**Education & Public Outreach (Working Lunch)** ***Speaker*****:** William Katzman, EPO Manager, LIGO Livingston Observatory (LLO) ***Description*****:** An overview of LIGO education and public outreach activities.
1:00 – 2:00 PM	**LIGO Science & Technology** ***Speaker***: Joe Giaime, Head, LIGO Livingston Observatory (LLO) ***Description***: An overview of LIGO scientific instrumentation and technological innovations. **Modern Methods of Schedule Risk Analysis** ***Speaker***: David Hulett, Hulett & Associates, LLC ***Description***: Early methods of quantifying risk analysis using Monte Carlo simulation placed probability distributions directly on activity durations. Developments in the last 10 years have allowed us to model risks much more specifically and intelligently. New methods for analyzing the impact of risk on a project's schedule will be introduced, including (1) distinguish uncertainty and project-specific risks, (2) apply risks to multiple activities (or categories of activities), (3) apply risks in series and in parallel, (4) model how duration correlation occurs, and (5) prioritize risks for focused risk mitigation.
2:00 – 2:20 PM	**Break**
2:20 – 4:00 PM	**Facility Operations & Maintenance Roundtable** ***Facilitators*****:** Richard Oram, Operations Manager, LIGO Livingston Observatory (LLO); Nigel Sharp, Program Director, NSF-MPS ***Description*****:** For this interactive roundtable discussion, LLO will present some aspects of operation and maintenance of a gravity wave observatory then others can share challenges and best practices that are commonly faced by large facility operators. **Practical Guidance to Strengthen Facility Estimates** ***Facilitators*****:** Jason Lee, Assistant Director, Applied Research and Methods, US Government Accountability Office (GAO) Kevin Porter, Large Facilities Advisor, NSF-LFO Erik Nylund, Crowe Horwath / Kforce Government Solutions (CH/KGS) ***Description*****:** NSF will briefly discuss new cost estimating and analysis requirements from the American Innovation and Competitiveness Act and how they are supported by

the Large Facilities Manual and GAO Cost Estimating and Assessment Guide. NSF and GAO will lead an interactive discussion emphasizing the applicability of the GAO Cost Guide and importance of Cost Estimating Plans and the Basis of Estimate for both Construction estimates and Operations and Maintenance estimates. GAO and CH/KGS will provide examples for discussion. Ample time will be provided for questions and answers.

4:00 – 5:00 PM **Buses – LIGO to Renaissance Baton Rouge Hotel**

Wednesday, May 3 **Renaissance Baton Rouge Hotel**

7:00 – 8:00 AM **Light Refreshments**

8:00 – 9:00 AM **Large Facility Innovations & Technology Transfers Discussion**
Speaker: Matt Hawkins, Head, NSF-LFO
Description: All NSF programs support NSF's mission "*to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense*." This type of support is a primary driver of the U.S. economy. NSF's Research Infrastructure also plays a key role in driving the U.S. innovation ecosystem by creating new (or enhanced) technologies and processes in order to meet the scientific objectives and advance human knowledge. Innovation can happen at every life-cycle stage, but it happens most readily during design, construction and operations. NSF and its Recipients have always been (and should remain) focused primarily on the science outcomes that our Research Infrastructure supports. However, as facilities costs rise in an era of challenging budgets, it may be advantageous to better articulate these innovative aspects in the "Broader Impacts" of major facility proposals. To best achieve this, and more broadly support NSF's mission, cataloging and quantifying these successes in a more formal and routine way may be beneficial. This session will focus on sharing examples of innovative activities driven by NSF-funded Research Infrastructure and discussing ways in which NSF can work with major facility Recipients to better describe the benefits on U.S. innovation and the economy.

Management Fee to Fee
Speaker: Jeff Lupis, Division Director, Division of Acquisitions and Cooperative Support (DACS), NSF
Description: An overview of the proposed new fee policy for large facilities.

9:00 – 9:20 AM **Break**

9:20 – 10:20 AM **Distributed Networks & Facilities Roundtable**
Facilitator: Rob Hengst, Large Facilities Advisor, NSF-LFO
Description: This session is a roundtable of NSF and Recipient personnel involved in distributed networks and facilities. Roundtable members will each briefly share their experiences on topics pertaining to distributed facilities such as centralized procurement, cyber infrastructure, site facilities maintenance, personnel/staffing, parts/storage, etc. This session is intended to be interactive with shared thoughts, experiences, questions, and answers throughout.

Performance Metrics –Strategy and Experience at the Department of Energy (DOE)
Speaker: Ben Brown, Senior Science and Technology Advisor, Office of the Deputy Director for Science Programs, DOE
Description: This is an interactive session to discuss examples of performance metrics for operating Facilities and a recently-implemented strategy at the DOE Office of Science for collection and synthesis of detailed statistical information across the 27 DOE user facilities. The practical challenges with this broad undertaking will be shared as well as the broad benefits envisioned for stakeholders. Attendees will be encouraged to share their experiences and explore ideas for strengthening current practices.

10:20 – 10:40 AM **Break**

10:40 – 12:00 PM **Idea Exchange Open Forum for Award Recipients**
Facilitator: Tim Cockerill, Director of Center Programs, Texas Advanced Computing Center, The University of Texas at Austin
Description: This session is intended for award recipients and offers an opportunity for the large facilities to share ideas amongst themselves. The goal of the session is to provide critical feedback to NSF in the form of reasonable, actionable, documented recommendations. Actionable recommendations will be provided to NSF during the open Workshop Debrief in the afternoon and addressed by NSF after the workshop.

Incurred Cost Audits & Data Collection Tool
Speaker: Eddie Whitehurst, Deputy Branch Chief, DACS-Cooperative Support Branch (CSB), NSF
Description: CSB will provide background and context on new requirements for incurred cost audits and the Large Facilities Data Collection Tool.

12:00 – 1:00 PM **Cybersecurity & CTSC (Working Lunch)**
Speaker: James Marsteller, Information Security Officer, Pittsburgh Supercomputing Center
Description: This session will provide an overview of the Center of Trustworthy Scientific Cyberinfrastructure (CTSC), including CTSC mission, past work with large facilities, key resources and events of interest to large facilities.

1:00 – 2:00 PM **Science Done by a Global Community**
Speaker: Gabriela Gonzalez, former Spokesperson, LIGO Scientific Collaboration
Description: This talk will focus on the main astrophysical results in gravitational wave astronomy generated by the work done by the LIGO Scientific Collaboration.

2:00 – 2:20 PM **Break**

2:20 – 4:00 PM **Uniform Guidance Procurement Standards**
Speakers: Eddie Whitehurst, Deputy Branch Chief, DACS-Cooperative Support Branch (CSB), NSF
Description: Overview of requirements from 2 CFR 200 Uniform Guidance 200.317-326 Procurement Standards which took effect December 26, 2016.

NSF Earned Value Management System Verifications
Speakers: Rebecca Yasky, Large Facilities Advisor, NSF-LFO
Description: NSF now utilizes an applied process for the compliance evaluation review (CER) and acceptance of a Recipient's earned value management (EVM) systems. A project-focused EVMS acceptance permits the use of other project and business review results and focuses the CER on the EVM specific processes.

Workshop Debrief - Open Forum & Actionable Recommendations from Idea Exchange
Facilitator: Kevin Porter, Large Facilities Advisor, NSF-LFO
Description: An open forum for workshop attendees to provide direct feedback to NSF-LFO and NSF-CSB and recommendations for future improvements and topics. Actionable recommendations developed during the Idea Exchange Open Forum for Award Recipients will be presented to NSF.

Monday, May 1 - Renaissance Baton Rouge Hotel		
	Continuous Learning Track	**Business Practices Track**
7:00 - 8:00	Registration, Light Refreshments	
8:00 - 9:00	Evolving NSF Oversight & Other Developments - Matt Hawkins, Head, NSF-LFO	
9:00 - 10:30	High Performance Teams on Science Projects: Successful Strategies and Lessons for Building an Engaged and Talented Team - Ed Hoffman, CEO, Knowledge Engagement LLC; former NASA Chief Knowledge Officer	
10:30 - 11:00	Break	
11:00 - 12:00	Antarctic Infrastructure Modernization for Science (AIMS) - Brandon Neahusan, AIMS, Leidos	
12:00 - 1:00	Federal Budget Outlook (Working Lunch) - Beth Blue, NSF-BD	
1:00 - 2:00	The Role of International Collaborations for Large Research Facilities - Mangala Sharma, NSF-OISE	BSR Hot Topics – Coordination of Administrative Business Reviews - Roland Roberts, NSF-BIO - Florence Rabanal, NSF-LFO
2:00 - 2:20	Break	
2:20 - 4:00	MREFC Process from a Facility Perspective - Demian Bailey, RCRV, OSU - Rita Pittmann, Leidos	Roundtable – Masters Forum – Creating a Successful Lessons Learned Approach: People, Process, Culture - Ed Hoffman - Rebecca Yasky, NSF-LFO
4:00 - 4:20	Break	
4:20 - 5:00	Cyberinfrastructure Investments & Opportunities - Bill Miller, NSF-CISE	Evolution of EVM and the Future - Wayne Abba, College of Performance Management

6:00 - 8:00	Reception Renaissance Baton Rouge Hotel

Tuesday, May 2 - LIGO Livingston Observatory		
	Continuous Learning Track	**Business Practices Track**
7:00 - 8:00	Registration, Light Refreshments - Renaissance Baton Rouge Hotel	
8:00 - 9:00	Buses - Renaissance Baton Rouge Hotel to LIGO	
9:00 - 9:15	LIGO Welcome - Albert Lazzarini, LIGO Deputy Director	
9:15 - 11:40	Observatory Tours	
11:40 - 12:00	Break	
12:00 - 1:00	Education & Public Outreach (Working Lunch) - William Katzman, EPO Manager, LLO	
1:00 - 2:00	LIGO Science & Technology - Joe Giaime, Head, LLO	Modern Methods of Schedule Risk Analysis - David Hulett, Hulett & Associates, LLC
2:00 - 2:20	Break	
2:20 - 4:00	Facility Operations & Maintenance Roundtable - Richard Oram, Operations Manager, LLO - Nigel Sharp, NSF-MPS	Practical Guidance to Strengthen Facility Estimates - Jason Lee, GAO - Kevin Porter, NSF-LFO - Erik Nylund, CH/KGS
4:00 - 5:00	Buses - LIGO to Renaissance Baton Rouge Hotel	

Wednesday, May 3 - Renaissance Baton Rouge Hotel			
	Continuous Learning Track	**Business Practices Track**	
7:00 - 8:00	Light Refreshments		
8:00 - 9:00	Large Facility Innovations & Technology Transfers Discussion - Matt Hawkins, Head, NSF-LFO	Management Fee to Fee - Jeff Lupis, Head, NSF-DACS	
9:00 - 9:20	Break		
9:20 - 10:20	Distributed Networks & Facilities Roundtable - Rob Hengst, NSF-LFO	Performance Metrics –Strategy and Experience at DOE - Ben Brown, DOE Office of Science	
10:20 - 10:40	Break		
10:40 - 12:00	Idea Exchange Open Forum for Award Recipients - Tim Cockerill, TACC-UT	Incurred Cost Audits & Data Collection Tool - Eddie Whitehurst, NSF-DACS	
12:00 - 1:00	Cybersecurity & CTSC (Working Lunch) - James Marsteller, PSC		
1:00 - 2:00	Science Done by a Global Community - Gabriela Gonzalez, former Spokesperson, LIGO Scientific Collaboration		
2:00 - 2:20	Break		
2:20 - 3:20	Uniform Guidance Procurement Standards - Eddie Whitehurst, NSF-DACS	Workshop Debrief - Open Forum & Actionable Recommendations from Idea Exchange - NSF-LFO & NSF-DACS	NSF Earned Value Management System Verifications - Rebecca Yasky, NSF-LFO
3:20 - 4:00			

Appendix B: Participant Information

National Science Foundation
2017 Large Facilities Workshop
Baton Rouge, LA
Monday, May 1 – Wednesday, May 3, 2017
Participants List

Wayne Abba
Abba Consulting

Edward Ajhar
National Science Foundation

Demian Bailey
Oregon State University

Ellen Baptiste Carpenter
Battelle

Christopher Bashus
UNAVCO

Martin Bloss
Green Bank Observatory

Elizabeth Blue
National Science Foundation

Sylvie Boucher
Canada Foundation for Innovation

Joel Brock
Cornell University

Tamara Brown
AURA Incorporated - Gemini Observatory

Peter Bryan
Lehigh University

Daniel Buchtel
National Science Foundation

Charles Burch
Cornell University

Daniel Calabrese
Large Synoptic Survey Telescope

Tim Cockerill
Texas Advanced Computing Center - The University of Texas at Austin

Hilda Colon Plumey
Ana G. Méndez University System and Arecibo Observatory

David Curren
Associated Universities, Inc.

Kathleen Dedrick
Cornell High Energy Synchrotron Source

Carol Deitesfeld
UNAVCO

Jennifer Ditsler
National Solar Observatory

Richard Farnsworth
Battelle

Montona Futrell-Griggs
National Science Foundation

Amy Garwood
Columbia University

Steven Geiger
National Radio Astronomy Observatory

Joseph Giaime
The Laser Interferometer Gravitational-Wave Observatory Livingston

Ranpal Gill
Association of Universities for Research in Astronomy

National Science Foundation
2017 Large Facilities Workshop
Baton Rouge, LA
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Participants List

Elizabeth Goebels
National Science Foundation

Teresa Grancorvitz
National Science Foundation

Eric Guetre
TRIUMF

Thomas Gulbransen
Battelle

Kurtis Gurley
University of Florida

Matthew Hawkins
National Science Foundation

Robert Hengst
National Science Foundation

Natalie Henriques
Texas Advanced Computing Center/The University of Texas at Austin

Giselle Hepker
Laser Interferometer Gravitational-Wave Observatory

Ed Hoffman
Ed Hoffman Consulting

Bauke Houtman
National Science Foundation

Robert Huck
University of Oklahoma

David Hulett
Hulett & Associates, LLC

Rex Hunter
Association of Universities for Research in Astronomy/National Solar Observatory

Katie Jacoby
Cornell High Energy Synchrotron Source

Tim Kashmer
National Science Foundation

Ken Kawasaki
Coho Consulting Services

Victor Krabbendam
Large Synoptic Survey Telescope

John Kulesz
KGS Government Services

Michele Lacey
International Ocean Discovery Program

Michael Landry
LIGO Hanford Observatory

Krista Laursen
Fusion Projectworks, LLC

Jason Lee
U.S. Government Accountability Office

Marie Lemoine-Busserolle
Gemini Observatory

Richard Leonard
Battelle

Elise Lipkowitz
National Science Foundation

National Science Foundation
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Roy Liu-Marques
Florida International University

Laura Lockledge
National Radio Astronomy Observatory

Pedro Lomonaco
Oregon State University

Jeff Lupis
National Science Foundation

James Marsteller
Pittsburgh Supercomputing Center

Jose Martens
Association of Universities for Research in Astronomy

Forrest Masters
University of Florida, Herbert Wertheim College of Engineering

Janet McCord
Texas Advanced Computing Center

Judy McEachern
National High Magnetic Field Laboratory

Pete McEvoy
Associated Universities, Incorporated

Christopher McLaughlin
National Radio Astronomy Observatory

Joseph McMullin
National Solar Observatory

Bill McVeigh
Association of Universities for Research in Astronomy

Farnyuh Menq
Natural Hazards Engineering Research Infrastructure

Meghan Miller
UNAVCO

William Miller
National Science Foundation

Subhashree Mishra
National Science Foundation

Christopher Morrison
Gemini South Observatory

David Morrissey
National Superconducting Cyclotron Lab

Gilberto Mosqueda
University of California, San Diego

Russell Moy
Southeastern Universities Research Association

Keith Nackerud
National Science Foundation

Brandon Neahusan
Leidos

Tim Nelson
Caltech LIGO Livingston Observatory

Erik Nylund
Crowe Horwath

Donna O'Malley
Mathematical & Physical Sciences/Astronomy

National Science Foundation
2017 Large Facilities Workshop
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The Laser Interferometer Gravitational-Wave Observatory

Eric Palm
National High Magnetic Field Laboratory

Joy Pauschke
National Science Foundation

Ron Payne
The National Center for Supercomputing Applications

Asita Perera
TRIUMF

Susan Perino
Battelle Ecology

Trisha Pinckney
Incorporated Research Institutions for Seismology

Rita Pittmann
Leidos

Kevin Porter
National Science Foundation

Mellisa Prunchak
National Science Foundation

Jian Qiao
Embassy of China

Florence Rabanal
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Tim Reeme
UNAVCO

Clare Reimers
Oregon State University

Jennifer Rice
University of Florida

Thomas Rimmele
National Solar Observatory

Roland Roberts
National Science Foundation

Carolyn Robertson
Florida International University Extreme Events Institute

Kaylyn Rogers
National Center for Supercomputing Applications

Jay Roloff
National Center for Supercomputing Applications

Jim Rosser
International Ocean Discovery Program

Anders Ryd
Cornell University

Val Schnader
The Association of Universities for Research in Astronomy

Matthew Schoettler
Natural Hazards Engineering Research Infrastructure SimCenter

Ethan Schreier
Associated Universities, Incorporated

Mangala Sharma
National Science Foundation

National Science Foundation
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Nigel Sharp
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Jamie Slater
Cornell University

Amy Smith
University Corporation for Atmospheric Research

Ericka Solano
University of Florida

Judith Strack
University of Florida

Virginia Taberski
University Corporation for Atmospheric Research

Jack Tade
Associated Universities, Inc.

Guebre Tessema
National Science Foundation

Verna Tomanek
Battelle Ecology

Anke Toth
National High Magnetic Field Laboratory

Michael Tuts
Columbia University

Catherine Vakhnina
Wisconsin IceCube Particle Astrophysics Center

Pablo Vidal
Associated Universities Incorporated

Catherine Walters
National Science Foundation

Lian Wang
Embassy of China

Joseph Wartman
University of Washington

Carolyn Watkins
Association of Universities for Research in Astronomy/National Solar Observatory

Amanda Watts
Oregon State University

Eddie Whitehurst
National Science Foundation

Carol Wilkinson
Wilkinson Project Consulting

Dan Wilson
University of California, Davis

Rob Woolley
Incorporated Research Institutions for Seismology

Rebecca Yasky
National Science Foundation

Dan Zehner
NHERI NCO

Ken Zeller
Battelle Memorial Institute

Jeff Zivick
National Science Foundation

Appendix C: Survey Data

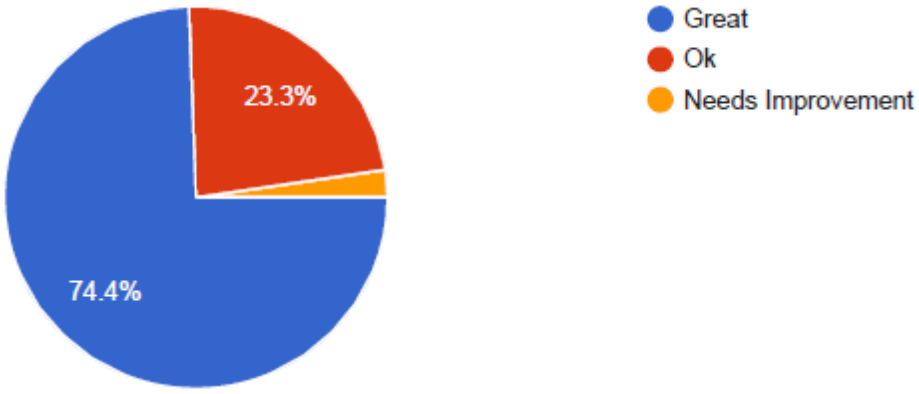
Appendix D: Survey Data

Large Facilities Workshop Day 1

43 responses

1. Overall workshop planning and communications by NSF?

43 responses



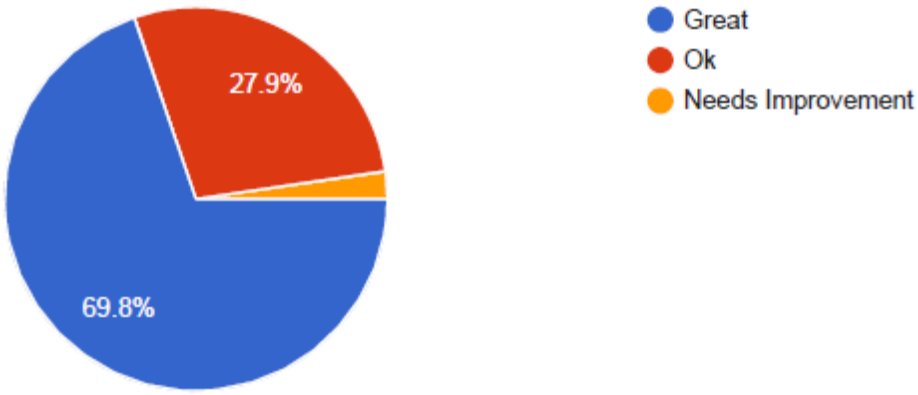
2. Specific comments or suggestions on overall workshop planning and communications by NSF

17 responses

Updates regarding the workshop received frequently and timely.
Matt's update to kick off the workshop is great at framing current LF status and outlining future administrative issues impacting the community.
Great Start to the conference. Look forward to the next couple of days.
I am loving the app!
Good speakers, helpful information presented.
Hotel reservations were rough, not enough time to book rooms.
Only way to know about Sunday registration was the hotel tv screen, nothing in agenda or app or website until late Sunday evening when I informed the organiser. No notice was taken off my dietary restrictions specified on registration form, $80 for half a plate of vegetables was very disappointing for my reception dinner, for $80 chef should have made MUCH more of an effort!
The app is fine; however, not everyone has an Ipad and using the app isn't easy with just a phone.
The link to the host hotel with the reduced rate was not prominent on the registration site.
more hotel rooms in block rate
All the sessions were great, I was disappointed that I could not attend all of them! If the sessions could be recorded it would be something that I would watch later on. Or extend the conference by a day so that we are able to see every session!
Start earlier planning for workshop to get topics from PIs
Everything is great. Perhaps having paper agendas would be good for attendees that are not able to download the NSF app due to technology issues, not having a smart phone, or not enough memory space on phone.
Well done!

We did not know the deatils of the workshop until one month before the workshop.
I know you have day jobs, but the announceents could come earlier confirming it is on and telling us the hotel, etc.
The App needed to have been clearer regarding room numbers for the different sessions

3. The purpose and intended audience of the workshop?
43 responses



4. Specific comments or suggestions on the purpose and intended audience of the workshop
9 responses

Detailed agenda comes out too late to get correct personnel to LFW
need to get community to recognize the networking possibilities and lead to more participation
Not Not sure if intended audience was addressed.
Good mix of scientific and administrative
sessions where input sought should be clearer
Need clear goals and objectives so facilities know who to send
Everything was great.
The workshop needs to broaden on more scientists and users, while keeping the management component.
Looking ahead - last year the DC meeting was packed with NSF Staff who weren't in Large Facilites. I appreciate what they do for us, but the meeting should be just for the LF staff and managers.

5. Please share your opinions about the Agenda for Day 1:

6. Specific comments or suggestions on the overall workshop structure or Agenda for Day 1?
16 responses

Provide rooms for breakout sessions for smaller groups to use as needed.
None
None. Great job!
Key Note presentation was excellent. Kudos to NSF for emphasizing the social/teaming aspect of a large project. I was hoping for more practical information around the EVM session. The history is not important but in the limited time we have at the workshop, practical information is more valuable.
Very disappointed in the $80 reception. Way overpriced for the food provided.
90 minute presentation is too long even when the talk is really good, which it was. I just couldn't pay attention that long.
The "Lessons Learned" session was not well described, i.e. the purpose was unclear.
Some of the breakout session talks were not very focused. As an example, for the discussion on the MREFC process, it was noted that a response to NEON was driving some of NSF's process but that was not covered in detail (i.e., what was done wrong, what were the lessons learned). Similarly, it was noted one project did not pass the EVMS validation; the details of this would have been useful for other projects.
Generally excellent. A bit more description of the sessions in the agenda might facilitate making good choices about which sessions to attend.
Would like more breakout session choices as an annual attendee I've attended some of the talks before
Hoffman shorter
I know NSF requires for lunch to be paid for that it be a working lunch. But it was very hard to focus at the end of the day after focusing since 8am! I would have preferred to have an actual lunch break
Each plenary talk should be about 30 to 40 minutes
Great!
Opening plenary was a bit long. Maybe break into two sessions.
Relevancy/Practicality of the Chief Knowledge Officer sessions was questionable

7. What did you like most about Day 1?
23 responses

Ed Hoffman's presentation and the Lessons Learned working session
interaction with LFO personnel
The Antarctic presentation.
Matt Hawkins seems very knowledgable and was always available to clarify or comment.
That the agenda and presentations were very informative.
I liked the breaks being longer and the on site workshop. I met so many more people this year on day 1!
LF updates and NSF budget update
BSR Hot Topics
Key note topic and speaker
NSF Staff more accessible this year.
Team building workshop
Key Note Speaker
All of the sessions stayed on time
Plenary and lunch
Budget
The updates from NSF about current hot topics
Ed Hoffman's talk was entertaining.
Meeting New People and the Information that was presented.
Well organized. Topics on point.
Ed Hoffman presentations
Initial meet and greet
Ed Hoffman was excellent. A very good speaker.
Budget update critical. McMurdo update fascinating.

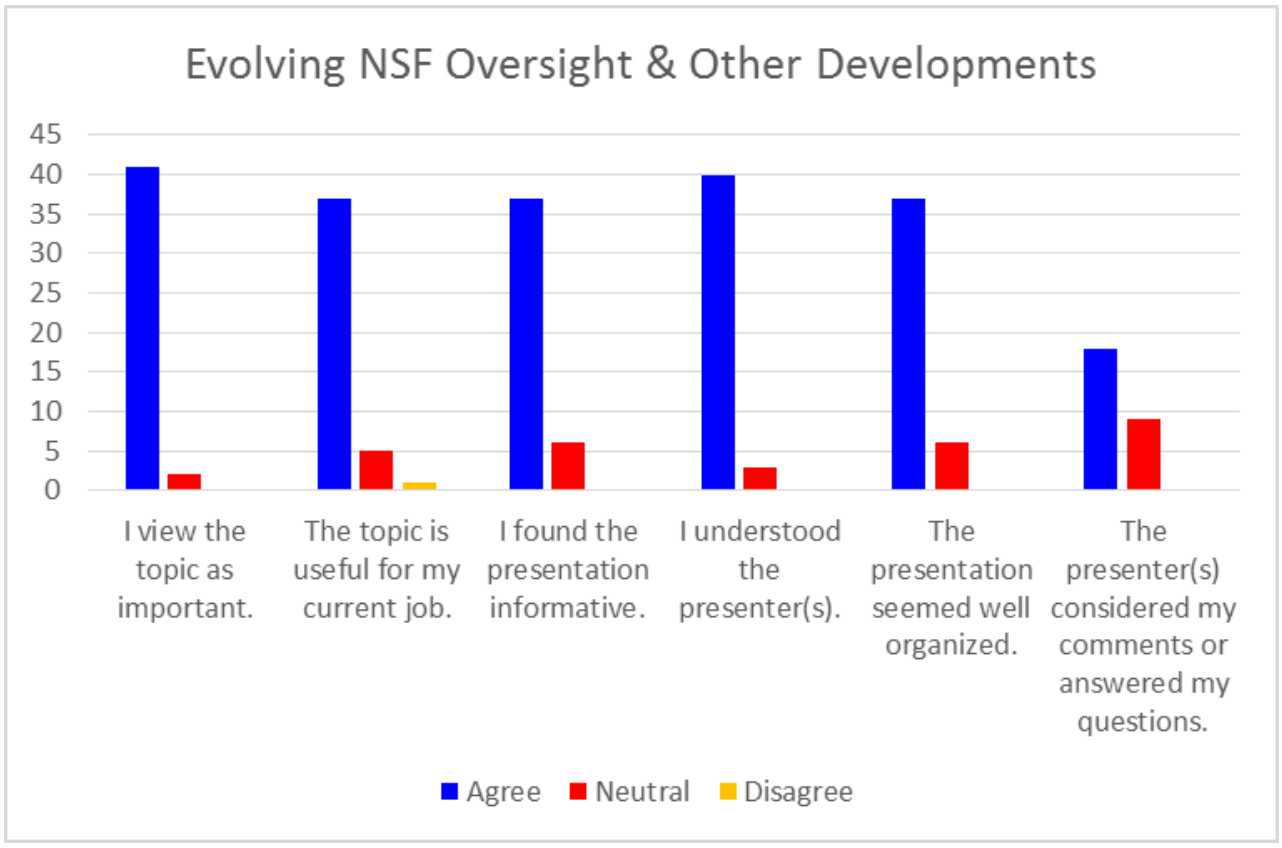
8. How could we have improved workshop planning and communications or Day 1?
14 responses

Cut the last session of the day and provide a longer break between the session and the reception for an organic breakout session for attendees to talk about Day 1 topics
Providing PPT ahead of time.
Include the presentations on Sunday rather than waiting until Monday to announce they would be available.
You should add information sessions, like orientations, for people new to working for an NSF funded large facility. If you are brand new, much to the material just goes right over your head, so it seems like a golden opportunity is being missed by not provided just general, "this is how the NSF is organized, this is our mission, this is how proposals work, these are the manuals you should know about" etc.
I thought it went well.
Bsr topic could have covered more lessons learned than the procedural. Would be nice to have some specific examples of various issues rather than all abstract representations.
Round Table - the goal of the session was not clear until the very end.
A quick run through of the app features would have been helpful

Fine
More information on the sessions, or even posting the slides earlier for review. Some of the sessions were not what I expected them to be and therefore were not as useful to me as I would have liked
Need better organized sessions to facilitate cross facility sharing at different levels of operations - directors, admin staff, education and outreach, etc. Check with the NSF ERC program on how they organize their annual meetings.
N/A
The APP is nice but needs augmentation with signage of what is in what room (I found the Hotel monitor on Wednesday...)
Hoffman plenary lacked content. Quite disappointed as this topic critical.

9. Other comments or suggestions:
12 responses

Tailor material to be useful to attendes. It's interesting to learn what NSF's internal processes are, but it doesn't help us do our jobs.
Room temperature was pretty cold in the morning but improved as the day progressed.
The reception was very expensive.
Page 1, why do I have to respond for parallel sessions I didn't attend?
The reception was extremely overpriced for what was offered. The price also prevented many folks from attending the event foregoing the opportunity to socialize with other attendees
Silly to require feedback survey answers when parallel sessions could not possibly be attended.
Please figure out how to support people w/dietary restrictions.
Matt mentioned that NEON was the elephant in the room. The NEON effect is obvious today on how projects are impacted, and the perception at the IG of how every NSF project is off the rails. I would like to have seen a presentation that talked candidly about all the lessons learned from NEON. How it went off the rails. Why was the management team replaced? What are the specific steps the new team is doing, as well as the NSF, to turn things around? On a similar note, I would like to have heard why the OSU Ship project failed the EVM validation and since there are two projects, DKIST and LSST ,that have successfully completed the validation, it would be of value to see what they did differently, and right. Although the EVM presentation was an interesting and well presented history of EVM, there was not any useful information about what it takes to successfully implement EVM in today's environment.
None
Roundtable was a bait and switch - not what the title said it was going to be. Size of room was good. Having the sessions in adjacent rooms was good. Food was great on Day 1 - really appreciated the local color of menu choices - and the grab and go on Day 3 was a great idea. It is difficult to plan travel before you know when the workshop ends. I think next year there should be an early announcement that it ends at 3pm on Day 3. The meeting space was nice last year but not having your car there meant retreating to the hotel to drive home. It was a long slog with the afternoon traffic. A big thanks to everyone who workd on this year's meeting. Probably the best one I have attended.
The reception was a ripoff
The temperature of the meeting room was absolutely freezing -made it difficult to concentrate on speakers
Tailor material to be useful to attendes. It's interesting to learn what NSF's internal processes are, but it doesn't help us do our jobs.
Room temperature was pretty cold in the morning but improved as the day progressed.


Evolving NSF Oversight & Other Developments
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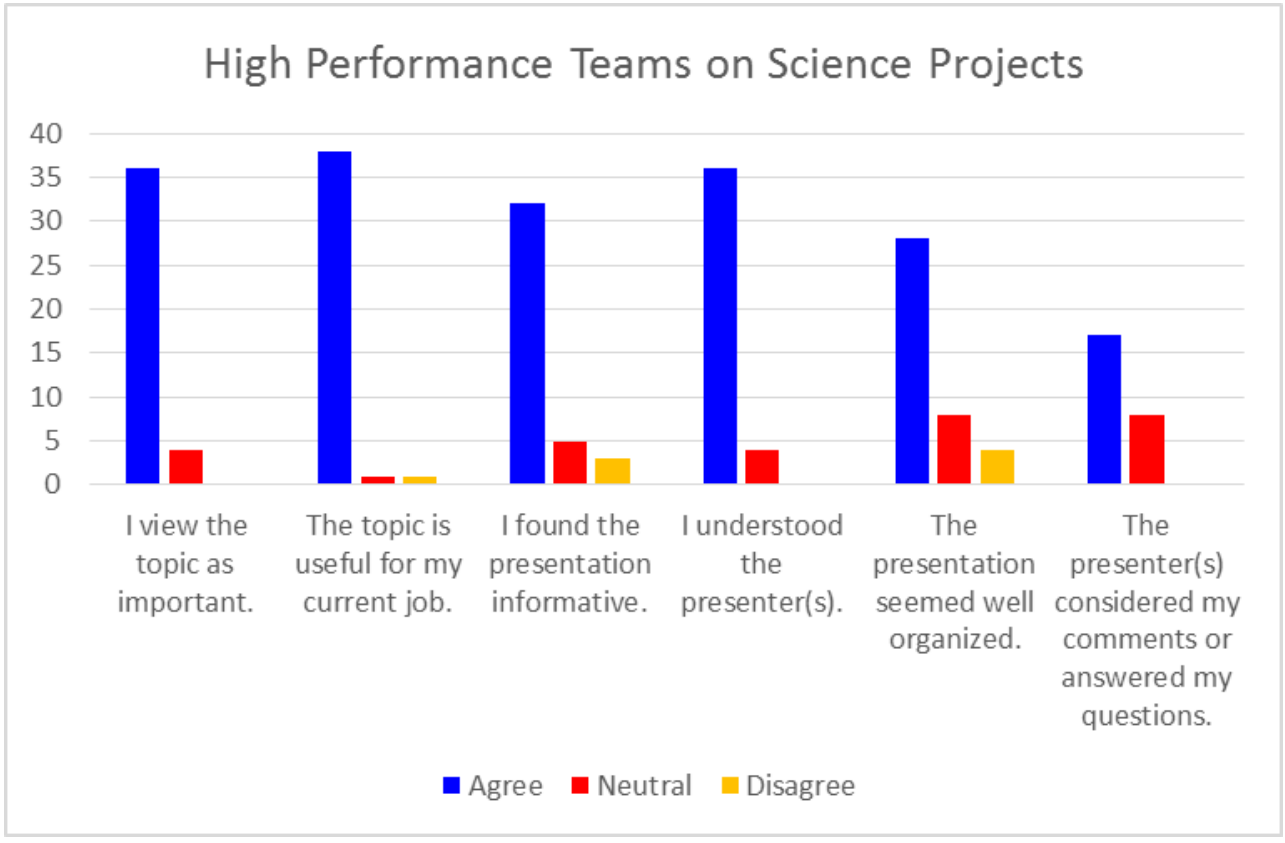
I view the topic as important.
The topic is useful for my current job.
I found the presentation informative.
I understood the presenter(s).
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree


High Performance Teams on Science Projects
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Agree
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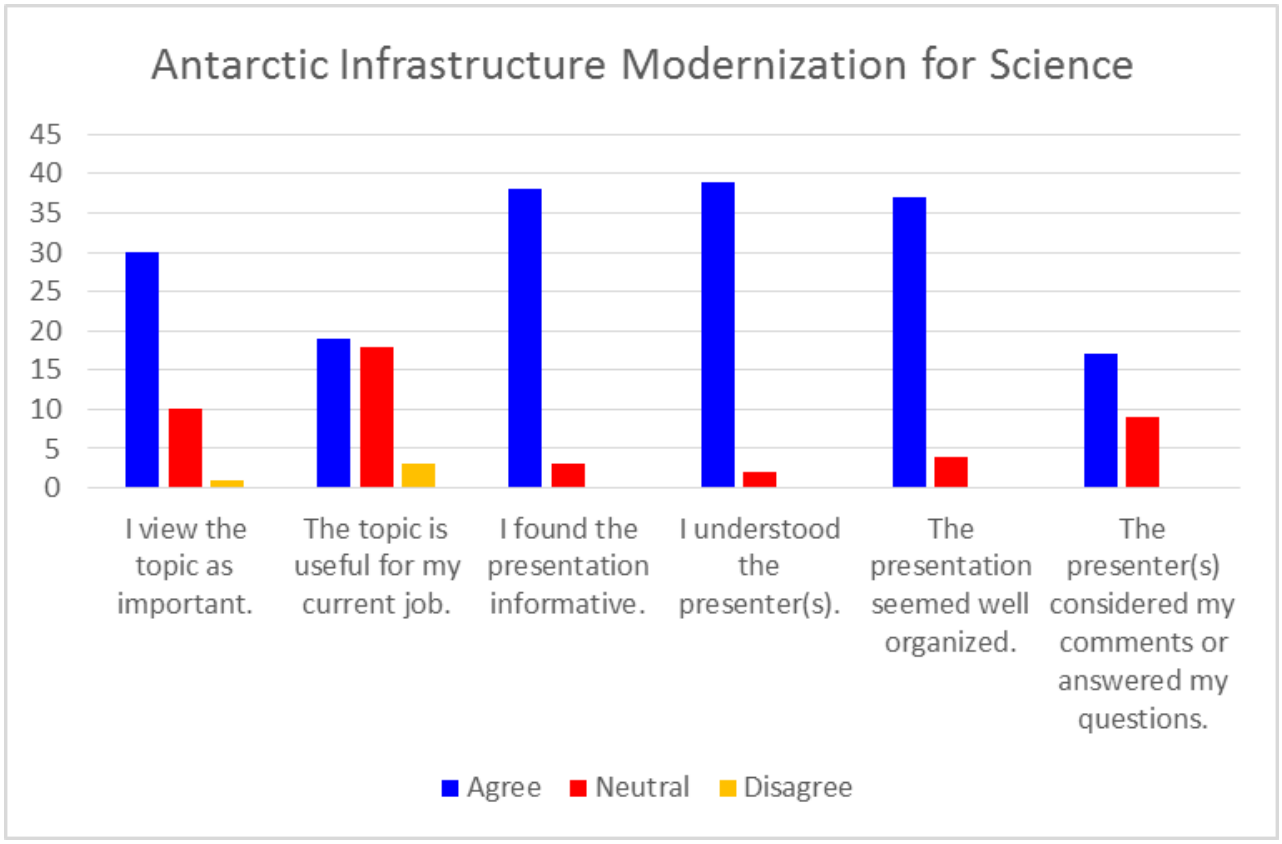
Antarctic Infrastructure Modernization for Science
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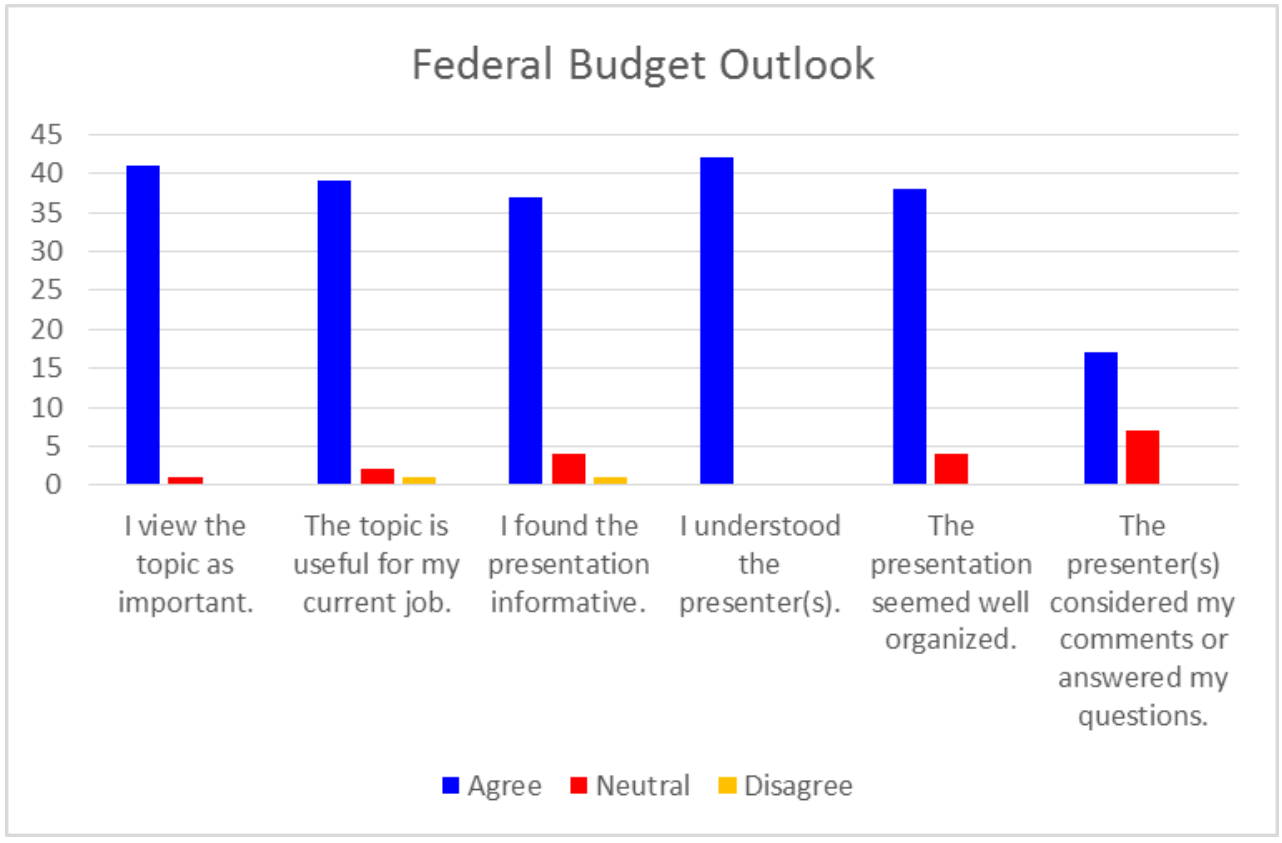
Agree
Neutral
Disagree


Federal Budget Outlook
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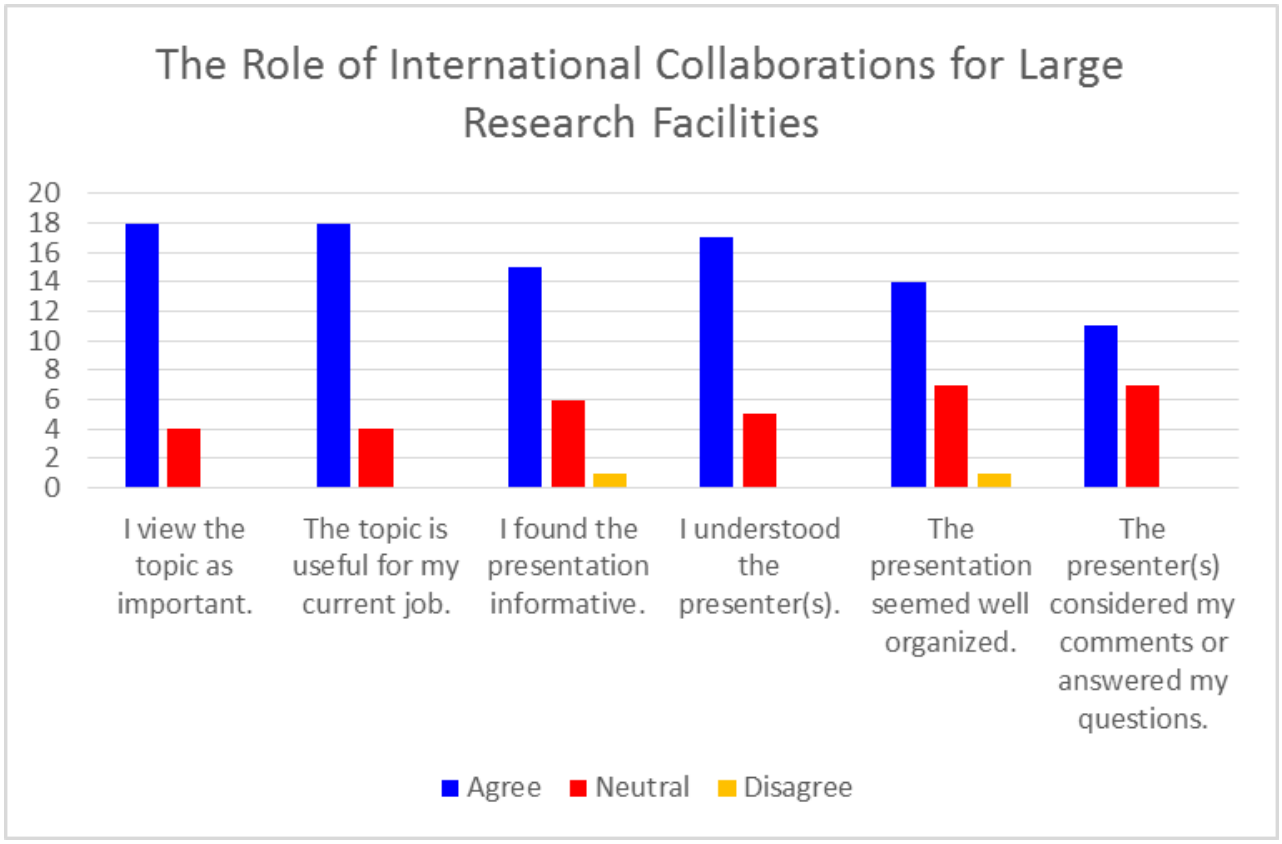
Disagree


The Role of International Collaborations for Large Research Facilities
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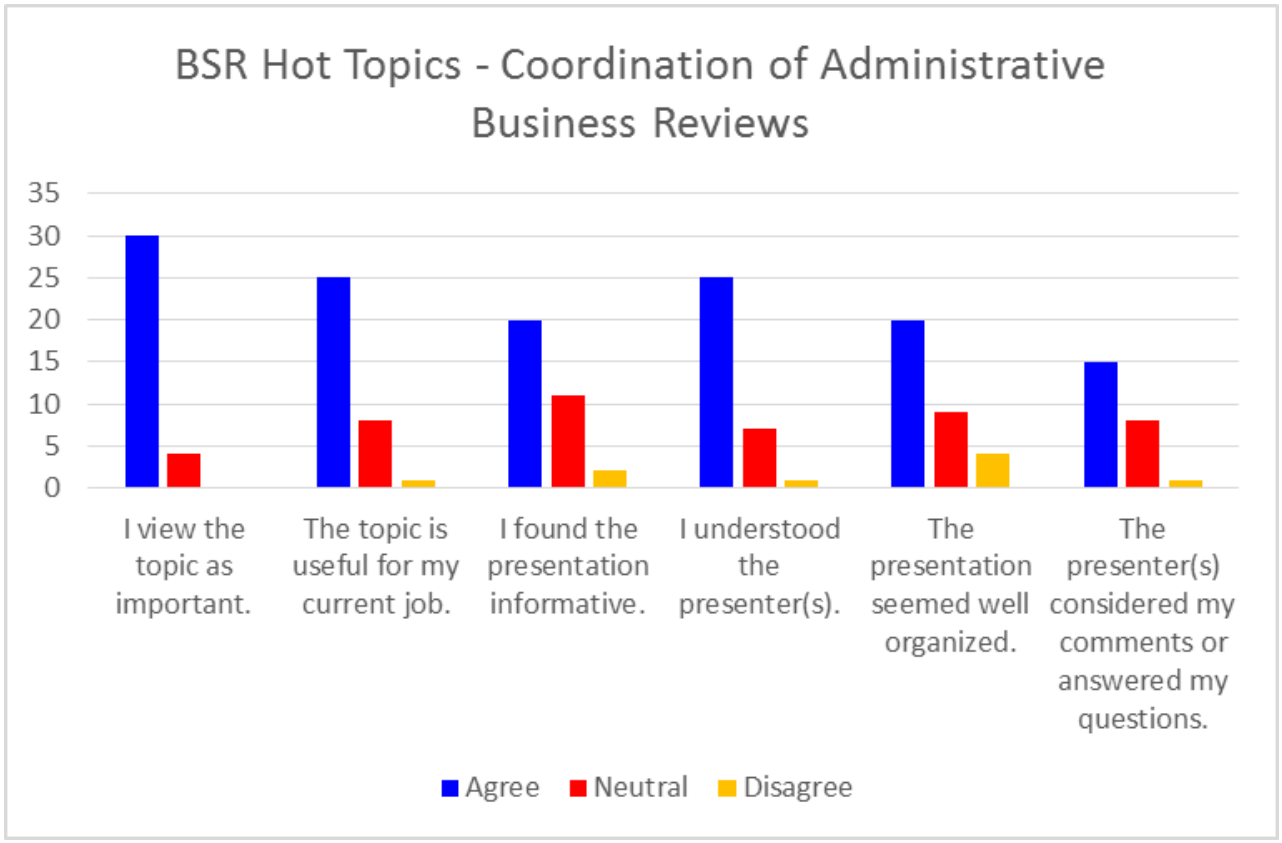
BSR Hot Topics - Coordination of Administrative Business Reviews
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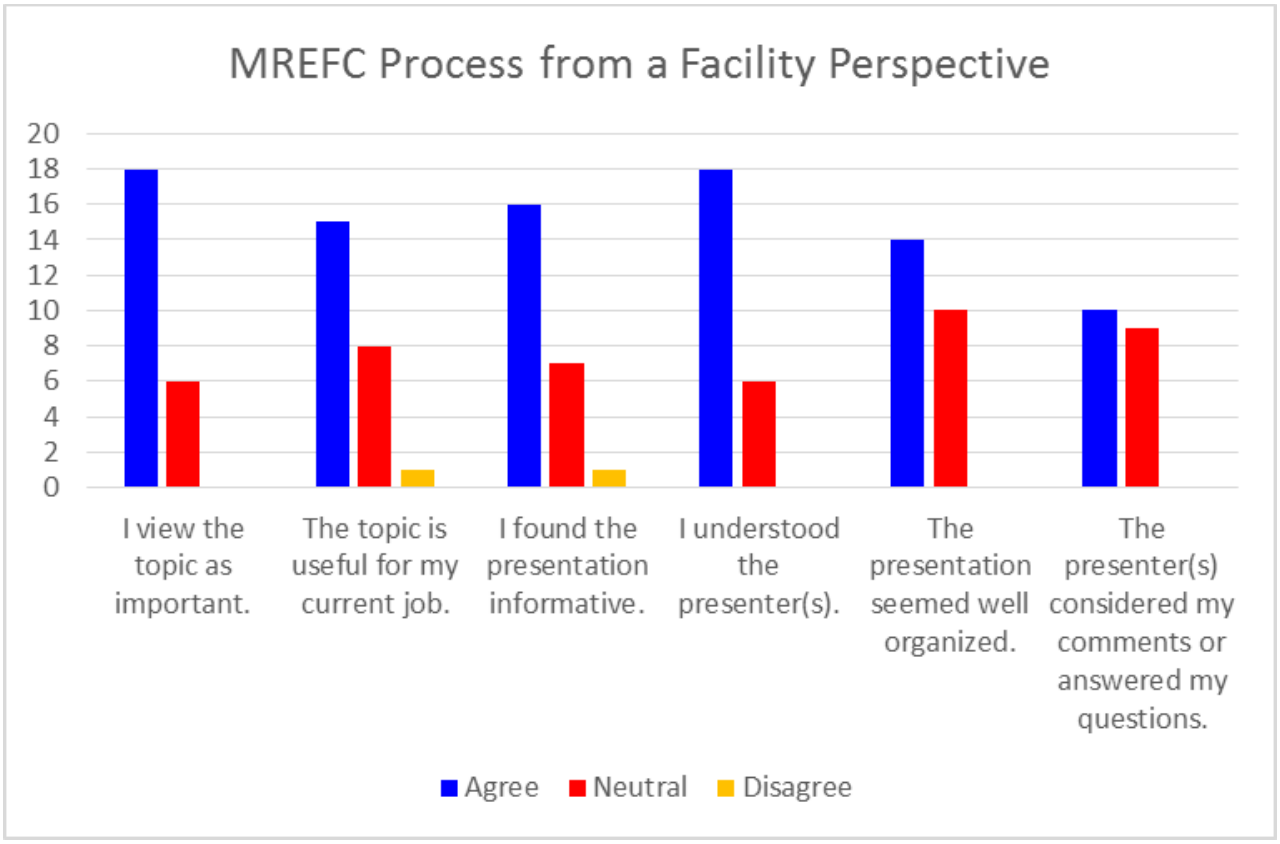
MREFC Process from a Facility Perspective
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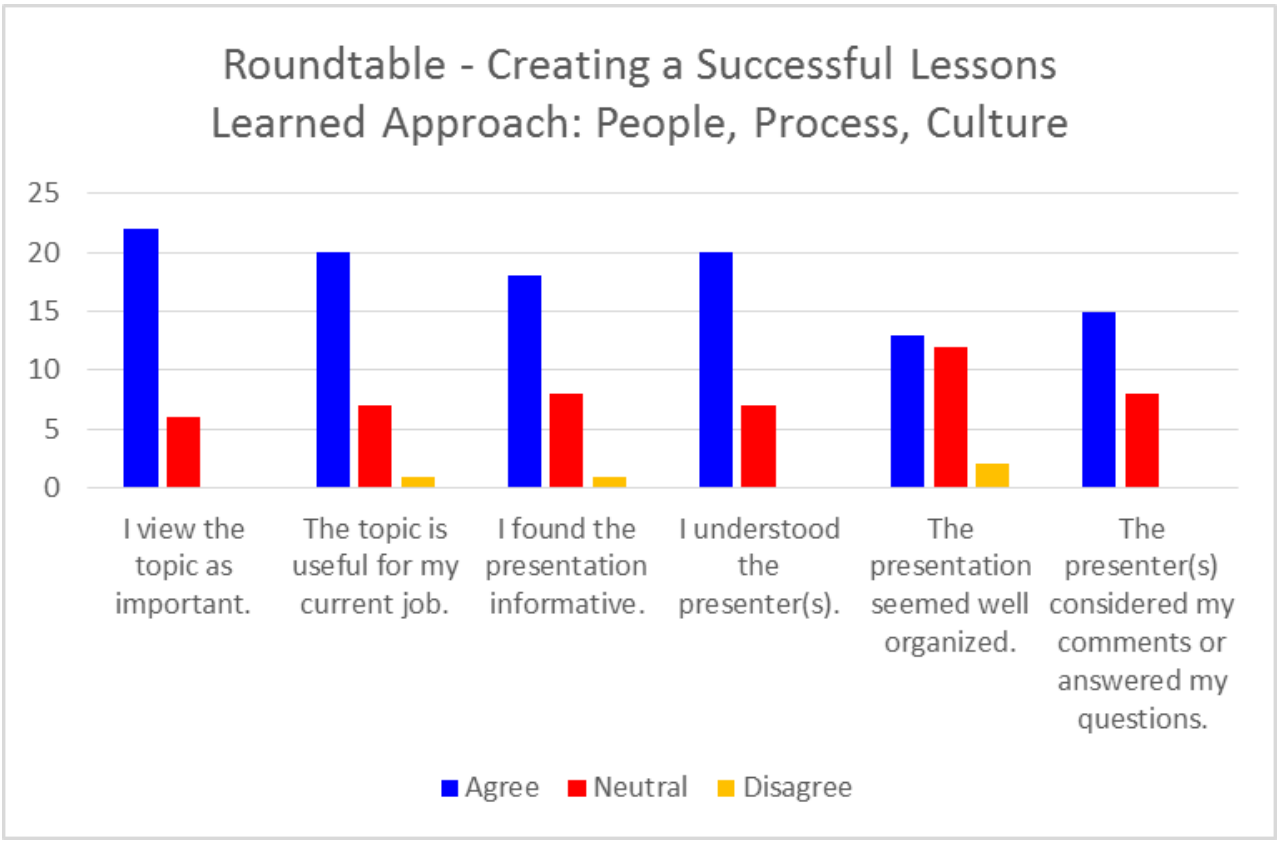
Roundtable - Creating a Successful Lessons Learned Approach: People, Process, Culture
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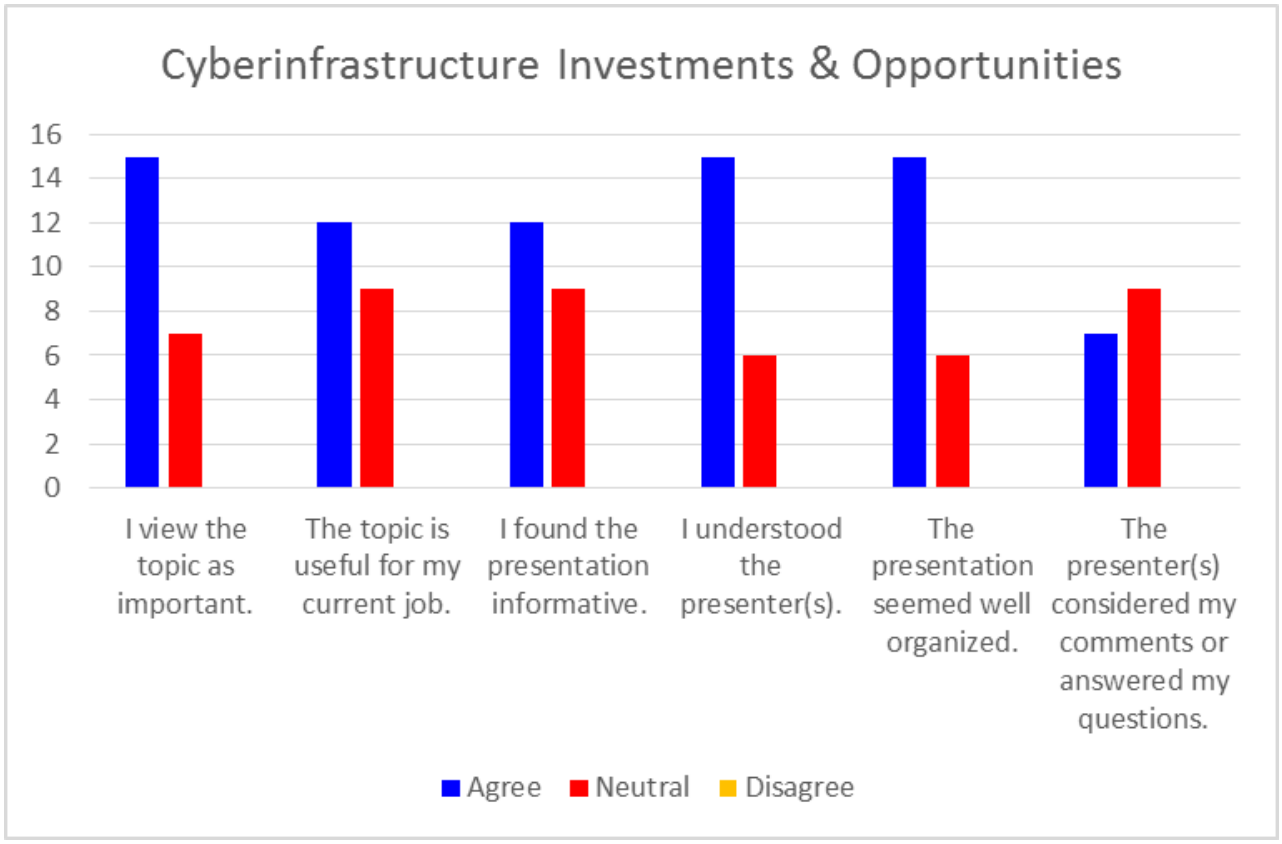
Cyberinfrastructure Investments & Opportunities
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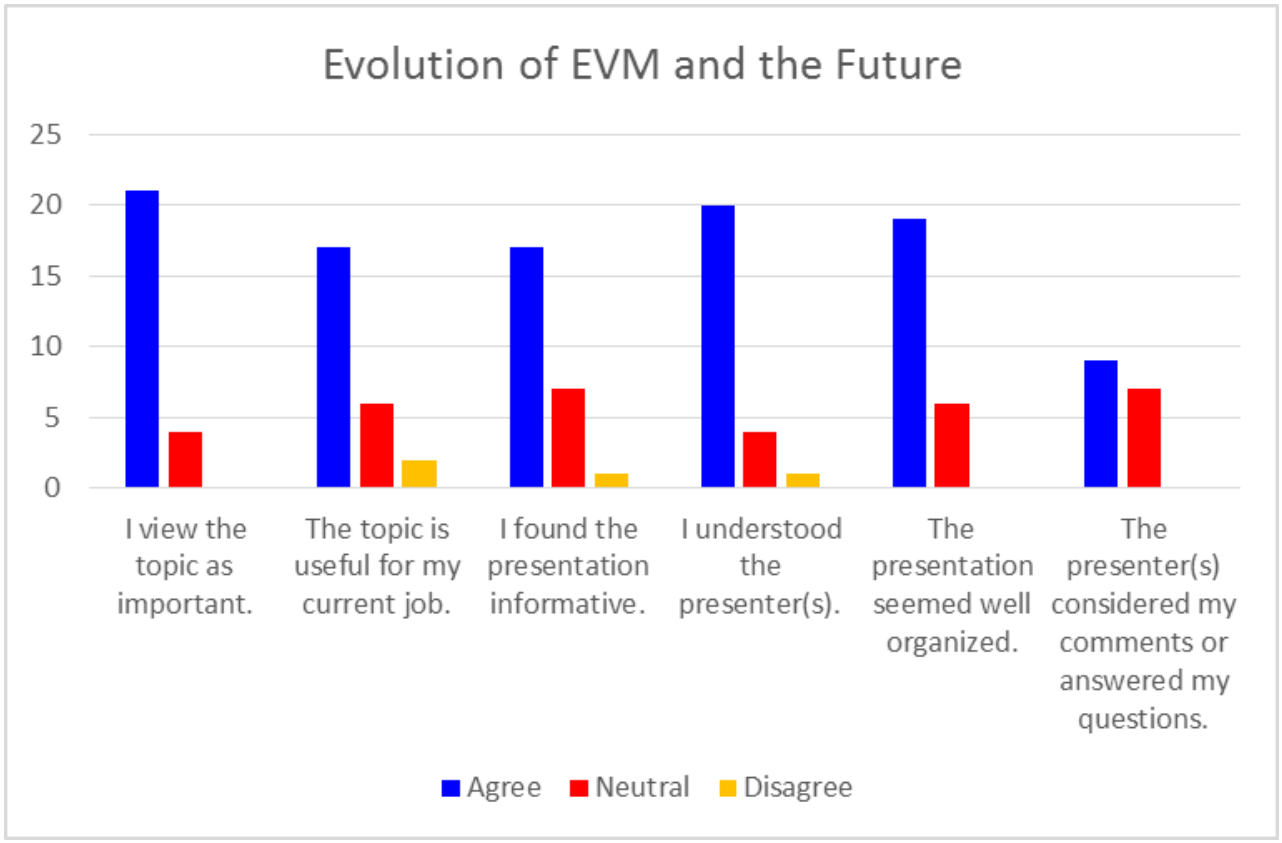
Evolution of EVM and the Future
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The presentation seemed well organized.
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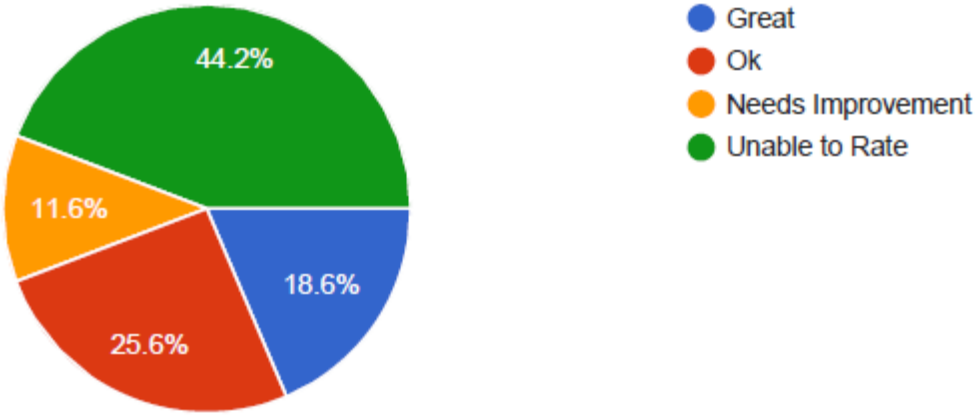
Agree
Neutral
Disagree

Large Facilities Workshop Day 2

43 responses

1. Reception

43 responses

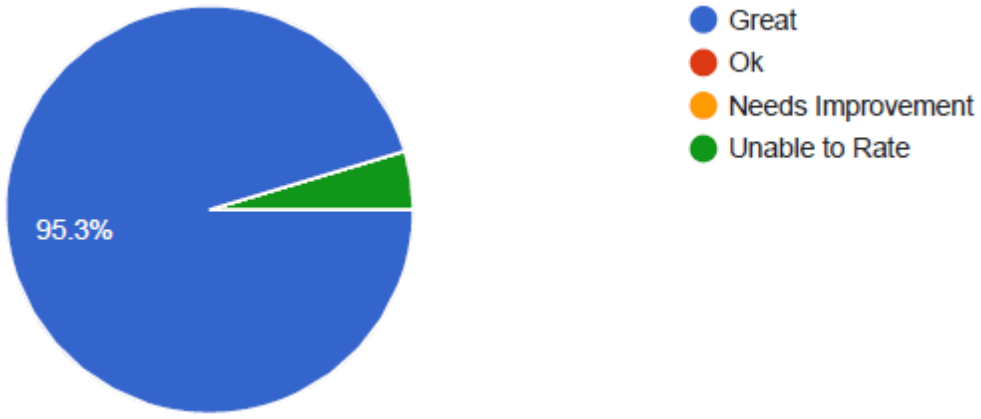


2. Specific comments or suggestions on the Reception

14 responses

The food choices were minimal for the cost of the reception. A significant number of attendees did not attend due to the cost.
Menu and food were not the same.
Did not attend. Too expensive for a reception that had to be paid with personal funds.
If you're referring to the opening night reception ~ it was WAY overpriced
Seemed really really expensive considering it wasn't a plated meal.
I thought the price was high for the food that was offered. Not many non-meat options.
Too expensive
$80 was way too expensive. I should have just gone to dinner with people I met at the conference and spent half as much.
Extremely overpriced for what was offered also cost prevented many attendees from attending
Cost seemed very high.
It wasn't clear to me why appetizers cost $80...
Too expensive to attend.
Disappointed in snacks for price
Did not attend as it seemed excessively expensive.

3. Tour
43 responses



4. Specific comments or suggestions on the Tour
16 responses

Tour guides were very knowledgeable and friendly.
The colored stars were a bit confusing since some colors looking at them on their own looked alike! It would have been more helpful to have a number or letter to differentiate the groups
Excellent leaders - very knowledgeable and professional
Enjoyed the tour; tour guides and personnel were great. Great coordination by the Event Planner;.
Great Tour! The LIGO group did an amazing job hosting all of us.
Loved that we were able to go into the buildings and take pictures. Great that staff that actually worked in the areas in the tour were able to participate.
It was great. The LIGO staff did a great job hosting!
Good mix of tour, session types
Tour was excellent!
The tour was great. A suggestion would be to offer water before going on the tour since it was a lot of walking
Outstanding.
Amazing
Wow!!! What a remarkable facility. Thanks so much for hosting us!
Awesome in every way.
Suggest water bottles be provided prior to tour

5. Please share your opinions about the Agenda for Day 2:
43 responses

6. Specific comments or suggestions on the Agenda for Day 2?
8 responses

Need more choices for breakout sessions.
Breaks were no announced so many did not know that drinks and snacks were available. The items served at breaks were exceptionaol!
Liked the mix.
The group conversations seem to be the most productive times, really need to give us more time to work on issues in small groups. Would benefit from having a meeting coordinator actually leading the structured conversations. Phoibus workshop at bio sphere did this successfully last year.
Ran out of time in both breakouts in the "facilities" track
Need more time to connect with each othet
The session on scheduling went way too far into the weeds on large construction projects and didn't focus nearly enough on operations level projects or actual science projects and how to manage those schedules.
APP didn't work in remove site, so some confusion about which session was where. Simple paper signage - low tech, cheap and effective would have been in order.

7. What did you like most about Day 2?
27 responses

The tour of the LIGO facilities.
Tour
The tour.
LIGO was awesome!
The tour of the facility was great!
I liked getting out of presentations and touring a facility. So much more was gained from that experience.
Tour, lunch
The ability to chat with NSF personnel and the presentations.
visit to the LIGO Science learning center
The Tour

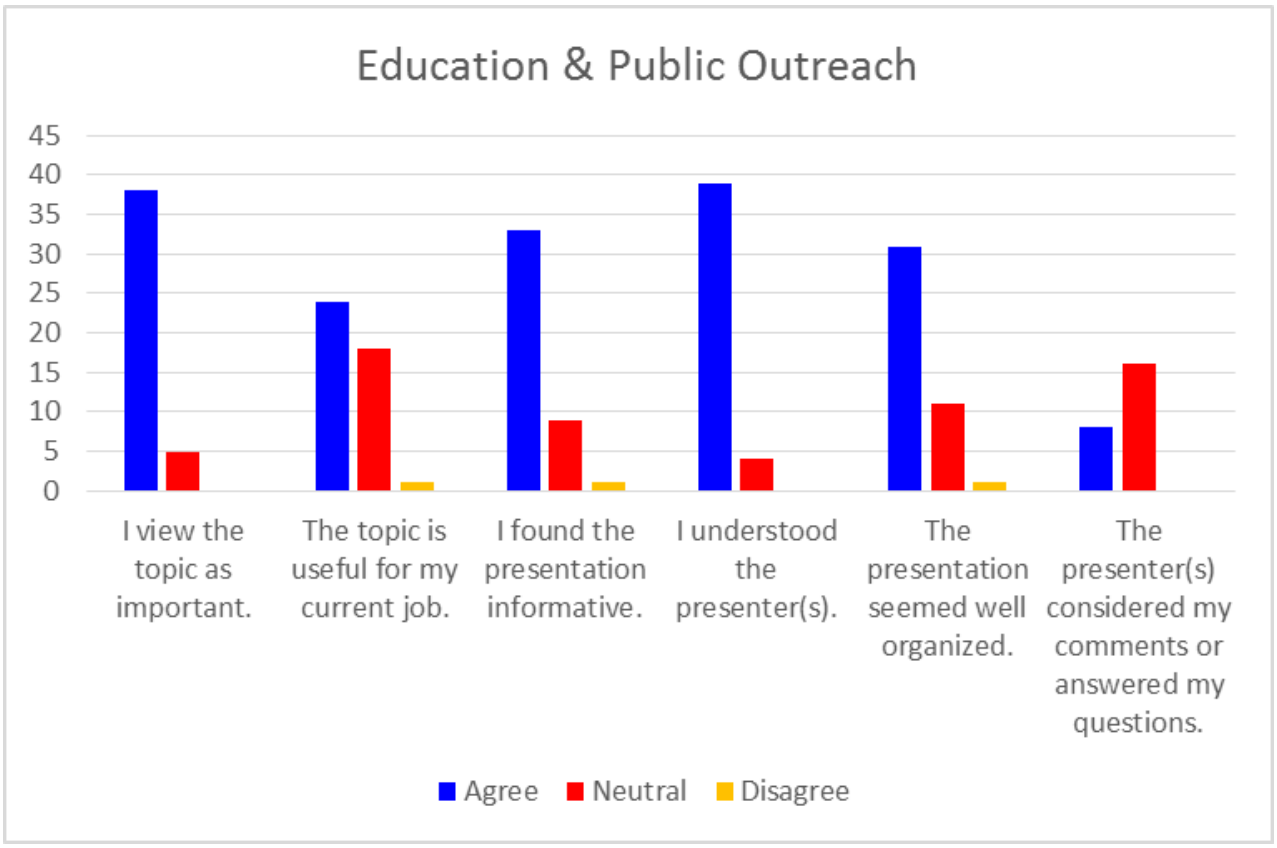
The mix of facility tour and presentations
Facility tour
Operations break out group discussion when we were talking in small groups.
tour hosts were very welcoming and well informed
LIGO Tour
Tour and presentations
Ligo tour was awesome
Mix of activities while on-site
The LIGO tour was excellent
The education center on the tour
The Tour was fantastic!
Tour
The tour was awesome! The food was very good.
The tour
Site visit
LIGO is an amazing facility
Trip to LIGO. They were great hosts.

8. How could we have improved Day 2?
14 responses

Great day! EPO discussion was,weak
Longer time with GAO and cost estimating.
We got ahead of schedule before lunch, and it would have been nice to have just moved the schedule up rather than have us take a 45 minute break followed by the lunch.
It was a little hot in the multipurpose room right after lunch. It was a recipe for sleep which may not have been honored the speaker or their important topic.
The Risk Assessment presentation should not have been after lunch. The speaker could not keep everyone's attention and seem to be selling his services rather than providing useful infol.
allowed for "normal breakfast"
NA
Weaved interactive sessions throughout more sessions so attendees could share more experienced with each other.
more time for breakout sessions in afternoon
More time for break out sessions
Shorter and more afternoon sessions
More time discussing with each other
I would have liked a more operational focused session or one that focused on how to help researchers schedule their projects and keep them on schedule as they are executed.
More time understanding the process ongoing at LIGO

9. Other comments or suggestions:
10 responses

Buses were very nice. Lunch was good and plenty of snacks. Great job all around!
Have the waters provided before the tour, or recommended to bring one along
There seems to be a lot of acronyms being used which is normal but not everyone knows what they stand for until they are told.
Great job by workshop planners and the event planners!
Would be great for NSF to consider breaking out the groups based on the areas of work or expertise. For example, fiscal, programmatic, compliance, etc..
The workshop is moving toward being a working workshop rather than a mini conference of presentations. It needs to move even further this way to interactive problem sharing and solution sessions. I feel like there's a lot of expertise from other awardees that I still am not learning from.
More options in sessions since some are repeated
The presentation on Risk/Monte Carlo seemed more like a commercial for the presenter than a practical guide for applying this technique. Additionally, the presentation did not offer any back tested results on how effective his application has been. The presenter also works under the general assumption that everybody lies to the Project Managers and that PMs derail the process. Why not approach it from the angle of how PMs can improve the data collection process. Technology allows for the same inputs to be collected with anonymous surveys. Monte Carlo is one technique for estimating risk, but relying solely on this to determine risk is flawed. You can get whatever result you want out of a tool, and if you enter the same data in different tools, you will likely get a different result. Even with Monte Carlo there is a great deal of subjectivity involved with assigning risks, probability percentages, and correlations. Another key factor is the stage at which it is performed in a project. During the life of a project many activities are added to the schedule so these obviously are not accounted for when MC is performed at the baselining of the project. Monte Carlo is good technique, but it should be approached with a perspective of common sense. The real value is the thought that goes into the process and the thinking through of the many variables that might occur so the risk and potential mitigations can be captured, but this should be used in conjunction with other techniques.
Several of the talks at the LFW are being done by presenters who are offering services, certifications, etc. Although best practices should be reviewed, in some cases (e.g., Modern Methods of Schedule Risk ...) it is unclear what measures have been used to establish this as a best practice or to evaluate its effectiveness based on real projects (vs existing practices). Until quantitative measures can inform judgment (e.g., ROI), it seems premature to guide projects in a specific direction.
WHY do I have to rate things I didn't go to? Next year please provide an opt out button: I did not attend this session - so I don't have to answer irrelevant questions.


Education & Public Outreach
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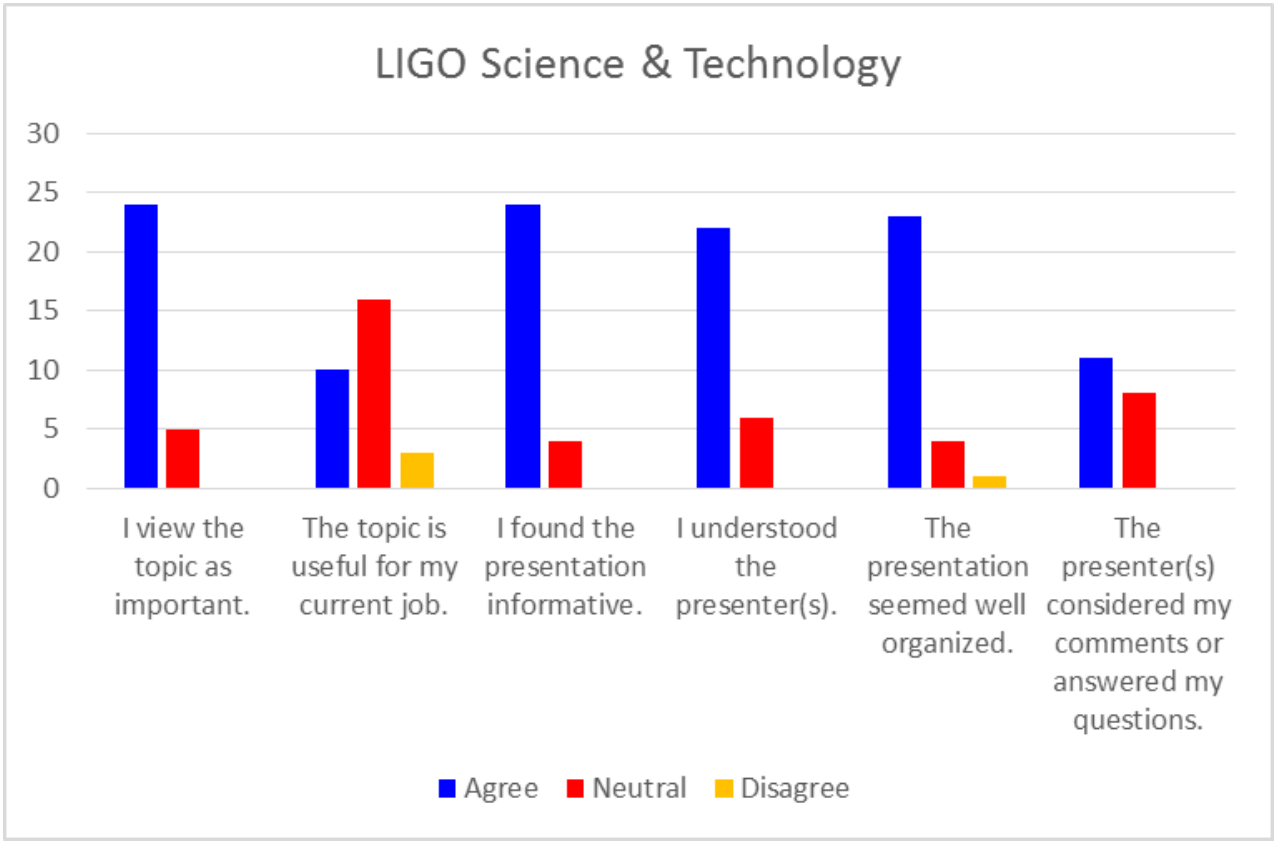
I view the topic as important.
The topic is useful for my current job.
I found the presentation informative.
I understood the presenter(s).
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree


LIGO Science & Technology
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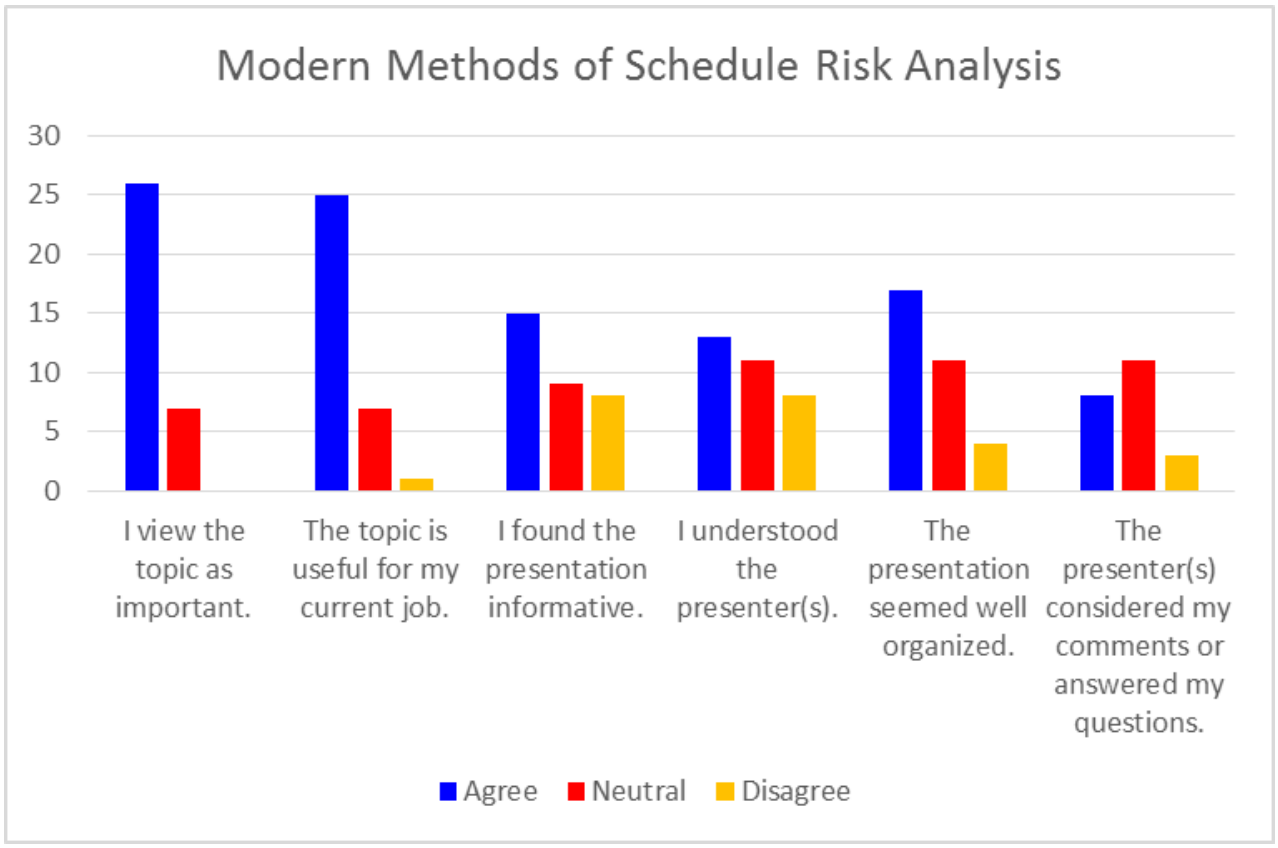
I view the topic as important.
The topic is useful for my current job.
I found the presentation informative.
I understood the presenter(s).
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree


Modern Methods of Schedule Risk Analysis
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I view the topic as important.
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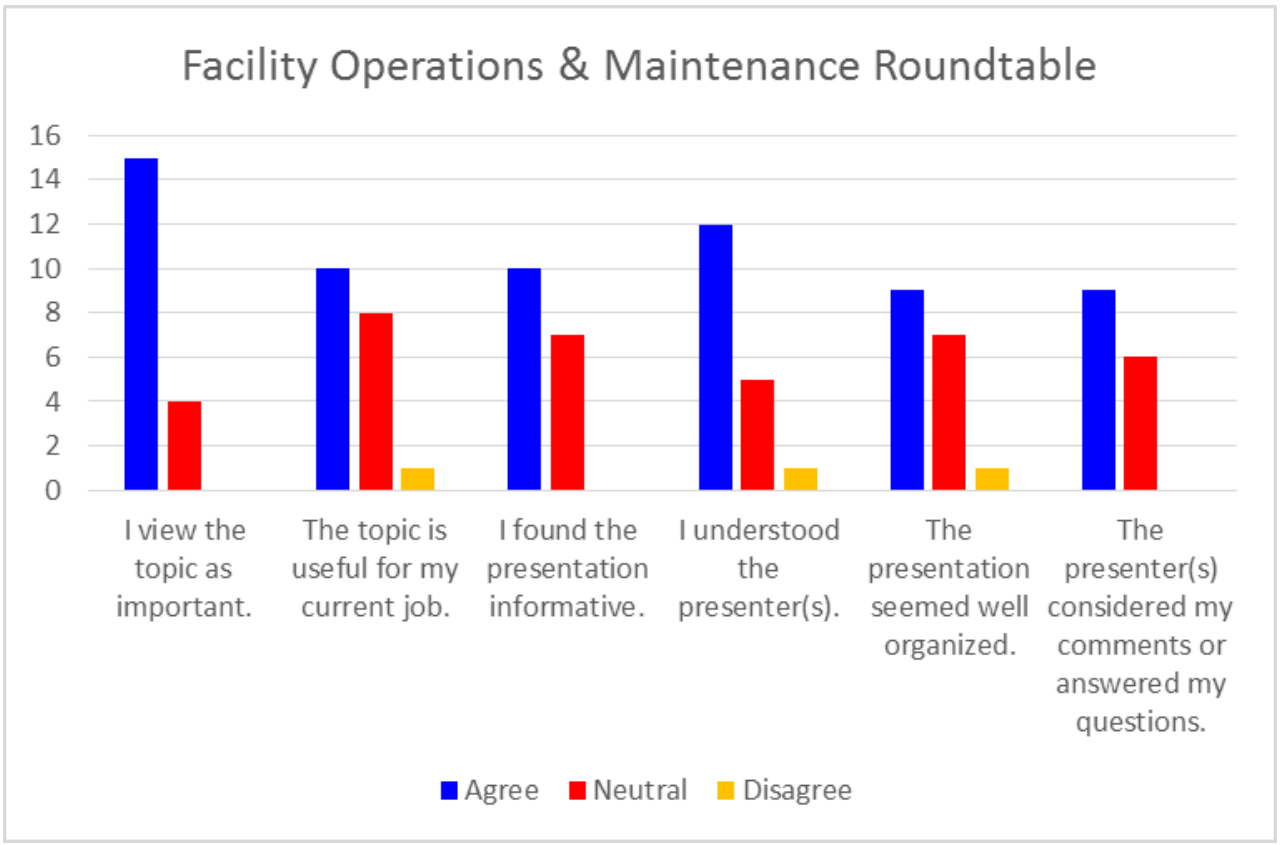
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree


Facility Operations & Maintenance Roundtable
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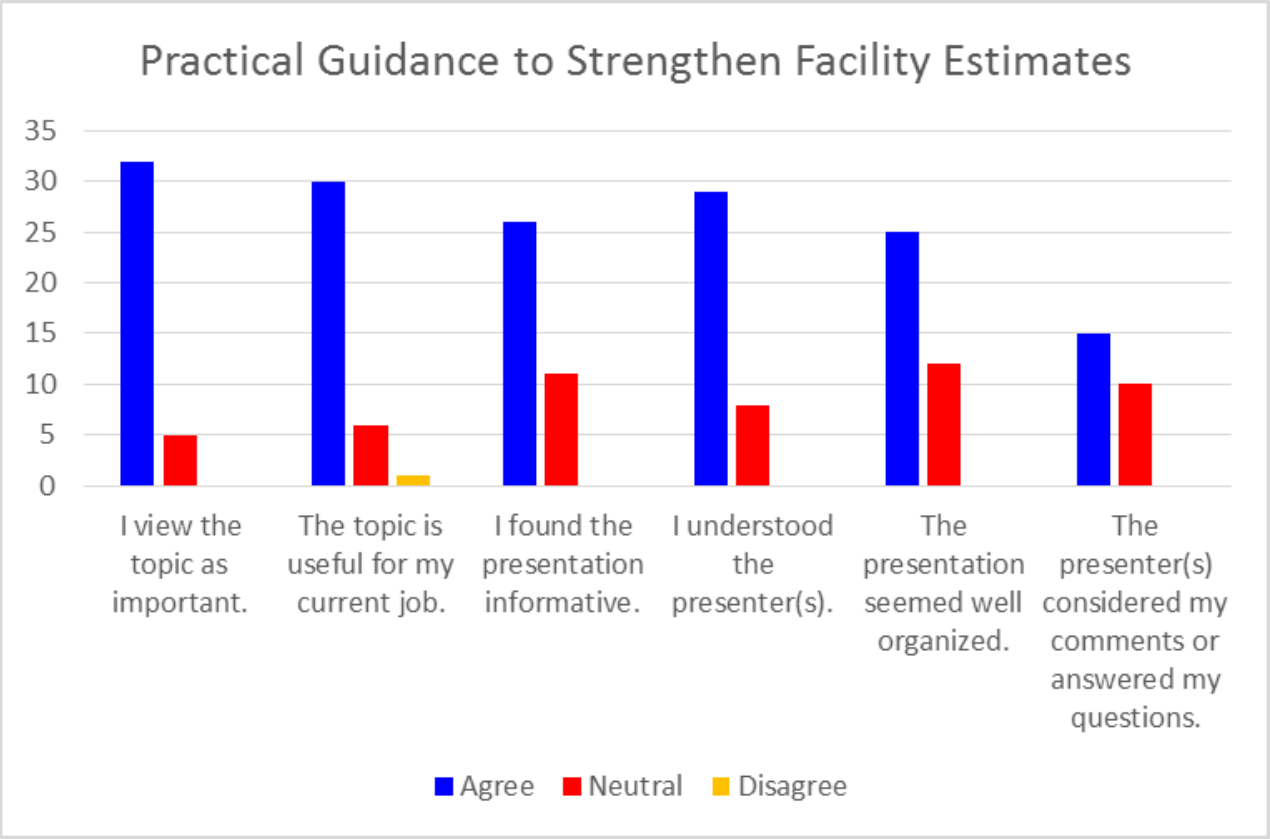
I view the topic as important.
The topic is useful for my current job.
I found the presentation informative.
I understood the presenter(s).
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree


Practical Guidance to Strengthen Facility Estimates
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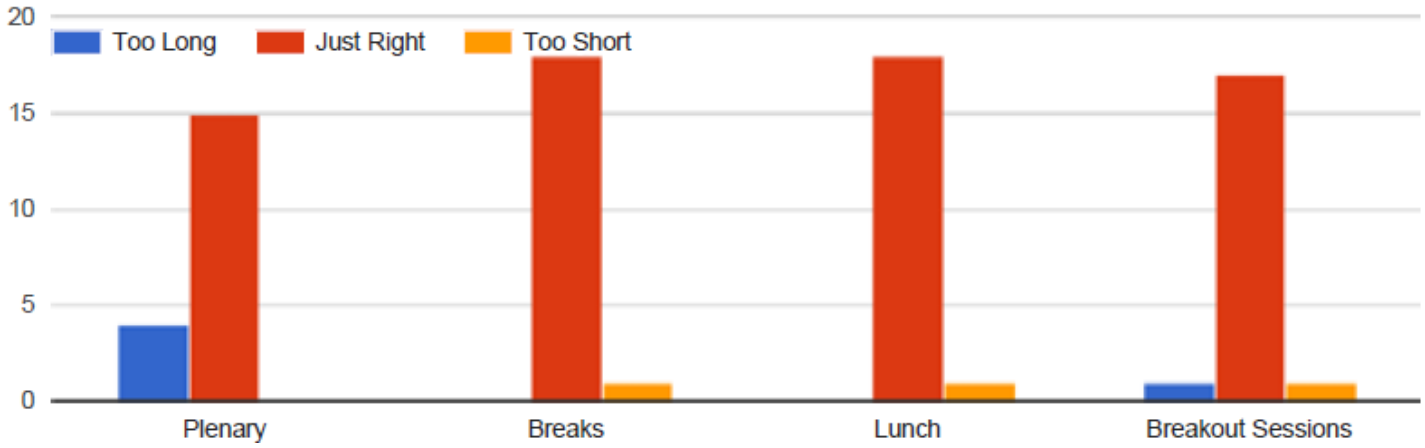
I view the topic as important.
The topic is useful for my current job.
I found the presentation informative.
I understood the presenter(s).
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree

Large Facilities Workshop Day 3

19 responses

1. Please share your opinions about the Agenda for Day 3:



2. Specific comments or suggestions on the Agenda for Day 3?

5 responses

I really enjoyed the breakout session that let LF managers talk to each other about issues they deal with in a candid, organic way. That was one of the most valuable parts of the workshop for me.
LIGO Science topic was very interesting
Yes, the room numbers were on the APP, but there was some uncessary milling around becuase the rooms weren't posted on a old fashioned paper sign. Low tech. VEry effective.
End earlier as people left early anyway to go home
Agenda Good - Was concerned that an important topic like the changes to the OMB guidance was saved to the end of the session.

3. What did you like most about Day 3?

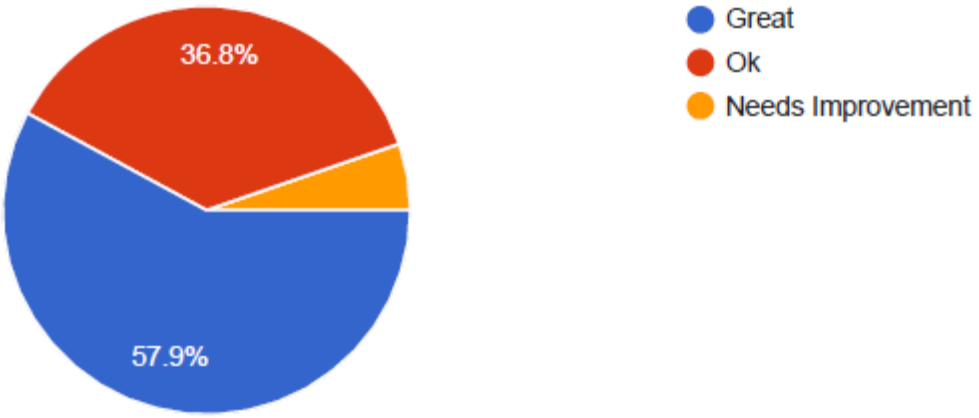
11 responses

The Idea Exchange for Awardees was the best session of the day. The organic, candid discussion was really valuable to cement the idea that we are a team under NSF, not just within our facilities. That collaboration will be critical in the future, and we need to encourage more sessions like this that are lightly structured.
Logo talk
Awardees
Science Done by a Global Community was inspiring.
LIGO Science topic
The presentation by Gabriela Gonzalez about LIGO
LIGO description
Open forum, discussions among NSF awardees
Ideas forum
Idea exchange
NA

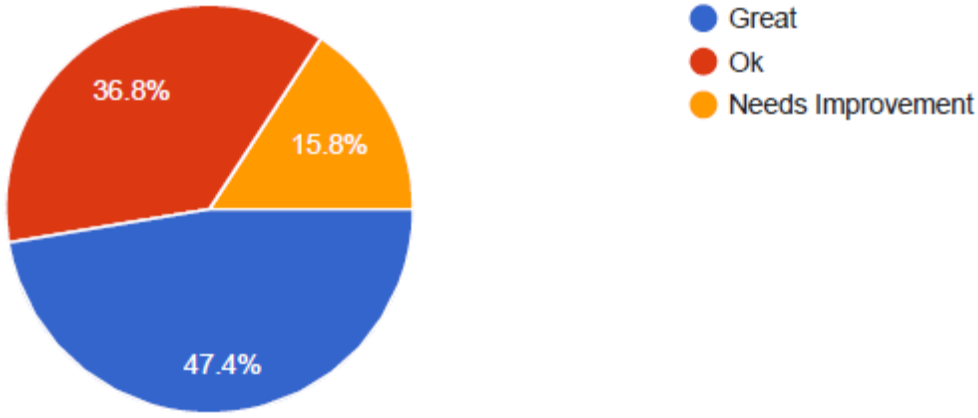
4. How could we have improved Day 3?
7 responses

Maybe a half day to accommodate travel
Let discussions continue into lunch instead of having a speaker.
Smaller plenary room on all three days?
NSF communication talks are too drawn out. Probably ALL of the important messages...fee, incurred cost, BSR could havr been delivered in a single focussed session.
better lunch option
End it after lunch
Moved procurement discussion earlier in the day

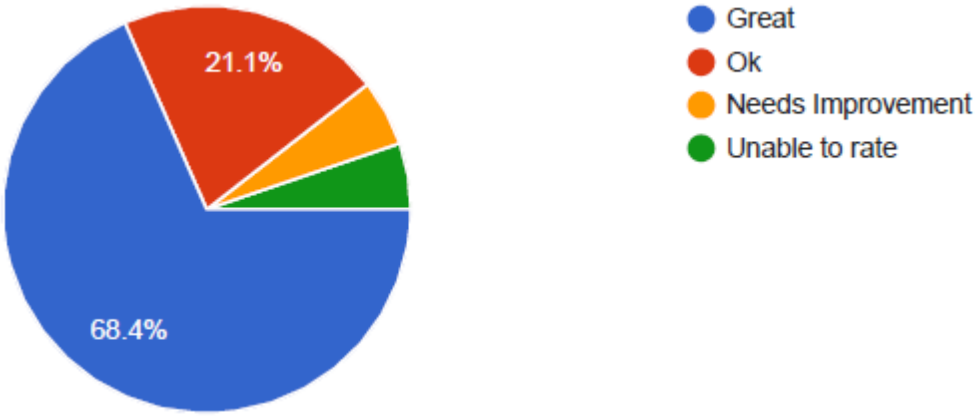
5. Meeting spaces?
19 responses



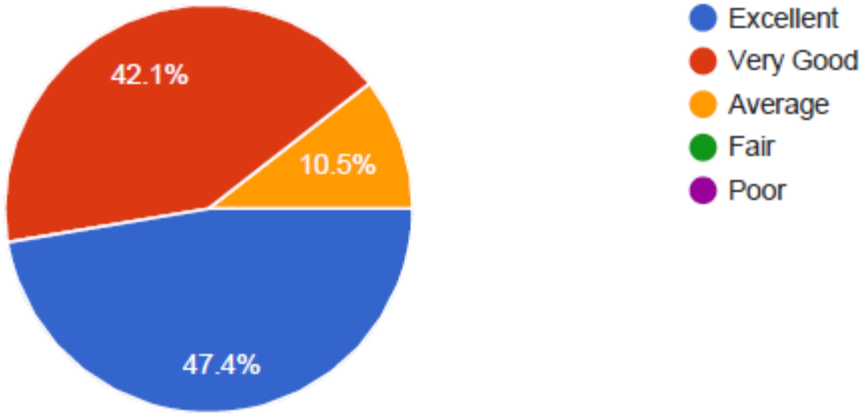
6. Lunch and Light Refreshments
19 responses



7. Workshop App
19 responses



8. Overall, how would you rate this entire workshop?
19 responses



9. Why did you give the workshop that rating?
12 responses

As a new person to the NSF, it was great to meet people from other Large Facilities and have a chance to get ideas about how to address issues I deal with every day.
Presentations generally informative
Room for improvement in logistics and mode of nsf info xfr.
Extremely well organized and thought provoking. Facilitated networking and collaboration.
It was exceptional
A nice combination of science, visiting a large facility, learning from different perspectives (like Ed Hoffman)
Good people doing good things, passionate about their work
it's my first NSF workshop experience; fulfilled my expectations but don't have a wide base to have a better comparison criteria
Enjoyed the LIGO tour and many of the presentations

very informative and applicable to work assignments
I think NSF did a great job responding to last years' comments and trying to get better engagement and working groups. I think next year will be even better.
I would have liked to attend the reception but it was far too expensive since I would have had to pay for it personally.

10. What session(s) should recur at the workshop each year?
19 responses

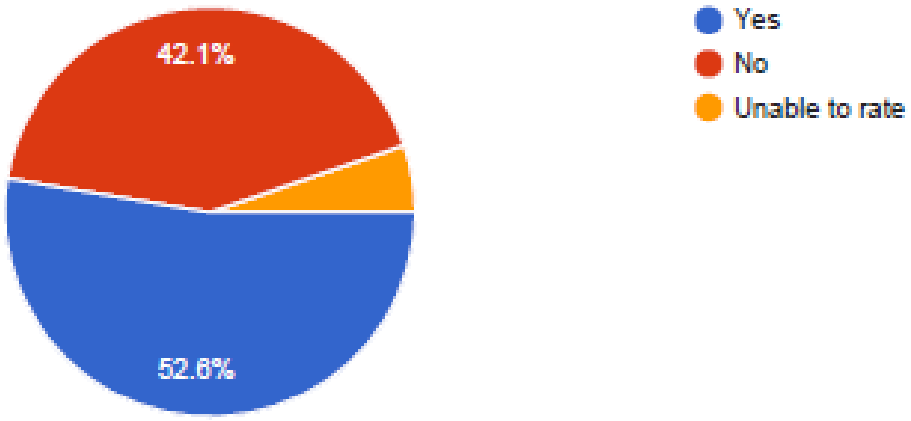
LFO overview
A round table and/or speaker on effective communication (a spin off of the operations and maintenance session)
The Idea Exchange
Business related
NSF updates,
Facilities round table; NSF updates
Awardees, lessons learned,
Budget follow-up; hands-on estimating workshop; NSF evolving developments.
Science topic
EVM, cost, risk
I think the working lunches were a valuable tool. We were given enough time to get lunch and visit a bit, and the presentations were an appropriate length.
How to motivate scientists/managers with successful/failure TED-type talks
Cost-schedule risk (my topic) people nee to understand and do
open forum, distributed networks (how to improve on lessons learned)
New Legislation and how it affects NSF
The budget presentation ma
anything related to MREFC
Idea group.
NA

11. Please suggest a topic or speaker for future workshops.
19 responses

How does NSF select large facility projects for all proposals
Engagement of NSF to facilitate the building of a user base
Scheduling methods for research projects that ease admin burden on researchers and facilities
OIG
Lessons learned from audits, lessons learned by facilities
Walking tightrope between science and politics
user engagement
Obtaining and leveraging science community feedback to improve operations.
How to structure a wbs for large facilities
Brief science presentations

accounting for PP&E in closeout of major construction projects. Perhaps have a panel of actual facilities and T. Pierce. Good topic for 2018
NSF - Natural Hazards Engineering Research Infrastructure (NHERI)
None
how to improve communications/collaboration with NSF
Diversity in the Science Community
Teamwork and collaboration
user facility best practices
User engagement. This was a topic of great concern for multiple attendees in the idea group. Running labs, we need to have users. How do we recruit, engage, and support users?
Bring in OMB to give a presentation on the federal budget and upcoming legislation.

12. Would you be interested in seeing poster boards presented by various facilities on topics of interest?
19 responses



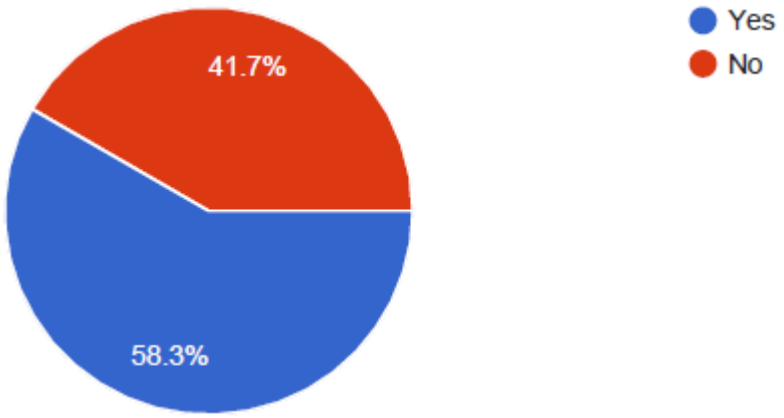
13. How could we improve future workshops?
10 responses

Lessons learned from prior workshops and an opportunity for cross facility sharing of lessons learned.
More unstructured sessions that allow for organic discussions around topics. Less PowerPoint.
Have separate sessions for facility directors, admin/business, education, etc
Teleconferences to set agenda
Food- include vegetarian options
A hard stop at 3pm on day three would allow more people to get out of town and save another night of hotel and per diem. More presentations from facilities.
Additional TED-talk presentations from "outside" experienced scientist/managers
More session choices since many are repeated
Facilitated working sessions, getting people to self identify issues and work together on solutions in fast paced conversations.
NA

14. How can we better get input, including topic or speaker suggestions, from our large facilities award Recipients?
12 responses

A Slack channel for Large Facilities managers and staff to keep in touch throughout the year, as well as shorter duration face-to-face meetings aside from the LFW.
Start early and have an awardee steering committee
Doodle poll 6 months prior
Online
Virtual focus group?
N/A
Engage Program Managers
pre workshop survey
Periodically send out surveys with topics for people to vote on as you build the agenda
email list
Engage 2-3 facility representatives to participate in workshop organization with NSF. Also, it would help to have overarching goals of the workshop to be a little more specific so that it can't be dismissed as vague.
Open up a forum - ask for contributions

15. For large facilities award Recipients: Would you be willing to join our workshop organizing committee to help improve future workshops (minimal time commitment, periodic phone calls)? If yes, please also email kporter@nsf.gov.
12 responses



16. Recommendations for science related venues or tours near Washington, DC for the 2018 workshop?
7 responses

Goddard Space Center, Archives warehouse,
NASA???
New NSF hq
Carnegie Institution for Science
N/A
Maybe a behind the scenes tour at the Museum of Natural History or Air and Space Museum or National Botanical Gardens.
?

17. Recommendations for 2019 workshop location at or near a large facility or facilities?
8 responses

I want to see one of the research vessels!
NCAR
Good idea
Boulder.
NCAR
Gemini Observatory - Hawaii
TACC for NHERI
NOAO or NCAR

18. What constitutes a successful workshop for you?
12 responses

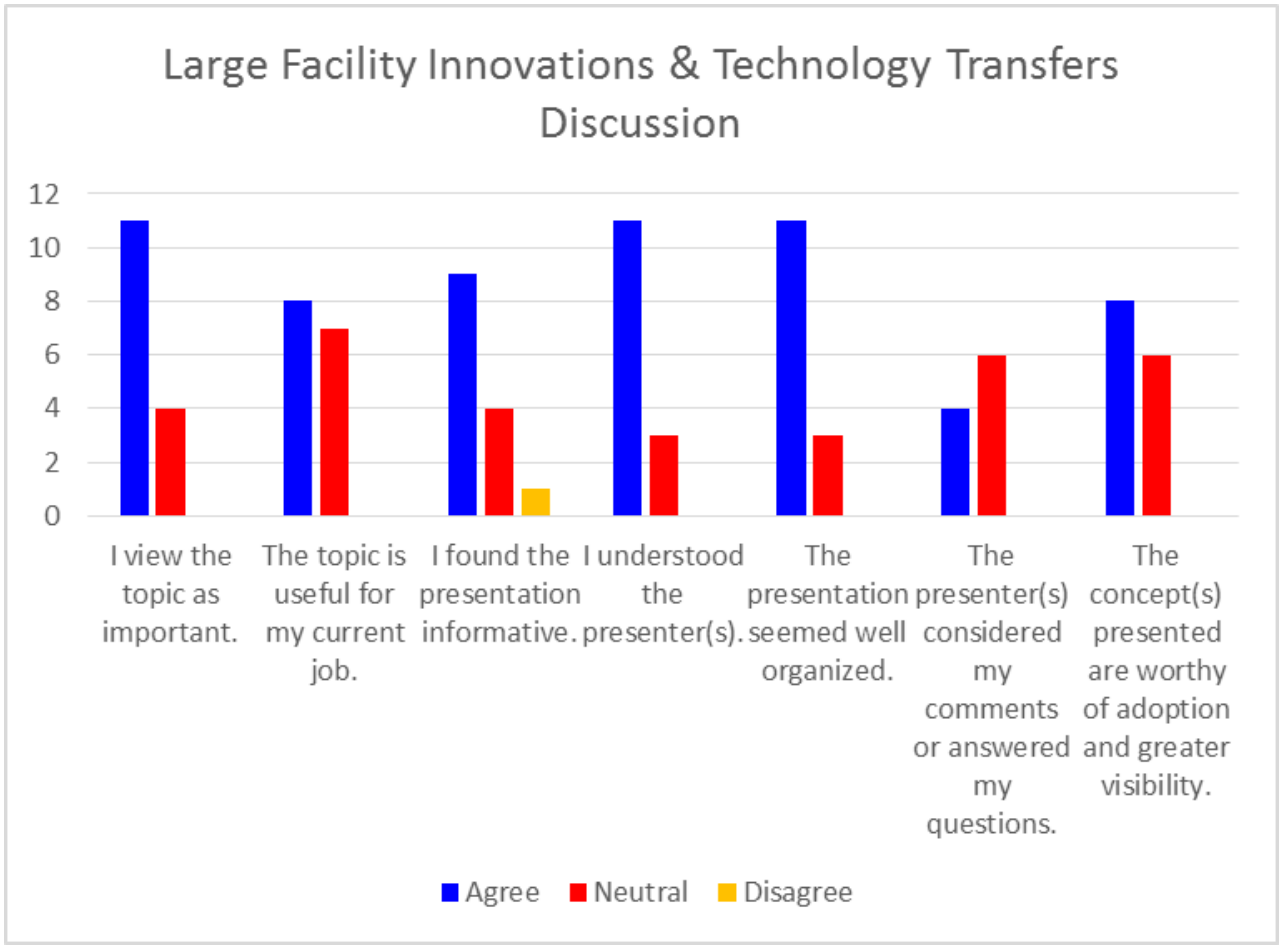
Information I can use
Hearing latest news, meeting folks with similar issues
I learn two to three new ideas that I can use at my own facility.
Useful content
Good networking. I think the list of attendees should have title and email address. I guess we can opt in through the app, but this option can be given in registration and assist in generating the list.
The one that provides new perspectives, contacts, procedures and solutions for our facilities
interesting topics, participation, networking
where there is a learning or something to take back and apply
Interesting talks and visiting the facilities
user facility related topics
I come away with some ideas I can use and some new and/or strengthened connections to people that can help me. I hope that others come away feeling like they can contact me for help, too.
Information is shared that is interesting and applicable.

19. What workshop(s) do you consider good examples to follow?
4 responses

NSF ERC GRANTEES MEETING - see Deborah Jackson in NSF ENG EEC
Lessons learned
NCURA
The PHOIBUS2 workshop mentioned earlier has some good ideas to leverage but doesn't capture the range needed for the LFW. The LFW is a big, diverse workshop that needs plenary sessions, working presentations, breakout group problem solving sessions, and brainstorming.

20. Other comments or suggestions:
5 responses

A common complaint regarded the due dates of proposals and reports that fall on or just after holidays. These tend to disrupt quality of life
Every speaker should use a microphone
So I think the model is now pretty strong...need to focus on stronger execution and maximize value to participants (e.g. improve oppty for interaction, reduce NSF communication footprint.) 1 suggestion, facilitate dinner groups.
Deliberation amongst panelists.
Really, a good workshop and the hotel was nice, although you couldn't walk anywhere. the LUX people did a nice job - helpful, on point, available.


Large Facility Innovations & Technology Transfers Discussion
12
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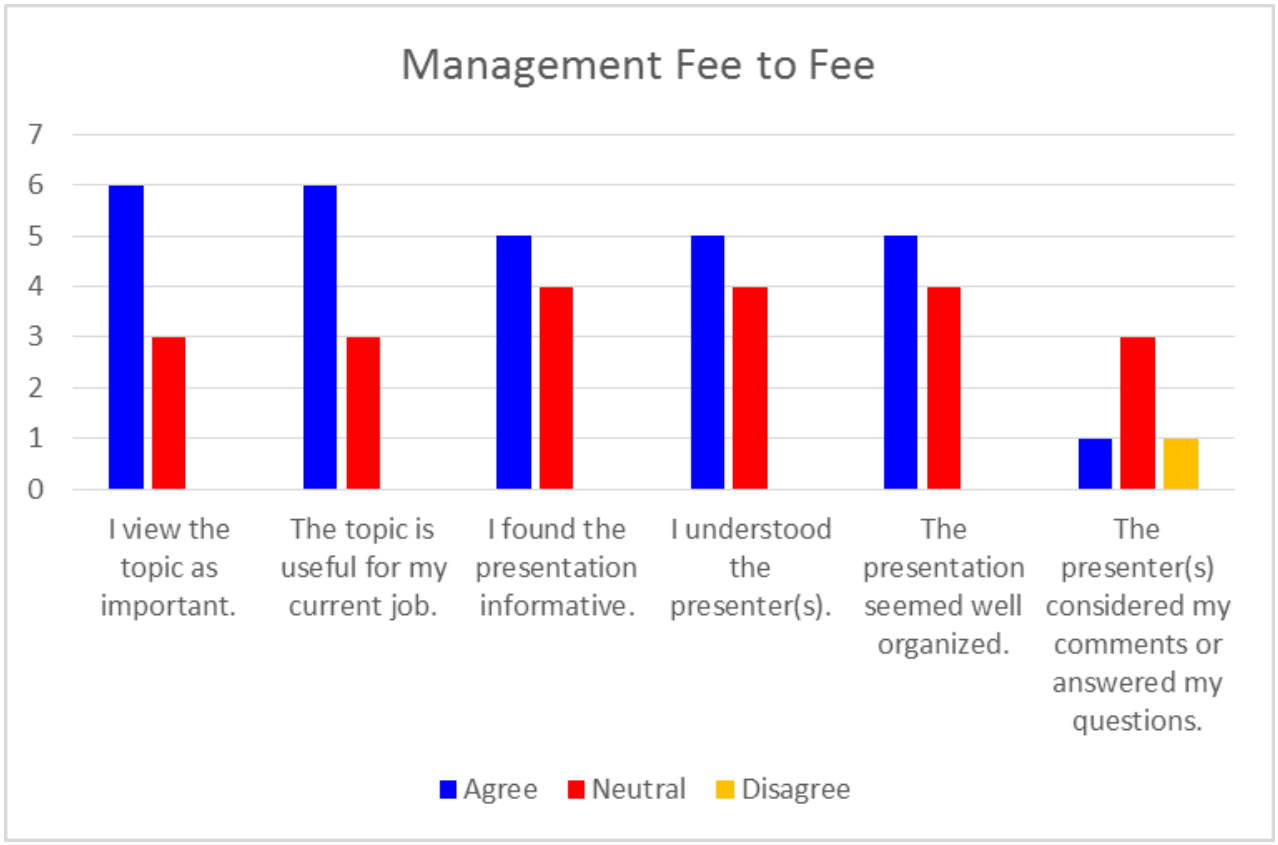
I view the topic as important.
The topic is useful for my current job.
I found the presentation informative.
I understood the presenter(s).
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
The concept(s) presented are worthy of adoption and greater visibility.
Agree
Neutral
Disagree


Management Fee to Fee
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I view the topic as important.
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The presentation seemed well organized.
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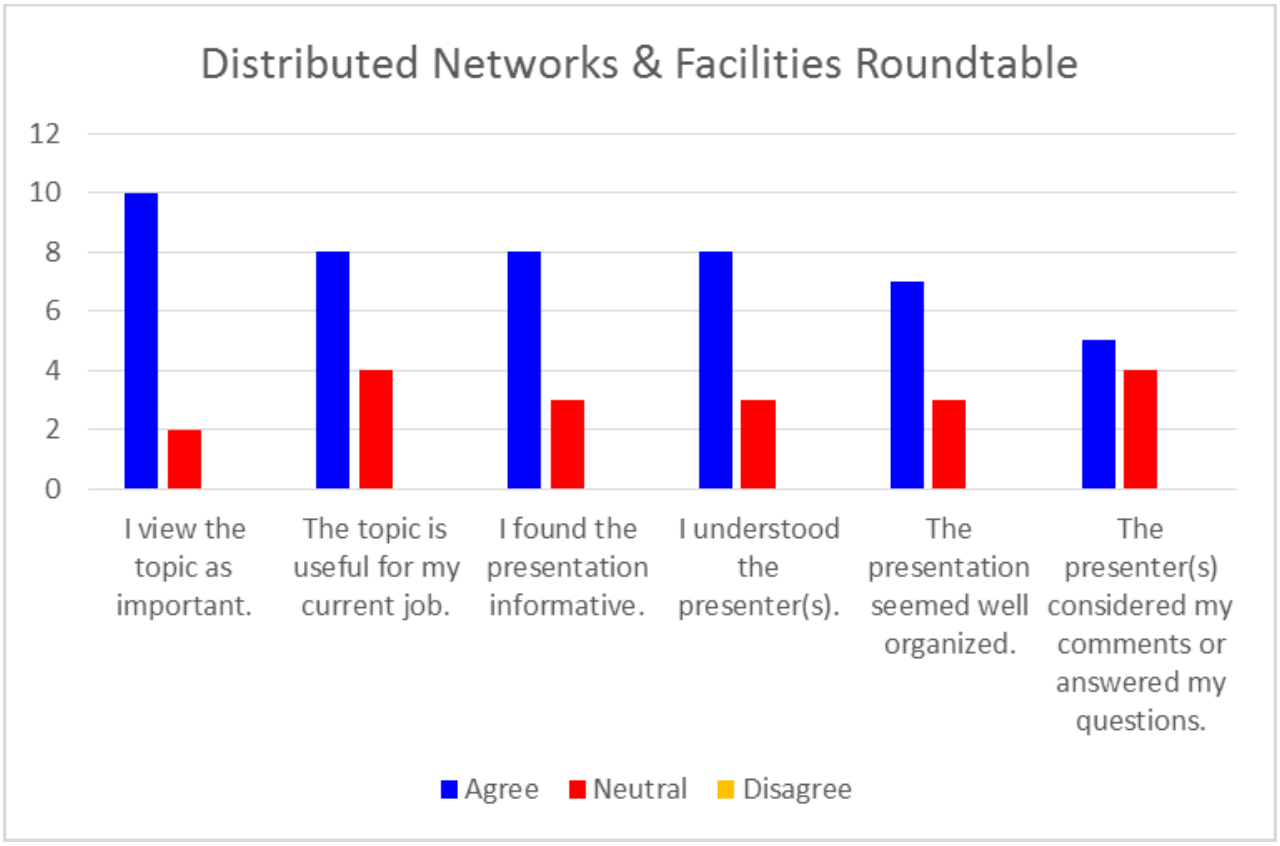
Agree
Neutral
Disagree


Distributed Networks & Facilities Roundtable
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I view the topic as important.
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I found the presentation informative.
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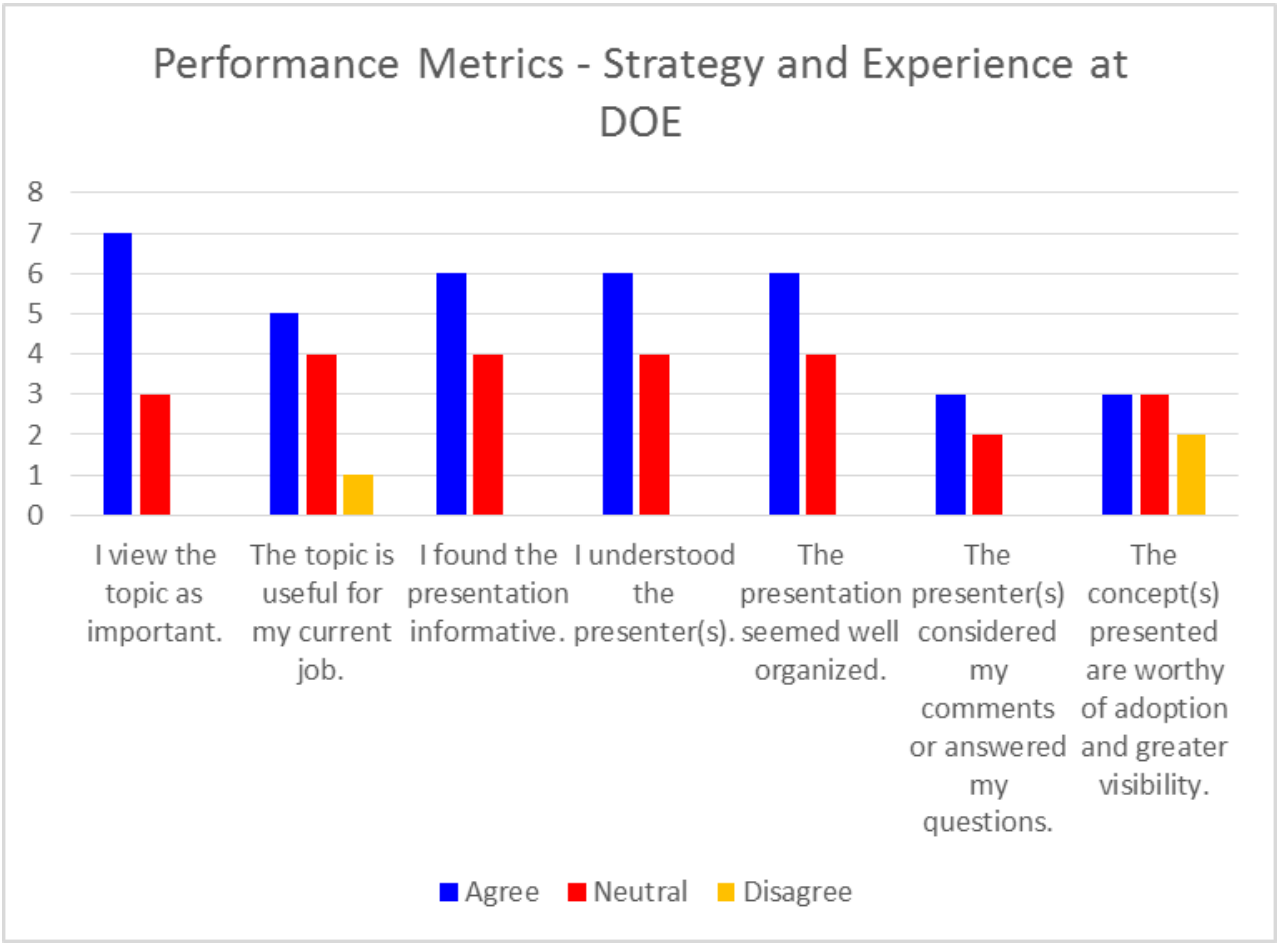
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree


Performance Metrics - Strategy and Experience at DOE
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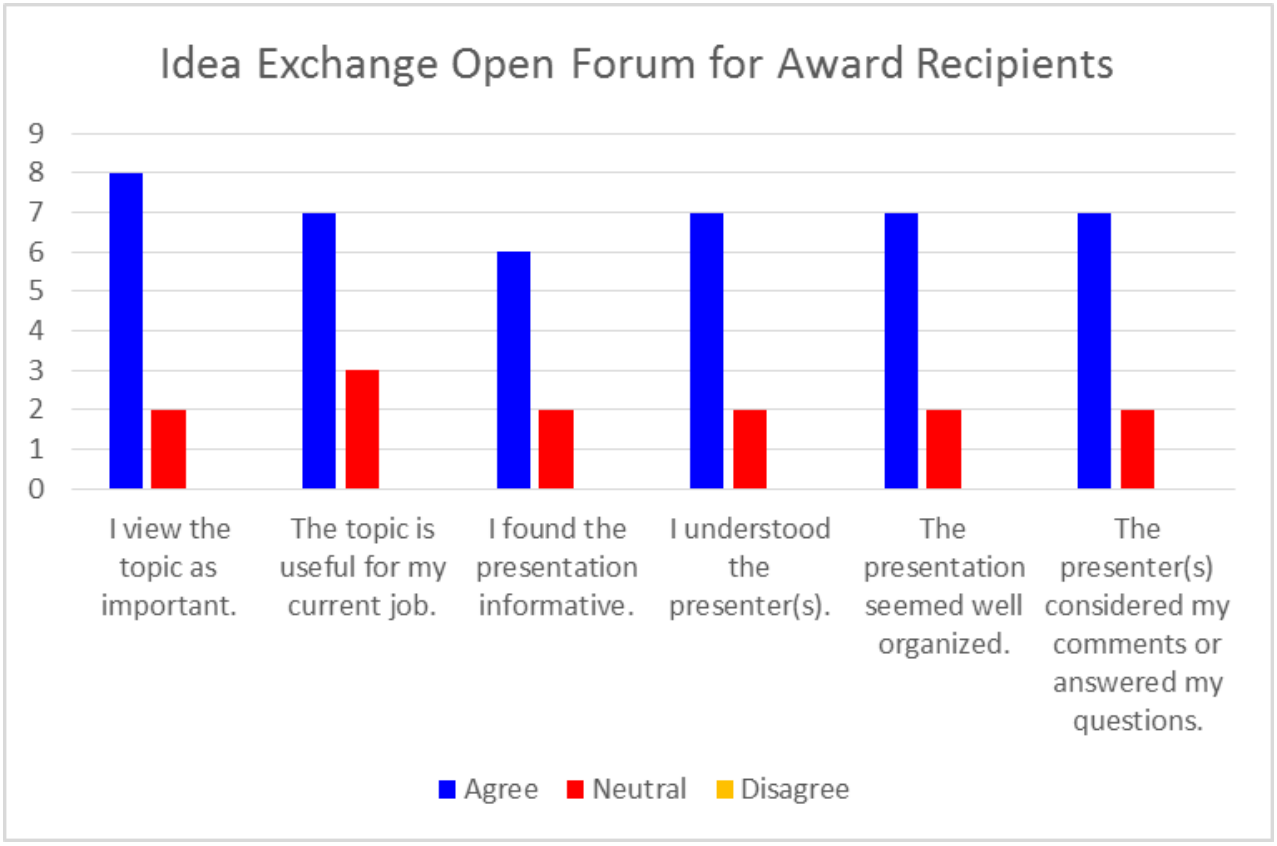
The concept(s) presented are worthy of adoption and greater visibility.
Agree
Neutral
Disagree


Idea Exchange Open Forum for Award Recipients
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I view the topic as important.
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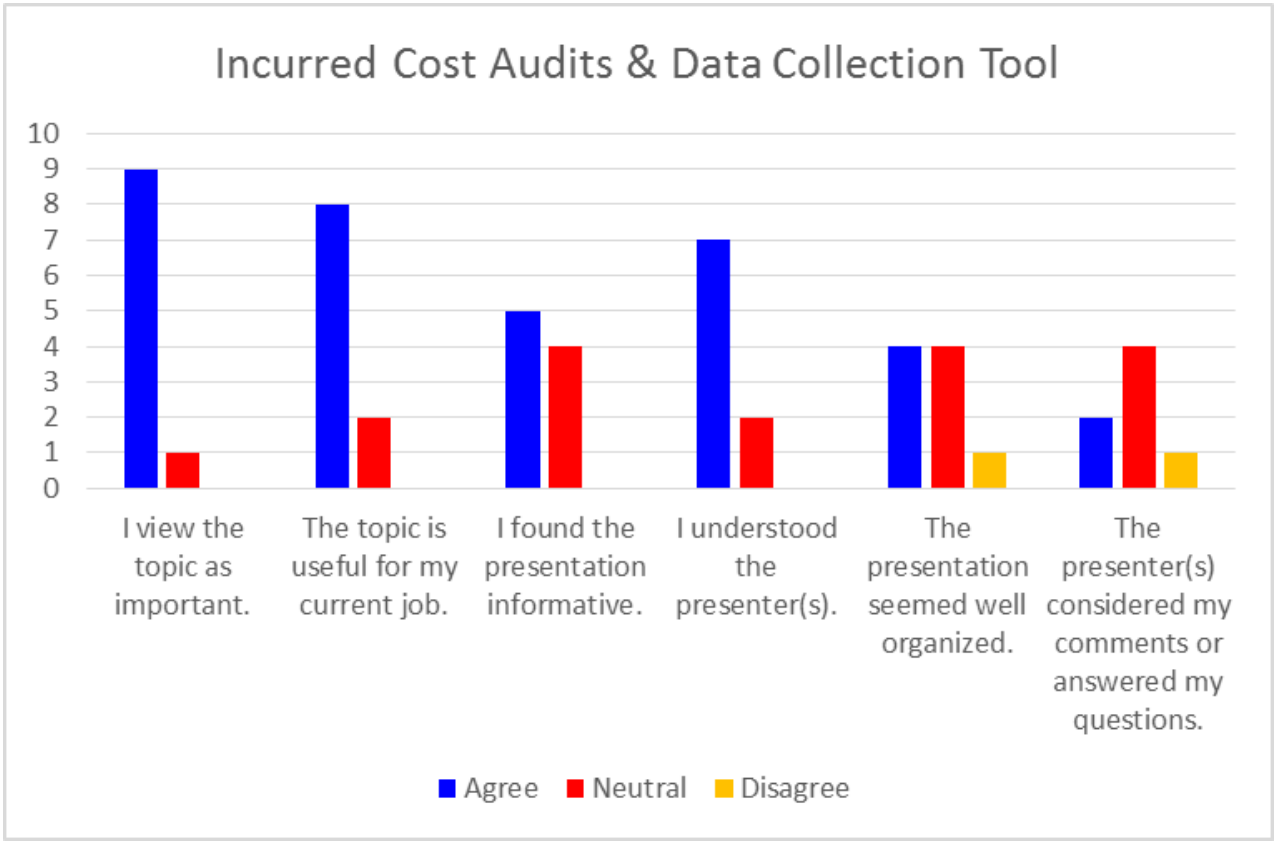
Agree
Neutral
Disagree


Incurred Cost Audits & Data Collection Tool
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I view the topic as important.
The topic is useful for my current job.
I found the presentation informative.
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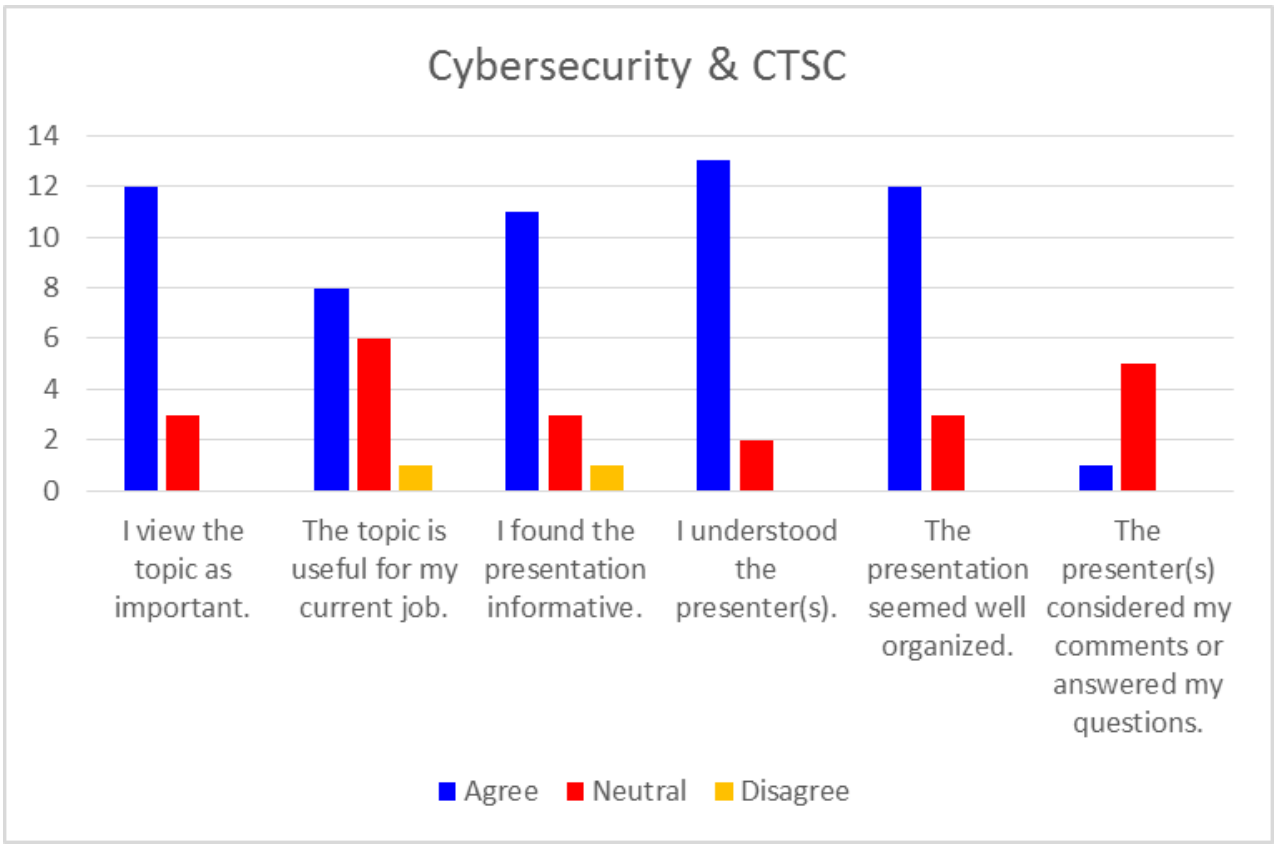
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree


Cybersecurity & CTSC
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I view the topic as important.
The topic is useful for my current job.
I found the presentation informative.
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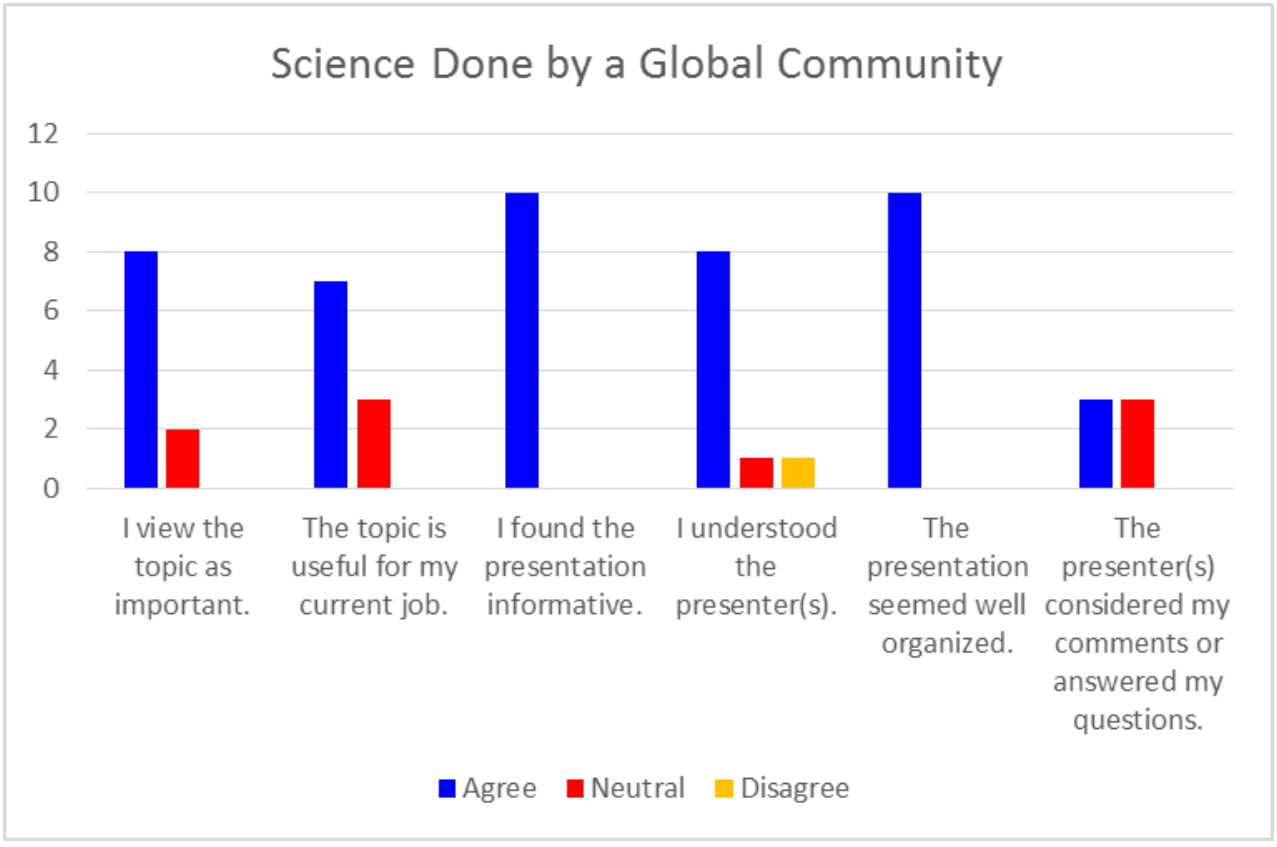
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree


Science Done by a Global Community
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I view the topic as important.
The topic is useful for my current job.
I found the presentation informative.
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The presentation seemed well organized.
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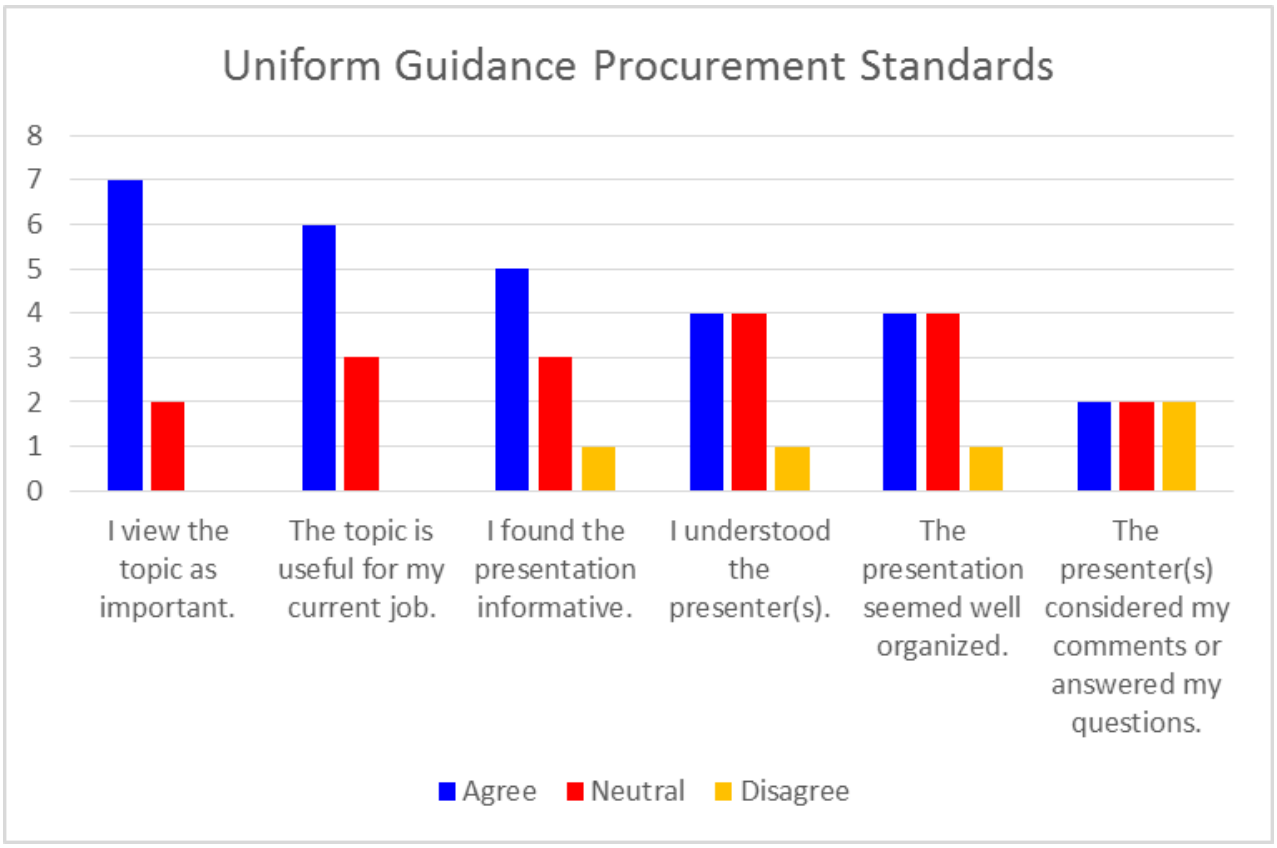
Agree
Neutral
Disagree


Uniform Guidance Procurement Standards
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The topic is useful for my current job.
I found the presentation informative.
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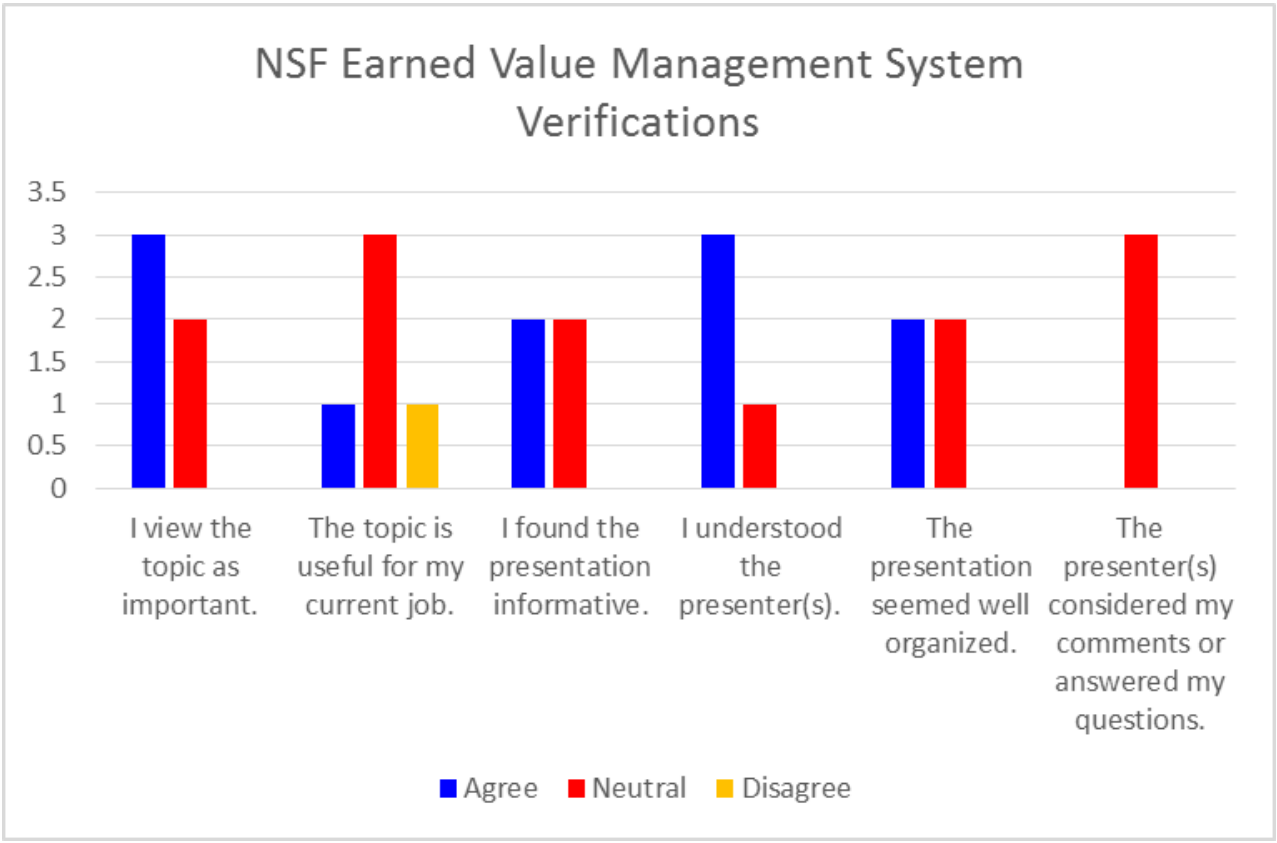
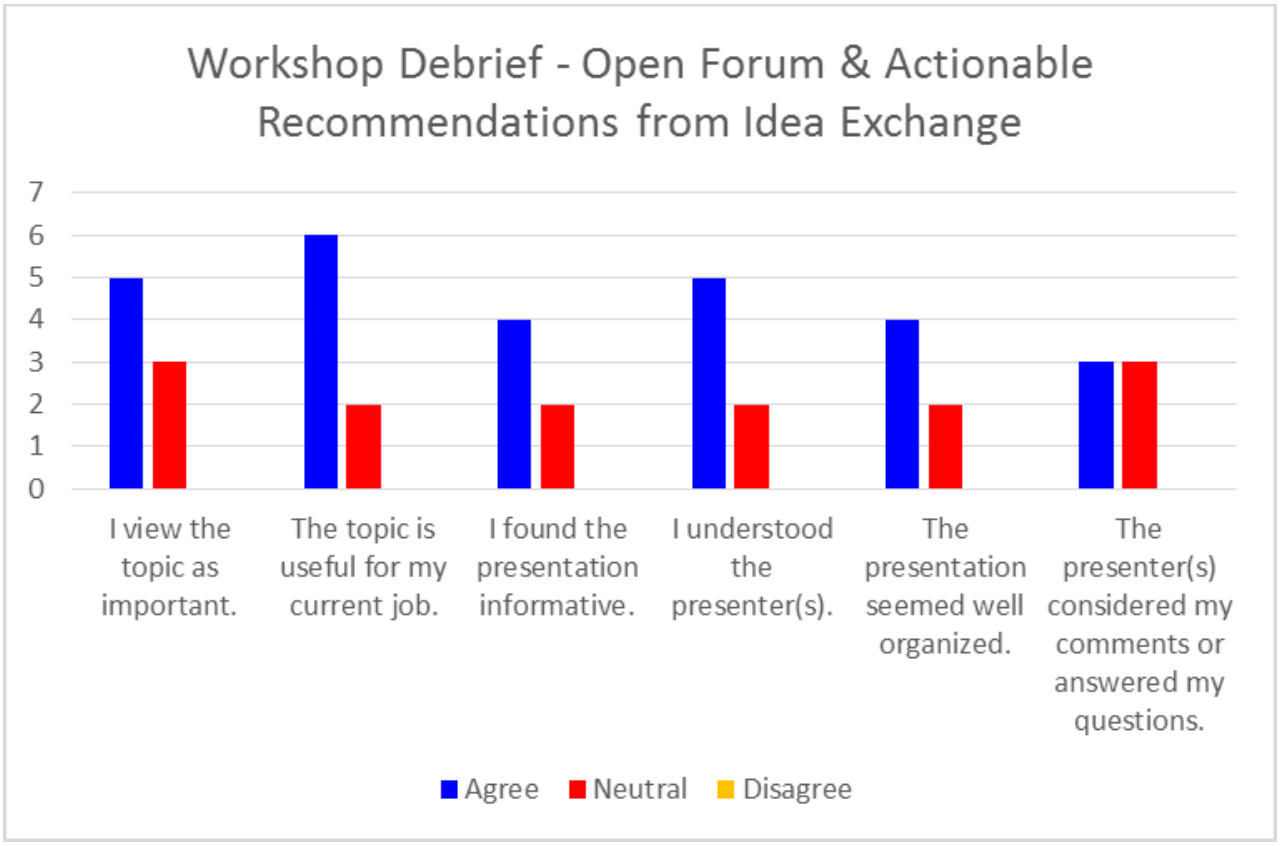
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree


NSF Earned Value Management System Verifications
3.5
3
2.5
2
1.5
1
0.5
0
I view the topic as important.
The topic is useful for my current job.
I found the presentation informative.
I understood the presenter(s).
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree


Workshop Debrief - Open Forum & Actionable Recommendations from Idea Exchange
7
6
5
4
3
2
1
0
I view the topic as important.
The topic is useful for my current job.
I found the presentation informative.
I understood the presenter(s).
The presentation seemed well organized.
The presenter(s) considered my comments or answered my questions.
Agree
Neutral
Disagree

Appendix D: Presentations

D.1 Monday May 1, 2017

Evolving NSF Oversight

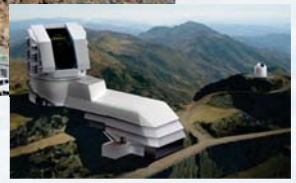
(& Other Developments)

Matt Hawkins
Head, Large Facilities Office
NSF Large Facilities Workshop
May 1-3, 2017
Baton Rouge/LIGO Livingston

Federal Budget

We're here! Perfect Timing…

Large Synoptic Survey Telescope (LSST)



- AURA
- 40% Complete
- Transition to Operations Review
- DOE Partnership (Camera)
- Complete: Late 2021
- Science Operations: Late 2022

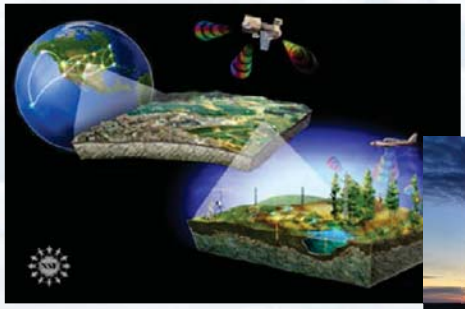
Overview

- Budget
- Quick Status of Projects in Design and Construction
- Recent Legislation
- NAPA Report – One Year Later
- Other Developments & Topics

Daniel K. Inouye Solar Telescope (DKIST)

- AURA
- 75% Complete (Fully Enclosed)
- Coudé Rotator Tested
- Complete: Summer 2020

National Ecological Observatory Network (NEON)



Courtesy: Chris McKay, BMI

- Battelle
- 80% Complete
- 55% Transitioned to Operations
- Complete: Early 2018

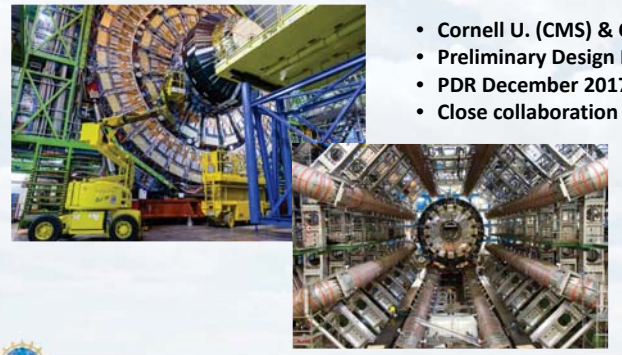
Regional Class Research Vessel (RCRV)

- Oregon State University
- Academic Research Fleet
- Final Design > Construction
- FY 2017 MREFC Budget Request

Antarctic Infrastructure Modernization for Science (AIMS)

- Leidos
- McMurdo Consolidation
- Preliminary > Final Design Phase
- Future MREFC Budget Request if approved/authorized

Large Hadron Collider High-Luminosity Upgrades (CMS & ATLAS Detectors at CERN)



- Cornell U. (CMS) & Columbia U. (ATLAS)
- Preliminary Design Phase
- PDR December 2017 & January 2018
- Close collaboration with DOE & CERN

Advanced Laser Interferometer Gravitational-wave Observatory (AdvLIGO)

- California Institute of Technology
- 99% Compete (Fall 2017)
- Data Computing System (DCS) implementation for greatest sensitivity
- Science Run O3

Recent Legislation

- American Innovation and Competitiveness Act (AICA) – Jan 2017
  - Close alignment with NAPA Recommendation
  - Full Life-Cycle Oversight
  - GAO Cost Estimating and Assessment Guide
  - **Independent Cost Estimate > Required (Timing and scope)**
  - **Incurred Cost Audits > Risk-based, at Completion, NTE 3 years)**
- Program Management Improvement and Accountability Act – Dec 2016

Major Multi-User Research Facilities Project
AICA Section 110 - "Major Facility"

- Anything funded through the **MREFC account**:
  - Construction, Acquisition & Commissioning (per statute)
  - Threshold at NSF's discretion
- Anything funded from the **R&RA account** *that can be constructed, acquired or commissioned* and has a Total Project Cost (TPC) for the Construction Stage of:
  - $100M or
  - 10% of the Directorate's Current Plan, whichever is less

Major Facility TPC Thresholds - FY 2016

	FY2016 Current Plan (CP)	Funding Account		
		R&RA (lesser of)		MREFC
		10% CP	or $100M	
BIO	723.3	72.33	72.3	$70
CISE	934.72	93.47	93.5	$70
EHR	878.97	87.90	87.9	$70
ENG	914.61	91.46	91.5	$70
GEO	1317.08	131.71	100.0	$70
MPS	1347.57	134.76	100.0	$70
SBE	271.88	27.19	27.2	$70
OIA	430.06	43.01	43.0	$70
OISE	49.04	4.90	4.9	$70

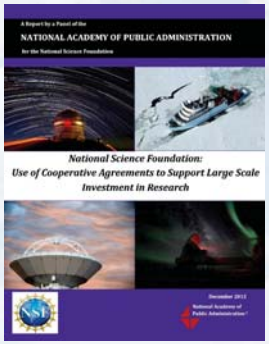
Mid-scale Research Infrastructure (RI)
AICA Section 109

- Funded from R&RA
- Construction TPC between **$4M** (MRI) & **$70M** (MREFC)

10 BIG IDEAS: *"Lowering the threshold for MREFC expenditures, with appropriate modification of processes, would increase the flexibility for excellent science to be done across the agency."*
Dr. Córdova

NAPA Study - One Year(+) Later

- Supported NSF's use of Cooperative Agreements
- "Equal emphasis" between business practices & science/technical
- Well-positioned for AICA
- Implementation loose ends:
  - Internal NSF oversight structure (MREFC Panel, etc.)
  - Implement "Lessons Learned" Requirement
  - Recipient certification in project management



Earned Value Management (EVM)

- Verification, Acceptance and Surveillance in lieu of Certification
- DKIST & LSST EMVS Accepted
- Construction Stage > **Required**
- Design Stage > **at Program discretion**
- Operations Stage > **Not required**
  - "Activities-based" vs. deliverables-based WBS
  - May be used on major upgrade sub-projects if beneficial

Terminology

"Contingency" > YES (Per Uniform Guidance & LFM)
"Allowance" > YES (in Basis of Estimate)
"Reserves" > **NO** (not allowed per Uniform Guidance)

Additional Topics

- RI impacts on U.S. "Innovation System"
- Operations Performance Metrics
- International Collaboration & Coordination

Large Facilities Manual (LFM) – March 2017 (NSF 17-066)

- Applicability (AICA definition of "Major Facility")
- Section 4.2 – Cost Estimating and Analysis (Revised)
- "Management Fee" > "Fee"
- Incurred Cost Audit Tool

LFO Website: https://www.nsf.gov/bfa/lfo/lfo_documents.jsp

NSF Documentation Related to Large Facilities:
- ✓ Proposal and Awards Policy and Procedures Guide (PAPPG)
- ✓ Large Facilities Manual (LFM)
- ✓ Business Systems Review (BSR) Guide
- ✓ NSF Internal Standard Operating Guidance – *"Consult with PO or G&AO"*

QUESTIONS & DISCUSSION?

How was your Workshop experience?

High Performance Teams on Science Projects:

Successful Strategies and Lessons for Building an Engaged and Talented Team

Dr. Edward J. Hoffman
Knowledge Engagement
PMI, Strategic Advisor
Columbia University, Executive in Residence
May 1, 2017

Shared Experience Poll

- Organizational strategies are always changing
- Unclear individual and team competencies and capabilities
- Organizational talent has difficulty finding critical knowledge quickly
- Managers support policies aligning to their interests, leading to silos
- It is always a challenge to work across organizational systems and boundaries
- Organizational politics and expectations are a problem for project success
- Administratively burdensome processes and procedures
- Data is everywhere but knowledge is scarce
- There is reluctance to share knowledge and insights

The Library of Babel – Jorge Luis Borges

Thoughts on Challenge and Opportunity

Challenge & Opportunity
Projects, Products, Entrepreneurship

	Complex Project-Based Organization	*Mass-Production Organization*	*Entrepreneurial Organization*
Product	One-and-only	Scalable manufacture	Permanent beta
Problems	Novel	Routine	Hackable
Technology	New/invented	Improved/more efficient	Frugal
Cost	Life cycle	Unit	-> Zero marginal
Schedule	Project completion	Productivity rate	Iterative
Customer	Involved at inception	Involved at point of sale	Involved in testing
Knowledge Need	Innovation	Continuous improvement	Bootstrap + innovation

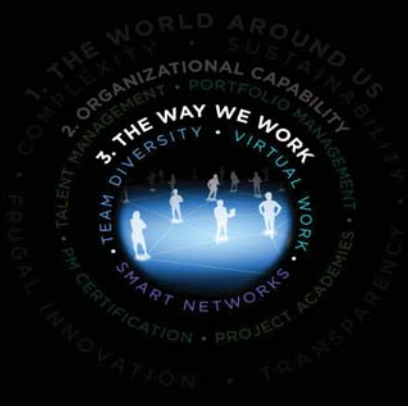
Challenge & Opportunity
Innovation Spans Generations

X-15 → Space Shuttle
Introduced: 1958 Retired: 2010

One of the X-15's many innovation legacies that it passed to the Shuttle was unpowered landing — both reentered the atmosphere as gliders

Thoughts on Organizational Expectations & Culture

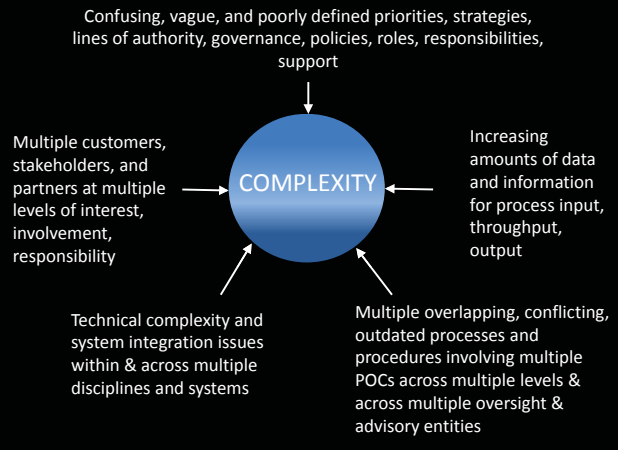
Expectations & Culture
Strategic Imperatives



Expectations & Culture
Strategic Imperatives

CONTEXT	FOUNDATIONAL NEEDS	WORKING PRINCIPLES	RISK MITIGATION APPROACHES
Project world	Leadership	Problem-centric approach	Certification
Digital technology	Knowledge	Accelerated learning	Portfolio management
	Talent management	Frugal innovation	
	Governance, management, and operations	Transparency	

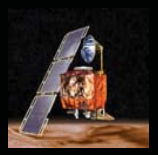
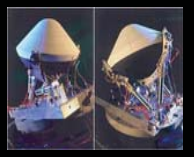
Expectations & Culture - Complexity



Expectations & Culture
Management Requirements

- Support and extend Knowledge Services gains for the NASA Technical Workforce towards improved accessibility, searchability, findability, and visualization
- No additional cost
- Least administrative burden
- Formal, rigorous, iterative, and Senior Leader supported
- Integrated, reinforcing, and actionable
- Measurable and objective

Expectations & Culture
Learning from Failure



Building and Maintaining Teams

Teams Have Preferences

Project Success & Failure

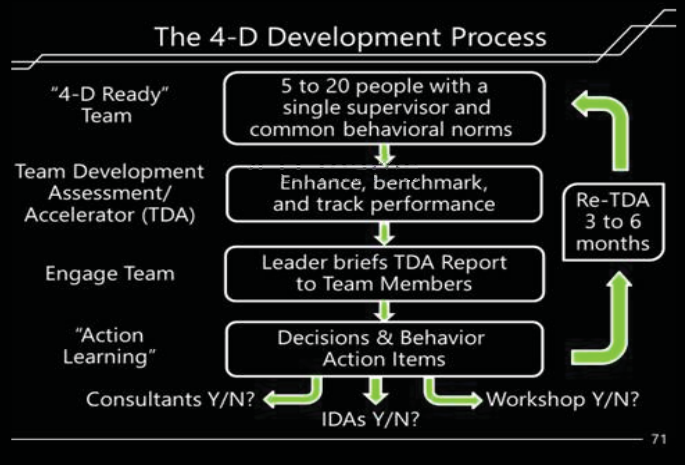
Failures: Challenger, Hubble, Columbia, Crash at Tenerife…

Vacant Dimensions, particularly emotional-side

Successes: Gamma Ray Observatory, Mars Pathfinder, Maven, STEREO…

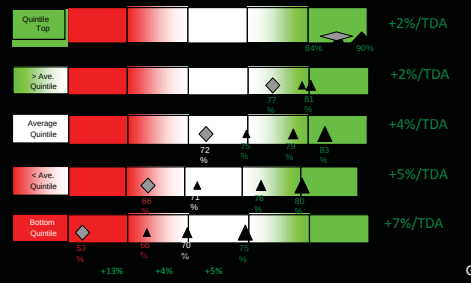
All Dimensions filled, more on the emotional-side

Building and maintaining high performance teams



Team Assessments *Drive* Performance Enhancement

Team performance increased ~4% per TDA cycle!



Grouped the teams by the quintile they began in

Thoughts on Individual and Team Talent Development

Context Shifting Worksheet – Take Action

Your (Troubling) Situation – succinctly stated

The Outcome(s) that you desire/require

Limiting Mindset: Experienced Emotions & Red Story-lines

Liberating Mindset: Expressed Emotions & Green Story-lines

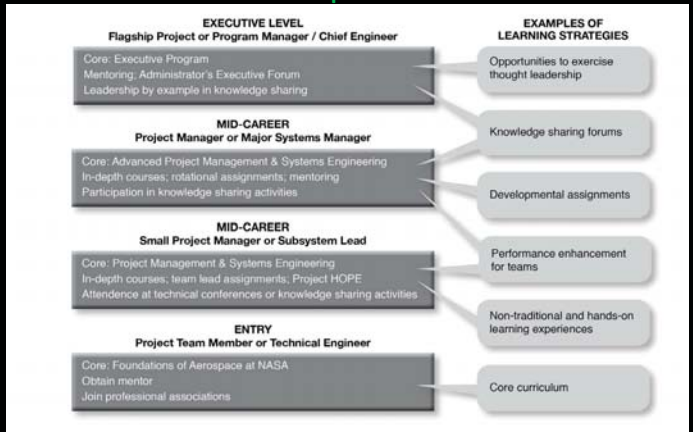
Express Authentic Appreciation	Address Unfortunate Realities
Address Shared Interests	Be 100% Committed
Appropriately Include Others	Avoid Blaming or Complaining
Rigorously Keep All Your Agreements	Clarify Roles, AccountabilityYour & Authority

Summarize Your Action Items

Confirm Adequacy of Actions

Talent Development
The 4 A's

Talent Development
A Career Development Framework



Talent Development
Transferring Knowledge

Chris Scolese, GSFC Center Director

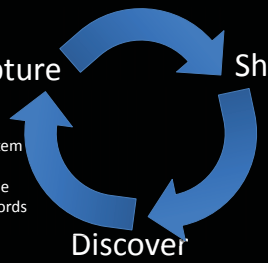
Talent Development - Technical

"…it's still hard to give up the technical side. I am a recovering engineer. But I recognize you just can't do that stuff anymore and to think you still have those skills is also really wrong…
"

- Bill Gerstenmaier, HEOMD Associate Administrator

Thoughts on Knowledge Services (not Knowledge Management)

Knowledge Services
Core Processes



Mature capability:
Case studies
Lessons Learned Info. System
Videos
Shuttle Knowledge Console
Knowledge-based risk records

Mature capability:
Online tools and portals
Face-to-face events
Communities of practice

Mature capability:
Search – enhanced ability to discover
Culture – expectation to discover
Nudges – reminders to discover

Knowledge Services
Message from Stakeholders

GAO 2002: "…fundamental weaknesses in the collection and sharing of lessons learned agency-wide."

ASAP 2011: "…recommends NASA establish a single focal point (a Chief Knowledge Officer) within the Agency to develop the policy and requirements necessary to integrate knowledge capture…"

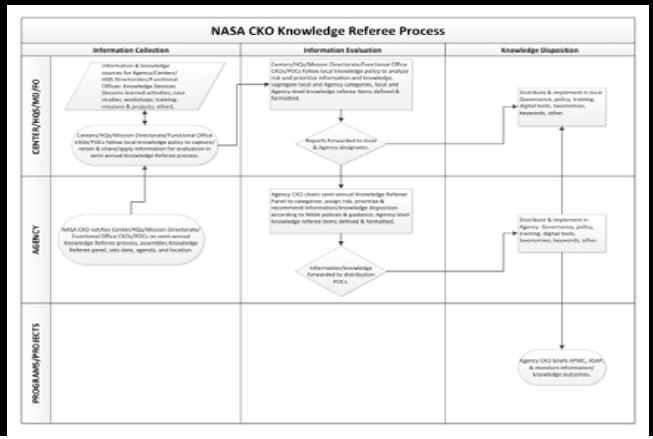
OIG 2012: "…inconsistent policy direction and implementation for the Agency's overall lessons learned program."

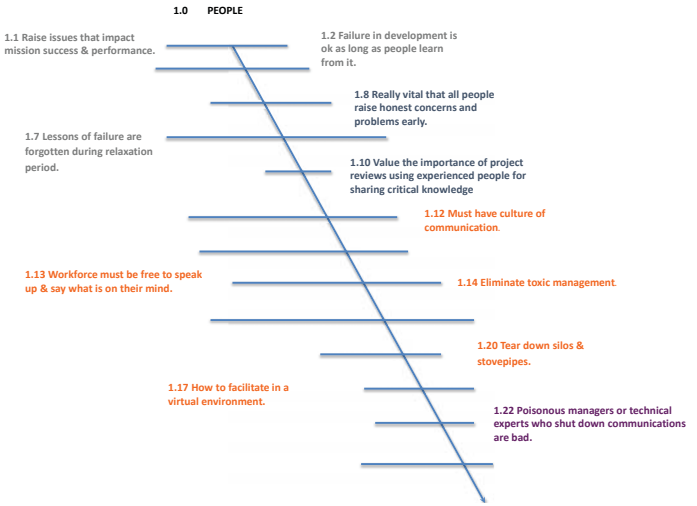
Knowledge Services
Policy and Governance

NASA collaboratively developed and adopted a new knowledge policy in November 2013

- Federated approach to governance
- CKOs appointed at Centers, Mission Directorates, Functional Offices, with Roles and Responsibilities
- Tools such as the first NASA Knowledge Map to form a common vocabulary and the km.nasa.gov portal to focus communications and distribution

Expectations & Culture - Critical Knowledge

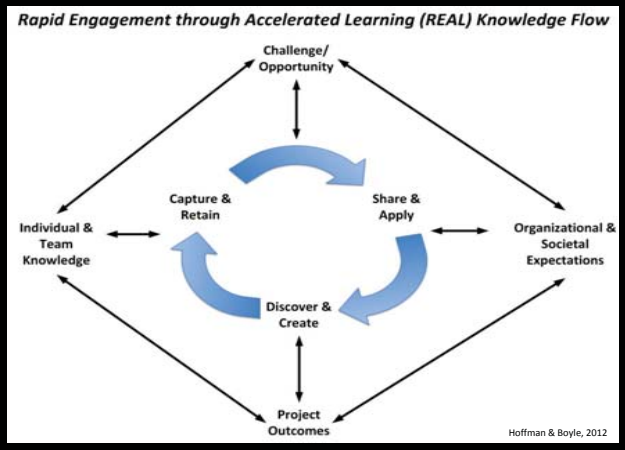




Leadership & Management
NASA's Gaps in Core Knowledge Processes

Leadership & Management - Challenges

- How do we find and search our knowledge?
- What are our Critical Knowledge priorities?
- What are the metrics and measures that capture effectiveness and efficiency in the core knowledge processes?
- Who do we optimize Knowledge Services for accelerated learning, engagement, and managing complexity?
- Can an understanding of biases and heuristics that drive organizational and societal expectations help organizations make better decisions and design better knowledge services?



Questions

Email:
edhoffma@gmail.com

Linked In:
https://www.linkedin.com/in/ed-hoffman-5033554

McMurdo Station, Antarctica
NSF Large Facilities Presentation

McM Station 1957- Navy (Early)

McM Station 1977- Navy (Late)

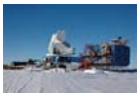
McM Station 2013 - Current

US Antarctic Program Science

NSF ANTARCTIC SCIENCES MISSION

NSF funds 150-200 science events each year across broad range of disciplines and Antarctic locations

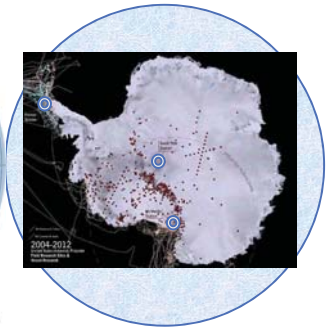
- Fundamental research and education:
  - to understand the Antarctic regions and linkages to global systems
  - to use polar regions as unique laboratories to understand the Earth, life, and the Universe
- Training the next generation of scientists
- Educating the public - why Antarctica matters to us and to the nation



NSF ANTARCTIC RESEARCH PROGRAMS

- Ocean Atmosphere
- Glaciology
- Integrated System Science
- Earth sciences
- Organisms and Ecosystems
- Astronomy, Astrophysics, and Geospace
- Instrumentation Facilities

Origins of the universe
Climate change
Ocean level rise
Origins of cosmic rays
Subatomic neutrino detection
Ozone hole measurements
Meteorites from other planets
Expansion of the universe
New dinosaurs
…and much more.



McMurdo Local & Sea Ice






McMurdo Based: Dry Valleys

- Unique highly sensitive environment, near field
- Helicopter supported
- Semi-permanent camp locations





McMurdo Based: Deep Field

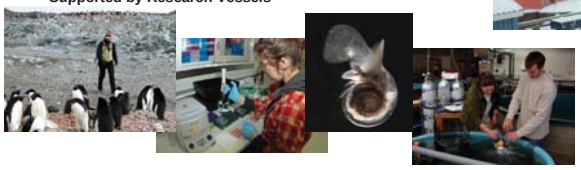
- Wide range of remote locations across the continent
- Primarily supported by fixed wind aircraft (LC-130, Twin Otter) out of McMurdo
- Secondarily supported by heavy equipment traverse
- Broad range of science disciplines




South Pole

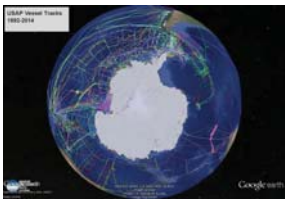
Palmer Station

- **Palmer Station is used year round**
- **LTER has long term marine/Palmer ecological studies**
- **Ongoing installed instruments for NOAA, CTBT and others**
- **On-going bird and other wildlife projects**
- **Supported by Research Vessels**



Research Vessels

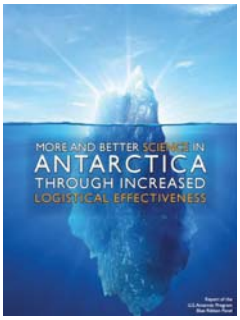
- **USAP Operates two research vessels: *Laurence M Gould (LMG)* and *Nathaniel B Palmer (NBP)* under charter to the ASC for the National Science Foundation (NSF)**
- **The ships provide support to USAP in various regions of the Antarctic and the Southern Ocean**
- **Primary functions include supporting variety of oceanographic research activities in the open ocean and in ice, as well as supporting land-based station and field programs**



McMurdo Station

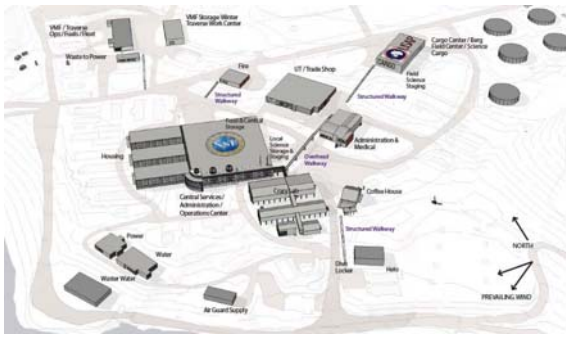
Project Definition

- **Master Plan 1.0 built upon all previously completed McMurdo Station studies.**



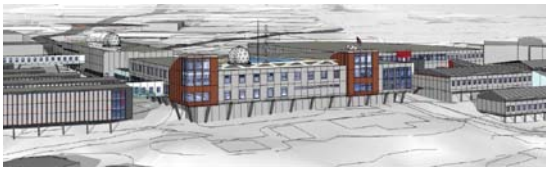
Project Definition

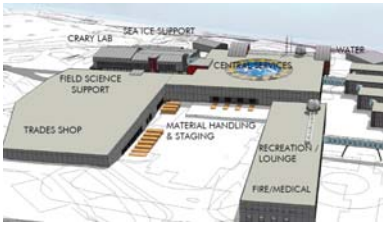
- **Master Plan 1.0 Final Build Out**



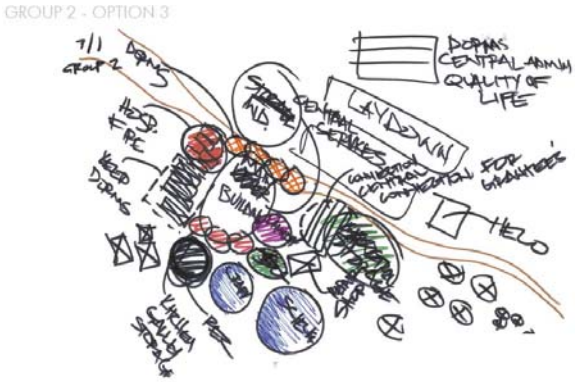
Project Definition

- **Master Plans served to define design parameters**





Operational Flow Development



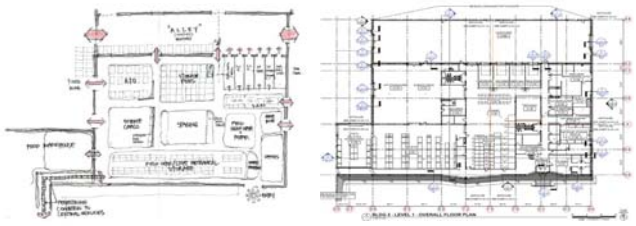
AIMS Conceptual Design Review, 31-Mar to 2-Apr, 2015

Operational Flow Development

AIMS Conceptual Design Review, 31-Mar to 2-Apr, 2015

Programming Method

- **Field Science Support Evolution**



FIELD SCIENCE SUPPORT FACILITY ADJACENCY DIAGRAMS

AIMS and MPSM Completion

In Scope for AIMS

MCMURDO STATION FUTURE-STATE

Fewer Buildings with Denser Occupancy

- *Less vehicle traffic, lower road maintenance*
- *Lower total building surface area which equates to better energy efficiency*
- *Less snow maintenance around station*

RESULT: A condensed station footprint and better utilization of space within buildings requires less staffing and a smaller vehicle fleet to execute operations

Current-state
>100 structures

Future-state
~20 structures

MCMURDO STATION FUTURE-STATE

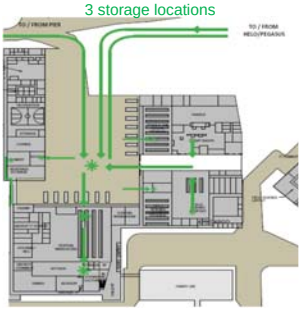
Consolidated Warehouses/Storage Locations

- *Minimizes number of touchpoints and reduces distance between touchpoints*
- *Reduces facilities costs/energy utilization*
- *Consolidates Pick, Pack, Ship workflows*

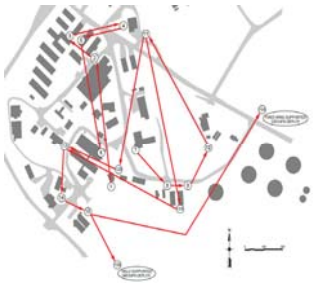
RESULT: An efficient local supply chain (inventory storage and distribution) requiring less staffing, computers, and material handling equipment

Current-state
>30 warehouses and storage sites

Future-state
3 storage locations



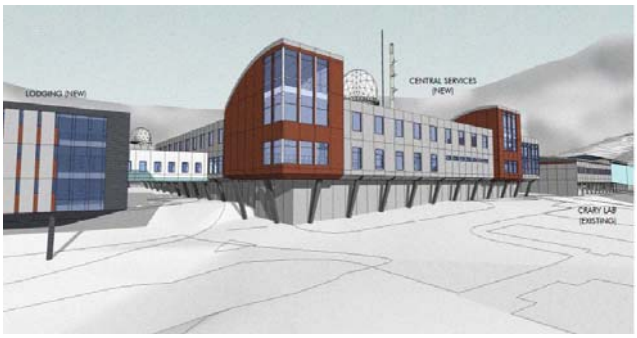
Grantee Movement Flow



AIMS Animation

McMurdo Test MP1

McMurdo Test MP2



McMurdo Exterior Test

McMurdo Exterior Test

McMurdo Exterior Test

McMurdo Exterior Test

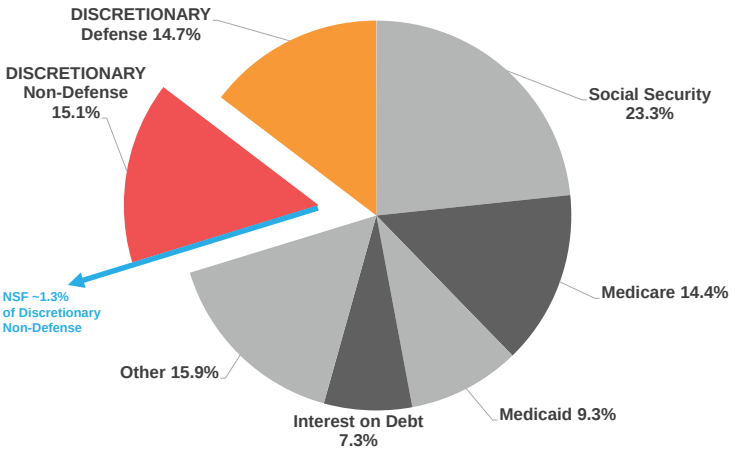
NSF Budget Update

NSF Large Facilities Workshop
Baton Rouge
May 1, 2017

Beth Blue
Analyst
NSF Budget Division

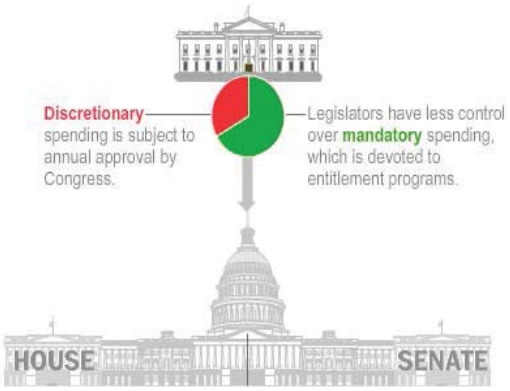
Outlays By Broad Category

based on FY 2017 Request



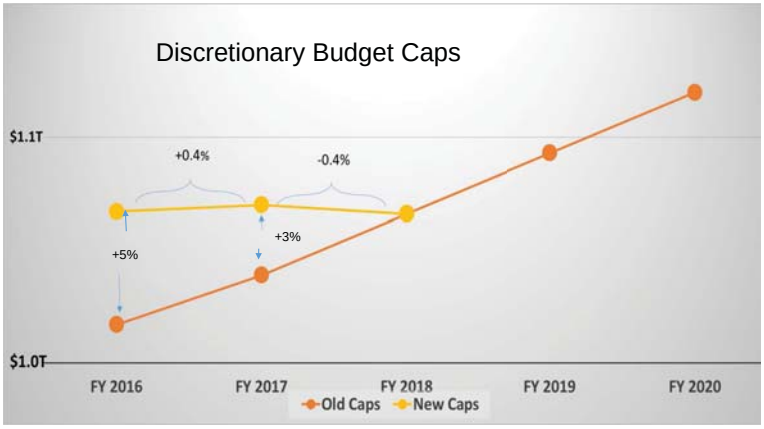
President submits budget

On or before the first Monday in February, the president submits to Congress a detailed budget request for the next fiscal year, which begins on Oct. 1.



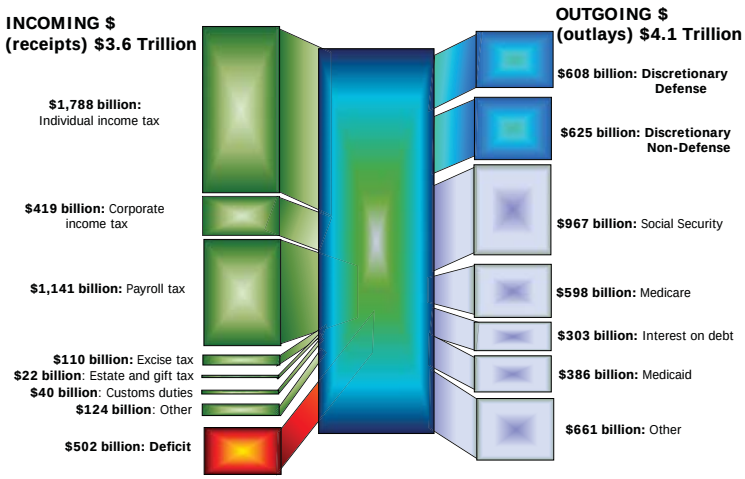
Source: Washington Post
http://www.washingtonpost.com/wp-srv/special/politics/federal-budget-process/noFlash.jpg

Current Events:
Bipartisan Budget Act of 2015 (P.L. 114-74)



Spending America's Income

Broad revenue and spending categories in the fiscal year 2017 budget request



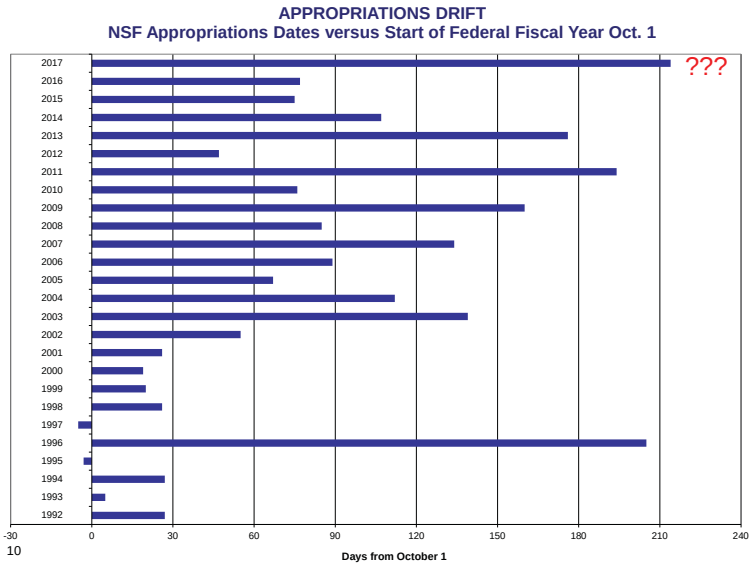
Totals may not add due to rounding.

FY 2017 NSF Funding Comparisons

- FY 2016 Enacted: $7.5 Billion
- FY 2017 Request: $8 Billion
  - $7.6 Billion in Discretionary
  - Additional $0.4 Billion in new Mandatory funding
- House: $7.4 Billion
- Senate: $7.5 Billion

FY 2017 Status

- Continuing Resolution through May 5th.
- Action needed for remainder of FY 2017
- Administration has proposed increase of $18 billion for Defense and DHS, to be offset by reductions in non-defense



FY 2018: Budget Blueprint

- Discretionary Spending Only
- Prioritizes Defense and Security
  - $54 billion shifted from non-Defense
- Limited Detail
- Reductions for R&D
  - DOE Science, -17%
  - NIH, -16%
  - EPA ORD, -48%
  - NASA, -1%
- NSF not specified

What's Next?

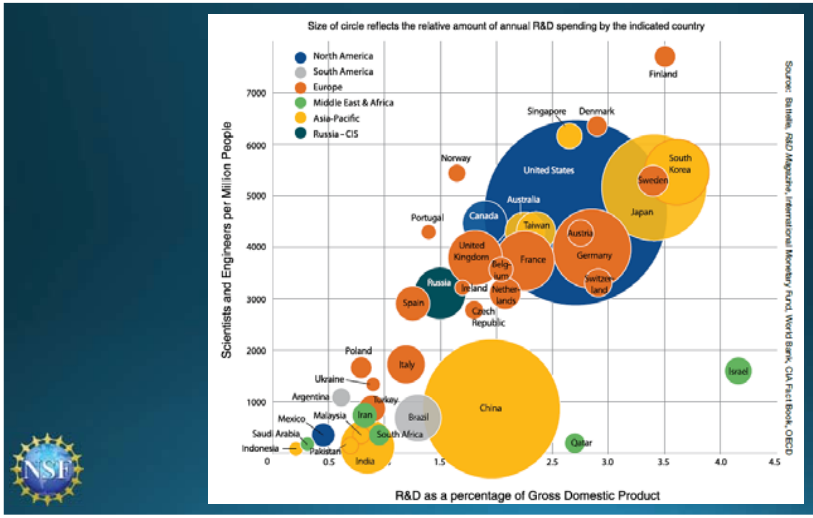
- By May 5: Congressional Action on FY 2017 Appropriations
- May 22: FY 2018 President's Budget (details)
- By October 1: Congressional Action on FY 2018 Appropriations

The Role of International Collaborations for Large Research Facilities

Dr. Mangala Sharma
Program Director, NSF Office of International Science and Engineering

2017 Large Facilities Workshop
Baton Rouge, LA

- **Session goals:**
  - Share common challenges and good practices to build effective international partnerships throughout lifetime of research facilities
  - Highlight good practices in international facilities management



Why International Research Collaborations?

- **Advance the FRONTIERS of Science and Engineering**
  - ACCESS to unique expertise, facilities, and phenomena
  - LEVERAGE limited resources, share costs + risks
  - EXCHANGE insights and techniques, expand knowledge base
  - ADDRESS national, transnational and global challenges
- **Prepare a GLOBALLY-ENGAGED U.S. S&E workforce**
  - NURTURE capable young researchers with strong networks overseas
  - DEVELOP a global perspective
  - FACILITATE mobility and brain circulation

NSF International Activities

- **NSF supports international collaboration (projects, facilities) when it enhances research and STEM education**

  NSF funds the US-side of international collaborations

- **Span all NSF Directorates and Offices - directorates provide most of funding**
- **Strengthen partnerships with, and leverage funding from, foreign counterpart funders**
- **Often involve cooperation with other U.S. government agencies, other governments, and private foundations**

Large Facility Projects

Rev: 2017-04-17

Facility	Acronym	Location	Stage	Recipient	DIR/DIV
United States Antarctic Program	USAP	Antarctica	Operations	Leidos	GEO/PLR
-- Antarctic Infrastructure Modernization for Science	AIMS	Antarctica	Design	Leidos	GEO/PLR
Arecibo Observatory	AO	Puerto Rico	Operations	SRI International	MPS/AST GEO/AGS
Academic Research Fleet	ARF	Distributed	Operations	Various (21 research vessels)	GEO/OCE
-- Regional Class Research Vessel	RCRV	Mobile	Design	Oregon State University	GEO/OCE
-- National Deep Submergence Facility	NDSF	Mobile	Operations	Woods Hole Oceanographic Institution	GEO/OCE
Cornell High Energy Synchrotron Source	CHESS	New York	Operations	Cornell University	MPS/DMR
Green Bank Observatory	GBO	West Virginia	Operations	Associated Universities Incorporated	MPS/AST
Gemini Observatory	Gemini	Chile & Hawaii	Operations	Association of Universities for Research in Astronomy	MPS/AST
IceCube Neutrino Observatory	ICNO	Antarctica	Operations	University of Wisconsin	GEO/PLR MPS/PHY
International Ocean Discovery Program (JOIDES Resolution)	IODP	Texas & Mobile	Operations	Texas A&M Research Foundation	GEO/OCE
International Ocean Discovery Program (Science Support Office)	IODP	California	Operations	University of California, San Diego Scripps Institution of Oceanography	GEO/OCE
Long Baseline Observatory	LBO	Distributed	Operations	Associated Universities Incorporated	MPS/AST
Large Hadron Collider	LHC	Switzerland	Operations / Design / Construction		MPS/PHY
-- A Toroidal LHC Apparatus (ATLAS) Detector Operations and High Luminosity Upgrade Design	ATLAS	Switzerland	Operations / Design	SUNY - StonyBrook	MPS/PHY
-- A Toroidal LHC Apparatus (ATLAS) Detector Phase I Upgrade	ATLAS	Switzerland	Construction	SUNY - StonyBrook	MPS/PHY
-- Compact Muon Solenoid (CMS) Detector Operations and High Luminosity Upgrade Design	CMS	Switzerland	Operations / Design	Princeton University	MPS/PHY
-- Compact Muon Solenoid (CMS) Detector Phase I Upgrade	CMS	Switzerland	Construction	University of Nebraska - Lincoln	MPS/PHY
Laser Interferometer Gravitational-wave Observatory	LIGO	Louisiana	Operations / Construction	California Institute of Technology	MPS/PHY
Large Synoptic Survey Telescope	LSST	Chile	Construction	Association of Universities for Research in Astronomy	MPS/AST
National Center for Atmospheric Research [FFRDC]	NCAR	Colorado & Wyoming	Operations	University Corporation for Atmospheric Research	GEO/AGS
Natural Hazards Engineering Research Infrastructure	NHERI	Distributed	Operations	11 Individual Awards to Various Universities	ENG/CMMI
National Ecological Observatory Network	NEON	Distributed	Construction Operations	Battelle Memorial Institute	BIO/DBI
National Geophysical Observatory for Geoscience	NGEO	Distributed	Operations	--	GEO/EAR
-- Geodesy Advancing Geosciences and EarthScope	GAGE	Distributed	Operations	UNAVCO	GEO/EAR
-- Seismological Facilities for the Advancement of Geoscience and EarthScope	SAGE	Distributed	Operations	IRIS Consortium	GEO/EAR
National High Magnetic Field Laboratory	NHMFL	Florida & New Mexico	Operations	Florida State University	MPS/DMR
National Nanotechnology Coordinated Infrastructure	NNCI	Distributed	Operations	16 member university consortium	ENG/ECCS
National Optical Astronomy Observatory [FFRDC]	NOAO	Arizona & Chile	Operations	Association of Universities for Research in Astronomy	MPS/AST
National Radio Astronomy Observatory [FFRDC]	NRAO	Distributed	Operations	Associated Universities Incorporated	MPS/AST
-- Atacama Large Millimeter/Submillimeter Array	ALMA	Chile	Operations	Associated Universities Incorporated	MPS/AST
-- Very Large Array	VLA	New Mexico	Operations	Associated Universities Incorporated	MPS/AST

Facility	Acronym	Location	Stage	Recipient	DIR/DIV
National Superconducting Cyclotron Laboratory	NSCL	Michigan	Operations	Michigan State University	MPS/PHY
National Solar Observatory [FFRDC]	NSO	New Mexico & Arizona	Operations	Association of Universities for Research in Astronomy	MPS/AST
-- Daniel K. Inouye Solar Telescope	DKIST	Hawaii	Construction	Association of Universities for Research in Astronomy	MPS/AST
Ocean Observatories Initiative	OOI	Distributed	Operations	Consortium for Ocean Leadership	GEO/OCE

NSF's global presence

International Collaborations & Large Facilities

- **Facilities located outside U.S. and/or distributed networks**
- **Cooperative partnerships of multiple international groups**

NSF's Large Facilities Manual (LFM) provides guidance:

- incorporating international input into the review process
- negotiating and managing international partnerships
- compliance with international agreements and treaties

"International partnerships are generally the most complex."

"International partner agencies need to understand the funding processes in the different countries involved."

Discussion:

- **What roles do various partners play - their contributions tangible and intangible?**
- **How did/do you identify potential partners?**
- **How did/do you negotiate and manage partnerships during various phases of facility construction and operation?**
- **How is your international collaboration structured and managed?**
- **What are the good practices for information sharing, conflict resolution within complex international collaborations?**
- **How do different cultures and approaches affect working together?**

Take home message:
What helps reduce barriers and improve efficiencies for international partnerships in research facilities?

BSR Hot Topic: Coordination of Administrative Business Reviews across the NSF Large Facility Portfolio

2017 Large Facility Workshop

Florence Rabanal, *Large Facilities Advisor*
Anna-Lee Misiano, *Grant & Agreement Specialist*
Roland P. Roberts, *Program Director, NEON* Operations

National Science Foundation
WHERE DISCOVERIES BEGIN

Purpose of Session and Outcomes

Share and discuss, NSF's strategy for identifying and managing risks associated with the large facility portfolio. Through this session we expect to:

- increase transparency to decision making process for administrative business-focused reviews conducted across large facility portfolio
- add to attendee's understanding by highlighting the key drivers underlying the decision-making process
- gather and understand Recipient challenges, and identify potential mechanisms to address these
- encourage information exchange

Key Drivers for Change in Monitoring Risks

- Breadth, number and type of oversight activities has changed, due to
  - Evolution of Regulations
  - Stakeholder Recommendations
  - Agency-prescribed
- Workload inefficiencies and increased burden on all stakeholders resulting from NSF's traditional approach to scheduling and executing reviews
- Institutional Maturity and lessons learned

Myth or Truth? Administrative Business Reviews

- NSF can elect to stop conducting administrative business reviews.
- A Business Systems Review serves as an audit?
- NSF is required to conduct Business Systems Reviews on a five-year cycle.
- An OIG audit substitutes for NSF's oversight.
- Business Systems Reviews usually involve a desk review, site visit and require expansive document collection before the review can be conducted.

Background

- In 2006 NSF implemented a Facility-focused oversight reviews, called business systems review (BSR). In the early years these were conducted on a five year cycle, aligned with the length of the award.
- Intervening period oversight on NSF's Large Facilities continued.
- In 2015, Large Facilities Office implemented a risk-based assessment to determine application of business systems review process.
- CSB process was implemented CY 2015 (summer)
- In early 2017, NSF pursued the streamlining of its current LFO and CSB processes, with goal of overarching risk framework to support decision making for all administrative oversight tools.

Scope and Focus NSF Large Facility Portfolio Risk Assessment

- Scope covers the NSF Large Facility Portfolio
  - Portfolio defined as: *Anything funded through the MREFC or R&RA ($100M or 10% of Directorate's Current Plan) account that can be constructed, acquired or commissioned* (**the big stuff**)
- Focus to identify risks associated with NSF responsibilities, NOT Recipient or Large Facility Project
  - Risks defined as "*threats and opportunities that NSF perceives to have an impact on NSF's objectives*"
- Output is a single coordinated process that brings together existing (but separately executed) risk assessments and informs the decision making of oversight (timing and type) for large facility portfolio

Administrative Oversight Tools

- Business Systems Review
  - Assesses that people, processes & technologies are in place to support administration and management of a facility
- EVMS Verification, Acceptance, & Surveillance
  - Evaluates and validates EVMS to ensure successful project implementation & provide good oversight and assurance information
- Accounting System Audit/Review
  - Assesses the adequacy of awardee's accounting systems
- Independent Cost Analysis
  - External analysis of the proposed budget to assess completeness & reasonableness
- Cost Incurred Audit
  - To ensure all costs incurred by the Recipient and charged to the government are allowable, allocable, and reasonable

Some Risk Factors Considered

- Financial
  - Award Size
- Administrative
  - 'New' Federal Awardee
- Institutional
  - Academic & Non-Profit Institutions

Risk Assessment Process

- Conduct Annually at the Portfolio Level, for each facility:
  - Identify risks through survey of key stakeholders (Program and BFA: LFO, DFM, DIAS, and CSB)
  - Organize Discussions, led by LFO and attended by Program and CSB, consider risk factors
  - Outline two-year strategy for managing risks
    - Agree upon those (risks) to accept and others to monitor through oversight
    - Select (existing) tool/s for oversight
    - Develop oversight plan (tool/s and timing)
- Aggregate and assess across the portfolio (decision made)
- Continuously Monitor Risks and Update
- Execute Oversight

Early Observations

- Coordination is effort intensive on front-end, but it will likely be reduced/recovered on back-end
- Rich discussions with varying perspectives critical
- Don't underestimate expert judgement, it will take you far
- Easy access to accurate and complete historical data and future plans is essential
- Standardization and Calibration of Risks and Tools would be helpful
  - Vocabulary/lexicon
  - Common risk categories
  - Guidance on Alignment of Tools to Risk
- Introducing more complex components (heat maps, probability tables) may/may not improve outcome
- Elements such as assumptions may be needed

Myth or Truth? Administrative Business Reviews

- NSF can elect to stop conducting administrative business reviews.
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Discussion Questions

- What additional information or actions are could to improve your understanding of the process and impacts on your Organization?

Discussion Questions

- Are there key factors that are not captured/considered in the current NSF risk assessment process?

Discussion Questions

- Within your own organizations, who do you see as the responsible parties involved in these reviews, and what changes do you see needed within your organizations to coordinate communication?

Discussion Questions

- Do you envision any un-intended (negative or positive) impacts from the risk-based process and if so, what are they?

Discussion Questions

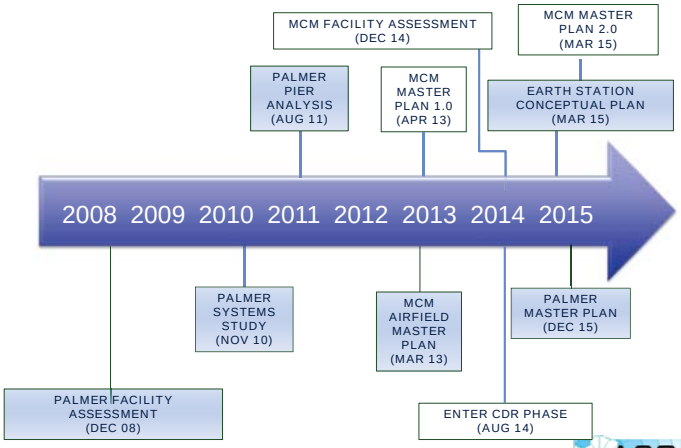
- What kind of Risk Assessment/Management is employed by your project/organization?

MREFC Process from a Facilities Perspective

Antarctic Infrastructure Modernization for Science (AIMS)

Rita Pittmann, Planning & Controls Manager
Leidos / Antarctic Support Contract
May 1, 2017
1 pm

How It All Starts – Pre-CDR



CDR – Lessons Learned

Positives:

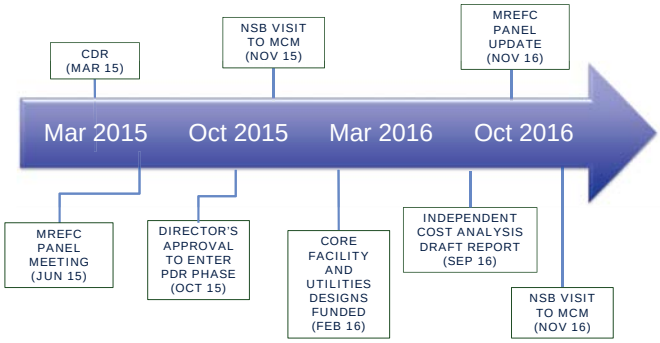
- Well established processes including Earned Value
- Previous experience existed in house on MREFC projects
  - In lieu of existing experience, the most important resource will be the Large Facilities Manual
  - Contact other programs/projects who have used the process
- Pictures are worth a thousand words

CDR – Lessons Learned (continued)

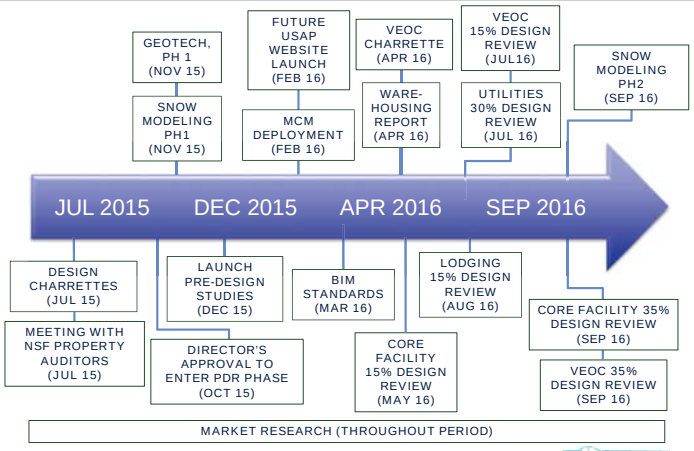
Challenges :

- High Level Scope Requirement Document –
  - Blue Ribbon Panel Report
  - No formal designs – only blocking diagrams
  - Multiple Facilities / Multiple Locations / Multiple Subcontractors
    - Subcontracting Strategy – Design/Build and Design Bid Build
- Only three months to prepare
  - Important to have enough time to properly staff
    - Risk Experts, Technical Writer
- Clear understanding of all MREFC deadlines and informational requirements
  - Leaving enough time for reviews
  - Read Ahead Package deliverable requirements
  - Who makes what decisions/Expect additional questions and clarifications

Post – CDR – NSF Activities



Post – CDR – AIMS Activities



PDR – Lessons Learned

Positives:

- Worked Closely with NSF Project Manager and LFO Representative
  - Questions regarding LFM – there is flexibility based on the project
  - Dry Run presentations
  - Weekly team meetings
- Visuals, Visuals, Visuals
- Understood Evaluation Criteria

Challenges:

- Delayed approval to proceed to PDR (4-5 months later than anticipated)
  - Unable to start design until approval
  - NSF provided a target number
  - Leidos is a FAR based contract – LFM is written more for cooperative agreements
  - Independent Cost Assessment-Extra Resources to answer questions

PDR – Lessons Learned (continued)

Challenges (continued):

Need sufficient time to meet the LFO requirements and schedule

- Our project may have benefited from additional time but because of other NSF priorities we continued on the current schedule
- Timeline from budget submission to start of project
- Difficult to manage LFO review timelines and subcontracting process
- Contingency tied to Risks
  - Risk register is a living document
- Draft LFM – undefined earned value section

Recommendation/Suggestions:

- Training and common understanding of the process

2017 MREFC Process from Oregon State University's perspective
(and that of the Project Manager in particular).

Demian Bailey, PMP

PRO

- MREFC Allows NSF to diversify its project management portfolio without over-burdening internal resources.
- MREFC process is flexible with regards to management structures: OSU team is the right size for this project. Not too big, but we have the resources to build the team we need. NSF's grant process enables this. No dedicated ship building office at NSF required.
- "Best Risk Management Process I've seen" –OSU's risk manager
- Good budgeting process. Let the requirements drive the design and let the requirements-driven design drive the budget formulation.
- Cooperative Agreement format, has in our experience been collaborative. We've been better off for our reviews, outside panels and consultants.
- NSF has done a good job shielding the project office from beltway and internal politics.
- Funding via grant (in R&RA) has kept us out of problems resulting from government shut downs.
- NSF has prioritized the success of the project. They want it to succeed and, over time, we have earned their trust as a partner… and vice versa. NSF has avoided micromanagement and whipsaw progress.
- NSF prefers to make decisions or give consent rather than give direction (usually). This may, on occasion or to those unaccustomed, seem like "rock management" because they actually often do have a course of action they prefer, but prefer not to dictate it. Once you figure this out and that it's not necessarily a game of "mother may I", there's actually more freedom. I find it better to propose solutions that work for the project than to wait for direction.
- The BSR gave impetus for the University to improve business practices. It gave the project leverage to help effect positive change.
- NSF has held me accountable. This can be uncomfortable or irritating at times. But it forces you to increase your vigilance, attention to detail, and avoid complacency.

CON

- The parallel nature of approvals (NSB/Congress). Getting congressional approval AFTER we have selected the shipyard has absolutely driven how we have structured the contract, the RFP, and our risk management process. The situation was exacerbated (though expected) by the on-going continuing resolutions.
- The uncertainty surrounding the program scenario has led to self-imposed inefficiencies. In the case of ships, the Navy has studied this and found it to be the major source of inefficiency.
- Budget reporting formats can be wonky (NSF Reporting Codes don't apply to large projects). All of our contracts have the same amount of space as our intern.
- Pushing the use of EVM to manage our fixed price contract has led to choices that are less than ideal. I understand the NSF-side drivers (accountability, the need for increased oversite, etc).
- Moving goal posts. This is a bigger deal for some than others, but we have needed to restructure our project in order to align with revisions of the LFM. This was a good thing in the medium and long run. In the short run it was a real pain revising the PEP, all the figures, etc. But, on the other hand, NSF was funding us and our ramp to MREFC was long. So, we really didn't have anything to complain about.
    - Goal Posts That Moved
        - Schedule risk requirements
        - EVM reporting requirements (audit)
        - Large facilities manual PEP structure… it's good now. Good changes.
- "Charge Letters" for reviews came after we submitted our package. Good for AIM.

Lessons Learned

- Don't underestimate the depth of project management requirements that NSF will want to see. As the project becomes more real, oversite and expectations grow for reporting and documentation. Hire a project controls specialist early.
    - If you are an academic or used to being on a tight budget, think bigger. Don't try to do everything yourself. i.e, Hire a risk manager and contract out aspects of the project for which you don't have the expertise. Do it right. From my experience, that is NSF's expectation. These are LARGE PROJECTS. With lots of scrutiny and oversite. Many of those people come from a DoD or DOE background and are used to projects with high overhead.
- Now that the LFM seems pretty firm, read and follow it closely. Might as well structure the entire project around it. But don't be too invested in your structure. Make choices based on what's best for the project in the long run… not what's easy or convenient in the short term.
- EVM Certification. I was opposed to expanding our EVM footprint, but it's required. I was skeptical about the EVM Audit, but it did actually expose so useful gaps and wasn't as bad as it could have been.
- NSF may struggle not applying the same Project Management regimes to "midsize" programs. I would expect trickle down requirements.
- Should have completely decoupled the R&RA process from MREFC. The risks got muddy as did the Total Project Cost.

Tips

- Align your PEP directly with the LFM.
    - Align your Business Systems section of the PEP with the BSR functional areas to facilitate the BSR.
        - And align your Project Reporting section of your PEP with the ANSI EVM Criteria to facilitate your EVM Audit.
- Assume positive intent. NSF wants to see your program succeed as much or even more than you do. They have a different set of demands that trickle down. Be open to their direction… but think critically about it and push back where warranted, but do your homework.
- Air your dirty laundry. Bring up sticky issues early and often. Even (or especially) those that you think NSF won't want to hear.
- Don't ask for direction. Use your team and propose solutions, don't bring problems. This isn't an operational-risk driven process (like the NASA space walk incident).
- Keep the LFM printed and within arm's reach on your desk. Don't try to build a program from scratch.
- Don't underestimate the importance of quality budget formulations and contingency development and use. These are the most import aspects of building a program that can withstand scrutiny.
- Keep a "beginner's mind". Avoid preconceived ideas and assume you have all the answers.

Creating a Successful Lessons Learned Approach: People, Process, Culture

Dr. Edward J. Hoffman
Knowledge Engagement
PMI, Strategic Advisor
Columbia University, Executive in Residence
May 1, 2017

Workshop Objectives:

Engage NSF practitioners in establishing a home grown process for learning from science projects

Create and promote a learning culture of reflective and sharing practitioners

Consider methods for establishing an engaging and effective lessons learned system that is practitioner useful and friendly

Enjoy sharing knowledge and conversation among NSF professionals

"A story to me means a plot where there is some surprise. Because that is how life is - full of surprises."

Isaac Bashevis Singer

Learning from Failure

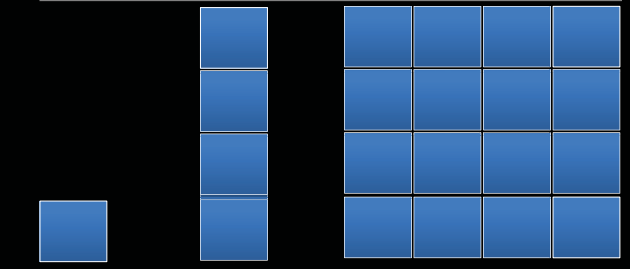
How Can Practitioners Share Stories?

- Examples of venues for stories that help promote a culture of sharing and openness
  - Masters with Masters: Expert practitioners and leaders sharing stories in facilitated dialogue with each other.
  - Knowledge Forums: Practitioner stories on specialized topics (e.g., lessons from the Space Shuttle, green engineering, lessons for Principal Investigators)

Key Assumptions and Biases

- Practitioners know best.
- 85-90% of learning takes place on the job.
- Learning is contextual — different career stages have different requirements.
- Optimal performance and learning come together at the team level.

Levels for Learning

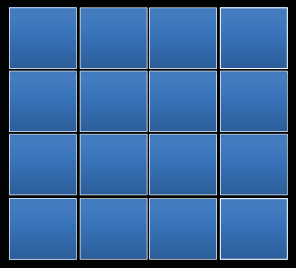


How Do People Learn from Project Stories?

Example: former astronaut and NASA Chief Safety Officer Bryan O'Connor's lesson from the Challenger accident.

Learning Strategy

Knowledge Sharing



- Live forums for sharing stories
- Case studies and publications
- Online tools for sharing (websites/portals, YouTube, social media)
- Defined processes for identifying, capturing and sharing knowledge
- Knowledge networks (e.g., communities of practice

Venues for Stories at NASA

- Agency-wide Forums
- Masters with Masters
- Local events

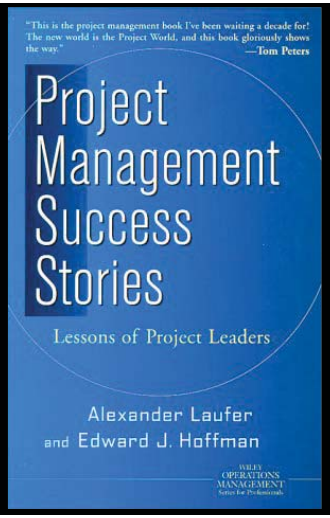
Stories are essential because they can convey context, emotion, and perspective.

- Transmit institutional memory from veterans to emerging leaders.
- Build a common understanding.
- Explore and learn from past decision points that led to successes or failures.
- Develop a community of reflective practitioners.

Storytelling helps us construct a sense of *dignity, meaning, and purpose* for our work.

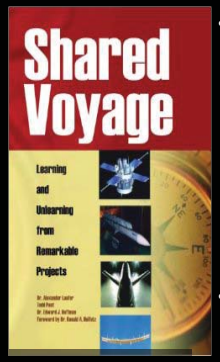
Whatever has a value can be replaced by something else which is equivalent; whatever, on the other hand, is above all value, and therefore admits of no equivalent, has a dignity.

- Immanuel Kant



Project Management Lessons of Leaders

Why Stories?



- Project stories that go untold are missed opportunities for learning.
  - Government-wide requirements call for foundational training for project managers.
  - Failures will happen; we need to learn from them.
  - Successes also have valuable lessons and best practices.
- What Successful Project Managers Do (MITSloan Management Review Laufer, Hoffman, Russell, Cameron Spring 2015)

A Good Story…

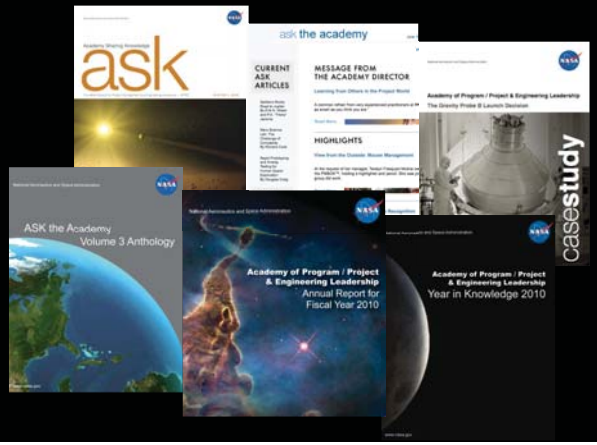
…starts with a problem, conflict, or challenge.

…describes a unique experience.

…describes concrete actions by people.

…makes a point — arrives at some basic truth.

Types of Stories: Publications



"**Design thinking** is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success."

— Tim Brown, president and CEO, IDEO.

Design Thinking Activity:

Design for a successful and formal process of learning from science projects

The Question

1. How can the NSF Large Facilities Science Projects, consistently and more formally learn from project missions, so that we are more adaptive, capable, and excellent organization?

Designing a Successful Learning Process

1. EMPATHIZE: Groups gather information through conversation and personal examples to develop a deeper understanding of the customer and the challenge.
2. DEFINE: Each Group defines and clearly articulates the problem they want to solve.
3. IDEATE: Ideas are generated by each Group in an attempt to inform the problem in terms of possible solutions.
4. PROTOTYPE: Each Group creates quick representations and models of the top ideas, emphasizing the graphical representation approach for better understanding.
5. TEST: Each Group briefs the other Groups on their new concept in a way that can be best integrated into their business culture and is then refined according to feedback.

Your Mission: Develop a great practice for formal and consistent learning from science projects

1. Empathy: Interview your group (10 minutes)

Share stories of how learning happens at NSF.

Take notes of the storyteller.

Gain empathy for the person telling the story.

Your Mission: Develop a great practice for formal and consistent learning from science projects

2. Empathy: Dig Deeper (10 minutes)

After the first set of stories about learning from science projects, follow up on things that intrigue you.

Dig for stories, feelings, and emotions.

Ask 'Why?'

Your Mission: Develop a great practice for formal and consistent learning from science projects

3. Define – Capture Findings & Take a Stand

Capture findings by collecting the group thoughts and reflect on what you have learned.

Synthesize your learning into two groups:

-Use verbs to express goals and wishes

-"Insights" are discoveries that might promote solutions

Take a stand by selecting the most compelling goal and most interesting insight to articulate a problem statement…

National Science Foundation
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LL Program Feedback – 3 Phases

Focus – maximum benefit, minimum burden

- Reporting
  - Annual Review Requirement to Report Lessons Learned (LL)
  - Discussed with the Review Panel or Separate Report to Program?
- "Distilling"
  - Are Recipients willing to participate on Committee?
  - Should Program Officers be on Committee?
  - What evaluation criteria
  - Charge to the Committee
- Sharing – Efficient and effective manner

National Science Foundation
OFFICE OF BUDGET FINANCE & AWARD MANAGEMENT

Potential Lessons Learned Categories

What categories most beneficial to share between Large Facilities?

Recipients
- Proposal Development
- MREFC Process
- User Management
- Cyberinfrastructure
- Operations
- Maintenance

NSF
- Budget
- Solicitation Development
- Proposal Review
- External Panels

Grants & Agreements | Institution & Award Support | Large Facilities | Budget
Financial Management | Acquisition & Cooperative Support

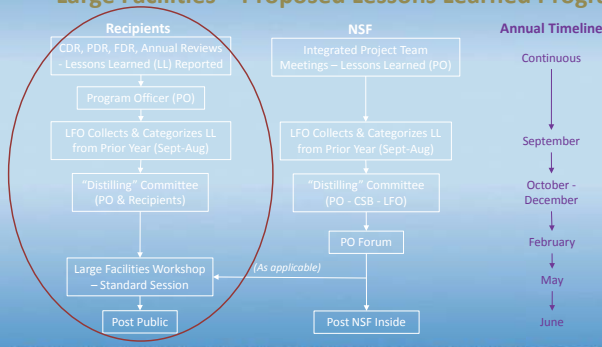
Your Mission: Develop a great practice for formal and consistent learning from science projects

5. Prototype: share and discuss (10 minutes)

Share your solutions & capture feedback

National Science Foundation
OFFICE OF BUDGET FINANCE & AWARD MANAGEMENT

Large Facilities – Proposed Lessons Learned Program



Grants & Agreements | Institution & Award Support | Large Facilities | Budget
Financial Management | Acquisition & Cooperative Support

Your Mission: Develop a great practice for formal and consistent learning from science projects

4. Ideate: generate alternatives to test (15 minutes)

Sketch at least 5 radical ways to solve your problem statement.

Write your problem statement and list 5 radical ideas

Share your solutions & capture feedback

Your Mission: Develop a great practice for formal and consistent learning from science projects

6. Test and Iterate: reflect & generate a new solution (10 minutes)

Sketch your big idea, note details if necessary!

Questions

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https://www.linkedin.com/in/ed-hoffman-5033554

Cyberinfrastructure Investments and Opportunities

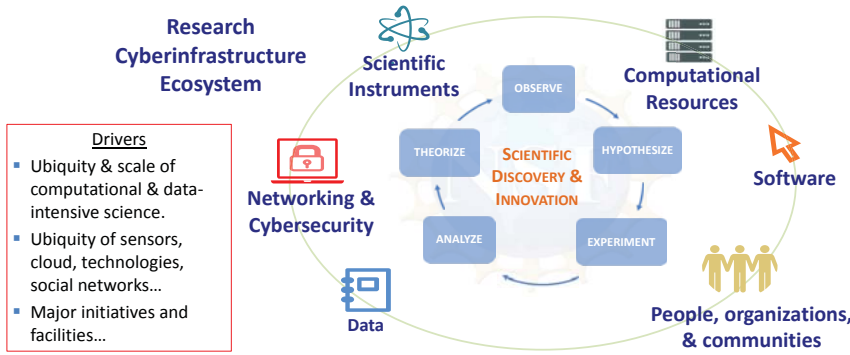
An update from the NSF Office of Advanced Cyberinfrastructure

BILL MILLER
SCIENCE ADVISOR, NSF/OAC
MAY 1, 2017

Outline

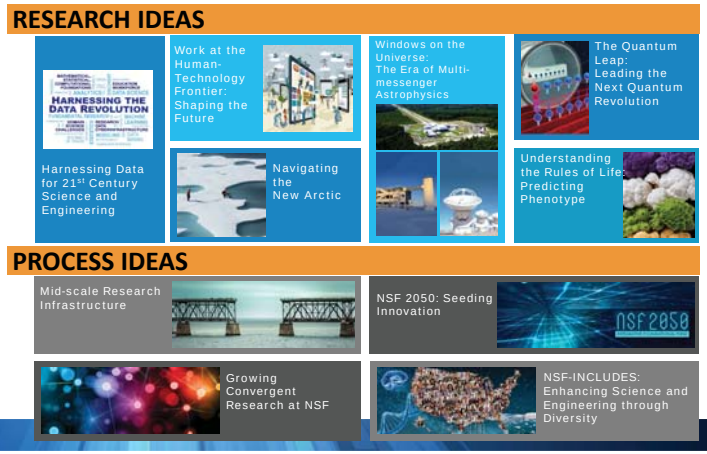
- Overview of Cyberinfrastructure
- OAC update and programs
- Looking into the Future
- Facility CI focus, upcoming workshop

NSF embraces an expansive view of Cyberinfrastructure driven by *evolving research priorities and scientific process*

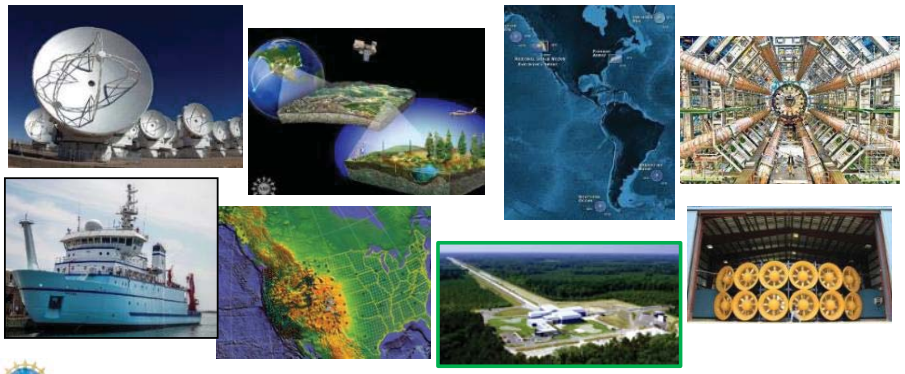


Drivers
- Ubiquity & scale of computational & data-intensive science.
- Ubiquity of sensors, cloud, technologies, social networks…
- Major initiatives and facilities…

NSF "Big Ideas" – all have CI implications

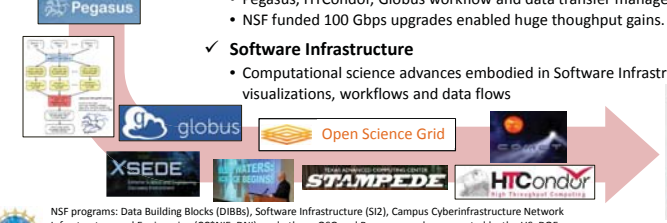


NSF Facilities are Increasingly CI Driven … and dependent on Shared CI



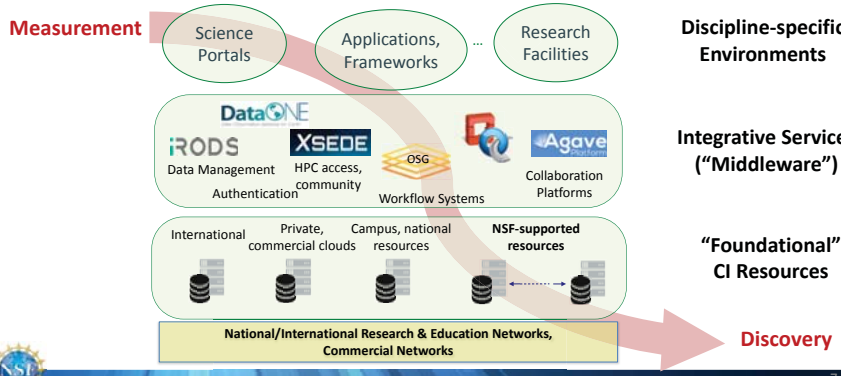
LIGO is enabled by NSF investments in instrumentation, computational science, cyberinfrastructure, and expert services

- ✓ **Researcher access to sustained Advanced Computing resources**
  - New intensive simulations of relativity and magnetohydrodynamics. Massive, parallel event searches and validation (100,000 models).
  - Advanced computing resources and services: Open Science Grid (OSG); Blue Waters (UIUC); Comet (SDSC), Stampede (TACC), XSEDE allocations, AWS….
- ✓ **Interoperable Networking, Data Transfer, and Workflow Systems**
  - Pegasus, HTCondor, Globus workflow and data transfer management
  - NSF funded 100 Gbps upgrades enabled huge thoughput gains.
- ✓ **Software Infrastructure**
  - Computational science advances embodied in Software Infrastructure, for simulations, visualizations, workflows and data flows



NSF programs: Data Building Blocks (DIBBs), Software Infrastructure (SI2), Campus Cyberinfrastructure Network Infrastructure and Engineering (CC*NIE, DNI), and others. OSG and Pegasus are also supported by the US. DOE.

Emerging discovery pathways at scale: Architecture view



Outline

- Overview of Cyberinfrastructure
- OAC update and programs
- Looking into the Future: NSF CI 2030
- Facility CI focus, upcoming workshop

CISE Office of Advanced Cyberinfrastructure (OAC)

Mission: Accelerate discovery and innovation across all disciplines through advanced CI

Science Drivers Domain science trends, agency priority areas, major facilities…

Investment areas High Performance Computing | Data Infrastructure | People: Learning & Workforce Devel | Networking & Cybersecurity | Software Infrastructure

Leadership, Partnership NSF Directorates, NSF and Federal Initiatives, Industry, International

Director: Irene Qualters
Deputy: Amy Friedlander
Science Advisor: Bill Miller
Coop Agreements: Al Suarez

High Performance Computing
Ed Walker, Bob Chadduck, Rudi Eigenmann

Data Infrastructure
Amy Walton, Bob Chadduck

Networking/Security
Anita Nikolich, Kevin Thompson

Software Infrastructure
Vipin Chaudhary, Rajiv Ramnath

Learning & Workforce Development
Sushil Prasad

www.nsf.gov/div/index.jsp?div=ACI

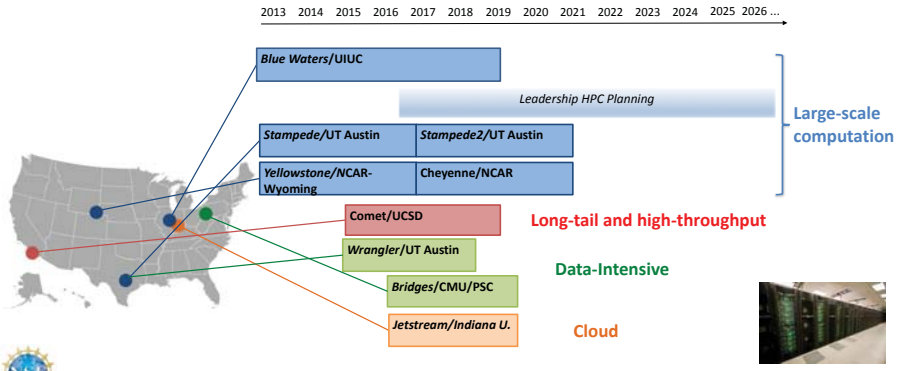
ACI Realignment → OAC

- 2013: *Office* of Cyberinfrastructure (OCI in OD) → *Division* of Advance Cyber Infrastructure (ACI in CISE).
- 2016 Review, including request for input from the community (DCL)
- Findings:
  - Well managed in CISE; budget has tracked CISE's
  - Leadership: visibility critical (external, internal)
- Outcomes:
  - Remain in CISE; renamed *Office* of Advanced Cyberinfrastructure (OAC), emphasizing its service to all S&E
  - Office Director participates in senior leadership meetings (SMaRT)
  - National searches for leadership (as for ADs)

High Performance Computing

NSF-supported National Computing Resources

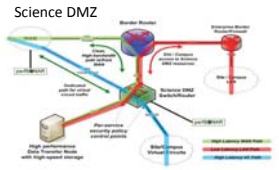
Complements Larger Aggregate Investments from Universities and other Agencies



Networking & Cybersecurity

CISE/OAC Networking Programs

- **Fundamental layer** that enables scientific discovery at the institutional, regional and global collaborative levels.
- **Campus Cyberinfrastructure (CC*)**. Upgrading and accelerating campus networking (10/100Gbps). Re-designing campus border to Science DMZs. Innovation, + much more.
- **International R&E Network Connections (IRNC).** Link U.S. research with peer networks in other world regions. Supports all R&E US data flows (not just NSF-funded).
  - Stimulates deployment and operational understanding of emerging network technology, best practices, 100Gbps connections.



Networking & Cybersecurity

OAC Cybersecurity

- **Cybersecurity Center of Excellence (CCoE)** – formerly Center for Trustworthy Scientific CI, www.trustedci.org.
  - Site reviews, code reviews, architecture reviews. Example engagements: Gemini, US Antarctic Program, LSST, OOI, LIGO, DKIST, NEON, Pegasus, PerfSonar, …
  - ➢ Open Science Cyber Risk Profile – asset/impact oriented approach for open science (DoE, NIH, NSF). Joint effort of CCoE & ESNet
- **Cybersecurity Innovation for Cyberinfrastructure (CICI)**. Topics: Secure and Resilient Architecture, Secure Data Provenance, Regional Cybersecurity
- **Secure and Trustworthy Cyberspace (SaTC).** – Cross-directorate program. OAC funds later stage/applied security projects that can secure scientific CI. Several "Transition to Practice" projects co-funded by Dept. of Homeland Security.
- **Annual Large Facilities Cybersecurity Summit**. ~120 attendees from NSF-funded science facilities. Next Summit: August 2017.

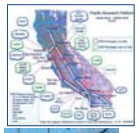
CTSC CENTER FOR TRUSTWORTHY SCIENTIFIC CYBERINFRASTRUCTURE

Example: Bro Intrusion Prevention/Detection software

driven by NSCI

Data Infrastructure

OAC Data Infrastructure: Accelerating Science, Building Community

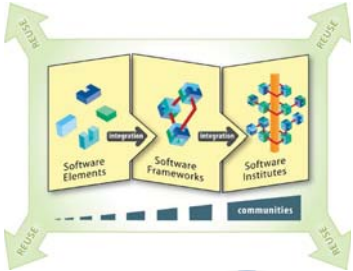


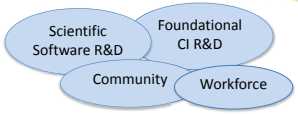

- **Data Building Blocks (DIBBs).** Funds CI/discipline collaborations, cross-disciplinary infrastructure, built on recognized capabilities, tangible products.
  - First PI meeting, Jan 2017 on Results, Challenges, Future Directions, and Gaps to inform future investments.
- **CC* collaboration.** Example topics: multi-institution, cloud resources, sharing mechanisms.
- **EarthCube.** Collaboration with NSF GEO. Topics: Building new communities, innovative interoperable solutions that link and integrate resources, new capabilities for data capture, discovery, access, processing and analysis.
- **Innovations at the Nexus of Food, Energy and Water Systems (INFEWS)**. NSF cross-cutting activity.

Software Infrastructure

OAC Software Investments

- **OAC Goal**: Catalyze and support unique, innovative software-intensive science ecosystems to advance research
- **Flagship - Software Infrastructure for Sustained Innovation (SI2)**. *Elements* ($500K/3 yrs), *Frameworks* ($1M/yr 3-5 yrs), *Institutes* ($3-$5m/yr 5-10 yrs).
- **Software "pipeline":**
  - R&D programs (SPX, CDS&E, DMREF, CRISP, Venture, …)
  - → Development and deployment (SI2)
  - → Outcomes: Sustainability, open source community, institutional support, education, SAAS, IP licensing, …



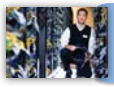


People

OAC Learning & Workforce Development

Communities of Concern

CI Contributors, Cyber-scientists
Develop new CI



CI Professionals
Deploy & support CI

CI Users
Exploit CI

New! **CyberTraining** - ***Training-based Workforce Development for Advanced Cyberinfrastructure*** (NSF 17-507)

- *Informal, scalable* training models and pilot activities - on topics in advanced CI, and computational and data-enabled science & engineering.
- OAC leads, with MPS, ENG, GEO, EHR/DGE, and CISE/CCF.
- $300K-500K over 1-3 years.
- **3 Tracks: 1**: CI Professionals. **2**: CI Contributors/Users in domain science and engineering. **3**: Undergraduate Computational & Data Science User Literacy.
- Excellent community response in the inaugural round.
- Next Deadline: *October 2017*

Outline

- Overview of Cyberinfrastructure
- OAC update and programs
- Looking into the Future
- Facility CI focus, upcoming workshop

❖ National Academies Study: Future HPC
❖ NSF CI 2030 survey: Science Drivers for Future CI
❖ National Strategic Computing Initiative: Exascale RFI

CIF21 fostered a rich NSF cyberinfrastructure ecosystem responsive to the *evolving discovery process.*


CI-Enabled Instrumentation


Computing Resources


Data Infrastructure


Gateways, Hubs, and Services

Cloud Resources & Services


R&E Networks, Security Layers

Coordination & User support


Software and Workflow Systems


Pilots, Testbeds


People, organizations, and communities

Many parts! … Working together? … The right architectures? … … Bottlenecks? … New pressures? …. Gaps?

Community input is informing NSF's strategic planning refresh for advanced CI

- ✓ National Academies report on NSF Advanced Computing (2016):
  - *Future Directions of NSF Advanced Computational Infrastructure to Support US Science in 2017 – 2022*
- ✓ NSF RFI on Future Needs for Advanced Cyberinfrastructure to Support Science and Engineering Research (NSF CI 2030), (2017)
- ✓ NSF and Joint agency assessments of the NSCI Exascale RFI (2015):
  - *NSF Assessment of Responses to the Request for Information (RFI) on Science Drivers Requiring Capable Exascale High Performance Computing and*
  - *Joint Agency Assessment of the Responses to the RFI on Science Drivers Requiring Capable Exascale High Performance Computing*
- ✓ PI and Disciplinary Workshops, e.g.:
  - Data Building Blocks (DIBBs) 2017 PI Workshop Final Report,
  - Software Infrastructure 2017 PI Workshop
  - *2017 NSF Cyberinfrastructure for Facilities Workshop, Sept 6-7, 2017*
- ✓ Input from other NSF Advisory Committees and other bodies.

High Performance Computing

Community Analysis of Future HPC

- 2016 National Academies Study, *Future Directions for NSF Advanced Computing Infrastructure to Support U.S. Science and Engineering in 2017-2020*
- Charge: "…*[E]xamine anticipated priorities and trade-offs for advanced computing for NSF-sponsored research"*
- Seven major recommendations across maintaining leadership, innovation, science needs, balance of capabilities (see backup slide).
- NSF formulating its response and actions.

Report: www.nap.edu/catalog/21886

NSF CI 2030 RFI

NSF Request for Information on Future Needs for Advanced Cyberinfrastructure to Support Science and Engineering Research

Dear Colleague Letter: www.nsf.gov/pubs/2017/nsf17031/nsf17031.jsp, Jan 5 - April 5, 2017

"NSF seeks input on scientific challenges, associated CI needs, and bold ideas to advance research frontiers over the next decade and beyond."

Question 1: Research Challenge(s) *[Including institutional challenges…]*

Describe current or emerging science or engineering research challenge(s), providing context in terms of recent research and standing questions in the field.

Question 2: Cyberinfrastructure Needed to Address the Challenge(s).

Describe any limitations or absence of existing CI or specific advancements that must be addressed to accomplish the identified research challenge(s).

Question 3: ***Any other aspects or issues that NSF should consider.***

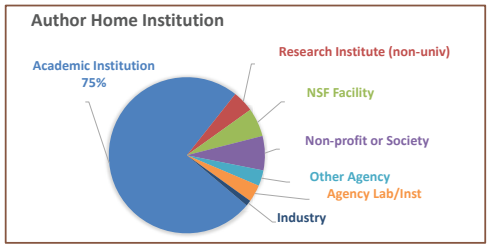
NSF CI 2030 RFI

First Look at Responses: Who?

Analysis is underway with NSF Advisory Committee for CI

136 Submissions → 50% Single Author, 50% Groups (2-15 Authors) } 366 Named Authors (339 Unique) (some were busy bees)

Geographic spread
- 39 States
- 9 Foreign contributors from 6 countries

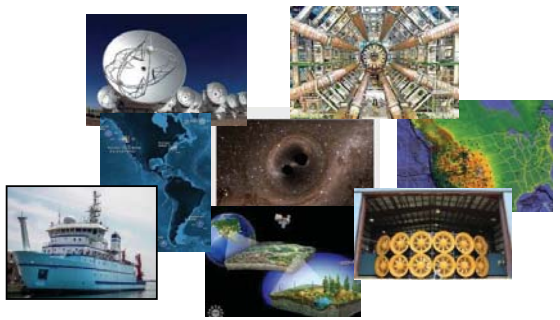


NSF CI 2030 RFI

NSF Facilities are well Represented

NSF Facility Contributors
- ARF/UNOLS
- Gemini
- LHC
- LIGO
- LSST
- NCAR
- NHERI
- NHMFL
- NOAO
- NRAO
- NSO
- RCRV

Mentioned
- DKIST
- Ice Cube
- IODP
- NEON
- OOI



ID#212 - Marine Crew of the R/V Atlantis & Marine Crew of the R/V Armstrong Shipboard Scientific Support Group (SSSG), WHOI

Outline

- Overview of Cyberinfrastructure
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NSF Workshops on Facility Cyberinfrastructure

- **Origin.** NSF Facility POs recognized a common challenge area, and OAC began internal discussions.
- **Overall Goal**. Enable direct and synergistic interactions between the NSF large facilities and the Cyberinfrastructure (CI) communities to jointly address needs of current and future facilities.
- **Desired outcomes**: Foster *collaborations* and *communities of practice*. Encourage *sharing* of *practices and solutions*. Inform *NSF program planning*.
- **First workshop** FY 2016 (December 2015). PI: Alex Szalay/JHU. Broad agenda, and emphasized data issues. Very successful. NSF Director gave a keynote.
- **Second workshop** upcoming September 6-7, 2017, Alexandria VA. Focus will be on facility CI designs and architectures – what is being done, internal "IT" vs. external CI resources being used, common issues, opportunities.

Thanks!

…

Bill Miller
Office of Advanced Cyberinfrastructure
WLMiller@nsf.gov
703-292-7886

NAS Report on Future NSF HPC Summary of Recommendations

Leadership

1. Grow comprehensive investments in advanced computing.
2. Support full range of science requirements for advanced computing.

Meeting Needs

3. Collect community requirements; develop roadmaps to inform decisions and set priorities.
4. Adopt approaches to consider investments in an integrated way with associated research.

On the Cutting Edge

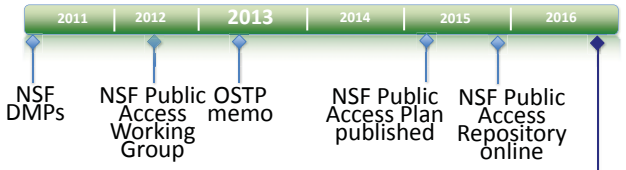
5. *Software.* Support development and maintenance of expertise, scientific software, and software tools relevant to advanced computing resources.
6. *Next-generation capabilities.* Make modest in next-gen hardware, software technologies to explore new ideas for next-gen capabilities. Adoption of radical new technology takes time.

Sustainability

7. Manage advanced computing investments in a predictable and sustainable way.

Report: www.nap.edu/catalog/21886

Public Access: recent USG activities (1/17)



US Government-wide (Jan. 2017)

- All subject Federal agencies have posted public access plans (compliance with 2013 OSTP memo)
- Published: "Principles for Promoting Access to Federal Government-Supported Scientific Data and Research Findings Through International Scientific Cooperation"
- New Open Science Working Group formed (NIH, NSF co-chairs)

College of Performance Management

Evolution of EVM and the Future

NSF Large Facilities Workshop
Baton Rouge, LA
May 1, 2017

Wayne Abba
President, CPM
wayne.abba@mycpm.org

Agenda

- College of Performance Management (CPM)
- Earned Value Management (EVM) – the Foundation of Integrated Program Management (IPM)
- Evolution of IPM
  - Past (Cost/Schedule Control Systems Criteria)
  - Present (Earned Value Management)
  - Future (Integrated Program Management)
- War Story – A Tale of Two Aircraft
- Summary and Q&A

THE COLLEGE OF PERFORMANCE MANAGEMENT (CPM)

WWW.MYCPM.ORG/

About CPM

- The College of Performance Management (CPM) is a global, non-profit, professional organization dedicated to developing and disseminating the principles and practices of earned value management and other project performance management techniques.
- We assist the project control professional and project manager in professional growth and promote the application of earned value management. We are a growing body of professionals dedicated to managing projects on time and on budget.

2017 CPM Events

- EVM World 2017
  - May 31 – June 2, 2017
  - New Orleans, Louisiana
  - Hyatt Regency New Orleans
  - Science & PM Track
- IPM Workshop
  - Oct 30 – Nov 1, 2017
  - Bethesda, Maryland
  - Bethesda North Marriott Hotel & Conference Center

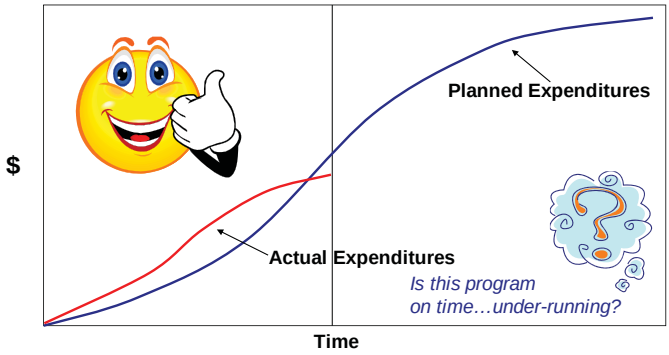
www.mycpm.org/news-events/events/

EARNED VALUE MANAGEMENT (EVM)

What is EVM?

- Earned Value Management (EVM) is a project management technique for measuring project performance and progress. In a single integrated system, Earned Value Management (EVM) is able to provide accurate forecasts of project performance problems, which is an important contribution for good project performance. It is therefore considered a Performance Management approach.

Without Earned Value



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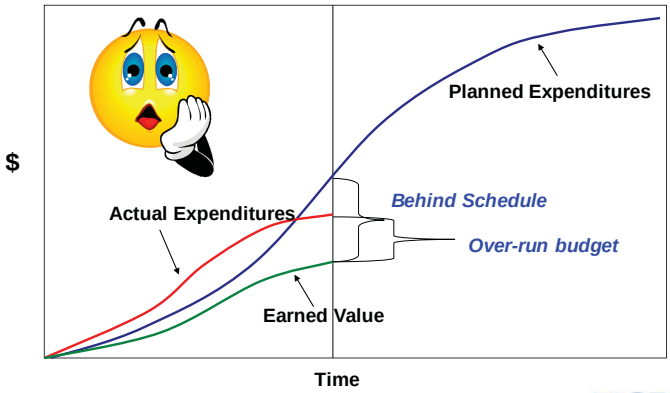
With Earned Value



EVM System Definition

- An EVMS for program management will effectively integrate the work scope of a project with the schedule and cost elements for optimum program planning and control. The primary purpose of the system is to support program management. The system is owned by the organization and is governed by the organization's policies and procedures.

EIA 748-98B
Earned Value
Management Systems

Using EVM Effectively

- Keys to success:
  - Emphasis on Program Planning
  - Integration of disciplines and processes
    - Systems Engineering
    - Scheduling
    - Cost Estimating
    - Procurement
    - Project Management
- Address management needs
  - Reporting as "by-product"

THE EVOLUTION OF IPM

PAST
PRESENT
FUTURE

EVM Origins

1960s

- Complex Defense Programs
- Multiple Customers
- Need for Improved Management
- Solution – PERT and PERT COST
- 10 versions by 1964
- Industry "How to Manage"

Industry Best Practices

Government Requirements

1967: DoD Instruction 7000.2
Cost/Schedule Control Systems Criteria (C/SCSC)

Criterion-based Management

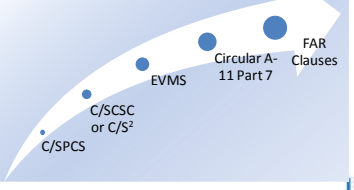
- Brief Statements of Attributes
- Not "How-To"
- Not a System
- Minimum Acceptable Standard

1997: DoD Regulation 5000.2-R
Earned Value Management Systems (EVMS)

US Government EVM Policy

- 1966 – Air Force Cost/Schedule Performance Control Specification
- **1967** – DoD Cost/Schedule Control Systems Criteria
- 1996 – OMB adopts C/SCSC in Circular A-11, Part 3
- 1997 – DoD adopts EVMS; OMB follows suit in A-11 Part 3 (now Part 7)
- 1998 – EIA Standard 748-98
- 2006 – Federal Acquisition Regulation Clauses issued

E arned
V alue
M anagement
S ystems



IPM

Performance Management Laws

- Government Performance and Results Act of 1993
- Federal Acquisition Streamlining Act of 1994, Title V
- Information Technology Management Reform Act of 1996 (Clinger-Cohen)
- **Program Management Improvement and Accountability Act of 2015**
- Implemented by Executive Office of the President, Office of Management and Budget (OMB)
  - … cost, schedule, and performance goals are to be controlled and monitored by using an earned value management system; and if progress toward these goals is not met, there is a formal review process to evaluate whether the acquisition should continue or be terminated. (Circular A-11, 2016)
- Audited by Government Accountability Office (GAO)

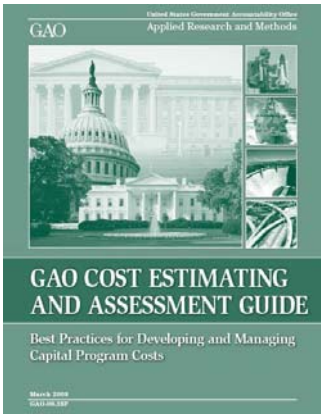
PMIAA

- Signed December 2016
- Reform Program Management in 4 ways by:

1. Creating a formal job series and career path for program managers in the federal government.
2. Developing a standards-based program management policy across the federal government.
3. Recognizing the essential role of executive sponsorship and engagement by designating a senior executive in federal agencies to be responsible for program management policy and strategy. Sharing knowledge of successful approaches to program management. [Have Chief Financial Officer? Name Program Management Improvement Officer]
4. through an interagency council on program management.

GAO Cost Guide

- Issued March 2009
  - 3 years in development
  - www.gao.gov
  - GAO-09-3SP
- Comprehensive
  - 20 chapters
    - 17 – Cost Estimating
    - 3 – EVM
  - 14 Appendices
  - 56 Tables
  - 42 Figures
  - 48 Case studies
  - 17 Checklists
- > 1,000's downloads
- Used by NSF LFO



Why GAO?

- New name reflects expanded role
  - Old - General Accounting Office
    - Financial audits ≈ 15% of workload
  - New - Government Accountability Office
    - Program evaluations
    - Policy analyses and legal opinions
    - Advocate for truth and transparency in government
    - Not just "what is wrong" but best practices
  - Cost guide intended for auditors and as a resource for agencies that lack capabilities of major agencies
- Schedule, Agile, Technology Readiness Levels, Analysis of Alternatives

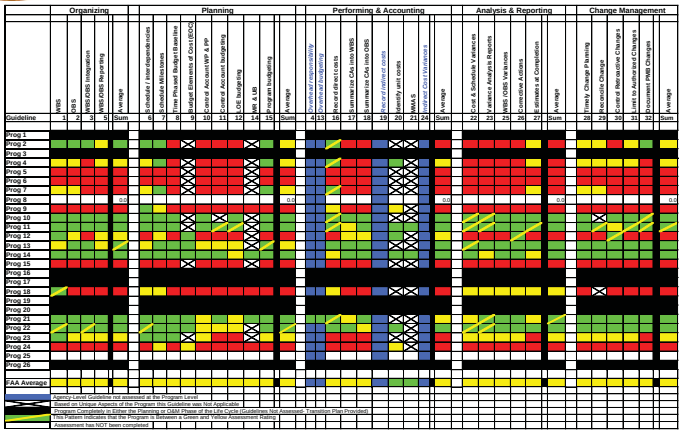
Using the GAO Cost Guide

- Program Audits
  - F-35 Lightning II (March 2008)
  - Office of Personnel Management Retirement System Modernization (March 2008)
- Agency Audits
  - Federal Aviation Administration (FAA) (July 2008)
- Government-wide Audit (October 2009)
  - GAO 10-2, Agencies Need to Improve the Implementation and Use of Earned Value Techniques to Help Manage Major System Acquisitions

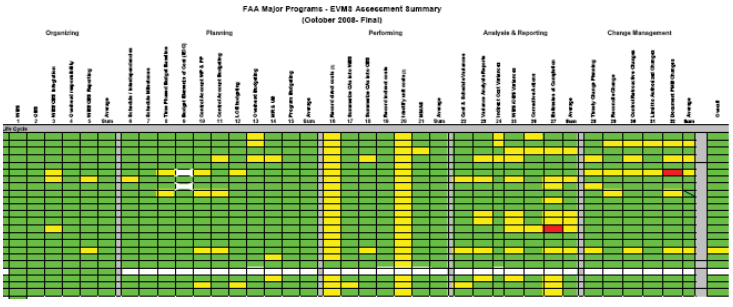
EVM at the Federal Aviation Administration

- OMB budget reduction 2004
- GAO "High Risk List"
- Began major transformation 2005
  - Policy
  - Guidance
  - Training
  - Program assessments
- EVM at Program Level
  - Prime, sub and support contractors
  - Government employees
- Working teams
  - Systems Engineering, Risk Management, Cost Estimating, Contracting, Finance, Operations
  - EVM Council

FAA EVM Assessment Summary (Baseline 2005)



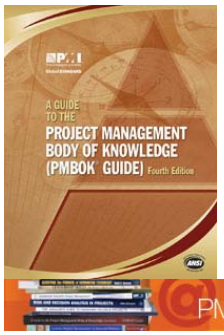
FAA EVM Assessment Summary (October 2008)



Major Milestone for the FAA

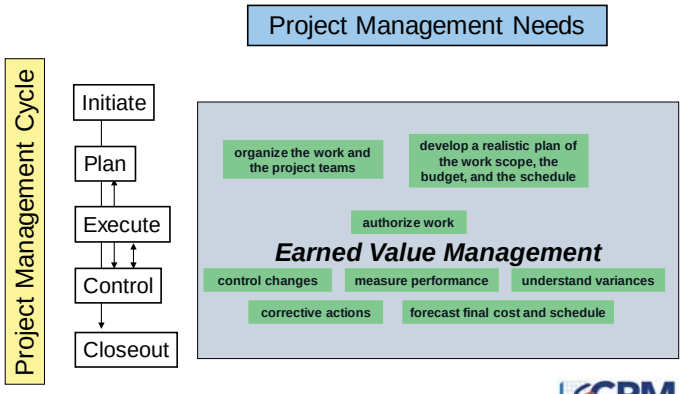
- January 2009 – after 14 years, GAO removed Air Traffic Control Modernization program from its list of high risk programs and operations
  - Significant progress
  - Fewer overruns and schedule delays
  - Going forward – place high emphasis on effective and efficient management
- The only program removed from the list
- EVM played a significant role

EVM Content in the PMBOK®

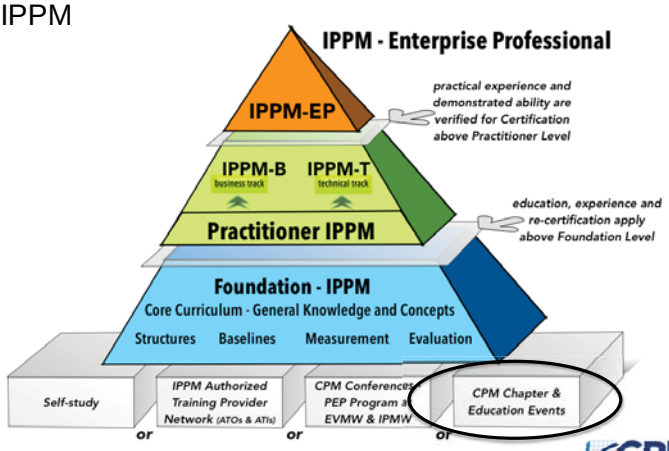


A Guide to the Project Management Body of Knowledge (PMBOK® Guide) - 4th Edition

EVM and Project Management



Integrated Program Performance Management – IPPM

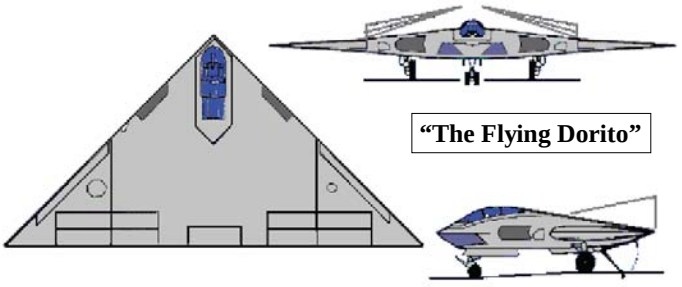


EVM and the International Organization for Standardization (ISO)

- Technical Committee 258
- 2 new Standards
  - Earned Value Management
  - Work Breakdown Structures
- CPM participating in 2 roles
  - Technical Liaison
  - US Technical Advisory Group (TAG)
- In addition, 2 CPM members on national teams --- Australia and Portugal

WAR STORY
A TALE OF TWO AIRCRAFT:
A-12 AVENGER II
F/A-18E/F SUPER HORNET

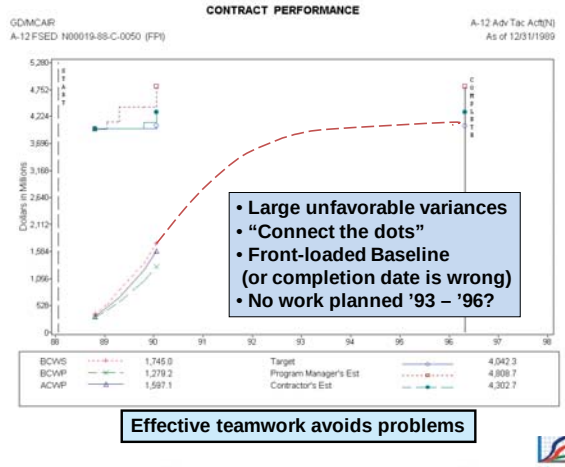
A-12 "Avenger" Concept



"The Flying Dorito"

Carrier-based Stealth Aircraft

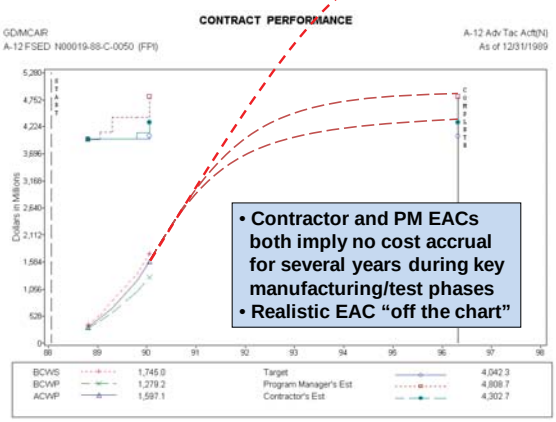
A-12 Contract – Front Loaded



- Large unfavorable variances
- "Connect the dots"
- Front-loaded Baseline (or completion date is wrong)
- No work planned '93 – '96?

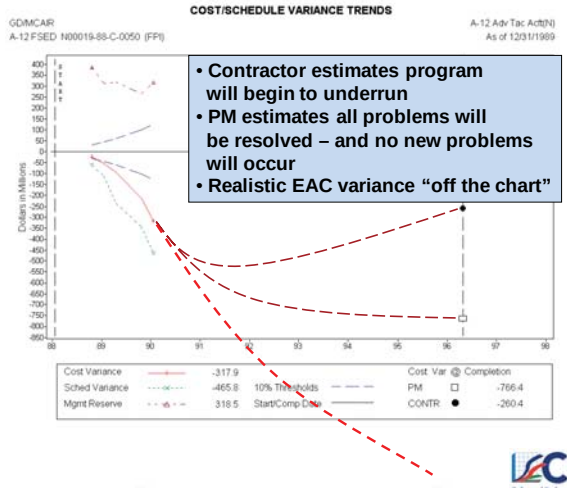
Effective teamwork avoids problems

A-12 Contract – Actual Cost vs. Est at Comp



- Contractor and PM EACs both imply no cost accrual for several years during key manufacturing/test phases
- Realistic EAC "off the chart"

A-12 Contract – Optimistic EACs



- Contractor estimates program will begin to underrun
- PM estimates all problems will be resolved – and no new problems will occur
- Realistic EAC variance "off the chart"

TLO #5

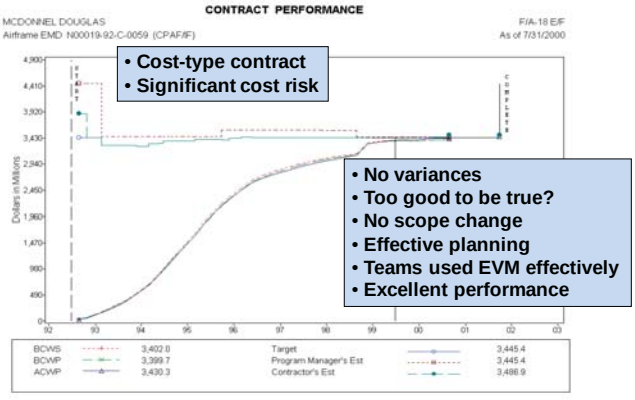
Secretary of Defense on A-12

- In canceling the A-12 program in 1991, Mr. Cheney said:

"This program cannot be sustained unless I ask Congress for more money and bail the contractors out. But I have made the decision that I will not do that. No one can tell me exactly how much more it will cost to keep this program going. And I do not believe a bailout is in the national interest. If we cannot spend the taxpayers' money wisely, we will not spend it."

- ***Failure or crisis changes behavior in bureaucracies***
- ***Largest contract termination case in history***
- ***23 years in litigation – 5 trials***
- ***Supreme Court heard case in January 2011 – remanded***
- ***≈ $2.7 Billion at stake***
- ***Resolved in 2014***
  - ***2 $198M credits***

Super Hornet Cumulative Trends

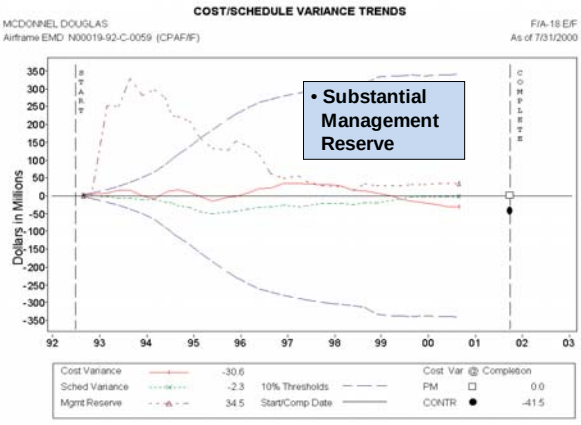


- Cost-type contract
- Significant cost risk

- No variances
- Too good to be true?
- No scope change
- Effective planning
- Teams used EVM effectively
- Excellent performance

Hold contractors accountable for management

Super Hornet Variance Trends



- Substantial Management Reserve

Post Script: F/A-18E/F in the Fleet

*"I wake up every morning and I want to kiss the Super Hornet on the lips." **

Navy Admiral John B. Nathman, vice chief of naval operations, commenting on the smoothness of the Super Hornet fighter jet acquisition program. Explaining what makes the airplane so lovable, he said "It's an efficient, effective platform… under cost, on schedule."

** National Defense Magazine (March 2005)*

SUMMARY AND Q&A

https://www.dau.mil/library/defense-atl/p/Current-Issue
Click on Previous Issues (Upper Right)

Summary and Q&A

- After 50 years, EVM remains the tool of choice for integrated schedule, cost and technical performance management and oversight of complex programs
- EVM is the cornerstone of major US government management initiatives
  - Openness, transparency and accountability are essential
  - Synergistic executive and legislative branch interests
- EVM is growing internationally and CPM is enhancing Technical Benefits Realization and Scheduling integration as core disciplines of IPPM
- Demonstrated effective management → credibility → budget support. Better management = more science!

?

Appendix D: Presentations

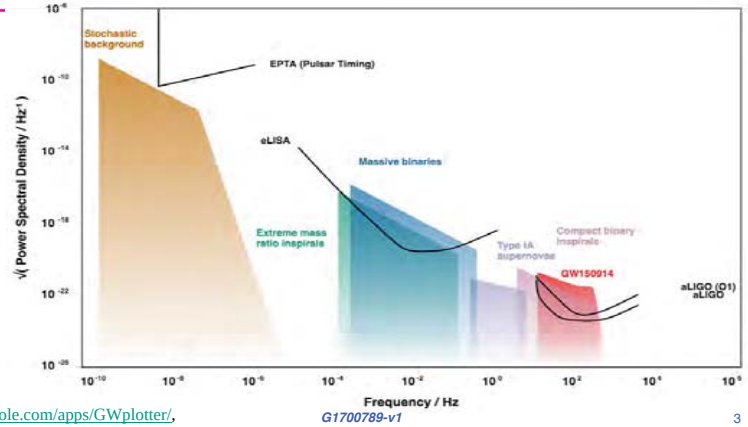
D.2 Tuesday May 2, 2017

Science and technology at LIGO

Joseph A. Giaime
LIGO Livingston observatory head (Caltech),
Prof. of physics and astronomy (LSU),
for the LIGO Scientific Collaboration

LIGO Scientific Collaboration

Efforts to observe gravitational waves



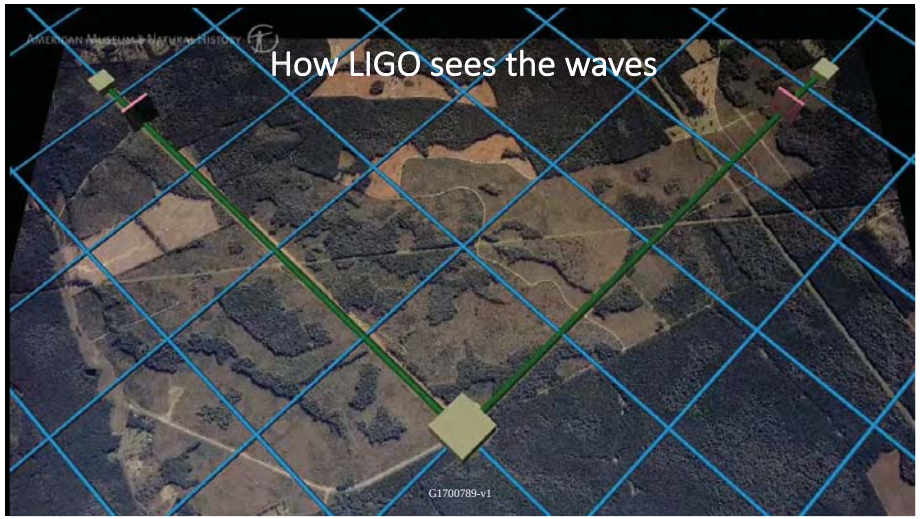
http://rhcole.com/apps/GWplotter/,

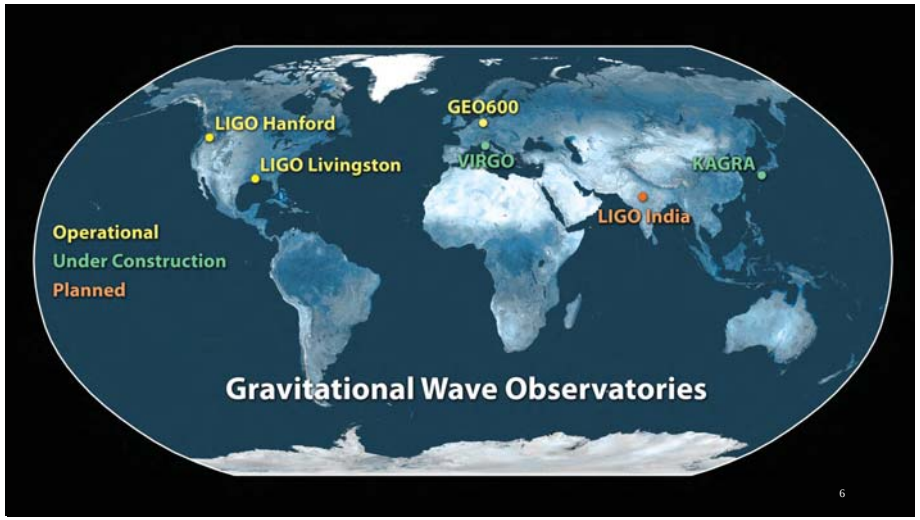
Generation of GW's

- GW radiation requires a time-varying non-zero quadrupole moment of the source's mass.
- Constants of nature come together to make the effect very tiny, even for enormous sources.
- 'Hertzian' experiment probably impossible.
- Sources include inspiraling binary compact objects, non-spherical core implosion, driven or relaxing normal modes of compact objects, …

$$h \simeq \frac{GM}{c^4}\frac{E_k^{\rm ns}}{r} \simeq 10^{-20}\left(\frac{E_k^{\rm ns}}{M_\odot c^2}\right)\left(\frac{10\,{\rm Mpc}}{r}\right)$$

where $E_{\rm k}^{\rm ns}$ is the non-spherical kinetic energy of the source. This formula is roughly the best-case, with optimal orientation.





Patience and stewardship over generations:

~100 years ago: Albert Einstein published his theory of General Relativity, including prediction of gravitational waves.

~50 years ago: Weber builds bar antennas to attempt detection of the waves.

~45 years ago: Key ideas for interferometric antennas developed by Weiss and others. Bar antenna work continues, including cryogenics.

~40 years ago: (U.S.) National Science Foundation funding of pre-LIGO R&D, continued GW detector research internationally, including Glasgow in the U.K. and MPQ in Germany.

~25 years ago: LIGO proposed to the NSF by MIT and Caltech.

~20 years ago: LIGO site construction began.

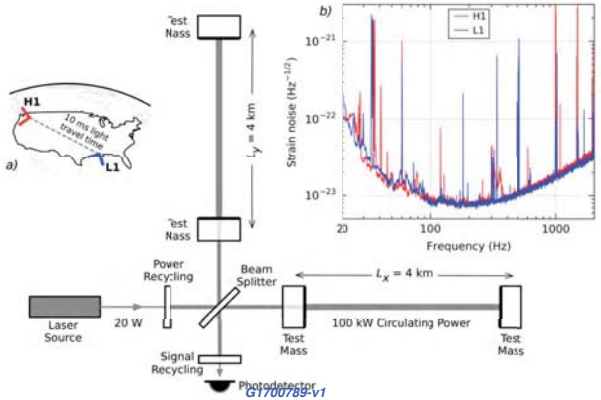
~15 years ago: initial LIGO running at design sensitivity.

~6 years ago: Advanced LIGO installation began with major international contributions, including from the U.K. and Germany.

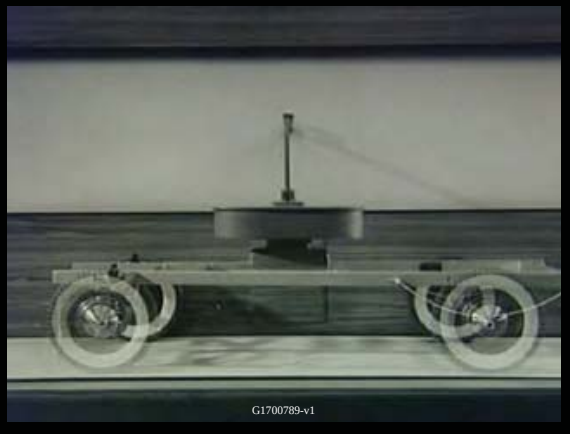
~now: Advanced LIGO detectors see astrophysical signals.

LIGO Hanford and LIGO Livingston

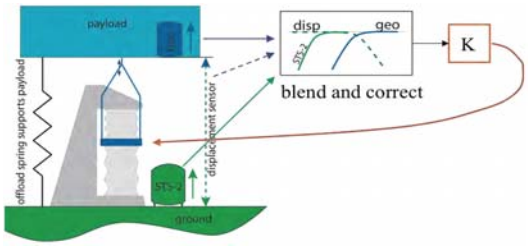
Advanced LIGO Detectors: installation 2010, first run fall 2015



1938 seismic isolation technology

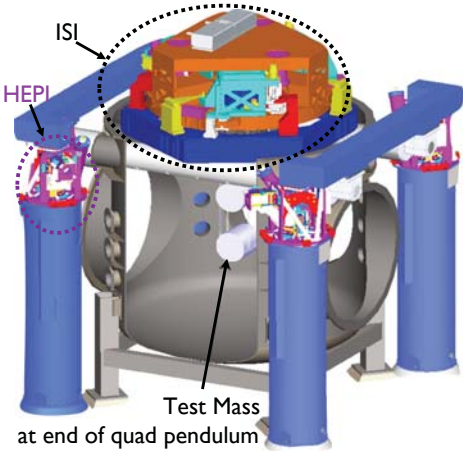


Active Seismic Isolation

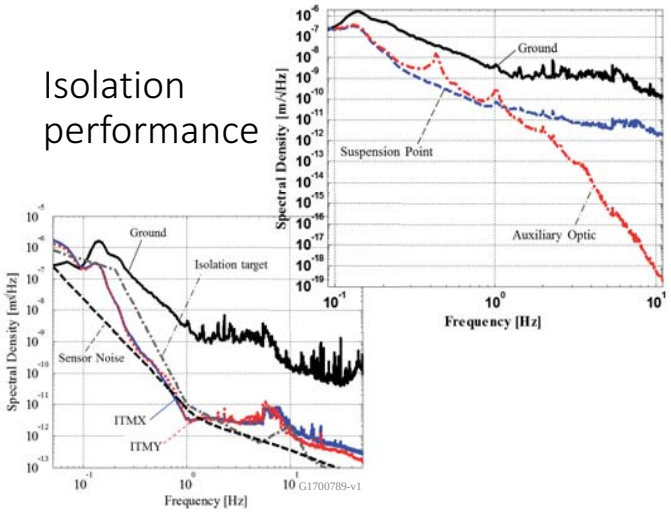


21st Century Seismic Isolation

- HEPI: Hydraulic External Pre-Isolator large throw, isolation below ~5 Hz
- ISI: Internal Seismic Isolation Isolates above ~0.2 Hz
- Quadruple pendulum: superior performance at 10 Hz and above



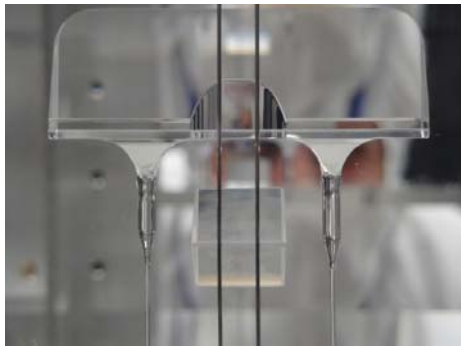
Isolation performance

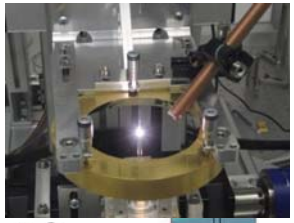


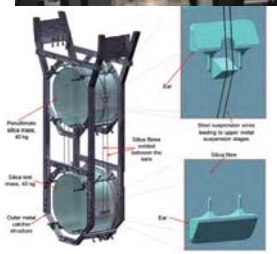
G1700789-v1

13

Quadruple Pendulum for test mass mirrors

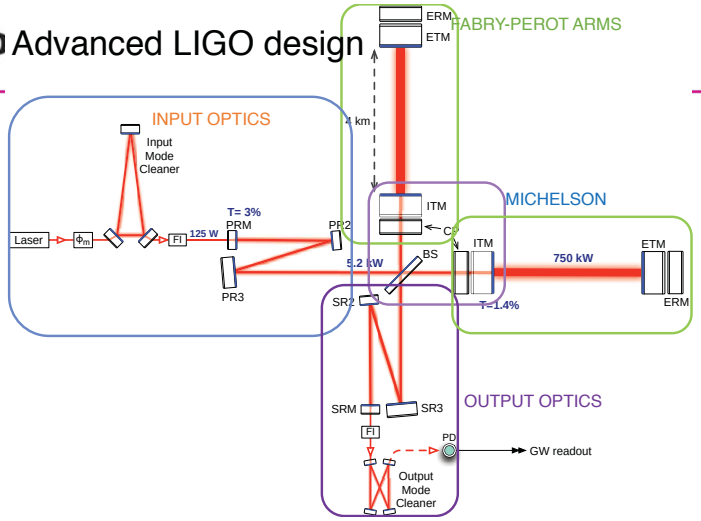






- UK supplied, Glasgow IGR-developed
- Fused silica suspensions, fibre-pulling, bonding and welding
- Coating R&D, major Glasgow activity

LIGO Advanced LIGO design



17

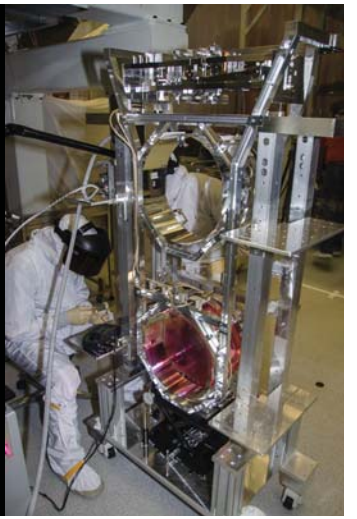
Monolithic Mirror Suspensions:

Fused silica test mass, hung from similar mass via pure silica fiber and 'ears.'

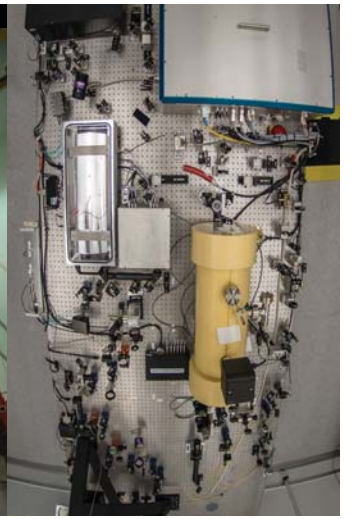
Design from U.K.-German GEO 600 suspension

GEO 600 photo

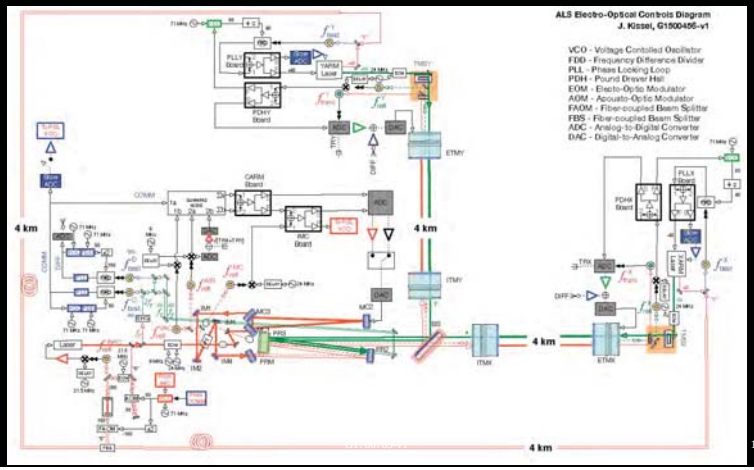
G1700789-v1



Installation

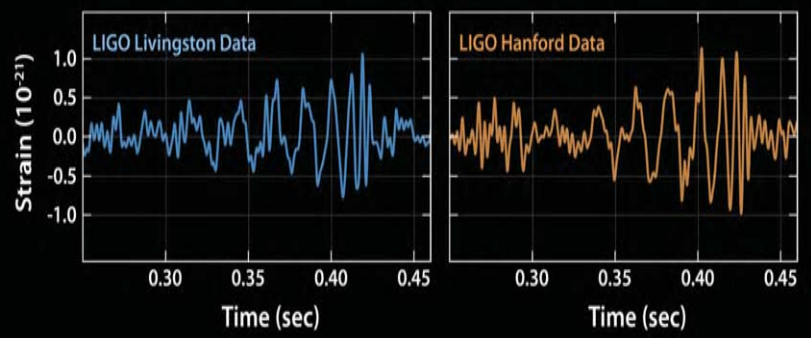


Optical alignment and control… just one part:

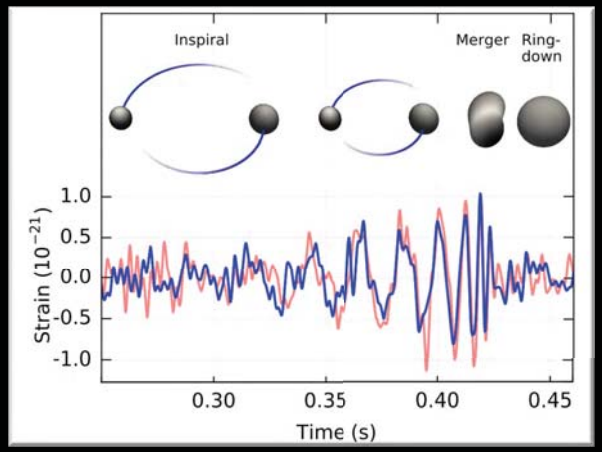


18

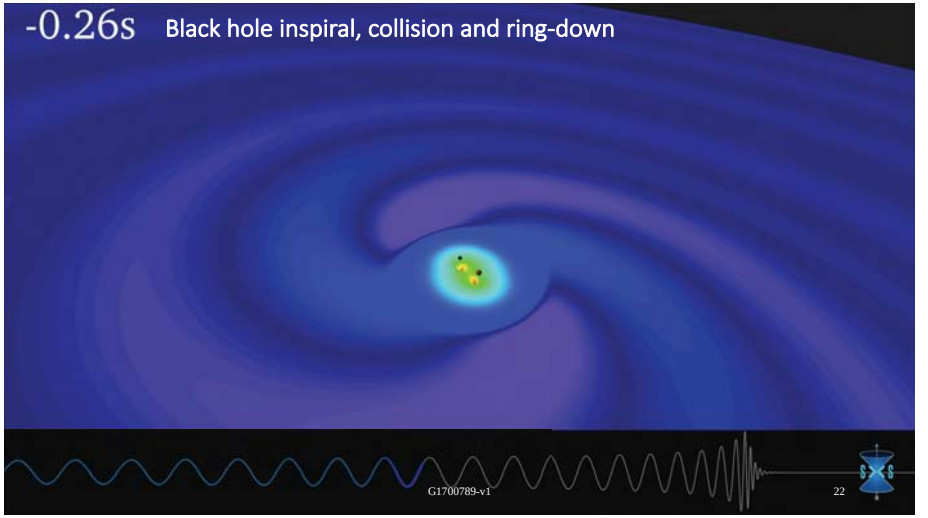
LIGO control room: lock acquisition



PRL **116**, 06112 (2016)



PRL **116**, 06112 (2016)



PRL 116, 061102 (2016) Selected for a Viewpoint in *Physics*
PHYSICAL REVIEW LETTERS
week ending 12 FEBRUARY 2016

Observation of Gravitational Waves from a Binary Black Hole Merger

B. P. Abbott *et al.*[*]
(LIGO Scientific Collaboration and Virgo Collaboration)
(Received 21 January 2016; published 11 February 2016)

On September 14, 2015 at 09:50:45 UTC the two detectors of the Laser Interferometer Gravitational-Wave Observatory simultaneously observed a transient gravitational-wave signal. The signal sweeps upwards in frequency from 35 to 250 Hz with a peak gravitational-wave strain of 1.0×10^{-21}. It matches the waveform predicted by general relativity for the inspiral and merger of a pair of black holes and the ringdown of the resulting single black hole. The signal was observed with a matched-filter signal-to-noise ratio of 24 and a false alarm rate estimated to be less than 1 event per 203 000 years, equivalent to a significance greater than 5.1σ. The source lies at a luminosity distance of 410^{+160}_{-180} Mpc corresponding to a redshift $z = 0.09^{+0.03}_{-0.04}$. In the source frame, the initial black hole masses are $36^{+5}_{-4}M_\odot$ and $29^{+4}_{-4}M_\odot$, and the final black hole mass is $62^{+4}_{-4}M_\odot$, with $3.0^{+0.5}_{-0.5}M_\odot c^2$ radiated in gravitational waves. All uncertainties define 90% credible intervals. These observations demonstrate the existence of binary stellar-mass black hole systems. This is the first direct detection of gravitational waves and the first observation of a binary black hole merger.

DOI: 10.1103/PhysRevLett.116.061102

PRL **116**, 06112 (2016)

4×10^{49} J/s peak power of source, 40 yotta yotta watt.

1×10^{25} meter distance to source, 10 yotta meter.

S.I. prefix chart … kind of dull.

4×10^{3} meter LIGO arm length, 4 kilometer.

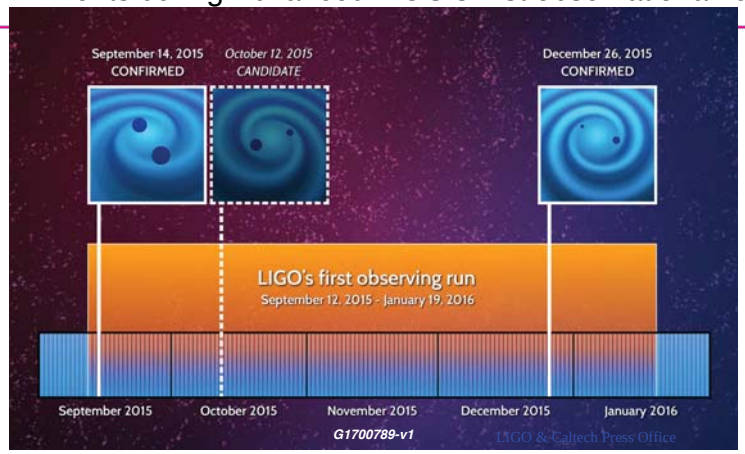
2×10^{0} meter test mass suspension length, 2 meter.

1×10^{-6} meter ground vibration, 1 micrometer.

1×10^{-18} meter arm difference at peak signal, 1 attometer.

Prefix Name	Symbol	1000^m	10^n	Decimal
yotta	Y	1000^8	10^{24}	1 000 000 000 000 000 000 000 000
zetta	Z	1000^7	10^{21}	1 000 000 000 000 000 000 000
exa	E	1000^6	10^{18}	1 000 000 000 000 000 000
peta	P	1000^5	10^{15}	1 000 000 000 000 000
tera	T	1000^4	10^{12}	1 000 000 000 000
giga	G	1000^3	10^9	1 000 000 000
mega	M	1000^2	10^6	1 000 000
kilo	k	1000^1	10^3	1 000
hecto	h	$1000^{2/3}$	10^2	100
deca	da	$1000^{1/3}$	10^1	10
		1000^0	10^0	1
deci	d	$1000^{-1/3}$	10^{-1}	0.1
centi	c	$1000^{-2/3}$	10^{-2}	0.01
milli	m	1000^{-1}	10^{-3}	0.001
micro	μ	1000^{-2}	10^{-6}	0.000 001
nano	n	1000^{-3}	10^{-9}	0.000 000 001
pico	p	1000^{-4}	10^{-12}	0.000 000 000 001
femto	f	1000^{-5}	10^{-15}	0.000 000 000 000 001
atto	a	1000^{-6}	10^{-18}	0.000 000 000 000 000 001
zepto	z	1000^{-7}	10^{-21}	0.000 000 000 000 000 000 001
yocto	y	1000^{-8}	10^{-24}	0.000 000 000 000 000 000 000 001

Events during Advanced LIGO's first observational run:



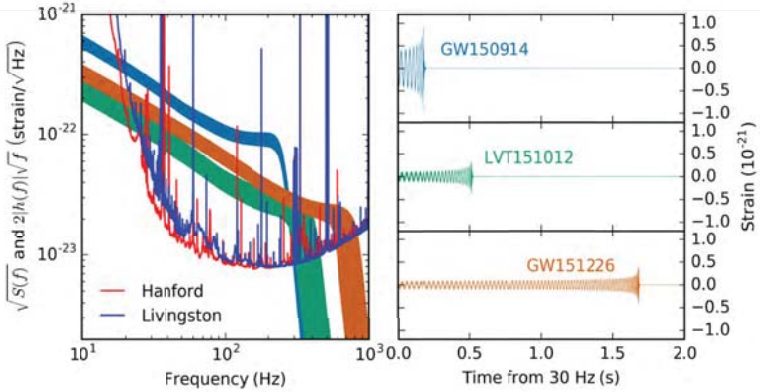
What have we learned about the systems that emitted the waves?
How do we learn more?

- Accuracy of most parameters improves with signal-to-noise ratio.
- Sky localization improves as more observatories are added.
- Some parameters, like spin, are hard to measure!

journals.aps.org/prl/abstract/10.1103/PhysRevLett.116.241103,
arxiv.org/abs/1606.04856 (accepted to PRX)

Event	GW150914	GW151226	LVT151012
Signal-to-noise ratio ρ	23.7	13.0	9.7
False alarm rate FAR / yr^{-1}	$< 6.0\times10^{-7}$	$< 6.0\times10^{-7}$	0.37
p-value	7.5×10^{-8}	7.5×10^{-8}	0.045
Significance	$> 5.3\sigma$	$> 5.3\sigma$	1.7σ
Primary mass m_1^{source}/M_{sun}	$36.2^{+5.2}_{-3.8}$	$14.2^{+8.3}_{-3.7}$	23^{+18}_{-6}
Secondary mass m_2^{source}/M_{sun}	$29.1^{+3.7}_{-4.4}$	$7.5^{+2.3}_{-2.3}$	13^{+4}_{-5}
Chirp mass M^{source}/M_{sun}	$28.1^{+1.8}_{-1.5}$	$8.9^{+0.3}_{-0.3}$	$15.1^{+1.4}_{-1.1}$
Total mass M^{source}/M_{sun}	$65.3^{+4.1}_{-3.4}$	$21.8^{+5.9}_{-1.7}$	37^{+13}_{-4}
Effective inspiral spin χ_{eff}	$-0.06^{+0.14}_{-0.14}$	$0.21^{+0.20}_{-0.10}$	$0.0^{+0.3}_{-0.2}$
Final mass M_f^{source}/M_{sun}	$62.3^{+3.7}_{-3.1}$	$20.8^{+6.1}_{-1.7}$	35^{+14}_{-4}
Final spin a_f	$0.68^{+0.05}_{-0.06}$	$0.74^{+0.06}_{-0.06}$	$0.66^{+0.09}_{-0.10}$
Radiated energy $E_{rad}/(M_{sun}c^2)$	$3.0^{+0.5}_{-0.4}$	$1.0^{+0.1}_{-0.2}$	$1.5^{+0.3}_{-0.4}$
Peak luminosity $L_{peak}/(erg\,s^{-1})$	$3.6^{+0.5}_{-0.4}\times10^{56}$	$3.3^{+0.8}_{-1.6}\times10^{56}$	$3.1^{+0.8}_{-1.8}\times10^{56}$
Luminosity distance D_L / Mpc	420^{+150}_{-180}	440^{+180}_{-190}	1000^{+500}_{-500}
Source redshift	$0.09^{+0.03}_{-0.04}$	$0.09^{+0.03}_{-0.04}$	$0.20^{+0.09}_{-0.09}$
Sky localization $\Delta\Omega/deg^2$	230	850	1600

Three events compared



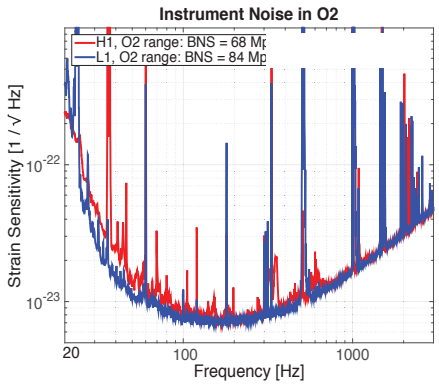
Phys. Rev. Lett. **116**, 241103, Phys. Rev. X 6, 041015 (2016)

Commissioning between O1 and O2 runs

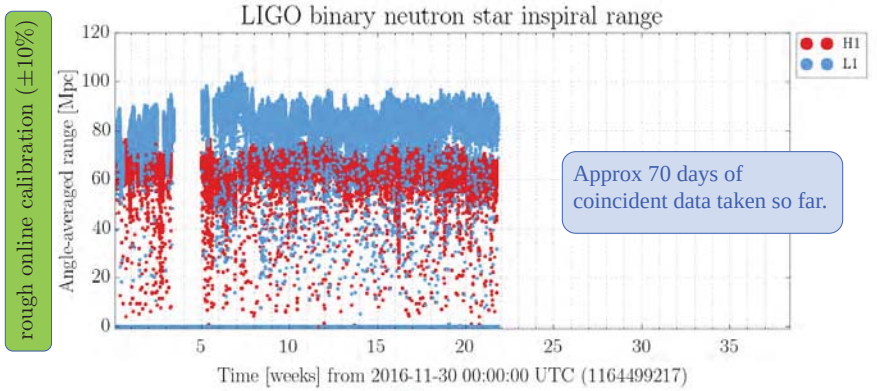
- High power stage of LIGO Hanford laser activated.
  - » Development of techniques to reduce buildup of opto-mechanical parametric instabilities.
  - » Thermal compensation and higher power.
  - » Study of beam jitter/geometry noise coupling to detector.
- Diagnosis and reduction of noise from scattered light off moving surfaces
  - » Several scattering sites identified in LIGO Livingston.
  - » Compensation plate now "correctly" misaligned.
  - » Scattering from photon calibrator periscope mirror identified, will be addressed later.
  - » Scattering and relative motion among one end station optics partially addressed.
- Test-mass bounce/roll dampers, new photodiodes, new pre-mode cleaner, Faraday isolator, etc., in L1.
- Removed accidental noise from temperature sensor instrumentation in L1

Second aLIGO observational run

- The second Advanced LIGO run began on November 30, 2016 and is currently in progress. As of March 1, 2017, approx. 34 days (0.093 year) of cumulative coincident data have been taken with L1 and H1, with a scheduled break between December 22, 2016 and January 4, 2017.
- Average reach of the LIGO network for binary merger events have been around 70 Mpc for 1.4+1.4 Msun, 300 Mpc for 10+10 Msun and 700 Mpc for 30+30 Msun mergers, with relative variations in time of the order of 10%.

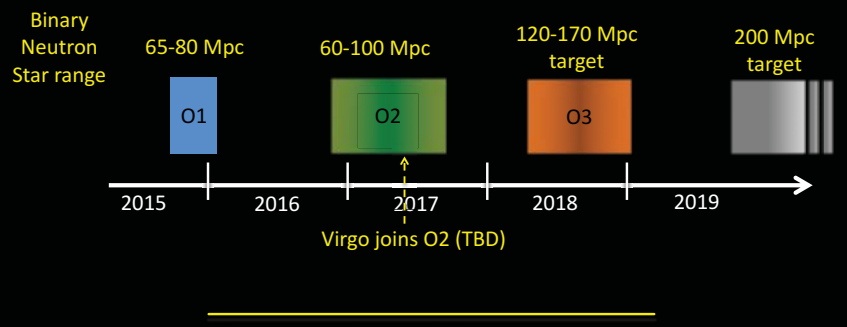


NS-NS range in O2 run …



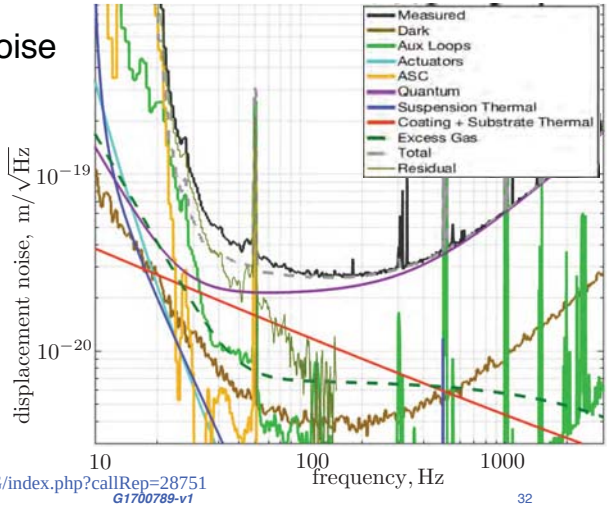
Plausible Observing Run Timeline

(plans still under development within the LIGO and Virgo Collaborations)



Displacement noise

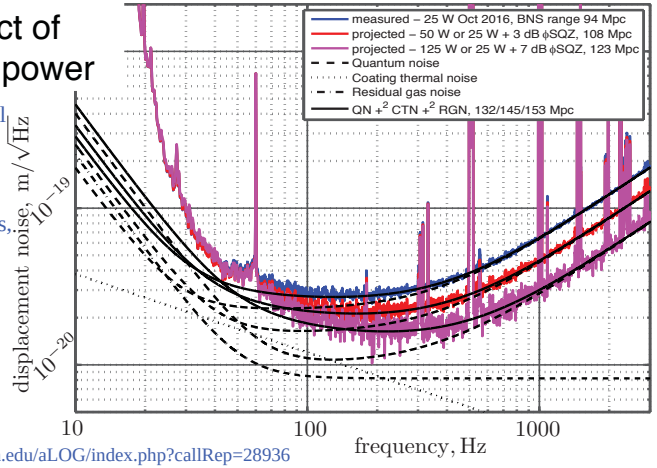
- Noise model of high-range data segment in Livingston (M. Evans).
- Tracks shot noise at high frequencies.
- Tracks servo-induced noise at low frequencies.
- Slight excess 30-100 Hz, attributed to light scattering from moving surfaces.



https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=28751

Potential effect of additional laser power

- V. Frolov's noise model of current best-case detector with higher laser power.
- Assumes current excess, coating and gas noises. Quantum adjusted.
- Current 25 W range, 94Mpc, might reach 108/123 Mpc with 50/125 W or 3/7 dB phase squeezing.



https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=28936

LIGO Science Education Center: a partnership with Southern University, the SF Exploratorium, and educators.

- The U.S. NSF has funded Southern Univ. BR, Caltech and the Baton Rouge Area Foundation to build and carry out educational programs related to LIGO science and inquiry-based learning.
- The LIGO SEC programs reach over 20,000 people each year, focusing on classroom visits and teacher training.
- Docents serve as role models for children who wish to pursue science and technology careers.

Recent LSU and Southern graduates at the helms of both LIGO detectors as the wave was detected

Nutsinee Kijbunchoo and William Parker

Modern Methods of Schedule Risk Analysis using Monte Carlo Simulations

Presented to the
2017 Large Facilities Workshop
Baton Rouge, LA

David T. Hulett, Ph.D., FAACE
Hulett & Associates, LLC
Los Angeles, CA

Agenda

- Modern Methods of risk analysis
- Collecting risk data
- Introducing uncertainty to the model
- Introducing risks as Risk Drivers
- Risk drivers model correlation between activity durations
- Risks may be entered in series or in parallel
- Offshore gas production platform project
- Use Categories to apply risks to multiple activities
- Prioritizing risks for management action
- Risk mitigation actions and Results (simple example)
- Probabilistic branching for test failure possibility

MODERN METHODS OF RISK ANALYSIS

Modern Methods of Schedule Risk Analysis(1)

- Earlier methods of quantifying risk analysis using Monte Carlo Simulation (MCS) placed probability distributions directly on activity durations
  - Did not distinguish risks from uncertainty
  - Could not disentangle the relative impacts of several risks on one activity
  - Could not assess the whole impact of a risk that affects more than one activity
  - Therefore, could not prioritize risks for risk mitigation

Modern Methods of Schedule Risk Analysis (2)

- In the last 10 years we have been able to specify risks and use those to directly drive the MCS
  - Distinguish uncertainty from risks
  - Model specific risks including systemic risks from benchmarking data
  - Represent failing a test with probabilistic branches
- This development allows us to model much more specifically and intelligently
  - Apply risks to multiple activities (categories of activities)
  - Apply risks in series and in parallel
  - Model how duration correlation occurs
  - Prioritize risks for focused risk mitigation

COLLECTING RISK DATA

Collecting Risk Data Using Confidential Interviews

- Data about risk may start with the Risk Register
- During one-on-one confidential interviews we always discover risks not on even well-developed and maintained Risk Registers
- This omission may be because there are some Unknown Knows that are not talked about in workshops
- Collect descriptions of the risk, probability it will occur, impact (multiplicative factors) on the scheduled durations and activities it will affect if it occurs
- Collect data on uncertainty too – 100% likely to occur with some impact

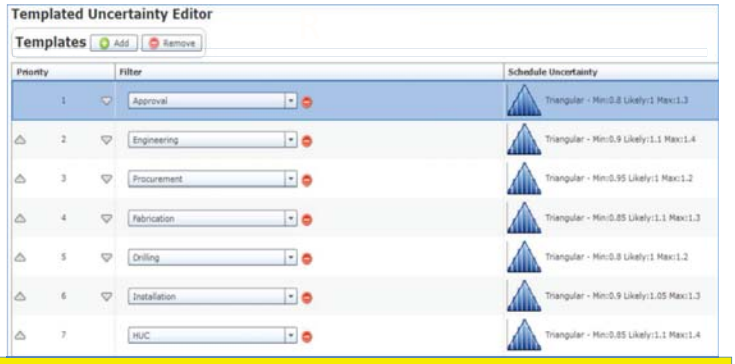
INTRODUCING UNCERTAINTY TO THE MODEL

Add components of Risk - Uncertainty

- Uncertainty is akin to "common cause" variation in the six sigma management
- "Common cause variability is a source of variation caused by unknown factors that result in a steady but random distribution of output around the average of the data. Common cause variation is a measure of the process's potential, or how well the process can perform when special cause variation is removed. ... Common cause variation is also called random variation, noise, non-controllable variation, within-group variation, or inherent variation."

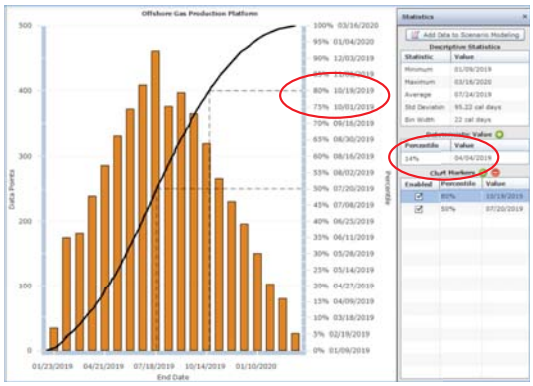
https://www.isixsigma.com/dictionary/common-cause-variation/

Specifying Uncertainty - Reference



Uncertainty ranges can be applied to different types of activities "reference ranges" Uncertainty can be correlated, in this case 100% to make overall project uncertainty model what people said during interviews

Schedule Risk with Uncertainty Only



Scheduled completion is April 4, 2019

With Uncertainty Only the P-80 completion is October 19, 2019, an addition of 6 ½ months

With Uncertainty only the likelihood of meeting the scheduled date is 14%

"P-80" means the date that the project will finish on or earlier than in 80% of the iterations

INTRODUCING RISKS AS RISK DRIVERS

Adding Project-Specific Risks

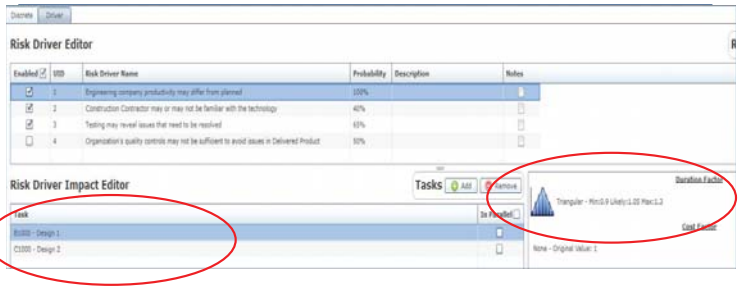
- Project Specific Risks are like special cause risk in the Six Sigma world
- "… Special cause variation is caused by known factors that result in a non-random distribution of output…Special cause variation is a shift in output caused by a specific factor such as environmental conditions or process input parameters. It can be accounted for directly and potentially removed..."

https://www.isixsigma.com/dictionary/special-cause-variation/

Root Cause of Variation – Risk Drivers

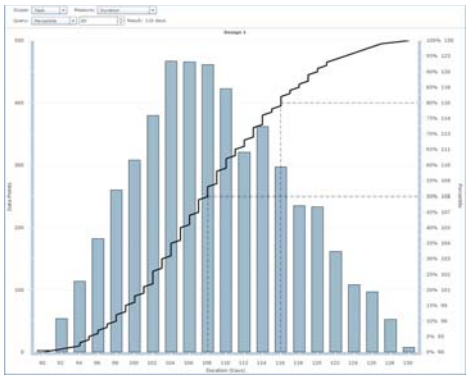
- Risk Drivers came about nearly 10 years ago as the author and a colleague asked Pertmaster, on behalf of a client, to develop this method
- Risk Drivers' impacts on scheduled durations are in ranges of multiplicative factors translated into probability distributions
- Risk Drivers can be assigned to many activities so it models how a strategic risk influences the project
- Some activities can have several risk drivers

Introducing the Risk Driver Method for Causing Additional Variation in the Simulation



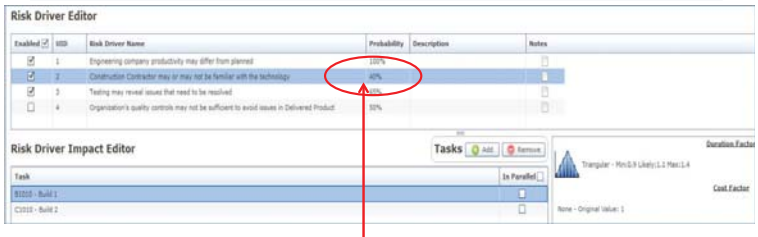
Four risk drivers are specified. The first is a general risk about engineering productivity, which may be under- or over-estimated, with 100% probability. It is applied to the two Design activities

100% Likely Risk Driver's Effect on Design Duration



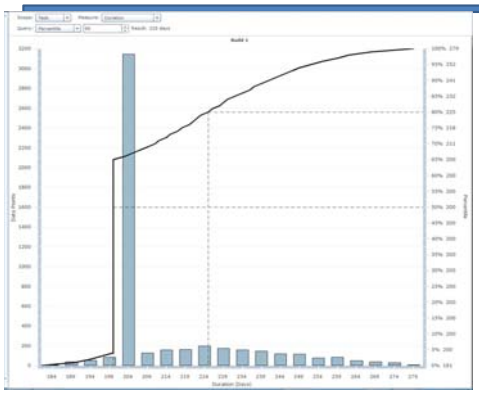
With a 100% likely risk the probability distribution of the activity's duration looks like a triangle. Not any different from placing a triangle directly on the activity

Risk Driver with Risk at < 100% likelihood



With this risk, the Construction Contractor may or may not be familiar with the technology, the probability is 40% and the risk impact if it happens is .9, 1.1 and 1.4. It is applied to the two Build activities

With a 40% Likelihood, the "Spike" in the Distribution Contains 60% of the Probability



Here is where the Risk Driver method gets interesting. It can create distributions that reflect:

- Probability of occurring
- Impact if it does occur

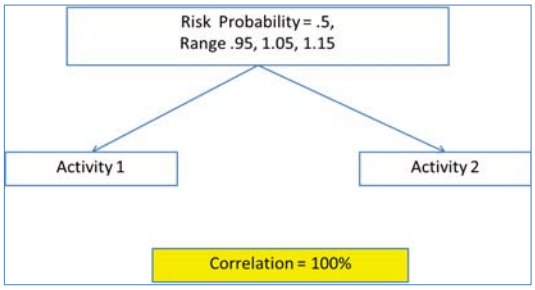
Cannot represent these two factors with simple triangular distributions applied to the durations directly

RISK DRIVERS MODEL CORRELATION BETWEEN ACTIVITY DURATIONS

Model Correlation of Activity Durations

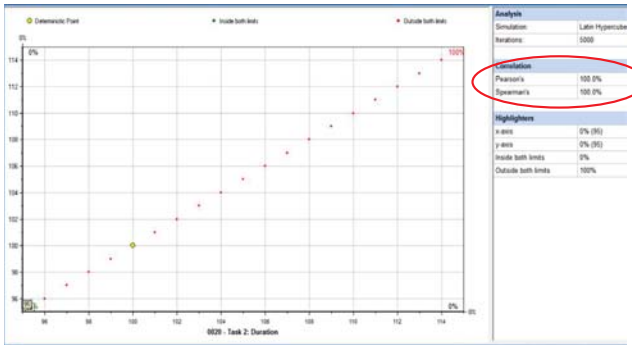
- A common question with schedule (or cost) risk analysis is; "Have you considered correlation?"
- Correlation is defined between pairs of durations. A matrix of correlation coefficients is created
  - Example – Tasks may be long because subcontractor may not be able to provide high productivity
  - Example – Tasks may be long because technology may not be well understood (low TRL)
- People do not do well guessing coefficients
- Using Risk Drivers removes this problem since it models how correlation occurs in projects

Risk Drivers Model How Correlation Occurs

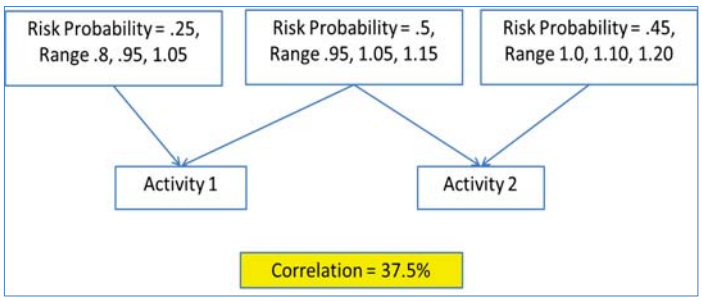


Correlation arises when two activities' durations are influenced by the same external, variable and influential force, a risk

Correlation of 100% Scatterplot

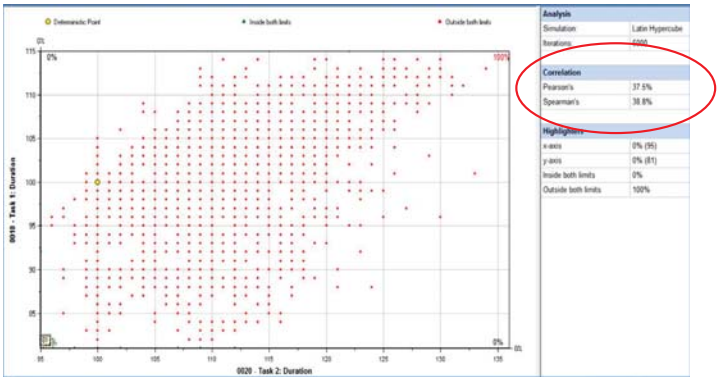


Introduce Two Confounding Risks



Two risks that affect only one but not the other activity duration drives down the correlation substantially

Scatterplot with 2 Confounding Risks



RISKS MAY BE ENTERED IN SERIES OR IN PARALLEL

Risks in Series or Parallel

- Some risks, if they happen, will stop progress until the impact is recovered
- Other risks are not that important and their recovery can occur simultaneously with other risks' recovery
- This matters only on the iterations when the two risks both occur
- An activity can be influenced by both series and parallel risks

Entering Risks in Series or in Parallel

If these two risks cannot be recovered from simultaneously, they are entered *in series*

Risk 1 1.2 factor

Risk 2 1.05 factor

Use (1.2 x 1.05 = 1.26) Factor, multiply the two

If recovery from two risks can be accomplished simultaneously, they are entered *in parallel*

Risk 1 1.2 factor

Risk 2 1.05 factor

Use 1.2 Factor, the largest factor only

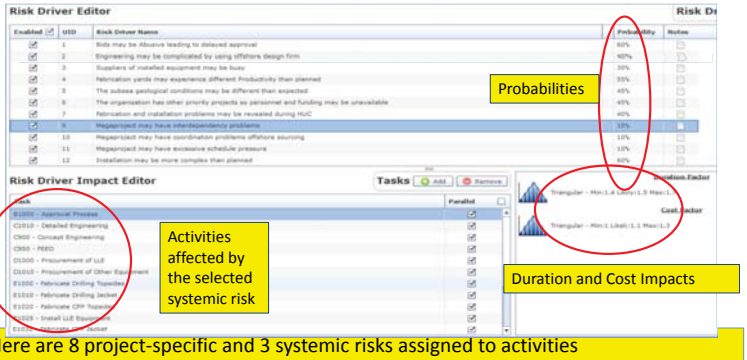
Results with Risks in Parallel or in Series

OFFSHORE GAS PRODUCTION PLATFORM PROJECT

Summary Schedule of a Megaproject

Offshore Gas Production Platform Project summarized from real projects
39 months duration, $1.7 billion cost
Developed in Primavera Risk Analysis® Simulated in Booz Allen Hamilton Polaris®

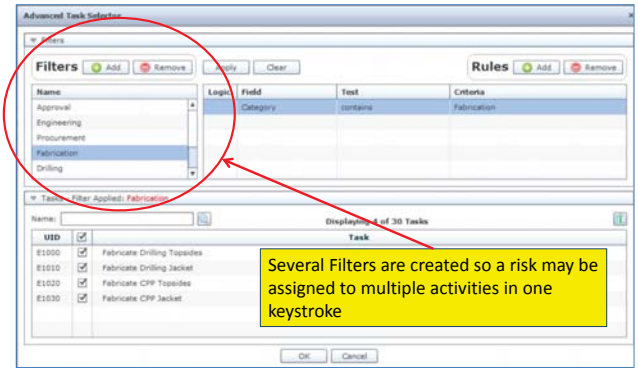
Project-Specific Risks as Risk Drivers



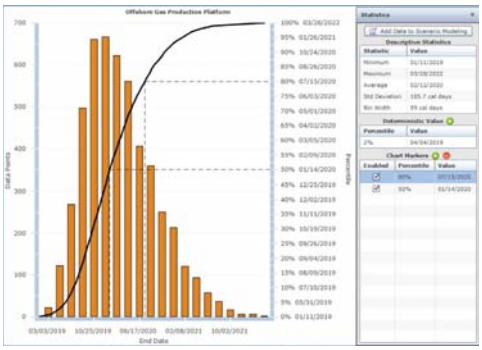
Here are 8 project-specific and 3 systemic risks assigned to activities
Most risks are assigned to several activities defined as a "category" for ease of application. Some activities have several risks assigned
The risks are specified by probability and impact, a distribution of multiplicative factors and are called "Risk Drivers." If they happen on an iteration a factor is chosen at random and multiplies the duration of all activities to which the risk is assigned

USE CATEGORIES TO APPLY RISKS TO MULTIPLE ACTIVITIES

Use Categories to Enable Assigning Risks to Multiple Activities



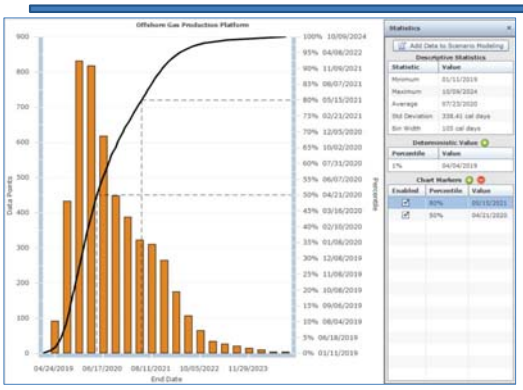
Add Project Specific Risks



Adding Project-Specific risks brings the P-80 to 7/15/20, 15+ months after the schedule date

The scheduled date is now only 2% likely

Adding 3 Systemic Risks

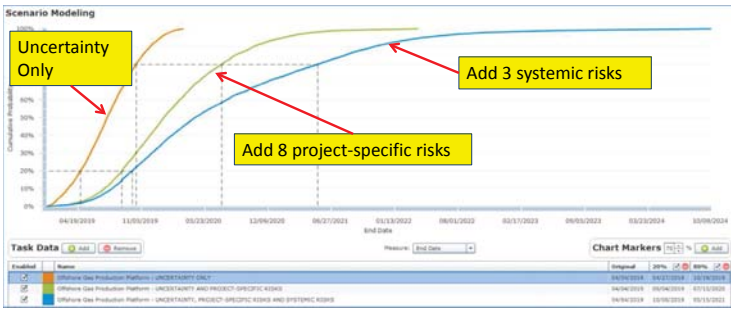


Three systemic risks often associated with large, complex projects:

- Interdependency
- Coordination
- Excessive schedule pressure

Adding these make the P-80 = 5/15/21 or about 25 + months late

Comparing Results with Uncertainty and Risks



PRIORITIZING RISKS FOR MANAGEMENT ACTION

Typical Risk Prioritization Method

- Typical tornado diagrams have limitations:
  - Report correlation coefficients, but management does not know how to turn these into actionable metrics
  - Correlation centers on the means of the distributions, but management cares about other targets, e.g., P-80
  - Usually report on activities, not risks, whereas management looks to mitigate risks
  - Even when they show correlation of risks with the finish date, the algorithm can show incorrect correlation leading to incorrect conclusions

Preferred Prioritization Method

Iterative Approach to Prioritizing Risks (Days Saved at P-80)								
Risk #	1	2	3	4	5	6	7	8
Priority Level (Iteration #)	Abusive Bids	Offshore design firm	Suppliers Busy	Fab productivity	Geology unknown	Coordination during Installation	Problems at HUC	Resources may go to other projects
1	X	X	X	X	X	X	X	**1**
2	X	X	X	**2**	X	X	X	
3	X	**3**	X		X	X	X	
4	X		X		X	X	**4**	
5	X		**5**		X	X		
6	X				X	**6**		
7	**7**				X			
8					**8**			

Iterative prioritization method requires many simulations to order the risks correctly @ P-80 in Days Saved

Risk Prioritization Results

Risk Prioritization Table for Risk Mitigation Workshop

Risks Prioritized by their Contribution to P-80 Finish Date		
UID	Name	Days Saved
11	Megaproject may have excessive schedule pressure	133
6	The organization has other priority projects so personnel and funding may be unavailable	129
9	Megaproject may have interdependency problems	117
2	Engineering may be complicated by using offshore design firm	77
10	Megaproject may have coordination problems offshore sourcing	42
4	Fabrication yards may experience different Productivity than planned	31
7	Fabrication and installation problems may be revealed during HUC	17
12	Installation may be more complex than planned	10
1	Bids may be Abusive leading to delayed approval	9
3	Suppliers of installed equipment may be busy	9
5	The subsea geological conditions may be different than expected	0
	Days saved by Completely Mitigating the Risks	574
	Days Contributed to the Schedule Margin by Uncertainty	198
	Total Pre-Mitigated Schedule Contingency	772

RISK MITIGATION ACTIONS AND RESULTS (SIMPLE EXAMPLE)

Mitigation Workshop

- Owner and Contractor meet separately with the same prioritized list of risks
- Propose their own risk mitigations with cost of the actions, owners of the actions and improvement in the risk parameters
- Mitigation must be new, not continued practices from before
- Joint Owner / Contractor meeting to agree
- Must commit to the mitigations to get credit

Risk Mitigation Workshop Forms

			Schedule Impact			Cost Impact			
Risk ID	Risk Description:	Probability	Optimistic Impact Factor	Most Likely Impact Factor	Pessimistic Impact Factor	Optimistic Impact Factor	Most Likely Impact Factor	Pessimistic Impact Factor	Activities Affected
26 b	Given the quantity of piping in the project, scope may be underestimated	30%	110%	130%	170%	110%	120%	130%	Name Contains Piping
	Mitigations Proposed								Cost Estimate, total all mitigations proposed
26b.1									$20 million
26b.2									Responsible person/persons
26b.3									Smith
26b.4									Jones
26b.5									
	Parameters After Mitigation								
26 b	Given the quantity of piping in the project, scope may be underestimated	15%	100%	115%	140%				

Fill out mitigation actions proposed, cost (ROM) for all actions as a group, risk owners, and parameters after mitigation

Risk Mitigation Simple Example

- Probability reduced by half for each risk
- Duration impact ranges reduced – mostly schedule risk mitigation
- No change for cost impact ranges
- Cost of mitigation actions range from $10 million to $40 million in Cash (resource) paid at front end
- Mitigation costs in this example total $220 million

Schedule and Cost Risk Post-Mitigated

PROBABILISTIC BRANCHING FOR TEST FAILURE POSSIBILITY

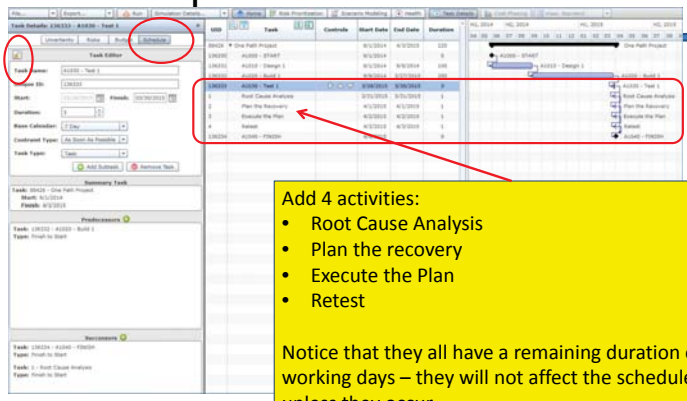
Probabilistic Branch with Test Failure

- Projects have many tests. Each of these is done because the system may fail, with consequences
- Seldom does the schedule include recovery activities, but is usually “success oriented”
- There is a probability of failure with consequences of added activities:
  - Root Cause Analysis of the Failure
  - Determining what to do
  - Doing what is planned
  - Retesting

Failing the Test may lead to Multiple Activities that are Not In the Schedule

- If fail the test all of these activities are needed
- If pass the test none is needed
- These 4 activities constitute a probabilistic branch, since the possibility of doing them is probabilistic
- There is a probability that the instrument or system will not pass the test
  - This probability is often underestimated

Set up the Probabilistic Branch

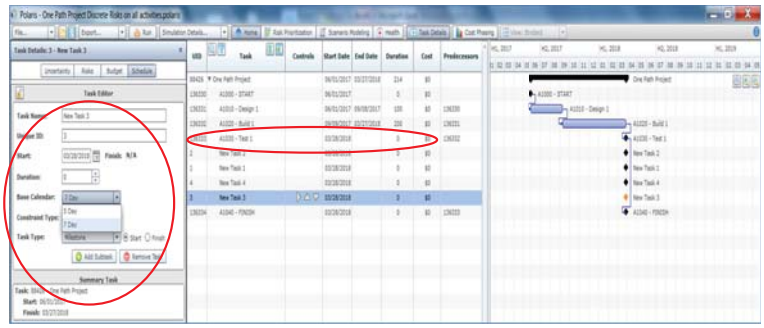


Add 4 activities:
- Root Cause Analysis
- Plan the recovery
- Execute the Plan
- Retest

Notice that they all have a remaining duration of 0 working days – they will not affect the schedule unless they occur

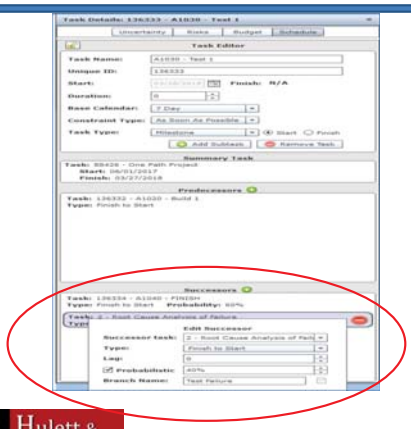
Using Booz Allen Hamilton Polaris®

Make the Probabilistic Branch Activities, Fix Calendars and Durations



Activity A1030 Test 1 is the node from which the project either finishes or fails and goes down the branch

Set the Test Failure Branch as Probabilistic

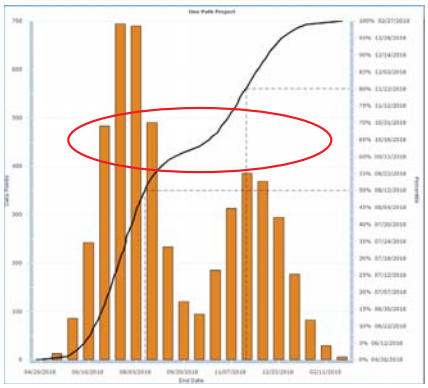


Make the branch 40% if it is 40% likely to Fail the Test first time

Give the New Activities Ranges of Impact, if they Happen

> Highlight the new activities in turn and give them uncertainties:
- Root Cause Analysis 20d – 40d – 60d
- Design the Fix - 10d – 20d – 40d
- Fix the Product - 10d- 30d- 50d
- Retest the Product - 20d – 30d – 50d

With the Probabilistic Branch in Place, Results may show Bi-modal Distribution



Probabilistic branch develops a shoulder at 60%

There can be more than one probabilistic outcome from a node. The probabilities need to sum to (40% + 60%) 100%.

Probabilistic branch can represent more planning than can be shown with a single probabilistic activity

Review

- Modern Methods of risk analysis
- Collecting risk data
- Introducing uncertainty to the model
- Introducing risks as Risk Drivers
- Risk drivers model correlation between activity durations
- Risks may be entered in series or in parallel
- Offshore gas production platform project
- Use Categories to apply risks to multiple activities
- Prioritizing risks for management action
- Risk mitigation actions and Results (simple example)
- Probabilistic branching for test failure possibility

Modern Methods of Schedule Risk Analysis using Monte Carlo Simulations

Presented to the
2017 Large Facilities Workshop
Baton Rouge, LA

David T. Hulett, Ph.D., FAACE
Hulett & Associates, LLC
Los Angeles, CA

Hulett & Associates

Aspects of Operations & Maintenance at GW Observatories

Richard Oram
Operations Manager at LIGO Livingston Observatory

NSF Large Facilities Workshop, May 2017

LIGO Laboratory: two observatories, Caltech and MIT campuses

- Mission: to develop gravitational-wave detectors, and to operate them as astrophysical observatories
- Jointly managed by Caltech and MIT; responsible for operating LIGO Hanford and Livingston Observatories
- Requires instrument science at the frontiers of physics fundamental limits

LIGO Laboratory's Overall Mission

- **Advanced LIGO Detectors – commission the newly constructed Advanced LIGO to design sensitivity**
- **Physics/Astrophysics Research - direct detection of gravitational waves and development and exploitation of gravitational-wave astronomy**
- **Precision Interferometry Research – research and development to upgrade and improve Advanced LIGO detectors**
- **Facilities - operate and maintain the LIGO Observatories and campus facilities**
- **Education and Public Outreach – develop scientific education and public outreach related to gravitational wave astronomy**
- **Develop the Global network – develop the international gravitational wave community to coordinate gravitational wave observations; support the construction of LIGO-India**

(Condensed from the LIGO Lab Charter)

Operation and Maintenance

The LIGO detector must run 7x24 during runs (since Nature can send events at any time

- **O&M** of Advanced LIGO detector, incremental sensitivity and robustness improvements.
- **O&M** Site and Facility and Vacuum equipment maintenance (now 20+ yrs. old)

Some Major Facility Lifecycle Renewals completed ahead of O1.

- **Re-roofing of Twelve original roofs & reinstall lightning protection- Completed Feb 2014 as specified with a 20 year warranty**
- **Renew original Main and End station chillers: 6 new & 1 refurbished- Completed Feb 2014**

Observatory Sites overview

- Sites:
  - LHO:1500 acres, LLO:180 acres.
  - Erosion control, flood control, grass, tumbleweed mowing/abatement.
  - Access control/ security.(LLO ~ 16km of border with forestry & hunters)
  - 13+ miles of paved access roads.
- Facility:
  - Potable water supplies and sewerage; treatment, testing and permitting.
  - Fire water storage, distribution, pumps, hydrants, sprinklers maintained to code. Fire control systems within buildings, including clean agent systems for critical electronics and computers.
  - 13.6 kV 3-phase power distribution to 480 V 3-phase panels, special balanced 117 V technical power for detector electronics.
  - Clean room lab areas, with HEPA-filtered air and contamination control protocols, precise temperature and humidity control, special low-vibration HVAC fans, remote chillers and plenum space to reduce temperature gradients, overhead cranes, fork lift trucks, aerial lifts, etc.
  - Office space, auditorium for collaboration and outreach meetings.
- Need to maintain facilities anticipating 20+ more years of operation.

Threat/ Disaster Management

Environmental Threats that affect sites and staff:

- **LIGO Livingston:** Hurricanes, tornadoes, heavy rain, flooding, lightning, high humidity, heat stress management, critters….
- **LIGO Hanford:** Snow, icy roads, extreme cold, extreme heat, scrub fires, tumbleweeds, critters…
- **Lesson learned:** Have a plan and fit in with what the community does.
  - For example, when New Orleans is likely to evacuate, normal commerce and transportation is impossible in the Livingston area, so we close our gate valves and evacuate the site. This must be done days before a hurricane landfall.

Property Lifecycle Maintenance Plan: Asset Condition Report

- LIGO M&O Cooperative Support Agreement (CSA) for FY2014-FY2018
- "Subject to the availability of funding, the Awardee will provide by October 1, 2016 an Asset Condition Report evaluating the remaining life of civil infrastructure at the LHO and LLO sites, and estimating the cost of significant replacement or refurbishment to be scheduled during Oct 1, 2018 - Sept 30, 2023."

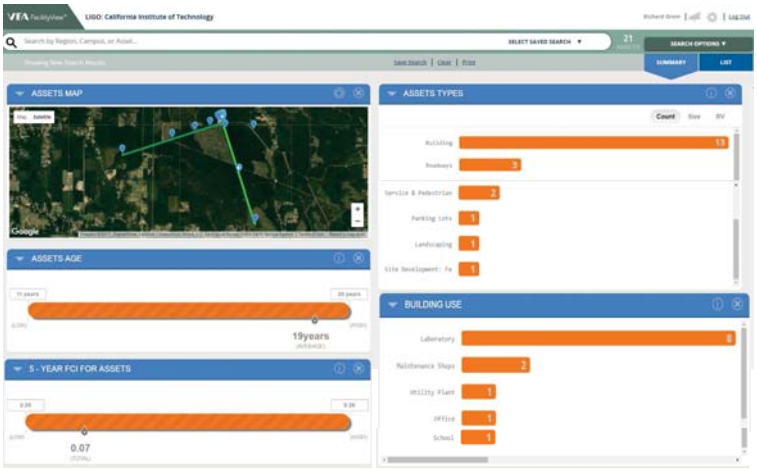
- In response LIGO selected a consulting civil engineering firm ([1]VFA inc., part of Accruent LLC.) and completed a condition assessment of the sites and provide staff training during July 2016.
- The data from this assessment are now entered into web based VFA.auditor and will be used for future maintenance management, capital planning & budgeting and report generation.

[1]VFA, Inc (an accruent company)- http://www.vfa.com/

Property Lifecycle Maintenance Plan Plan Development

- The VFA assessment team consisting of an architectural, mechanical, and an electrical consultant performed assessment inspections of 26 buildings and associated assets (13 buildings each at LLO and LHO).
- The VFA assessment team used the **ASTM standard (E1557-09 (2015)) Uniformat II Classification for Building Elements-** classifying building specifications, cost estimating, and cost analysis. The elements are major components common to most buildings.
- **Uniformat** estimating applies unit-cost data to building-system and component site elements. This "systems" approach uses a hierarchical structure of cost elements, beginning at Level 1 with basic systems, such as Substructure, Exterior Enclosure, and Interior Construction, and proceeding to successively more detailed subdivisions of these systems at Levels 2-5. See GSA.gov.- Uniformat.
- Estimates for Systems and Requirement Actions were made using RSMeans tables for 2016. RSMeans supplies construction cost information for North America used to estimate the costs of construction and renovation projects. For more information on RSMeans, go to www.rsmeans.com.

Property Lifecycle Maintenance Plan VFA Facility and FacilityView



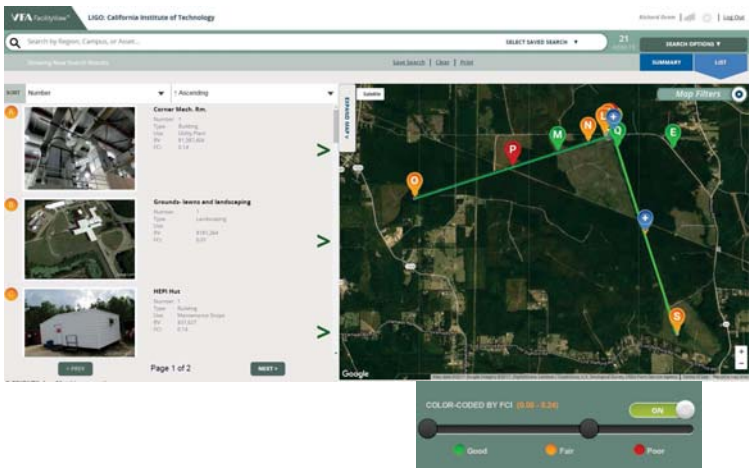
The Facility Condition Index (FCI)

- **The Facility Condition Index (FCI), a standard used to indicate the condition of an asset or assets, is the ratio of the cost of requirements divided by the current replacement value (CRV) of the asset. The CRV is the total value of all systems that make up a particular asset. The lower the FCI value the better the condition of the building or asset.**
- **The FCI is calculated as:**

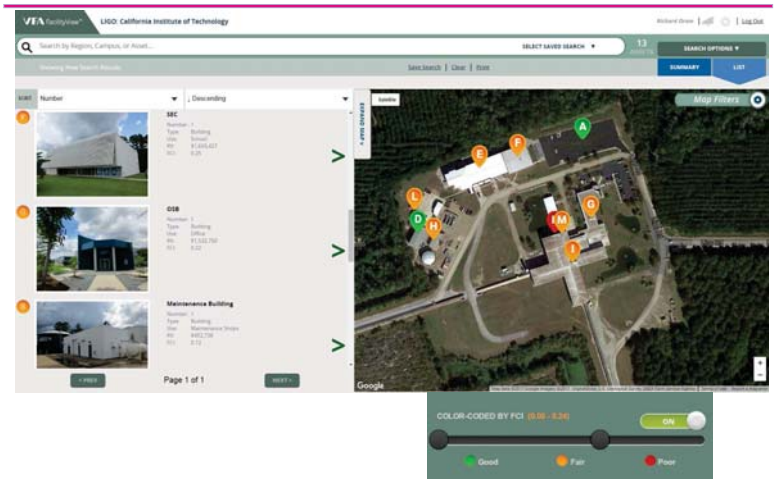
$$FCI = \frac{\text{Total FCI Requirements}}{\text{Current Replacement Value}}$$

- **FCI calculations result in the determination that each asset or assets fall into the qualitative description of excellent, good, fair or poor. The lower the FCI value the better the condition of the building.**

Property Lifecycle Maintenance Plan VFA Facility and FacilityView



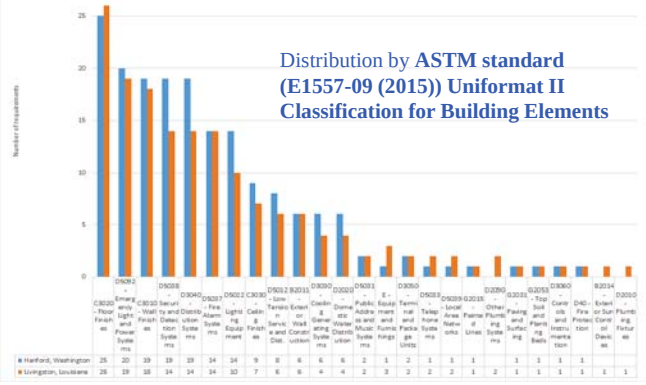
Property Lifecycle Maintenance Plan VFA Facility and FacilityView



Property Lifecycle Maintenance Plan FY2019 – 2023

Total of 339 Requirements/Renewals over Five years.

- A Requirement is a facility need or a deficient condition that should be addressed, including deferred maintenance, code issues, functional requirements, and capital improvements.
- Requirement records are created underneath the Asset where the condition occurs. Each Requirement has an Action, which is a remedy for the condition that includes itemized cost estimates.



Property Lifecycle Maintenance Plan: Peer Review

➢ **NSF review recommendation:**

» "Have the Property Life Cycle Maintenance Plan peer reviewed and vetted by maintenance professionals from a similar large science facility (e.g. JPL, Fermilab, etc.) annually."

➢ **We now include Lifecycle maint. section in LIGO's Annual Work Plan:**

» The property lifecycle plan is a list of planned activities and budgetary estimates for accomplishing maintenance activities.

» LIGO is now conducting this peer review activity with appropriate external reviewers from ESO, Fermilab and Smithsonian facilities.

Some unique aspects of maintenance @ GW Observatories

Always being conscious of need to be quiet in the work that we do.

- Site maintenance activities and equipment adjusted for minimum disturbance (vibration and E/M interference).

Weekly Preventive Maintenance squeezed into a Four hour period every Tuesday 9 am – 1 pm. (LLO and LHO nearly coincident)

- ➢ Use of CMMS (FAMIS) to organize and schedule Tuesday PMs
- ➢ Contractors provide service and regular maintenance during 4 hour/week period.
- ➢ Rigorous use of work permit process to communicate, approve and de-conflict non-routine work

LIGO-specific considerations:

- LIGO Lab members are part of the LIGO Scientific Collaboration, so we are part of our user community. Various LSC members contribute to O&M.
- GW science greatly rewards even small range improvements, so steady-state operation often includes incremental improvements.

Improved Operational Processes:

Computerized Maintenance Management System (CMMS)

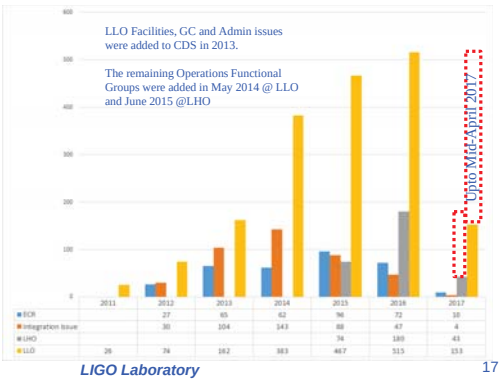
- **Computerized Maintenance Management:**
  - ➢ ***Preventative Maintenance*:** planned and organized using FAMIS cloud based CMMS
  - ➢ ***Corrective Maintenance, Integration issues*:** reported and tracked using customized bugzilla software, locally called FRS (Fault Reporting System). Software bugs/features tracked with bugzilla instances.
  - ➢ "Process Flow for Engineering Operations of the LIGO Detector Systems".
    - » Rigorous use of work permit process to communicate, approve and de-conflict non-routine work
  - ➢ Spares procurement and planning.
    - » Non-detector (infrastructure) spares to be tracked in FAMIS.
    - » Detector spares tracked using aLIGO-developed Inventory Control System ICS.
- Performance monitoring and reaction:
  - ➢ Key performance indicator "dashboard."
  - ➢ In weekly reviews, recurring faults are noted and receive additional analysis, as are faults that cause significant downtime.
- Facility Asset Condition Report completed.
- Property life-cycle maintenance plan, budgets and tasks for maintenance, now formally part of annual work plan:

Computerized Maintenance Management System

Operations Management Team: Bug 33 - OMT charge to implement maintenance database services for both Observatories

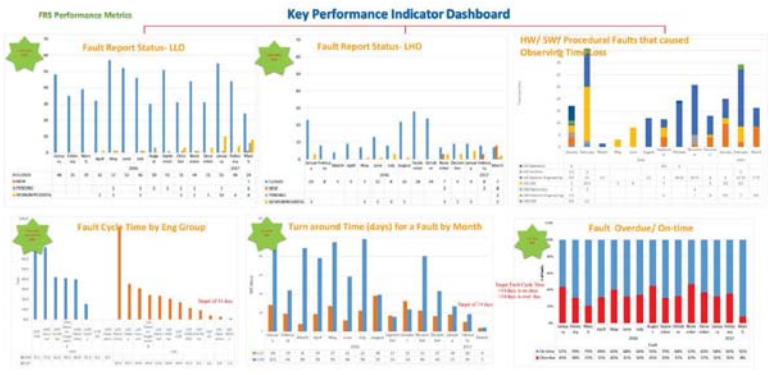
➢ **Corrective Maintenance (FRS): In progress:** Daily use of the Fault Reporting System (FRS) to improve response time and quality of service provided to fault reports and service requests. Operations groups now daily use operational data (from aLOG, FRS, Work Permits) to prioritize and schedule daily/weekly work plans and drive decisions.

➢ **LHO/LLO** roll out of **FRS 2.0** combined FRS & Integration Issues & ECR Tracker : The CMMS team members along with LIGO Systems Engineering have defined requirements (FRS 2.0 user's manual: T1400332) for a unified implementation of the FRS (for both observatories) together with the functionality of the aLIGO integration issues tracker



Activity: Operations use of FRS Key Performance Indicators

https://services.ligo-la.caltech.edu/FRS



Link to Weekly Key Performance Indicator Dashboard is https://services.ligo-la.caltech.edu/KPI

Observatory Operations

Observing time scheduled into Observing blocks - O1, O2, O3 etc. punctuated by Commissioning periods, Planned Engineering and Engineering Runs (~month)

aLIGO Observing runs.

- ✓ O1 ~ 4 months,
- ⚠ O2 ~ 6+ months
- O3 ~ 12+ months

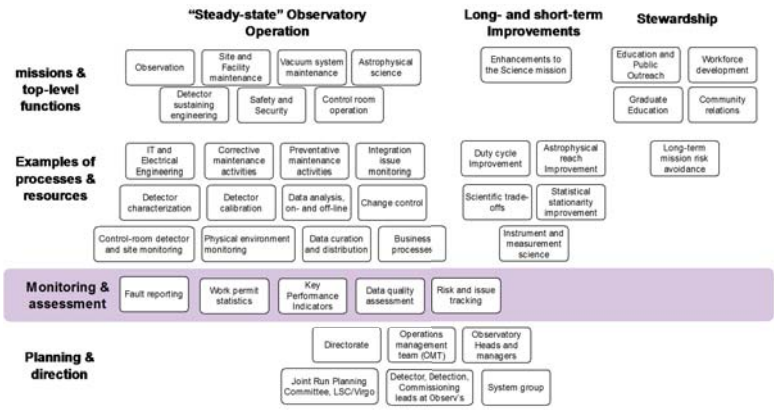
Control room is staffed 24/7 by "on-duty operator" during observing runs to monitor and operate detector, maximize uptime and provide safety.

Weekday support and then overnight and weekend "On-call" by team of Detector Engs, Scientists, SWE, EE, Facility and Vacuum Eng. and Managers.

Observatory operations hinge upon the goodwill and professionalism of the amazingly dedicated staff.

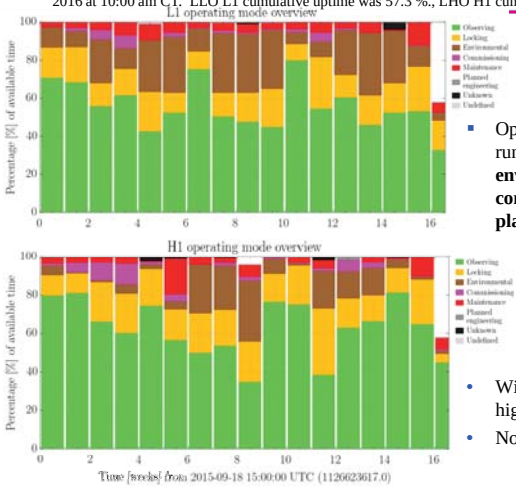
Staff assignments are adjusted, and family life altered to operate detector as reliably as possible.

A large number of functions, resources and tools, organized by specialized teams



O1 Performance: Observing summary

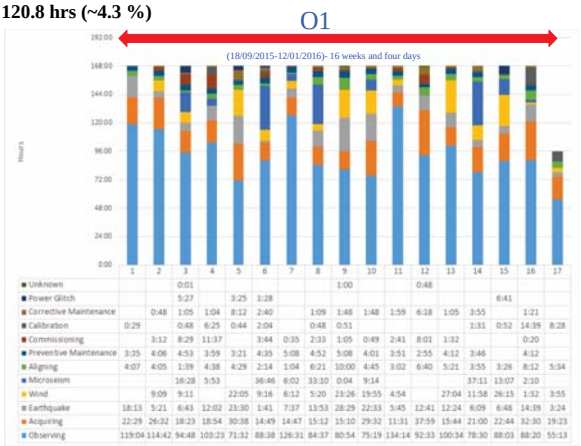
O1, which began at 10:00 am CT on September 18th, 2015. O1 ran for 16 weeks and 4 days and ended January 12th 2016 at 10:00 am CT. LLO L1 cumulative uptime was 57.3 %., LHO H1 cumulative uptime was 64.6 %.,



- Operators tracked status during run, **observing**, **locking**, **excess environmental noise**, **commissioning**, **maintenance**, **planned engineering**, etc.
- Winter run included expected high ground motion and storms
- No evident trends.

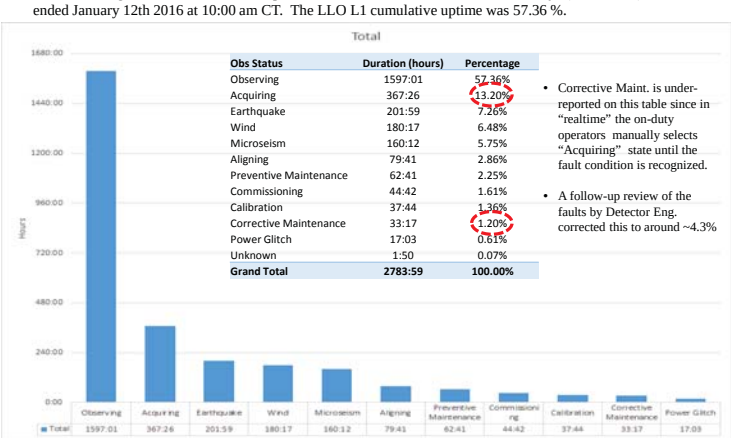
LLO O1 Performance: Observing summary

O1 L1 cumulative uptime was 57.3 %; Observing Time Loss due to HW/SW/Procedural faults was 120.8 hrs (~4.3 %)



LLO O1 Performance: Observing summary

- O1, which began at 10:00 am CT on September 18th, 2015 ran for 16 weeks and 4 days (2784 hours) and ended January 12th 2016 at 10:00 am CT. The LLO L1 cumulative uptime was 57.36 %.



Obs Status	Duration (hours)	Percentage
Observing	1597:01	57.36%
Acquiring	367:26	13.20%
Earthquake	201:59	7.26%
Wind	180:17	6.48%
Microseism	160:12	5.75%
Aligning	79:41	2.86%
Preventive Maintenance	62:41	2.25%
Commissioning	44:42	1.61%
Calibration	37:44	1.36%
Corrective Maintenance	33:17	1.20%
Power Glitch	17:03	0.61%
Unknown	1:50	0.07%
Grand Total	**2783:59**	**100.00%**

- Corrective Maint. is under-reported on this table since in "realtime" the on-duty operators manually selects "Acquiring" state until the fault condition is recognized.
- A follow-up review of the faults by Detector Eng. corrected this to around ~4.3%

O1 Performance:

Detector Engineering Operations & Maintenance: O1, which began at 10:00 am CT on September 18th, 2015. O1 ran for 16 weeks and 4 days and ended January 12th 2016 at 10:00 am CT.

The L1 and H1 detectors achieved an NS-NS inspiral range of ~60-80 Mpc during O1; No major Commissioning breaks or interventions were necessary.

LLO L1 cumulative uptime was 57.3 %., LHO H1 cumulative uptime was 64.6 %. Double Interferometer cumulative uptime was 42.8 %.

LLO:Observing Time Loss due to HW/SW/Procedural faults was 120.8 hrs (~4.3 %).

Opportunities for Improving Observing uptime > 60%: (Any low hanging fruit ?)

- Better strategies for maximizing coincident observing. (PMs, no risky WP)
- Streamlining "acquiring process" (>10%)
- Wind and microseism remediation (>12%) (somewhat seasonal, run planning?)
- Power glitches (~1%)

O1 & O2 Performance: Observing summary

O1

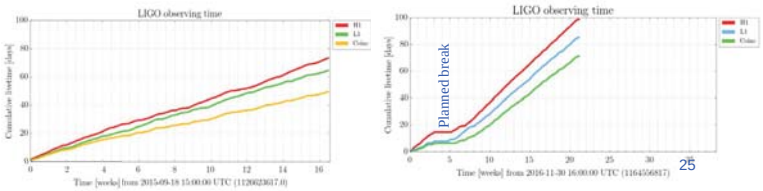
O1, which began at 10:00 am CT on September 18th, 2015. O1 ran for 16 weeks and 4 days and ended January 12th 2016 at 10:00 am CT. Double Interferometer cumulative uptime was 42.8 %.

O2 still in progress

O2 commenced 10:00 am CT Nov 30th 2016. As of Friday April 28th 2017, (21+ weeks or 3270 hours) into O2, Double Interferometer cumulative uptime is around 52.1%.

Duty Factor

Total Observing Time



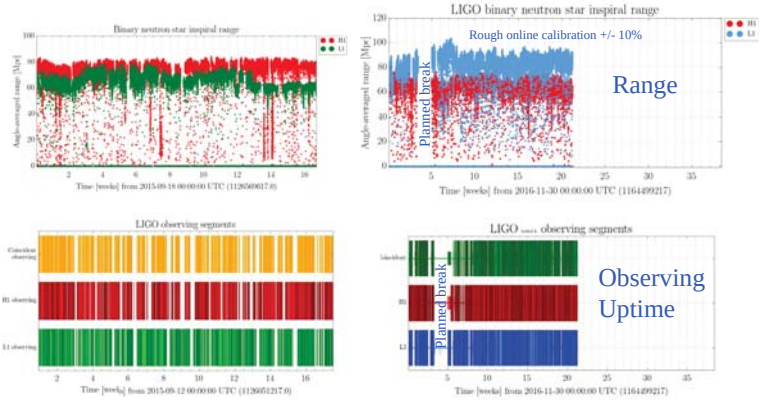
O1 & O2 Performance: Observing summary

O1

- ***The L1 & H1 detector achieved a NS-NS inspiral range of ~60-80 Mpc during O1***

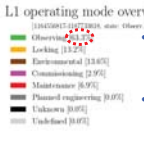
O2 still in progress

- ***The L1 & H1 detector achieved a NS-NS inspiral range of ~65-95 Mpc during O2***

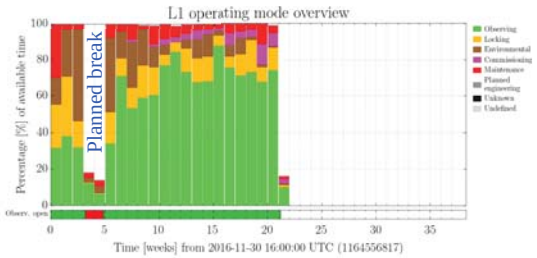


LIGO O2 Operational State and Mode

Livingston



- O2 commenced 10:00 am CT Nov 30th 2016. As of Friday, (21+ weeks) into O2, Overall L1 operations has achieved a cumulative uptime of around 63.3%.
- This performance is a little better than expected performance of ~60% and the trend is improving.
- The main cause of down time are **environmental**, **locking**, **preventive maintenance**, **commissioning time** and faults that required **corrective maintenance**.



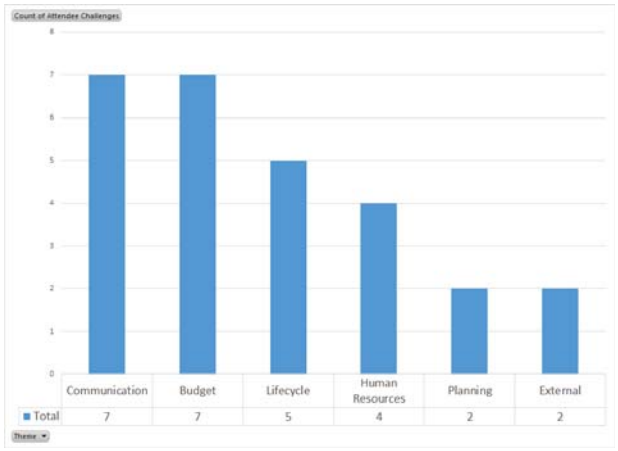
Operator-reported Top-level modes: Causes of state.

Conclusion

- **LIGO's Operation and Maintenance has been informed by 20 years of observatory site activities, together with robust Lab-wide engineering, systems, business and managerial support.**
- **The Advanced LIGO Project provided a firm foundation of change control, documentation, issue tracking, etc., that remain in use.**
- **We are implementing several modern managerial systems, including computerized maintenance management, tracking performance indicators, quantitative long-term maintenance planning, etc.**
- **The first observational run O1, and the demands place on operations from the detection, were handled successfully.**
- **We are 21+ weeks into O2, which is proceeding well. Many thanks to the amazingly dedicated staff.**

Thank you!

Round Table Discussion on common challenges to LF O&M



Common communication challenges

Count of Attendee Challenges Theme	Attendee Challenges	Total
Communication	Communication across observatory.	1
	Consistancy in guidance.	1
	Coordination across multiple layers of management.	1
	Developing consistent processes across observatory	1
	Repeat requests for detailed data previously provided.	1
	Terminology inconsistantly applied.	1
	User communities desires shift, even as our protocols sought consistency for changes.	1
Communication Total		7

Common budget challenges

Count of Attendee Challenges Theme	Attendee Challenges	Total
Budget	Aging equipment, high repair costs of obsolete equipment versus higher replacement costs.	1
	Budget uncertainties.	1
	Funding stagnation (flat budget)	1
	Operating while constructing. Not always ready for prime time.	1
	We are not allowed to keep or budget for "reserves". How then do we pay for unexpected failures of major equipment or instrumentation?	1
	We have items of equipment & infrastructer that cost > $250k, but we cannot establish a reserve for when they break. Ideas: A) Allow programs to set aside/establish a reserve bi-annually in the pop budget, or B) NSF create a pool for access by large facilities when a critical item breaks.	1
	We have to spend or budget to zero on the last day of an award. We then start a new award. We then start a new award with no "cushion". Certainly not any "reserves". This is a big problem.	1
Budget Total		7

Common lifecycle challenges

Count of Attendee Challenges Theme	Attendee Challenges	Total
Lifecycle	Aging/outdated equipment.	1
	Challenges stemming from technical needs & limitations.	1
	Cyber infrastructure evolution, i.e. when do software platform upgrades warrant rebuild?	1
	Rapid evolution of software - freeze critical systems?	1
	When we finish and operationalize a facility, some components have 10 years old technology at commissioning. How can NSF fund upgrades early in operationis to avoid early obsolence?	1
Lifecycle Total		5

Common HR challenges

Count of Attendee Challenges Theme	Attendee Challenges	Total
Human Resources	Complete routine work efficiently with limited staff and budget with available skill sets.	1
	Hiring, training and retaining staff to work in remote locations	1
	How do you deal with "problem" personnel in a university environment? Tennured and/or essentially tennured staff.	1
	Lack of succession/backup	1
Human Resources Total		4

Common Planning challenges

Count of Attendee Challenges Theme	Attendee Challenges	Total
Planning	Being really good at being proactive and even better at being reactive when unplanned projects or problems occur.	1
	Plan preventative maintenance and repairs/enhancements around observing work by staff and vendors.	1
Planning Total		2

Common external challenges

Count of Attendee Challenges Theme	Attendee Challenges	Total
External	External partnerships dependencies.	1
	With a continental scale, neon has varied situations - wildfire, floods, migration of protected species, etc., not in our control but impacts performance. Very dynamic.	1
External Total		2

Practical Guidance to Strengthen Facility Estimates

NSF Large Facilities Workshop
May 1-3, 2017

Jason Lee, GAO
Kevin Porter, NSF
Erik Nylund, CH/KGS

Purpose

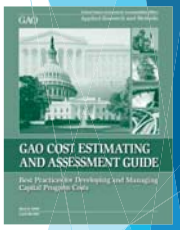
- Strengthen Estimates – Construction, Operations & Maintenance
- Highlight Requirements and Best Practices
- Emphasize Importance of Cost Estimating Plans, Basis of Estimate
- Provide Practical Examples
- Answer Questions

Overview

- Background – AICA, LFM, Definitions
- GAO
  - 12 Steps & 4 Characteristics
  - Cost Estimating Plans (CEP) Examples
  - Basis of Estimate (BOE) Examples
- Independent Contractor – Kforce Government Solutions & Crowe Horwath
  - Role doing independent cost assessments for NSF per GAO
  - NSF CEP & BOE Examples
- Misc Items

American Innovation & Competitiveness Act - Oversight of NSF Large Facilities

One Hundred Fourteenth Congress
of the
United States of America



- "shall strengthen oversight and accountability over the full life-cycle… in order to maximize research investment"
- "ensure that policies for estimating and managing costs and schedules are consistent with the best practices described in the Government Accountability Office Cost Estimating and Assessment Guide"
- "require that any pre-award analysis of a major multi-user research facility project includes the development and consideration of the full life-cycle cost"

AICA - NSF - Construction

- "may not approve or execute any agreement to start construction on any proposed major multi-user research facility project unless…
  - "external analysis of the proposed budget has been conducted"
  - "independent cost estimate (ICE) of the construction of the project has been conducted using the same detailed technical information as the project"
  - "considered the analyses… and the independent cost estimate… and resolved any major issues"

AICA - NSF - Operations

- "shall require an independent cost analysis (ICA) of the operational proposal for each major multi-user research facility"

Large Facilities Manual – Section 4.2

- Strengthen Estimates & Clarify NSF expectations
- Implement AICA Requirements
- Supplement GAO Cost Guide w/ NSF specific info
- Clarify NSF Cost Analysis process
  - Duration & NSF participants
  - Conducted at each Design Stage-Gate Review for Construction
  - Conducted at proposal submission for Operations
  - ICE and ICA inform NSF Cost Analysis > **They DO NOT replace it!**
- Correct information/detail into estimate at proposal submission
  - Reduce burden & frustration for Recipient & NSF
  - Reduce time to award

7

Cost Estimating Plan (CEP)

- AACE International – Recommended Practice No. 36R-08
  - "establish and communicate how the preparation, development, review and approval of the estimate will be completed"
- LFM – includes NSF specific needs
  - "A plan describing how the cost estimating guidance in this manual will be implemented, how the cost estimate will evolve over time, and how the "Cost Model Data Set" will meet the various needs of the project. The CEP should typically include a narrative and sufficient detail explaining the ground rules and assumptions, roles and responsibilities, practices, systems, and calculations used to develop the cost estimate. "

8

Basis of Estimate (BOE)

- AACE International – Recommended Practice No. 34R-05
  - "Written documentation that describes how an estimate, schedule, or other plan component was developed and defines the information used in support of development. A basis document commonly includes, but is not limited to, a description of the scope included, methodologies used, references and defining deliverables used, assumptions and exclusions made, clarifications, adjustments, and some indication of the level of uncertainty"
- Project Management Institute
  - "Supporting documentation outlining the details used in establishing project estimates such as assumptions, constraints, level of detail, ranges, and confidence levels."
- LFM
  - PMI definition
  - Additional guidance on our expectations, level of detail, acceptable justifications

9

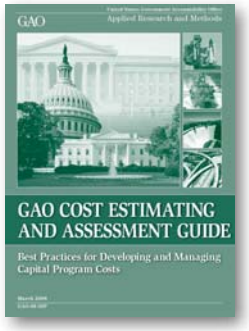
The Role of GAO in Government

Known as the investigative arm of Congress, GAO exists to support Congress in meeting its constitutional responsibilities. To that end, GAO works to

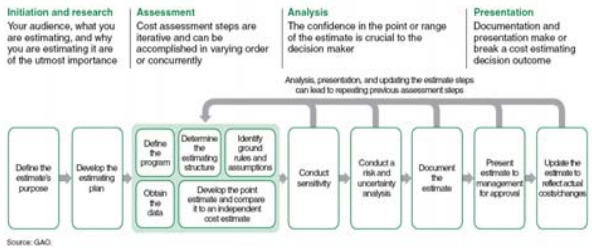
- Help improve the performance of federal government
- Ensure government agencies and programs are accountable to the American people
- Examine the use of public funds, and
- Evaluate federal programs by providing analyses and recommendations to help Congress make informed oversight and funding decisions

Cost Estimating and Assessment Guide

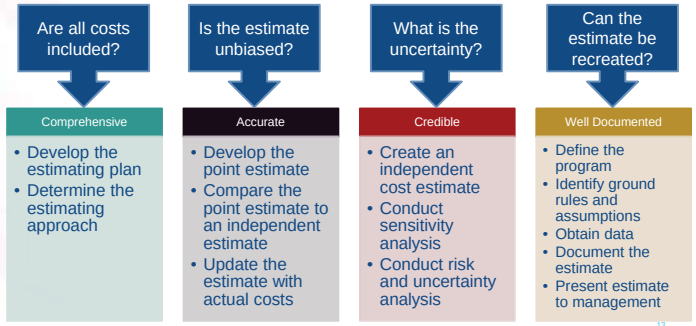
- Drafted 2005-2007, published in 2009
- Outlines GAO's criteria for assessing cost estimates during audits
- Contains 20 chapters with supporting appendixes
- Chapters 1-17: developing credible cost estimates and the 12-step cost estimating process for developing high quality cost estimates
- Chapters 18-20 address managing program costs once a contract has been awarded and discuss Earned Value and risk management
- Also provides case studies of prior GAO audits to show typical findings related to the cost estimating process



A Reliable Process for Credible Cost Estimates



Characteristics of Reliable Estimates



Comprehensive Cost Estimates

A comprehensive estimate

- Includes both government and contractor costs of the program
- Covers the full life cycle of the program, from inception of the program through retirement **(not just the Construction Stage)**
- Applies to both FAR-based contracts and Cooperative Agreements

Comprehensive Cost Estimates - Examples

California High-Speed Passenger Rail: Project Estimates Could Be Improved to Better Inform Future Decisions – GAO-13-304

> "While the O&M estimate includes common elements for administration and support costs, the O&M WBS is greatly simplified. As a consequence, up to two-thirds of O&M costs are collected in a single cost element."

DHS and GSA Need to Strengthen the Management of DHS Headquarters Consolidation – GAO-14-648

> "GAO found that the 2013 cost estimate…does not include a life-cycle cost analysis of the project, including the cost of operations and maintenance."

VA Construction: Improved Processes Needed to Monitor Contract Modifications, Develop Schedules, and Estimate Costs – GAO-17-70

> "All applicable costs for the construction contract appear to be included in the cost estimate…. However, VA's $341-million cost estimate for activating the Denver facility is not well supported."

A Focus on Step 2 and Step 10

Step 2: Develop the Estimating Plan

1. A written study plan
   - Determines the estimating team's composition
   - Identifies subject matter experts
   - Includes a schedule for the cost estimating effort
2. Team includes experienced and trained cost estimators
3. Estimating team is from a centralized office

Not meeting Step 2 criteria is typically a cause for why other best practices are not met

Step 2: Census Bureau Estimate Plans

2020 Census: Census Bureau Needs to Improve Its Life-Cycle Cost Estimating Process – GAO-16-628

> "We found the Bureau had little planning information among its documents supporting its cost estimate. Early fundamental planning and guidance documents such as general policies and procedures for cost estimation…can contribute to consistent control over the process used to develop a cost estimate and help ensure that desired standards and practices are implemented."

> "Eight years later, the absence of guidance to control the cost estimation process persists. Investment in the planning documents to help control and support cost estimation early in the estimation cycle, such as…guidance on key steps and process flows [and] assignment of responsibilities…can help institutionalize practices and ensure that otherwise disparate parties in the process operate consistently."

Step 10: Document the Estimate

Good documentation should describe the cost estimating process, data sources, and methodologies.

- Cover Page and Introduction
- Executive Summary
- Introduction
- System Description
- Program Inputs
- Methodology by Cost Element
- Data by Cost Element
- Narrative text
- Cost tables
- Sensitivity analysis
- Uncertainty analysis
- Management approval
- Tracked updates
- Contingency derivation

Step 10: Documentation for a "Never-Ending" Program

Checked Baggage Screening: TSA Has Deployed Optimal Systems at the Majority of TSA-Regulated Airports, but Could Strengthen Cost Estimates – GAO-12-266

"TSA did not adequately document many assumptions or methodologies underlying its cost model to the extent that would allow someone unfamiliar with the cost estimate, using only the available documentation, to easily re-create the estimate."

NSF – High Quality CEP & BOE Example – Construction

- Antarctic Infrastructure Modernization for Science (AIMS)
  - Successfully completed Preliminary Design Review (PDR)

AIMS – CEP

4.5.1. Cost Estimating Plan

The baseline cost estimating process takes the project estimate from program mission need through contract closeout, utilizing the Government Accountability Office (GAO) 12-step process for estimate development (Table 8).

Table 8: GAO 12-step estimating process.

Step	Description
1	Define estimate's purpose
2	Develop estimating plan
3	Define program characteristics
4	Determine estimating structure
5	Identify ground rules and assumptions
6	Obtain data
7	Develc
8	Condu
9	Condu
10	Docun
11	Preser
12	Updat

4.5.2. Methodology

The estimate for CDR was a parametric estimate based on facility-blo diagrams from Master Plans, knowledge from subject matter experts USAP, and historical records. The intent was to provide a cost range f purposes. The estimate for PDR is based upon greater levels of detail below. The primary estimating tools are 1) RSMeans - an industry-wi construction estimation database; 2) ASC's estimating subcontractor proprietary estimating data developed by the contractor; 3) Sage Timb estimating software; and 4) Excel spreadsheets used to capture items ancillary costs and consolidate estimating sources into a single estima

4.5.3. Estimate Classification

The accuracy level of the AIMS estimate is based on the Association for the Advancement of Cost Engineering (AACE) International's recommended practice No. 17R-97, *Cost Estimate Classification System*, Rev. November 29, 2011. The AACE classification for the current estimate is Class 3-4, which gives a range of -15% to +30%, based on the maturity levels of the estimate and project documents (Table 9). The estimate will be reclassified as design and specifications mature through the PDR and FDR, with improved accuracy at each phase.

Table 9: AACE International estimate classes

Estimate Class	Primary Characteristic: Maturity Level Of Project Definition Deliverables (as % of complete definition)	Secondary characteristic: End Usage (typical purpose of estimate)	Secondary characteristic: Methodology (typical estimating method)	Secondary characteristic: Expected Accuracy Range (typical variation in low and high range (a))
Class 5	0% to 2%	Functional area or concept screening	SF or M2 factoring, Parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Schematic design or concept study	Parametric models, assembly driven model	L: -10% to -30% H: +20% to +30%
Class 3	10% to 40%	Design development, budget authorization, feasibility	Semi-detailed unit, costs with assembly level line item	L: -5% to -15% H: +10% to +20%
Class 2	30% to 75%	Control or bid/tender, semi-detailed	Detailed unit cost with forced detailed take-off	L: -5% to -10% H: +5% to +15%
Class 1	65% to 100%	Check estimate or pre-bid/tender, change order	Detailed unit cost with detailed take-off	L: -3% to -5% H: +3% to +10%

AIMS - CEP

Table 1: BOE Cost Estimating Sources

Cost Estimating Source	Rationale
Vendor quotes to Leidos:	
Independent estimating companies:	
Leidos internal subject matter experts (SMEs):	
Industry standards and sources:	
Historical knowledge:	

4. Universal Assumptions

AIMS personnel provided the subcontracted estimating firms with specific assumptions to use in developing their estimates. Some of the assumptions are applicable to narrow aspects of the project and are therefore included only in that specific BOE. Others are applicable to the project across multiple portions of the estimate and therefore are listed here instead of being repeated within multiple BOEs. Not all assumptions are listed here, but Table 3 provides a list of the assumptions that are relevant to multiple BOEs, a reason or justification for inclusion, and a brief description of the impact to the project.

Table 3: BOE Universal Assumptions

5. Universal Exclusions

AIMS provided the subcontracted estimating firms with specific exclusions to use in the development of their estimates. Some of these are applicable to narrow aspects of the project and are therefore included only in those specific BOEs. Others are applicable to the project across multiple portions of the estimate and therefore are listed here instead of being repeated within multiple BOEs. Table 4 below lists the exclusions, provides a reason or justification for including them, and provides a brief description of the impact to the project.

Table 4: BOE Universal Exclusions

*BOE organized per AACE International Recommended Practice No. 34R-05. (2010)

AIMS – BOE* - WBS 5.4.1

BASIS OF ESTIMATE

WBS 5.4.1.03 – Transition

1.0 Transition Basis of Estimate (WBS 5.4.1.03)

1.1 Technical Scope Detail

One of the core tenants of the McMurdo Master Plan is that new McMurdo Station facilities should be designed and constructed in such a way that the station remains operationally functional during

1.1.1 Temporary Facilities (5.4.1.03.01)

SUBCONTRACTOR STAGING FACILITY

The construction subcontractor for the core facility will require

CONTRACTOR STAGING FACILITY

Design (5.4.1.03.01)

This is the estimated cost for the design builder to complete a design

Procure (5.4.1.03.01)

This is the estimated cost for the design builder to procure construction materials

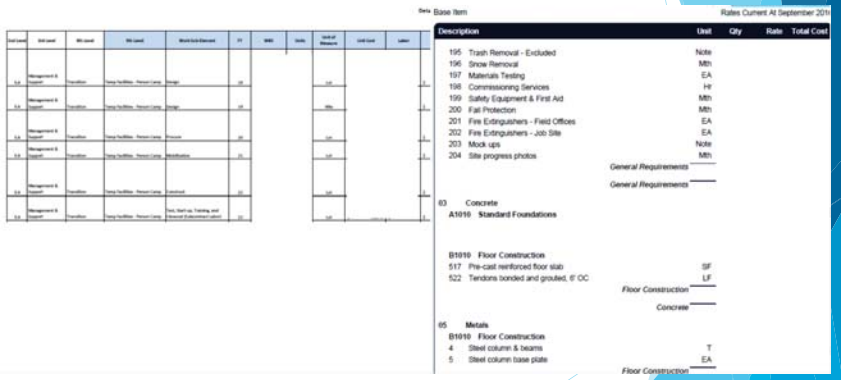
Mobilization (5.4.1.03.01)

This is the estimated cost for the design builder to mobilize equipment and supplies to Port Hueneme, California and McMurdo Station. This is calculated against estimated construction costs. These

Construct (5.4.1.03.01)

This is the estimated cost for the design builder to construct the facility (labor and materials). This is

AIMS – BOE – WBS 5.4.1



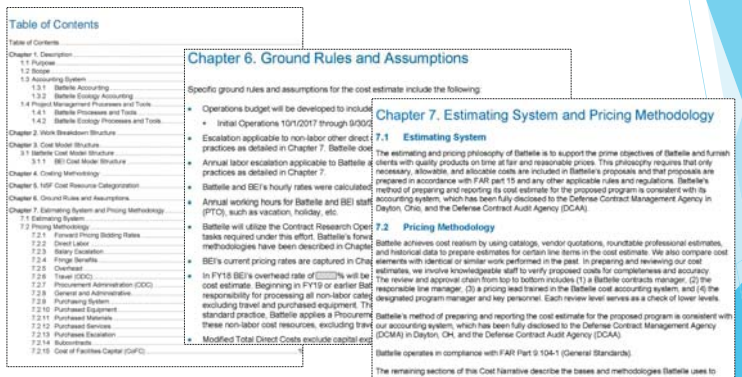
Description	Unit	Qty	Rate	Total Cost
195 Trash Removal - Excluded	Note			
196 Snow Removal	Mth			
197 Materials Testing	EA			
198 Commissioning Services	Hr			
199 Safety Equipment & First Aid	Mth			
200 Fall Protection	Mth			
201 Fire Extinguishers - Field Offices	EA			
202 Fire Extinguishers - Job Site	EA			
203 Mock ups	Note			
204 Site progress photos	Mth			
General Requirements				
General Requirements				
03 Concrete				
A1010 Standard Foundations				
B1010 Floor Construction				
517 Pre-cast reinforced floor slab	SF			
522 Tendons bonded and grouted, 6' OC	LF			
Floor Construction				
Concrete				
05 Metals				
B1010 Floor Construction				
4 Steel column & beams	T			
5 Steel column base plate	EA			
Floor Construction				

AIMS – BOE – WBS 5.4.1

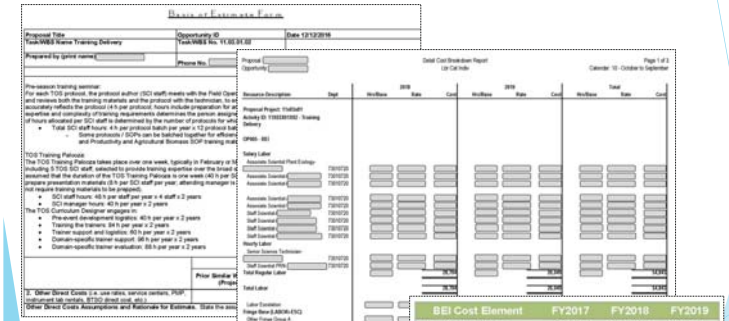
NSF – High Quality CEP & BOE Example – O&M

- National Ecological Observatory Network (NEON)
  - Some elements under construction
  - Some elements in operation

NEON CEP & BOE Example – O&M

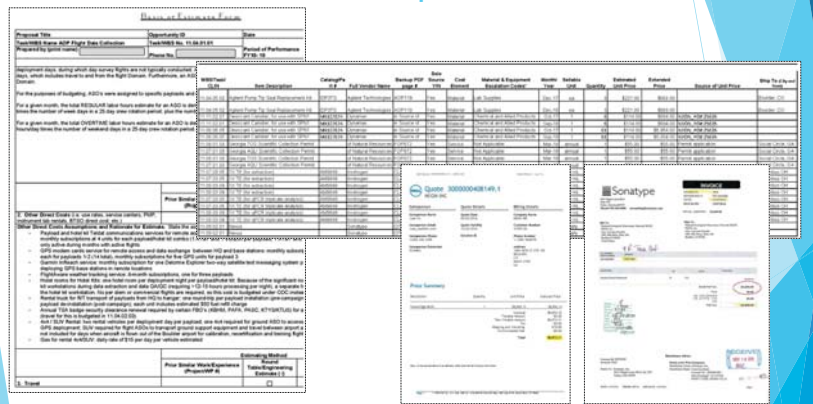


NEON CEP & BOE Example – O&M *(continued)*



BEI Cost Element	FY2017	FY2018	FY2019
Regular Full-Time Labor Fringe	XX.X %	XX.X %	XX.X %
Temp Full-Time & Temp Part-Time Labor Fringe	XX.X %	XX.X %	XX.X %
Overhead	XX.X %	XX.X %	XX.X %

NEON CEP & BOE Example – O&M *(continued)*



NSF - CEP & BOE Examples – Summary Leading Practices/Observation

- Complete BOE document with good project and scope description
- Clear linkages from BOE to Cost Book (via WBS)
- Thorough and well-documented assumptions for cost drivers, cost estimating methods, and data sources
- Integrated cost model which includes build up from lowest to highest levels of the WBS
- Use of a "quality standard" as though cost estimate will be subject to third party review and such that third party can replicate
- Supportable cost escalations; and indirect/fringe/overhead rates
- Sufficient documentation of risk and sensitivity analyses; discussion of cost estimate limitations

NSF - CEP & BOE Example – O&M

- **NSF is not prescriptive – Tailor to your facility!!**
- Academic Research Fleet
  - Ship Operations format established by OCE is both the CEP and the BOE
  - "WBS" elements are the various Level of Effort cost categories defined by OCE
  - Suitable for NSF to conduct a cost analysis (mainly Program)

Can Contingency be used during Operations Stage?

- Yes (per LFM 4.2.6)
  - Must comply with paragraph 200.433 of the Uniform Guidance (Held separately to manage project risk)
  - Must comply with LFM - formal risk assessment, Risk Management Plan, Risk Register, contingency calculation
  - Approved by NSF
  - Generally for major up-grade sub-elements of Ops proposal
- Example?

§ 200.433 Contingency provisions

- (a) Contingency is that part of a budget estimate of future costs (typically of large construction projects, IT systems, or other items as approved by the Federal awarding agency) which is associated with possible events or conditions arising from causes the precise outcome of which is indeterminable at the time of estimate, and that experience shows will likely result, in aggregate, in additional costs for the approved activity or project. Amounts for major project scope changes, unforeseen risks, or extraordinary events may not be included.
- (c) Payments made by the Federal awarding agency to the non-Federal entity's "contingency reserve" or any similar payment made for events the occurrence of which cannot be foretold with certainty as to the time or intensity, or with an assurance of their happening, are unallowable, except as noted in § 200.431 Compensation—fringe benefits regarding self-insurance, pensions, severance and post-retirement health costs and § 200.447 Insurance and indemnification.

*Adapted from AACE International

Do you really mean Allowance not Contingency?

- Allowance*: Resources included in the basis of estimate for baseline cost estimates to cover the cost of known but as-of-yet undefined details or requirements for an individual WBS element. May be used when the level of project definition may not enable certain costs to be estimated definitively or times when it is simply not cost effective to quantify and cost every small item included with the WBS element, but reliable correlations are available.
- Past project experiences, demonstrated statistical correlation → Most likely costs
- Examples:
  - Preliminary Design – design or material take-off allowance
  - Small Items - Bolts, structural steel connections
  - Hand excavation/backfill (vs. machine excavation/backfill)

Questions?

- Kevin Porter
  - kporter@nsf.gov
  - 703-292-7484

Appendix D: Presentations

D.3 Wednesday May 3, 2017

Major Facility Innovations & Technology Transfers Discussion

- Can you think of examples where a technical problem was solved or a process need satisfied in a new or novel way that not only advanced the capabilities of the organization that developed it, but also the broader science community? These might include:
  - Working with your sponsoring institution(s) or with facility staff.
  - New product designs, metrology techniques, fabrication methods, test configurations, new data processing methods, different governance or funding structures, etc.
  - New to the facility, new to the scientific enterprise, new to the world, and/or considered "disruptive" innovation.
- Can you think examples where a contractor or sub-contractor moved their company or sector forward by advancing the "state-of-the-art" in order to meet a scientific or technical requirement?

Major Facility Innovations & Technology Transfers Discussion

- Does your facility track innovation activity in any way, such a patent applications or other methods?
  - If so, how and what does your organization look for?
- Is anyone at your facility familiar with NSF's Business R&D and Innovation Survey (BRDIS)?
- How could Recipients work with NSF to highlight the innovative nature of major Research Infrastructure (Similar to NASA's "Spinoffs" publications) in a way that does not add undue administrative burden?

"Management Fee to Fee"

2017 NSF Large Facilities Workshop Presentation

Jeff Lupis, Division Director
Division of Acquisition and Cooperative Support
Office of Budget, Finance, and Award Management
jlupis@nsf.gov (703) 292-7944

May 3, 2017

Presentation Outline:

- Strengthened NSF Business Practices
- Key findings of the NAPA Report on Business Practices
- Addressing NAPA's Recommendation on Management Fee
- Next Steps

Drivers for Strengthened Business Oversight Processes:

- Office of the Inspector General (OIG) Reports focusing on NSF's cost oversight policies and procedures
- Outside Stakeholder interest
- National Academy of Public Administration (NAPA) Report on NSF "Use of Cooperative Agreements to Support Large Scale Investment in Research"
- American Innovation and Competitiveness Act (AICA)
- NSF internal recognition that increased oversight (and documentation) is necessary given the high dollar value and complexity of these awards

Key Areas Strengthened:

- Increased pre-award cost analysis to establish the final award cost
- Increased review of Recipient accounting systems
- New requirements for submission of incurred cost information in a specified format (worksheet) to facilitate incurred cost audits
- New requirements to perform incurred cost audits during award performance (now impacted by AICA) and at award completion
- New fee policy
- Increased oversight on contingency estimating and use
- Increased use of independent cost assessments

Key Findings from NAPA Report:

- Academy Panel found that cooperative agreements are the appropriate mechanism to support NSF's development of large-scale research facilities
- Panel recognized the tremendous efforts NSF had undertaken during the prior year to implement new policies and practices that respond to the OIG and congressional concerns
- Panel stated that NSF needs to apply increased emphasis on internal management of the business practices critical to enhancing oversight and project success
- Full Report: http://napawash.org/images/reports/2015/NSF_Phase_2_Comprehensive_Report.pdf

Cooperative Agreements vs. Contracts for Facilities:

- Reference Federal Grant and Cooperative Agreement Act of 1977
- Cooperative Agreements appropriate for most NSF facility efforts:
  - ✓Work performed under the awards is not for the direct benefit and use of NSF, but rather the scientific community at large
  - ✓NSF does not construct/operate the facilities directly, but does retain oversight responsibilities (stewardship role)
- Antarctic Program is a notable exception where a contract is used, since work is performed for the direct benefit and use of the United States Government (supports NSF's responsibilities under the Antarctic Treaty)
- Fee policy for NSF cooperative agreements is set forth in Large Facilities Manual (LFM), while fee policy for contracts is set forth in the FAR

NAPA Recommendation to Eliminate Management Fee

- NAPA Report Recommendation 4.3 (pg. 47):
  - Objective: To eliminate the additional management burdens and potential for funding inappropriate expenses posed by management fee
  - Recommendation: NSF should eliminate the practice of including management fee in cooperative agreements in future projects
- NAPA recommended alternatives to providing management fee
  - NSF should consider addressing expenses as indirect costs or through use of award contingency
  - If necessary, NSF could request legislative authority to identify as allowable costs any significant expenses that would not qualify under this approach

Examples of Appropriate Uses of Management Fee

- Working Capital
- Facilities Capital
- Other ordinary and necessary expenses, such as:
  - ✓Contract terminations and loses
  - ✓Certain appropriate educational and public outreach activities
  - ✓University visitor support programs and student exchange programs
  - ✓Research activities valuable to the scientific pursuits of the organizations but not directly required to support funded programs
  - ✓Financial incentives to obtain and retain high caliber staff

NSF Actions to Address NAPA Recommendation

- NSF formed a task group with expertise to address viability and efficacy of implementing the NAPA Recommendation
  - Group organized in March 2016. Included expertise from NSF Program Offices, Business Functions, and Office of the General Counsel
  - Group considered a range of options to address expenses in addition to those recommended by NAPA
- NSF updated the NSB on progress at May 8-9 NSB Meeting
  - Analysis to date indicated that expenses could not be addressed as indirect costs or contingency
  - Allowing fee helps ensure competition among qualified organizations
  - NSF would continue to use management fee and complete the analysis of the policy's impacts

Final Findings of Management Fee Group

NAPA Finding: Address management fee expenses through indirect costs or contingency

NSF Response: Analysis confirms that expenses addressed through management fee cannot be effectively met through indirect costs or contingency

Other Findings:

- Eliminating management fee would disadvantage large facility awardees
- Eliminating management fee would have a detrimental effect on incentivizing highly qualified organizations from competing for large facility awards
- NSF's current management fee policy is administratively burdensome on both NSF and awardees
- Even current management fee guidelines do not completely eliminate the risk of funding questionable expenses
- NSF should more broadly consider other approaches to providing fee for these limited number of awards (9)

A note on "burden" and the impact on Recipients…

- Questionnaire provided to NSF Recipients receiving fee in March 2016
- Key inputs received by Recipients included:
  - ✓Importance of fee to organizations in order to efficiently manage awards
  - ✓Increased administrative burden and delays in timely determination of fee amounts
  - ✓Continued ambiguity and risk to organizations in interpreting appropriate fee expenses
  - ✓Negative impact on morale by reducing funding of legitimate low-cost but morale building expenses
  - ✓Disadvantages awardees compared to other organizations receiving higher fees for managing large facility awards under contracts

Options Considered by NSF (and briefed to NSB)

1. Adopt fee-types consistent with those typically provided in government contracting
2. Adopt fee-types consistent with those typically provided in government contracting, with additional guidelines to awardees including examples of inappropriate uses of fee. NSF retains authority to require reporting on fee expenditures
3. Continue use of the current NSF management fee policy
4. Continue use of the current management fee policy as a base fee, plus allow flexibility to add additional fee-types with the requirement for awardees to affirm that they will not use fee for prohibited purposes

Option Selected (briefed to NSB)

1. Adopt fee-types consistent with those typically provided in government contracting.
2. Adopt fee-types consistent with those typically provided in government contracting, with additional guidelines to awardees including examples of inappropriate uses of fee. NSF retains authority to require reporting on fee expenditures.
3. Continue use of the current NSF management fee policy.
4. Continue use of the current management fee policy as a base fee, plus allow flexibility to add additional fee-types with the requirement for awardees to affirm that they will not use fee for prohibited purposes.

Next Steps:

- NSF will "adopt fee types consistent with those generally provided in federal government contracting" which includes considering policies in FAR 15.4 on use of a structured approach for determining fee ("weighted guidelines" weights and factors)
- NSF will update guidelines to awardees including examples of inappropriate uses of fee
- NSF will continue to require separate tracking of fee expenses
- NSF will continue to retain authority to consider reductions in fee for non-compliance with guidelines

Next Steps:

- NSF has already updated the Large Facilities Manual to reflect the new policy
- NSF will issue revised implementing procedures and an updated award provision
- NSF will perform additional outreach with Stakeholders and Recipients
- NSF will ensure compliance with AICA
- NSF will address timing issues for roll out of the new policy

National Science Foundation
OFFICE OF BUDGET FINANCE & AWARD MANAGEMENT

NSF Large Facilities Workshop 2017

Distributed Networks & Facilities Roundtable

Facilitator:
Rob Hengst
NSF Large Facilities Advisor

Session Information:
Wednesday
May 3rd, 2017
9:20am – 10:20am

Distributed Networks & Facilities

- Example Facilities:
  - National Ecological Observatory Network (NEON)
  - Geodesy Advancing Geosciences and Earthscope (GAGE)
  - Seismological Fac's for the Advancement of Geoscience & Earthscope (SAGE)
  - Ocean Observatories Initiative (OOI)
  - Academic Research Fleet
- Distributed Network & Facility Topics:
  - Centralized procurement
  - Cyber infrastructure
  - Site facilities maintenance
  - Personnel/staffing
  - Parts/storage

Centralized procurement:

- Sample topic ideas:
  - What threshold do you use to set procurement authorities?
  - Is there a trigger which signals centralized procurement versus local?
    - Dollar amount?
    - Quantity?
  - If local procurement exists, what training is done for those employees working around the country, and not at recipient's headquarters?
  - Anything else you find pertinent to the topic?

Cyber infrastructure:

- Sample topic ideas:
  - What level of cyber infrastructure is controlled locally versus centrally?
  - Any network or data product issues with remote sites?
  - Were there any CI challenges experienced during construction on distributed sites?
  - At what level do data back ups occur?
  - How much training do local employees receive concerning maintaining CI equipment and systems?
  - Anything else you find pertinent to the topic?

Site facilities maintenance:

- Sample topic ideas:
  - How are facilities maintenance needs and activities tracked across the network of the large facility?
  - Are maintenance contracts set up centrally, to be performed by local affiliates near sites?
  - Are local recipient employees entering into local maintenance agreements?
  - What emergency facilities maintenance plans, contracts, etc does your organization have in place to respond quickly (to expediently restore data gathering and distribution)?
  - Anything else you find pertinent to the topic?

Personnel & staffing:

- Sample topic ideas:
  - What are the challenges associated with hiring into a distributed project during operations?
  - Are there any span-of-control issues concerning personnel/staffing particular to a wide-scale distributed project?
  - How do you keep widely-distributed employees 'connected' to the overall mission and vision of the organization?
  - Are there any additional personnel safety and security issues connected with distributed operations?
  - Anything else you find pertinent to the topic?

Parts & storage:

- Sample topic ideas:
  - How are decisions made to store spare parts at various locations?
    - Centrally stored and maintained
    - Regionally stored and maintained
    - Locally stored and maintained
  - How are controls and good stewardship of property and spares instilled across the widely distributed network and facility?
  - How are you measuring parts availability versus up-time for critical pieces of equipment across the distributed network?
  - Are self-storage contracts set up centrally, to be utilized by distributed employees locally near sites?
  - Anything else you find pertinent to the topic?

Richard Leonard
Battelle Ecology
May 3, 2017

National Ecological Observatory Network (NEON)

NEON as a Distributed Network

81 field sites

- 47 terrestrial
- 34 aquatic

Located in **24** STATES (plus Puerto Rico)

Approximately **180** DATA PRODUCTS

NEON is scheduled to complete construction and fully transition to operations in 2018.

Instrumentation and People

- Instrumented systems
  - Connected to central data architecture in Boulder
  - Centrally monitored/locally maintained
- Observational systems
  - Local staff
  - Soil/Vegetation
  - Mammals/Insects
  - Experience/Training/Partners

Quality Systems

- NEON Project Specific Plans
- Organization Externally Audited Quality Systems
  - ISO-9001, Management Systems
  - ISO-17025, Calibration
- Data Quality/Data Confidence
  - 1000's of external users
- Training, 200 new field staff every year
- Consistency across 5000 miles

ISO 9001

ISO 17025 ACCREDITED LABORATORY

Distributed Procurement

- Decentralizing
  - E-Procurement
    - Local domain staff are able to order materials and field supplies under $3,000, once their requisition is reviewed and approved by the appropriate Control Account Manager (CAM)
  - Controls Costs
  - Improve Responsiveness
- Risk Mitigations
  - Audits
  - Central Review

coupa

neon National Ecological Observatory Network | BATTELLE It can be done

National Ecological Observatory Network is a project sponsored by the National Science Foundation and operated under cooperative agreement by Battelle.

720.746.4844 | neonscience@BattelleEcology.org | www.battelle.org/neon

UNAVCO

Centralized procurement:

- What threshold do you use to set procurement authorities? – *varies by position, most employees up to $1,000; unless preauthorized travel*
- Is there a trigger that signals centralized procurement versus local?
  - *$1,000 (unless related to pre-approved travel & travel budget)*
  - *Project Managers approve up to $5,000; Purchasing agent acquires*
  - *$5k - $ 25k: Director approves; Purchase Order required*
  - *Quantities Cannot be artificially disaggregated to evade limits*
  - *Over $25,000 President approves*
  - *Board review delegation annual*
- Regional staff: *PMs and up - biannual face-to-face training R/A/A*
- Anything else you find pertinent to the topic?

Cyber infrastructure:

- What level of cyber infrastructure is controlled locally versus centrally? *Only laptops and station communications are decentralized*
- Any network or data product issues with remote sites? *Mostly only when third party Internet providers fail; duplicate connections do not protect against a local cable severed*
- Were there any CI challenges experienced during construction on distributed sites? *Each of the 1,100 sites have a cost-optimized solution – land line, cell modem, radio shot hubs*
- At what level do data back ups occur? *Sample rate-dependent ring buffers onboard GPS receivers; two independent backup strategies at archive*
- Employee CI training do local employees receive? *Any appraisal- or supervisor-vetted professional development fully supported*

Site facilities maintenance:

- Sample topic ideas:
  - How are facilities maintenance needs and activities tracked across the network of the large facility? *Site monitoring, data flow, State of Health, site logs.*
  - Maintenance contracts central or local affiliates near sites? *For PBO, regional staff perform routine and responsive maintenance. For community/international networks – partnerships are leveraged.*
  - Are local recipient employees entering into local maintenance agreements? *No. Agreements are all negotiated & vetted centrally*
  - What emergency facilities maintenance plans, contracts, etc does your organization have in place to respond quickly (to expediently restore data gathering and distribution)? *Varies with capability and diminished funding. Transitioning to best effort basis with cuts.*

Personnel & staffing:

- Sample topic ideas:
  - What are the challenges associated with hiring into a distributed project during operations?
  - Are there any span-of-control issues concerning personnel/staffing particular to a wide-scale distributed project?
  - How do you keep widely-distributed employees 'connected' to the overall mission and vision of the organization?
  - Are there any additional personnel safety and security issues connected with distributed operations?
  - Anything else you find pertinent to the topic?

Parts & storage:

- spare parts?
  - Two major regional offices and satellite offices include storage
  - Trucks are uniformly outfitted and interchangeable
  - Other regions have storage unit stashes, near airports if needed
- How are controls and good stewardship of property and spares instilled across the widely distributed network and facility?
- How are you measuring parts availability versus up-time for critical pieces of equipment across the distributed network?
- Are self-storage contracts set up centrally, to be utilized by distributed employees locally near sites?
- Anything else you find pertinent to the topic?

U.S. DEPARTMENT OF ENERGY | Office of Science

DOE Office of Science User Facilities

NSF Large Facilities Office Annual Workshop

May 3, 2017

Benjamin L. Brown, Ph.D.
Senior Science and Technology Advisor

ben.brown@science.energy.gov

Outline

- Background on the user facilities
- Our journey to create a corporate framework
- Early gains
- Acknowledgement: my colleague, Mariam Elsayed, has been a key to this work

SC = "Office of Science"

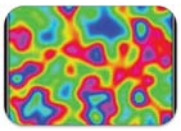
The Journey

- We defined "user facility."
- We defined "user."
- We learned how each facility counts users.
- We built a database of users ("user statistics").
- We built tools to show others.

Office of Science FY 2016: $5.35B

Dr. Murray slide

Largest Supporter of Physical Sciences in the U.S.*



Research: 42%, $2.2B

~40% of Research to Universities

> 22,000 Scientists Supported

Funding at >300 Institutions including all 17 DOE Labs

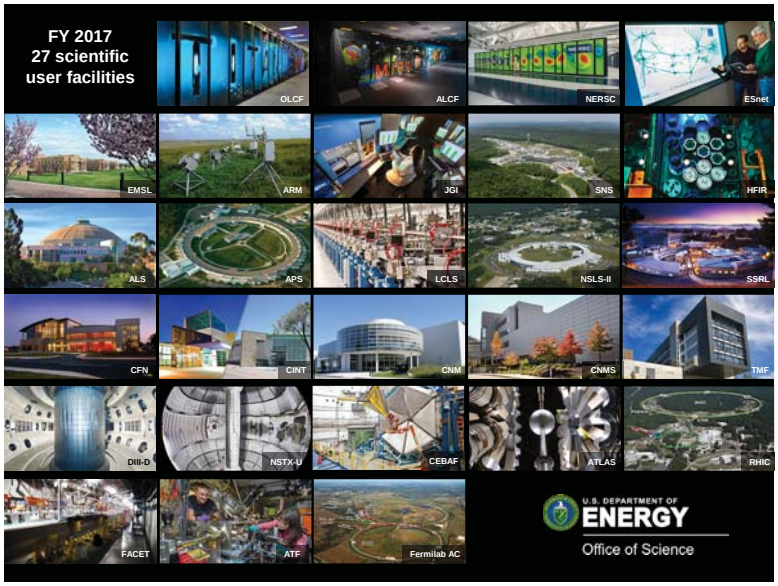
Construction: 13.5%, $723M

Facility Operations: 38%, $2.02B

>33,000 Scientific Facility Users**

* 43% of all physical sciences, 30% of computer science and math

** from all 50 states and DC



A user facility is a federally sponsored research facility available for external use to advance scientific or technical knowledge under the following conditions

Open

The facility is open to all interested potential users without regard to nationality or institutional affiliation.

Accessible

The facility provides resources sufficient for users to conduct work safely and efficiently.

Competitive

Allocation of facility resources is determined by merit review of the proposed work.

Unique

The facility capability does not compete with an available private sector capability.

Free

User fees are not charged for non-proprietary work if the user intends to publish the research results in the open literature. Full cost recovery is required for proprietary work.

Collaborative

The facility supports a formal user organization to represent the users and facilitate sharing of information, forming collaborations, and organizing research efforts among users.

Communicating the Story of the User Facilities

The Long Game

"I have constituents who depend on our national labs."

"Your state/district has a national lab and mine doesn't."

Challenges to Telling the Story of the User Facilities

- No corporate data on the users
- Heterogeneous portfolio
- Complex institutional relationships

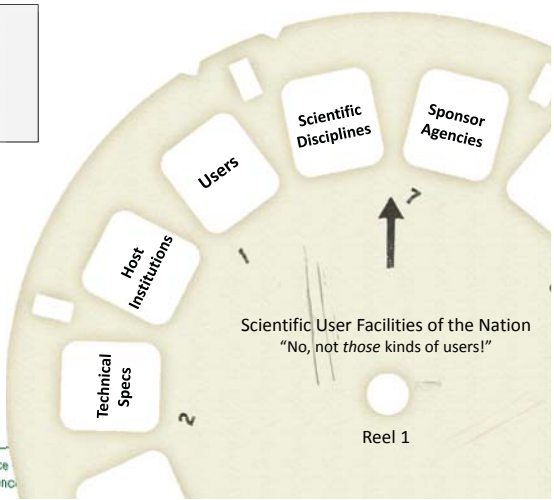
SC's Cognizance Challenge

Grantee

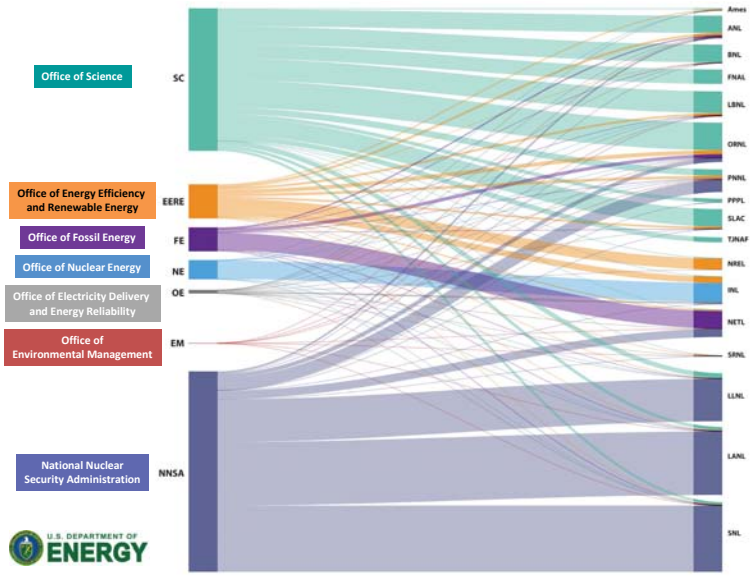
Facility user

User Facility

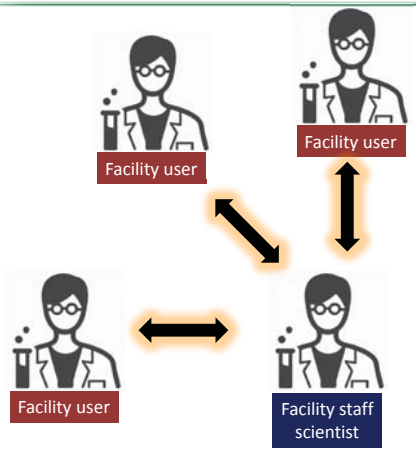
Telling the whole story is challenging



Telling the whole story is challenging



User Facilities are hubs

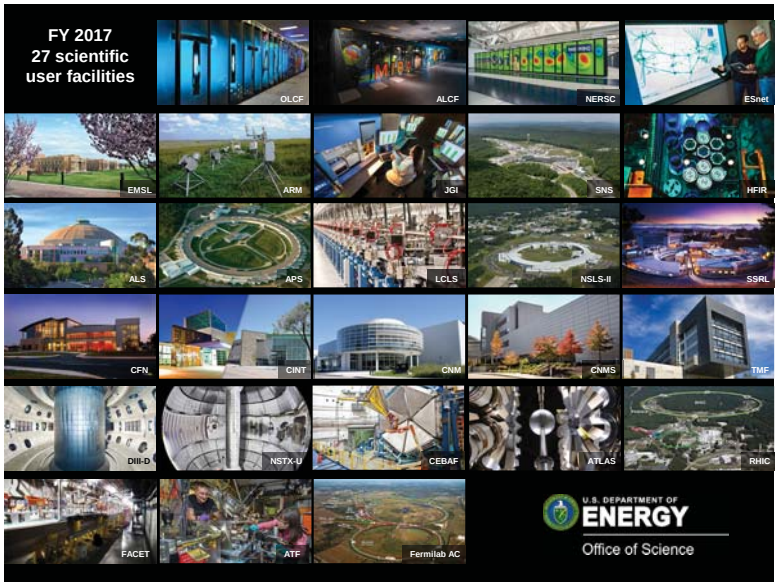


Discovery
new science across disciplines

Service
National Laboratories

Collaboration
hub for new connections

Vigor
pace and youth



Why user statistics matter

- Telling the story of the user facilities
- Understanding how science is done, and how it is evolving
- **Let's go back in time to 2013**

Defining and counting users

- **Goals:**
  - understand and articulate the spectrum of user activity
  - check veracity of current practices (overcounting?)
  - identify gaps and opportunities (undercounting?)
  - improve transparency for facilities and stewards
  - respect historical data streams
  - avoid unfunded mandates/logistical nightmares for facilities

Strike a balance between

- creating a system for rigorous, historical, sortable corporate user statistics (inspired by BES experience with the synchrotrons)

and

- providing flexibility to facilities and stewards.

… and it has to work for all 31 SC user facilities

A note about process

Formed federal working group and defined "user facility" [2011]

Initial working group discussions / draft user definition [spring/summer 2012]

Information call to the SC user facilities [Aug-Sept 2012]

Refinement and vetting within the Office of Science [Late 2012 – early 2013]

Defining and counting users

Outcome:

- a high-level **definition** applicable to all SC user facilities that defines three categories of user: On-Site, Remote, Data

coupled with

- a set of more detailed **"practices statements"** that explain the user statistics collection practices specific to each facility, or class of facilities.

  The stewards – the SC Science Programs – are the authors of these statements.

The high-level definition (applies to all SC user facilities)

A user is an individual or a member of a research team who is granted access to resources at a user facility through an approved peer-reviewed proposal. An individual is counted as a user only once for a given facility in a fiscal year.

Each user of a scientific user facility is reported annually in one of three hierarchical subcategories:

- **On-Site User** – an individual who is physically present at the facility at least once during the fiscal year.
- **Remote User** – an individual who remotely accesses the facility at least once during the fiscal year.
- **Data User** – an individual who remotely accesses data from an electronic archive supported by the facility at least once during the fiscal year.

Footnotes to the high-level definition

- A user need not be specifically named on the proposal; for example, personnel who join a research project after the proposal is approved are eligible to be counted as users. Individuals who pay for non-research specialty services and who are not covered by an approved peer-reviewed proposal or who visit the facility for tours or educational purposes are not counted as users. Accreditations to research "outputs" such as author lists of resultant publications or patents from work at the facility are not an acceptable basis for counting users.
- Each individual is counted as only one user per facility per fiscal year regardless of how much work they perform or the number of projects with which that user is associated. An individual who utilizes more than one Office of Science user facility may be counted by each facility. There is no expectation that user facilities will share or compare user databases. For most, but not all, facilities the annual reporting period is the fiscal year.
- Reporting of a user who qualifies in more than one subcategory should resolve to the "higher" subcategory. For most, but not all, facilities On-Site trumps Remote and Data, and Remote trumps Data.

Practices statements (tailored)

Each practices statement contains two sections:

- **Capabilities provided to users:**

  A summary description that provides context for the typical ways that users interface the facility. The description includes:
  - a short summary of the science that the facility enables
  - the defining physical characteristics of the facility that inform how individuals utilize the facility
  - the mode(s) in which it is utilized, including whether users work in series or in parallel
  - a summary of the differences between the types of users.

- **Methods of acquiring user statistics:**

  A description of how the facility counts the three categories of user: On-Site, Remote, and Data. In some instances the description includes the logistical criteria by which the facility counts users (e.g., through execution of a user agreement and completion of safety training).

Practices statement for all BES user facilities

- **On-Site User:** An individual who is physically present at the facility to conduct research on an approved research proposal.

  The facility shall count each user who has completed registration, training, safety documentation, has a valid user agreement, and has a badge that facilitates tracking.

- **Remote User:** An individual who has been granted the authority to remotely produce data through computer access, or by shipping samples to facility scientists for data measurements, or by receiving custom-manufactured materials, tools, or devices from the facility scientists because the facility has unique or unusual capabilities to fabricate.

  The facility shall count each user who has completed registration, obtained required permissions for remote access, has a valid user agreement, and submitted an experiment safety form.

- **Data Users:** N/A. None of these facilities generate electronic data archives that would be utilized by the external community. An individual who reduces and/or analyzes data and who is neither an On-Site nor a Remote User is not counted as a Data User.

Practices statements: example of tailoring

All BES user facilities

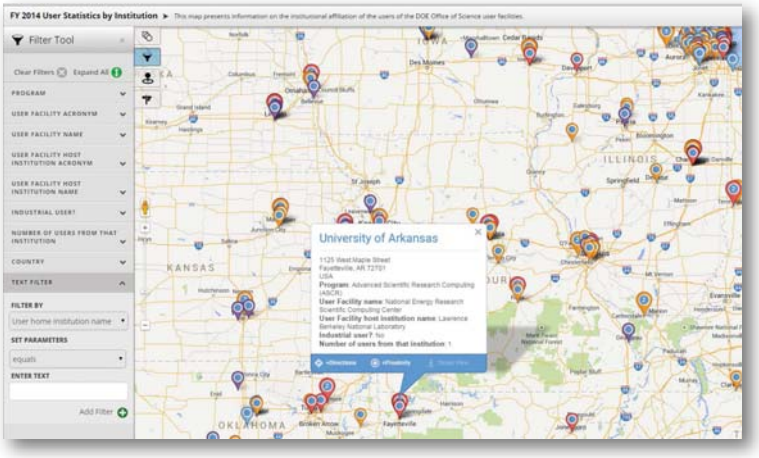
- **Remote User:** An individual who has been granted the authority to remotely produce data through computer access**, or by shipping samples to facility scientist for data measurements, or by receiving custom-manufactured materials, tools, or devices from the facility scientists because the facility has unique or unusual capabilities to fabricate.**

All NP user facilities

- **Remote User:** An individual who has been granted the authority to remotely produce data through computer access **or who has developed equipment or software at their home institution that plays a role in the production of data during the experiment.**

Results and Early Gains

You can explore interactive maps of SC grantees and facility users on our website



National Lab Day on the Hill
April 20, 2016

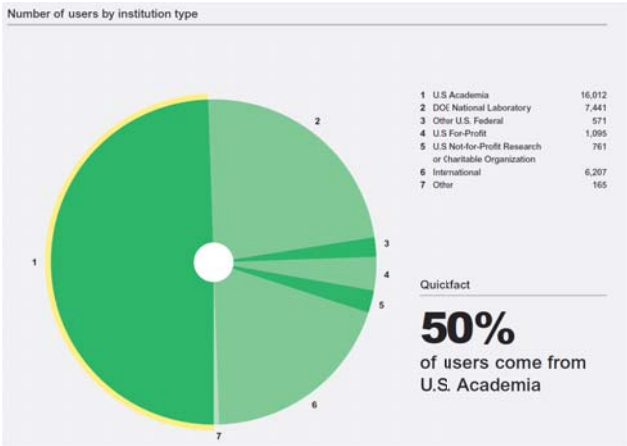
National Lab Day on the Hill
April 20, 2016

Office of Science User Facilities Summary Report, FY 2015

http://science.energy.gov/user-facilities

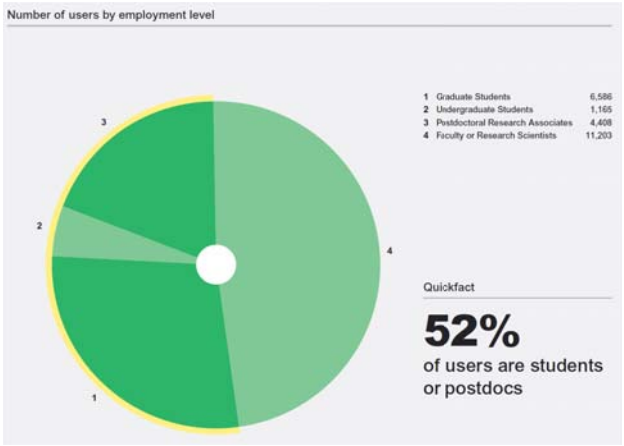
First ever corporate user/project level data!

Number of Users by Institution Type



Number of Users by Employment Level

Note: users for whom this information was not reported were omitted from this analysis

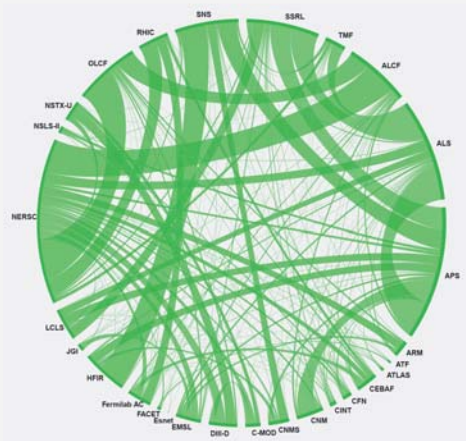


User Projects with Support from One or More Federal Agency

Industrial Institutions

User Crossover Among SC User Facilities, FY 2015

The width of the ribbon connecting two facilities corresponds to the number of users who utilized both of those facilities



Quickfact

3,000+
users performed research at two or more facilities in FY 2015

The Journey:

Led by the Federal sponsors, collaborating and listening to the experts on the ground

- We defined “user facility.”
- We defined “user.”
- We learned how each facility counts users.
- We built a database of users.
- We built tools to show others.

Thank you!

Questions?

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2017 NSF Large Facilities Workshop

Incurred Cost Audits and the Large Facilities Financial Data Collection Tool

May 3, 2017

Eddie Whitehurst, Deputy Branch Chief, *Cooperative Support Branch*

Goal and Objectives of Today's Presentation

To provide additional background and context for the Incurred Cost Audit requirements and the Large Facilities Financial Data Collection Tool:

- Why must an Incurred Cost Audit be performed?
- What are the requirements and due dates?
- What, When and Where is the Large Facilities Financial Data Collection Tool and How do you use it?

Incurred Cost Audit

Big Picture on Audits?

- The purpose of Audits are to provide prudent oversight for those responsible for the effectiveness, efficiency, and economy of the recipients' operations and the use of Federal funds.
- Recipients should be prepared for such an audit at any time based on 2 CFR 200.205-7 of the Uniform Administrative Requirements, Cost Principles and Audit Requirements for Federal Awards and as stated in the terms and conditions in the Cooperative Agreement.

Incurred Cost Audit

What is an Incurred Cost Audit?

- Incurred Cost Audits determine whether costs are reasonable, applicable to the award, determined under generally accepted accounting principles and not prohibited by the award, by statute or regulation, or by previous agreement with, or decision of, the Grants and Agreements Officer.
- Incurred cost audits are usually performed by an independent third party auditor.

Incurred Cost Audit

Why must an Incurred Cost Audit be performed at NSF?

- The NSF Office of Inspector General issued a series of OIG Alert Memos identifying concerns associated with NSF's management of large facility cooperative agreements.
- The American Innovation and Competitiveness Act (AICA) is a United States federal law enacted in 2017, which requires new oversight rules of NSF major multi-user research facility projects.
- NSF updated the Large Facilities Manual to address new requirements.

Incurred Cost Audit

What are the requirements?

- NSF will conduct an incurred cost audit for large facility awards above $100M.
- The audit will occur at least once during construction at a time determined based on risk analysis and length of the award.
- The length of time between audits may not exceed 3 years; and an audit must be performed at the completion of the construction phase.
- An audit can occur during operations based on risk analysis.
- An audit must be performed at the completion of the award.
- Recipients must submit annual financial expenditures on CAs and CSAs using the Large Facilities Financial Data Collection Tool.

Incurred Cost Audit

How does NSF determine Risk?

- The Uniform Administrative Requirements require that all agencies awarding cooperative agreements, must have in place a framework for evaluating the risks posed by applicants before they receive Federal awards.
- NSF staff will review a recipient's financial stability; quality of management systems and ability to meet the management standards; to effectively implement statutory, regulatory, or other requirements imposed and history of performance.
- Annual risk assessments are now captured as part of NSF's Coordination of Administrative Business Reviews.

Preparation for Incurred Cost Audit

Why the Large Facilities Financial Data Collection Tool?

- The Large Facilities Financial Data Collection Tool, was created by NSF to assist recipients in preparing and recording financial expenditure information for its cooperative agreements for large facilities.
- This tool is required for submission of the financial expenditure data.
- The Large Facilities Financial Data Collection Tool is a macro-enabled Excel workbook that provides recipients a single, standardized method for submitting direct and indirect expenditure data.
- The tool will enable NSF and independent auditors to more easily and consistently review the required financial data.

Large Facilities Financial Data Collection Tool

What does the Large Facilities Financial Data Collection Tool provide?

- It assist recipients in submitting substantiated program expenditures for construction and operations and management costs for its large facility cooperative agreements and cooperative support agreements over $100 million.
- It assists auditors by providing basic information about the recipient and the award which include; institutional data, award data, annual expenditures, sub-awards, sub-contracts and consultants.

Large Facilities Financial Data Collection Tool

When do recipients submit the required financial expenditures using the Large Facilities Financial Data Collection Tool?

- Recipients must submit the Large Facilities Financial Data Collection Tool annually to their cognizant Grants Officer 60 days after the end of the current funding year (current performance period).
- If based on Risk, the Terms and Conditions of the award or during a scheduled Incurred Cost Audit the recipient may need to submit more frequent financial expenditures using the Large Facilities Financial Data Collection Tool.

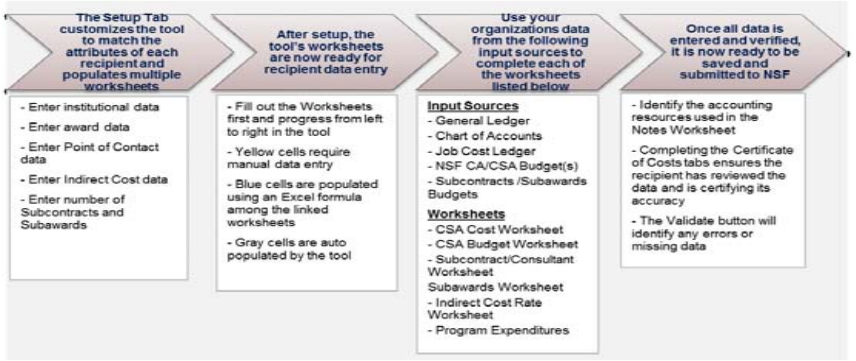
Large Facilities Financial Data Collection Tool

Where can information on Incurred cost audits and the Large Facilities Financial Data Collection Tool be found?

- Large Facilities Manual, Section 4.5.3.4 Incurred Cost Audits
  https://www.nsf.gov/pubs/2017/nsf17066/nsf17066.pdf

- The Large Facilities Financial Data Collection Tool can be viewed on both the Large Facilities Office and the Cooperative Support Branch public webpage:
  https://www.nsf.gov/bfa/lfo/lfo_documents.jsp
  https://www.nsf.gov/bfa/dcca/csb/index.jsp

Large Facilities Financial Data Collection Tool



CTSC

CENTER FOR TRUSTWORTHY SCIENTIFIC CYBERINFRASTRUCTURE

The NSF Cybersecurity Center of Excellence

The NSF Cybersecurity Center of Excellence: Current and Future Large Facilities Impacts

James A. Marsteller

NSF Large Facilities Workshop
May 3rd 2017

trustedci.org

NSF Cybersecurity Center of Excellence (CCoE)

CTSC began with a 3-year NSF grant in 2012.

Re-funded in 2015 for 3 years by ACI/OAC Cybersecurity Innovation for Cyberinfrastructure (CICI) solicitation.

3. Cybersecurity Center of Excellence

NSF-funded cyberinfrastructure presents unique challenges for operational security personnel. The research environment is purposefully built as an "open" one, in which data is freely accessed among collaborators. As such, sites, centers, campuses and institutions that host cyberinfrastructure must find the right balance of security, privacy and usability while maintaining an environment in which data are openly shared. Many research organizations lack expertise in technical and policy security and could benefit from an independent, shared security resource pool.

A Cybersecurity Center of Excellence must:

- Provide leadership to the NSF research community in the continuous building and distribution of a body of knowledge on the topic of trustworthy cyberinfrastructure;
- Conduct security audits and security architecture design reviews for projects at multiple scales, from large Major Research Equipment and Facilities Construction (MREFC) projects to small CI developments;
- Ensure adoption of security best practices in the NSF research community;
- Provide situational awareness of the current cyber threats to the research and education environment, including those that impact scientific instruments;
- Develop a threat model (or multiple threat models if appropriate), identifying the vulnerabilities in NSF-funded cyberinfrastructure and scientific data associated with that cyberinfrastructure and recommending countermeasures to protect the systems; and
- Host an annual workshop in addition to meetings, seminars, training and other events in order to interact with members of the NSF community, industry, government and academia who wish to collaborate on projects and other initiatives.

http://www.nsf.gov/pubs/2015/nsf15549/nsf15549.htm

http://trustedci.org/who-we-are/

CENTER FOR APPLIED CYBERSECURITY RESEARCH INDIANA UNIVERSITY

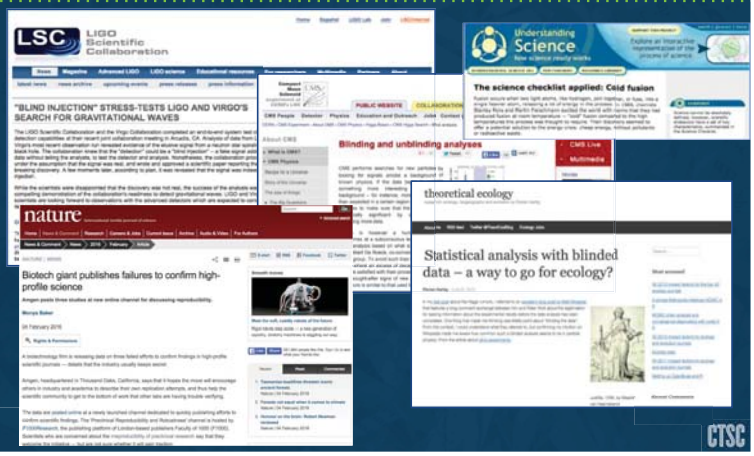
NCSA

PITTSBURGH SUPERCOMPUTING CENTER

THE UNIVERSITY OF WISCONSIN MADISON

NSF

Why Cybersecurity Matters? Trusted and Reproducible Science



Caution: "Our data is public" doesn't save the day

Reputation, trust, and other "intangibles" matter.

Integrity and availability of data

Illicit use of systems

Availability of instruments

Hacktivism

Etc.

Center for Trustworthy Cyberinfrastructure The NSF Cybersecurity Center of Excellence

Mission

Provide the NSF community a coherent understanding of cybersecurity's role in producing trustworthy science and the information and know-how required to achieve and maintain effective cybersecurity programs.

Vision for the NSF Science Community

1. For the NSF science community to understand fully the role of cybersecurity in producing trustworthy science.
2. For all NSF projects and facilities to have the information and resources they need to build and maintain effective cybersecurity programs appropriate for their science missions, and responsive to evolving risks and requirements.
3. For all NSF Large Facilities to have highly effective cybersecurity programs.

CCoE Thrusts

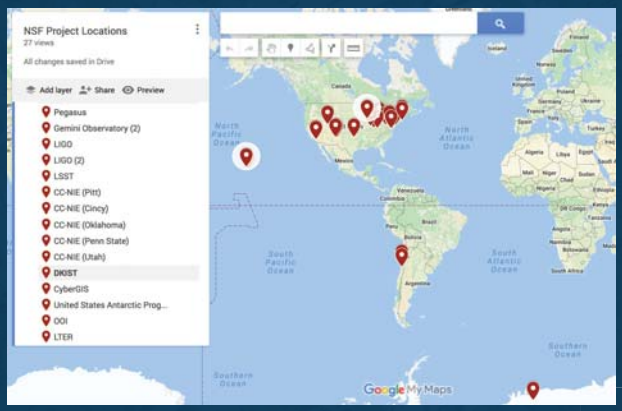
Building Community
NSF Cybersecurity Summit, Monthly Webinars, Blog, Email Lists, Partnerships, Benchmarking Survey, LFs Security WG

Sharing Knowledge
Guide to Developing Cybersecurity Programs for NSF Science and Engineering Projects, Identity Management Best Practices, Situational Awareness, Training, OSCRP

Collaboration to Tackle Challenges: Engagements (LFs)
LIGO, SciGaP, IceCube, Pegasus, CC-NIE peer review, DKIST, LTERNO, DataONE, SEAD, CyberGIS, HUBzero, Globus, LSST, NEON, U. Utah, PSU, OOI, Gemini, Array of Things, IBEIS, SciGaP, US Antarctic Program...

More information at trustedci.org

CCoE Engagement Map



http://trustedci.org/application

Demand outpaces Supply: March 17th Deadline for 2017Q3-4 engagements.

Activities Impacting the NSF Large Facilities

NSF Large Facilities:

Orange: CTSC Past Engagee

Academic Research Fleet ARF
Antarctic Infrastructure Modernization for Science AIMS
Arecibo Observatory AO
Atacama Large Millimeter/submillimeter Array ALMA
Cornell Laboratory for Accelerator-based Science and Education CLASS
Daniel K. Inouye Solar Telescope DKIST
Gemini Observatory GEMINI
Geodetic Facilities for Advancement of Geoscience & EarthScope GAGE
Green Bank Observatory GBO
IceCube South Pole Neutrino Observatory IceCube
JOIDES Resolution International Ocean Discovery Program JOIDES
Large Hadron Collider LHC
Large Synoptic Survey Telescope LSST
Laser Interferometer Gravitational-Wave Observatory LIGO
Long Term Ecological Research Network LTER
National Center for Atmospheric Research NCAR

Green: Need to Connect

National Ecological Observatory Network NEON
National Geophysical Observatory for Geoscience NEGO
National High Magnetic Field Laboratory NHMFL
National Nanotechnology Coordinated Infrastructure NNCI
National Nanotechnology Infrastructure Network NNIN
National Optical Astronomy Observatory NOAO
National Radio Astronomy Observatory NRAO
National Solar Observatory NSO
National Superconducting Cyclotron Laboratory NSCL
Natural Hazards Engineering Research Infrastructure NHERI
Ocean Observatories Initiative OOI
Polar Facilities and Logistics
Seismology Facilities for Advancement of Geoscience & EarthScope SAGE

Large Facilities Security Working Group

Proposed to FacSec 9/2016 - " To develop a relationship between those responsible for cybersecurity across the LFs and to advance the development and implementation of best practices, standards and requirements within the CI community."

- First meeting on January 26th 2017
  - Attended: Ice Cube, CMS, LIGO, LSST, NHMFL NOAO
  - Established LF Security mailing list
- Monthly calls
- Develop lines of Communication / Build Community

Large Facilities Security Working Group

Current Goals:

- Provide critical input on LF software requirements for software producers.
- LF participation in CCoE Situational Awareness initiative (90% by LFs by 2019).
- Increase CTSC's awareness of current issues, challenges, and successes at the LFs.

Large Facilities Security Working Group

Current Goals:

- Build consensus so we can, where feasible, communicate with a unified voice.
- Engage LF Security working group for input on the Guide, Community Survey, Training needs and other topics as needed.
- Provide feedback and input on the Cybersecurity subsection of the large facilities manual.

Large Facilities Security Working Group

USAP		NCAR	Jose Castilleja
Arecibo		NHERI	Nathaniel Mendoza
Academic Fleet		NEON	Tom Gulbransen, Rick Fransworth
CHESS		SAGE	
Green Bank		GAGE	
Gemini	Chris Morrison	NHMFL	Peter Jensen
Ice Cube	Steve Barnet	NNCI	
IODP (Joides Resolution)		NOAO	Steve Grandi
LBO		NRAO	Patrick Murphy
LHC/ATLAS		NSCL	
LHC/CMS	Mine Altunay	NSO	Eric Cross, Shawn Granen
LIGO	Randy Trudeau	OOI	Juan jose Villalobos, Ivan Rodero
LSST	Alex Withers		

NSF Cybersecurity Summit

- Inaugural summit in 2004 in response to cyber attack affecting many NSF funded projects
- CTSC Relaunched Summit in 2013 after 4 year hiatus
- Opportunity for CI, MREFCs to collaborate: solve common challenges, develop best practices, share experiences/knowledge, training sessions
- Who: NSF POs, LF leadership, Researchers, IT staff
- Help to address the changing threat landscape for NSF CI

NSF Cybersecurity Summits

- 2016 Summit
  - 98% of respondents selected "Good" or "Excellent."
  - Best CFP response to date (19 proposals)
  - Summit Report published to community on http://trustedci.org/2016summit
- 2017 Summit
  - Dates selected: August 15-17
  - CFP and Student Program Announced
  - 2018 Summit in Alexandria

2017 Summit Call For Participation (CFP)

Now accepting community proposals:

- Plenary Presentations
- Training Sessions
- Table Talk Sessions
- Student Program
- CFP Deadline June 5th

Seeking CFPs addressing:

- Lessons Learned
- Budgeting for Cybersecurity
- Cybersecurity Metrics
- Risk Acceptance Practices
- Software Assurance

Email CFPs (1-5 pages) to CFP@trustedci.org
More information: http:/trustedci.org/2017-nsf-cfp/

2017 NSF Cybersecurity Summit:

August 15-17, 2016 - Arlington, Virginia

http://trustedci.org/summit

Software Security

- Generally: Feedback from Large Facilities to CI development community would be useful.
  - What services would be useful?
  - How can they be developed to be most useful?
- Community standards for production software development are lacking, particularly for security.
  - E.g. assurance, patching, testing
- CTSC will convene Large Facilities and software developers (e.g. SI2) to determine reasonable expectations for production software security.

Situational Awareness

Advise NSF CI community about relevant software vulnerabilities and provide guidance on mitigation.

Leverage NIST, US-CERT, XSEDE, REN-ISAC, and other sources of vulnerability information.

Currently eight identified Large Facilities subscribed.

http://trustedci.org/situational-awareness/

Cybersecurity Guidance for Large Facilities

- NSF Large Facilities Manual currently has minimal guidance on cybersecurity (Section 5.3)
  - https://www.nsf.gov/bfa/lfo/lfo_documents.jsp
- CTSC drafted guidance based on our engagements with Large Facilities
- Have shared with NSF Large Facilities Office. Will share with Large Facilities Security WG and broader community.
- Guidance is freely available for use by Large Facilities and NSF LFO.

NSF Community Cybersecurity Benchmarking Survey

trustedci.org/survey

Goal: To produce a report on the aggregated state of cybersecurity across the community and track the improvement of that state over time.

Plan to repeat annually with community support.

Nine large facilities responded in 2016.

NSF Community Cybersecurity Benchmarking Survey Findings:

- Security budgets: Large Facilities range from 0.02% - 1.5% of annual budget.
- Big projects range from 0.25% - 4.58% of annual budget
  - Average cybersecurity budget as a percentage of IT budget sits at the low end of the average values found in industry.
- Few respondents produce inventories of critical systems or use data classification scheme.
- Most respondents with annual budgets above $1M detected cybersecurity incidents in past year (Large Facilities - 7 of 9)

NSF Community Cybersecurity Benchmarking Survey Findings:

- Large Facility respondents indicate a greater concern than respondents in the other categories for threats of sabotage or other events affecting availability of critical systems.
- All respondents reported that they develop software in house.
- Nearly all respondents undertake some cybersecurity policy development. However, several respondents, including 3 of 16 with >$1m dollar budgets, do not employ a framework or identified guidance resource to help shape the cybersecurity program.
- Many projects do not have process for accepting residual information security risk.

What programmatic cybersecurity safeguards has your project or facility implemented?

	All	Large Facilities	Big	Small
Maturity Models	2	1	1	0
Strategy, policy or plan	11	7	3	1
Documented standards or baselines	12	7	4	1
Risk assessments	11	7	4	0
Inventory critical assets	9	5	3	1
Monitor security intelligence	7	4	3	0
Cyber incident response plan	12	8	3	1
Improvement roadmap	8	5	3	0
Data classification	8	5	3	0
Periodic awareness training	9	6	2	1
Disaster recovery plans	12	7	4	1
Governance structure	8	6	2	0
External review	8	5	2	1
None	8	0	0	8

NSF Community Cybersecurity Benchmarking Survey

Looking ahead, CTSC will use this report to fuel discussions and inform its services. Moreover, we will look for community feedback on whether to conduct a survey in 2017 and, if so, how to improve it.

View the complete community cybersecurity survey report: http://hdl.handle.net/2022/21355

Staying in contact with the CCoE

Join our email lists for discussions and updates:
http://trustedci.org/ctsc-email-lists/

Blog: http://blog.trustedci.org/

Twitter: @TrustedCI

CTSC
CENTER FOR TRUSTWORTHY SCIENTIFIC CYBERINFRASTRUCTURE
The NSF Cybersecurity Center of Excellence

Thank You

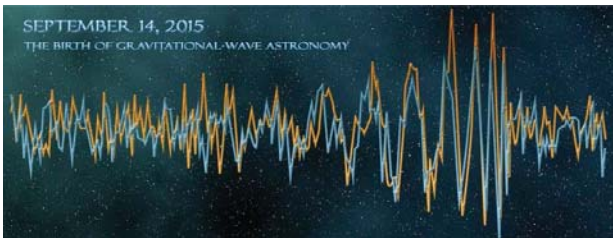
trustedci.org

We thank the National Science Foundation (grant 1547272) for supporting our work.

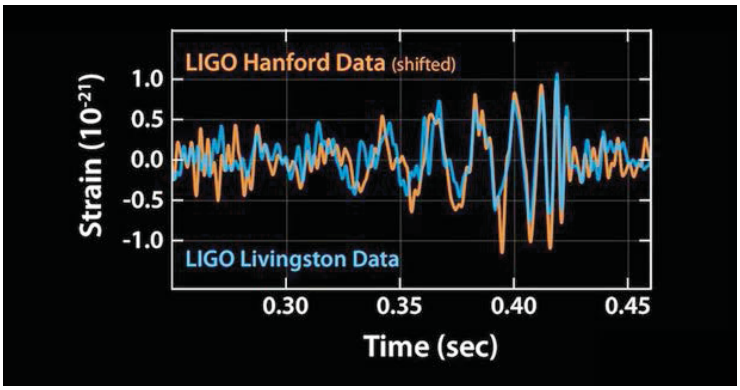
The views and conclusions contained herein are those of the author and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, of the NSF.

Science Done by a Global Community: The LIGO Scientific Collaboration

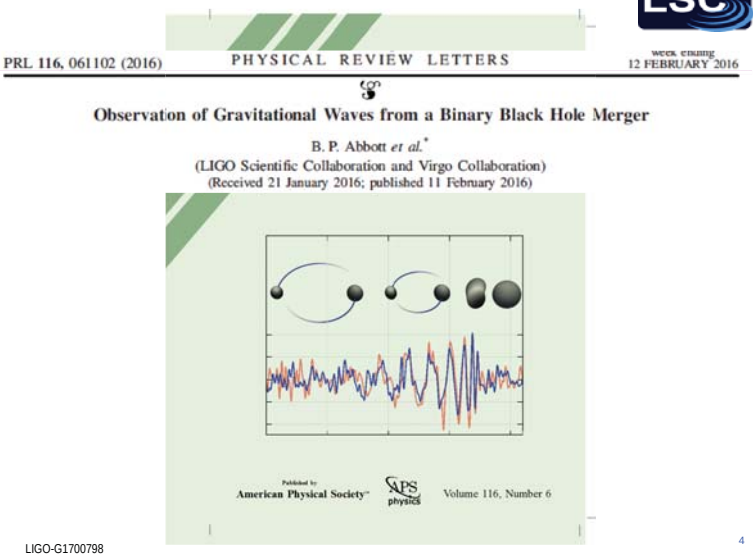
Gabriela González,
Louisiana State University



On Sept 14 2015…



February 11: We did it!


PRL 116, 061102 (2016) PHYSICAL REVIEW LETTERS week ending 12 FEBRUARY 2016

Observation of Gravitational Waves from a Binary Black Hole Merger

B. P. Abbott *et al.**
(LIGO Scientific Collaboration and Virgo Collaboration)
(Received 21 January 2016; published 11 February 2016)

Published by American Physical Society — APS physics — Volume 116, Number 6

LIGO detectors

Hanford, WA

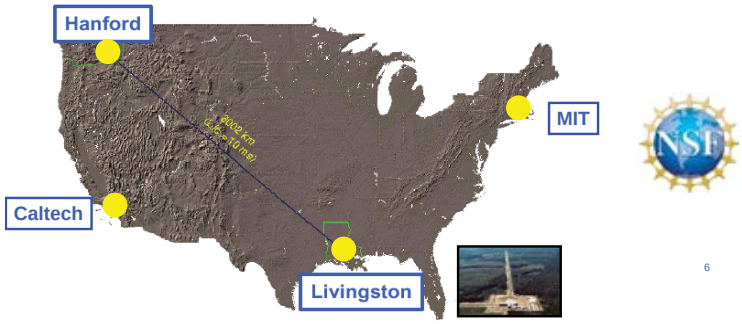
Advanced LIGO detectors:

MAX-PLANCK-GESELLSCHAFT
Science & Technology Facilities Council
Australian Government Australian Research Council

Livingston, LA

LIGO Laboratory

- Mission: Observe gravitational wave sources; operate the LIGO facilities; develop the instrument science and technology; scientific education and public outreach.
- NSF Major Research Facilities Construction LIGO grant in 1992 and in 2008; cooperative agreements since 1992, jointly managed by Caltech and MIT.
- ~170 scientists, engineer and staff; includes physicists working on instrument science and data analysis.



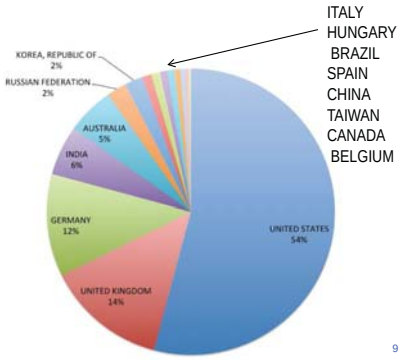
LIGO Scientific Collaboration

LIGO-G1700798

8

LIGO Scientific Collaboration

~1,200 members, >90 institutions, 15 countries.



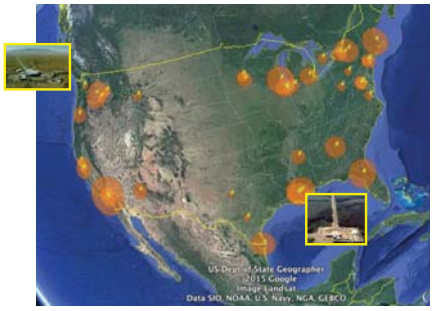
www.ligo.org

LIGO-G1700798

9

LSC-USA

- Large institutional diversity: large and small departments, graduate and undergraduate institutions, several serving large under-represented groups.
- Most US groups are supported by NSF with competitive, single investigator NSF grants. LIGO Laboratory (~30% of LSC) is supported by a cooperative agreement from NSF with Caltech and MIT.
- Many LSC “graduates” now working in STEM industries (Intel, Synaptics, Google, SpaceX, Apple, Facebook,…), national facilities (Lincoln Labs, NASA, …) and academia.



LIGO-G1700798

10

LIGO and LSC

- **The LSC and the LIGO Laboratory together make up “LIGO”.**
- LSC Mission: The LIGO Scientific Collaboration (LSC) is a **self-governing collaboration** seeking to detect gravitational waves, use them to explore the fundamental physics of gravity, and develop gravitational wave observations as a tool of astronomical discovery.
- LSC Responsibilities:
  - data analysis strategy, goals, and timeline, and carry out the data analysis program;
  - identify priorities for research and development, and carry out the R&D program;
  - carry out a public outreach, and provide educational opportunities for young people;
  - disseminate the results of the data analysis program and the R&D program;
  - participate in the scientific operations of the LIGO detectors;
  - perform internal evaluation of progress in data analysis and R&D.

www.ligo.org

LIGO-G1700798

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LIGO Scientific Collaboration

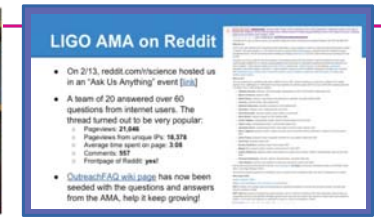
- Some LSC Principles:
  - Open: “No individual or group will be denied membership on any basis except scientific merit and the willingness to participate and contribute as described in this Charter.”
  - Member agreements (MOUs) describe scientific, not financial, commitments.
  - Democratic: Spokesperson and working group leaders elected (w/2 yr terms).
  - Formal LSC/LIGO Lab interaction: “LIGO directorate” consists of the LSC spokesperson, and the Executive and Deputy Directors of the LIGO Laboratory. The LIGO Directorate will be ex officio members of all planning and evaluative bodies of the LSC. (On the ground, there are no differences between LIGO Lab LSC members and other group members, other than funding.)
- Some history:
  - Created in 1997, already international (Germany, UK, Australia, Russia).
  - Initially ~25 groups, 200 people, Rai Weiss (MIT) initial spokesperson 1997-2003
  - Peter Saulson (Syracuse University) elected spokesperson 2003-2007, David Reitze (University of Florida) 2007-2011, GG (Louisiana State University) 2011-2017
  - Current spokesperson is David Shoemaker (MIT), with Deputy spokesperson Laura Cadonati (Georgia Tech).

LIGO-G1700798

12

Education and Public Outreach

Multimedia



Social media

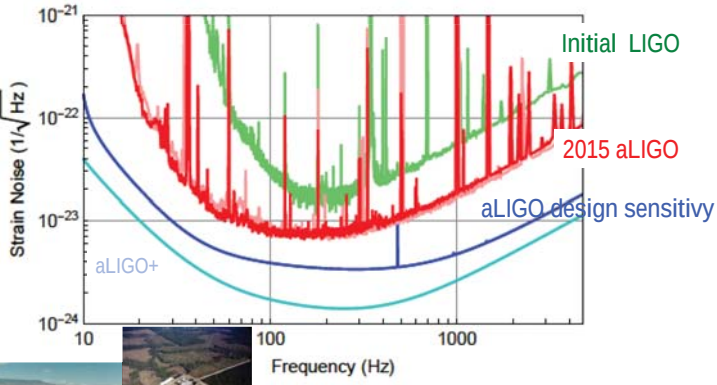
Science teachers' education

Science fairs, exhibits,
Science Education Center

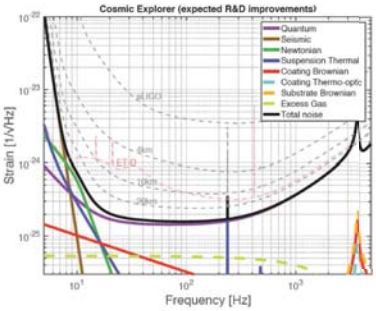
Other important LSC activities

- Diversity
  - LSC has a Diversity Committee. Some initiatives:
    - LSC Diversity statement; anti-harassment policy, LSC "best practices"
    - LSC "Ombudsperson" (former NSF program officer!)
    - LIGO summer undergraduate fellowships sponsored by NSBP and NSHP
    - "Family grants" to attend LSC meetings
    - Set up a booth and organize sessions in scientific meetings of women and minorities
- Academic mentoring
  - The LSC has an "Academic Advisory Committee" to care about mentoring of young members. Some recent activities:
    - Student and postdoc events and useful tutorials.
    - "Industry panels" with colleagues working now in industry.
    - Mentoring program: a platform for members of the LSC to form and maintain mentoring relationships.

LIGO Science: GW Technology and Astrophysics

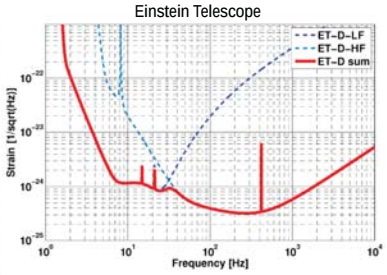


The future: 3rd generation detectors

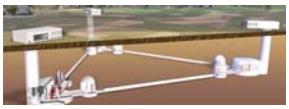


arXiv:1607.08697

Einstein Telescope

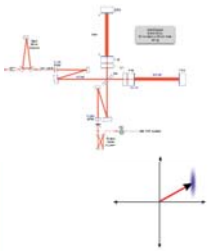


S.Hild et al., Classical and Quantum Gravity, 28 094013, 2011



http://www.et-gw.eu/

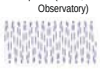
LIGO Detector Technology

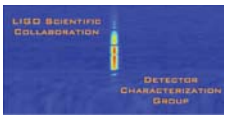


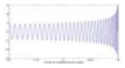
Five instrumental working groups – white paper LIGO-T1600119 (dcc.ligo.org)
about R&D for future detectors with improved sensitivities

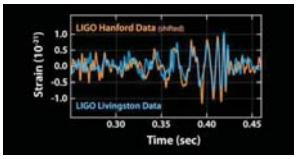
LIGO Data Analysis

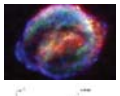
Crab pulsar (NASA, Chandra Observatory)

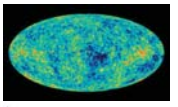












NASA, WMAP

Four analysis working groups (plus calibration, detector characterization, software and computing)
white paper LIGO-T1600115 (dcc.ligo.org)
about search plans for Adv LIGO and Virgo detections

Detections in O1

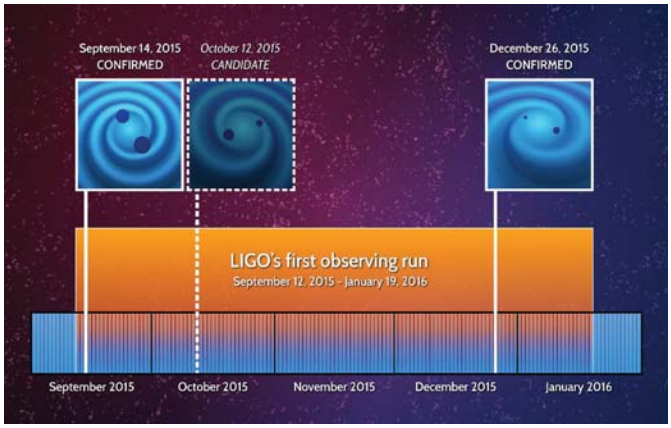
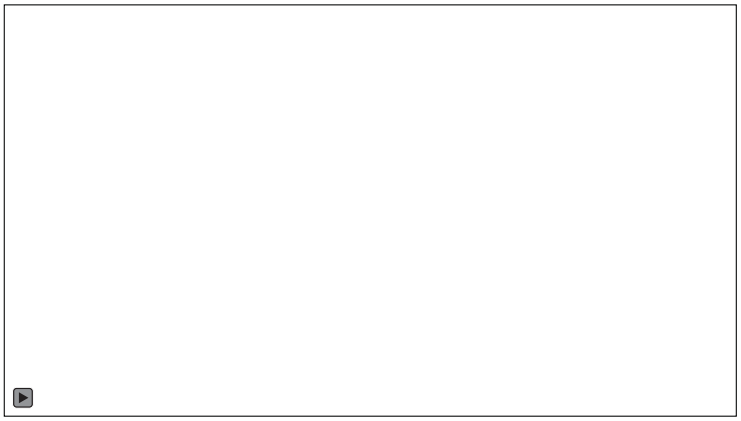
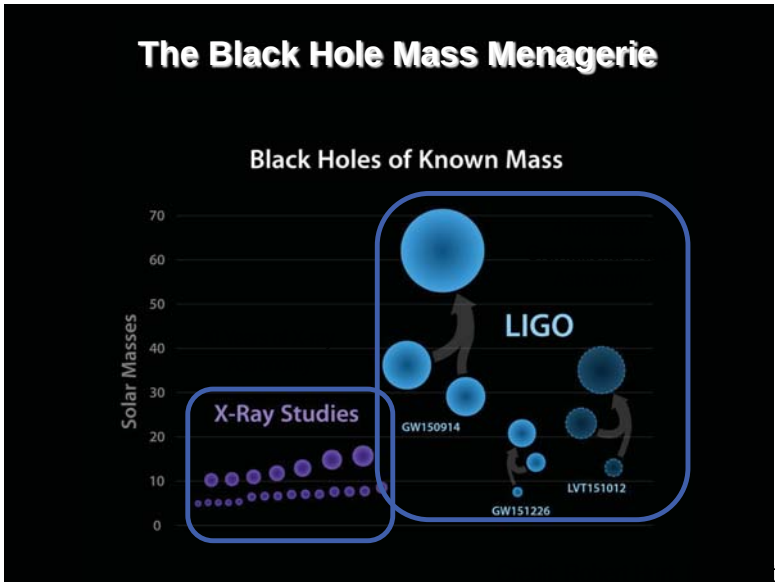


Image credit: LIGO

Gravity's music

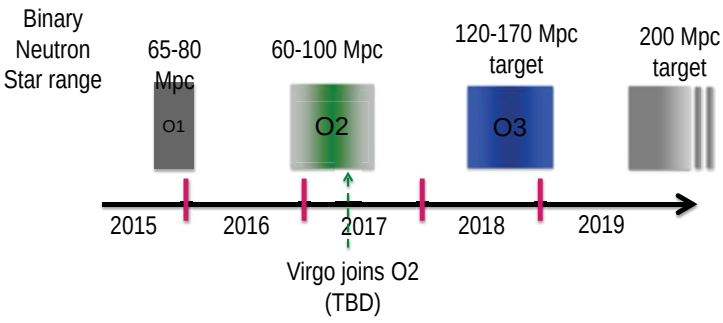


The Black Hole Mass Menagerie

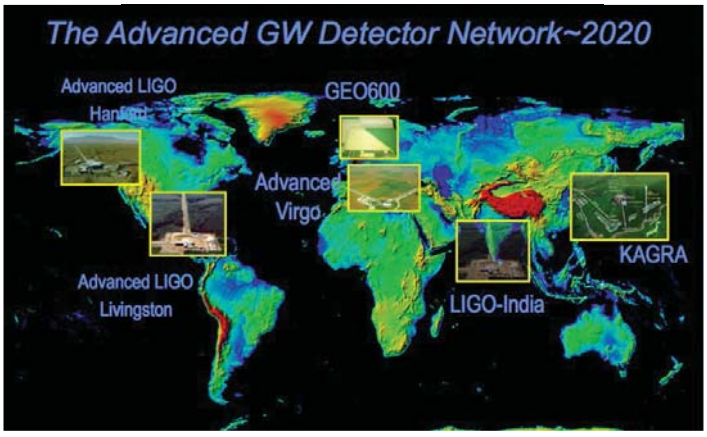


Plausible Observing Run Timeline

(plans still under development within the LIGO and Virgo Collaborations)



LIGO leads but it's not alone: gravitational wave network



Multi-messenger astronomy: GW/EM observations

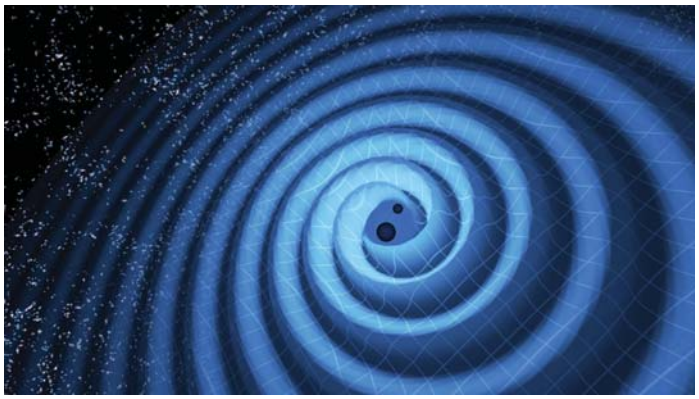
We will obtain rich astrophysics combining gravitational-wave and electromagnetic information.

- LSC and Virgo opened a call to sign agreements for the identification of EM counterparts to GW triggers in Advanced detectors starting in 2015
- We have more than 60 agreements with about 150 instruments covering the full spectrum, from radio to high-energy gamma-rays.
- Shortly after a few detections, LSC/Virgo will publicly release GW triggers for follow up: dcc.ligo.org, LIGO-M1200055
- We have made initial LIGO data public (losc.ligo.org), and will make Advanced LIGO data public after curated and a proprietary period.

Conclusions

- Although atypical, the LSC model with an open and international collaboration created around a “LIGO Laboratory” has been very successful.
- Large size has already many challenges. More challenges lie ahead: collaboration model is evolving in the presence of detections and open data, funding for future detectors, …
- The field will always need a large collaborative team working on operations, timely science analysis, and R&D ready for installation in new detectors, as well innovative methods for analysis and research on new technologies.

Gravitational waves astronomy: this is just the begnning!



www.ligo.org

UPDATE to Procurement Presentation

On 5/17/2017 OMB issued a one year grace period on the Uniform Guidance procurement standards. The presentation can be used for future adoption or if you are adopting the Uniform Guidance procurement standards.

https://s3.amazonaws.com/public-inspection.federalregister.gov/2017-09909.pdf

As many of you are aware, OMB in partnership with the COFAR was considering proposed changes to 2 CFR last summer and fall that have since been held up due to the ongoing government and regulatory reform efforts, therefore, OMB is now granting one final grace period for non-Federal entities who choose not to implement the Uniform Guidance procurement standards. Non-federal entities who wish to take advantage of this grace period must document this internally, continue to follow the standards in prior OMB guidance, and begin preparing for implementation of the procurement standards prior to the end of this third and final extension. Any future changes to 2 CFR will be considered as part of the larger government and regulatory reform efforts and the final President's Management Agenda.

2017 NSF Large Facilities Workshop

Procurement Standards

May 3, 2017

Eddie Whitehurst, Deputy Branch Chief, *Division of Acquisition and Cooperative Support*

Goals and Objectives of Today's Presentation

To provide additional background and context for the required Uniform Guidance Procurement Standards

- Why are the Procurement Standards important now?
- What are the requirements?
- The Bear claw

Procurement Standards

Big Picture on Procurement Standards?

- The Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal awards became effective on December 26, 2014.
- For the procurement standards in §§200.317-200.326, non-Federal entities may continue to comply with the procurement standards in previous OMB guidance (superseded by this part as described in §200.104) for two additional fiscal years after this part goes into effect.
- The Procurement Standards became effective on December 26, 2016.
- The American Innovation and Competitiveness Act (AICA) amended the micro-purchase amount.

Procurement Standards

General Procurement Standards Requirements

- The recipient must have written Procurement Standards and policies.
- Maintain oversight to ensure that contractors perform in accordance with the terms, conditions, and specifications of their contracts or purchase orders.
- Written standards of conduct covering organizational conflicts of interest.
- Procedures must avoid acquisition of unnecessary or duplicative items.
- Encouraged to enter into inter-entity agreements of common or shared goods and services.

Procurement Standards

General Procurement Standards Requirements

- Encouraged to use Federal excess and surplus property in lieu of purchasing new equipment and property.
- Encouraged to use value engineering clauses in contracts for construction projects to offer reasonable opportunities for cost reductions.
- You must award contracts only to responsible contractors possessing the ability to perform successfully.

Procurement Standards

General Procurement Standards Requirements

- Records must detail the history of procurement including: rationale for the method of procurement, selection of contract type, contractor selection or rejection, and the basis for the contract price.
- A time and materials type contract may be used only after a determination that no other contract is suitable and if the contract includes a ceiling price that the contractor exceeds at its own risk.
- Be responsible, in accordance with good administrative practice and sound business judgment, for the settlement of all contractual and administrative issues arising out of procurements.

Procurement Standards

General Procurement Standards Requirements

- You must take all necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible.
- If a state agency or agency of a political subdivision of a state and its contractors must comply with section 6002 of the Solid Waste Disposal Act.
- You must perform a cost or price analysis in connection with every procurement action in excess of the Simplified Acquisition Threshold including contract modifications.

Procurement Standards

General Procurement Standards Requirements

- You must make available, upon request of the Federal awarding agency or pass-through entity, technical specifications on proposed procurements to ensure that the item or service specified is the one being proposed for acquisition.
- You may accept an approved bonding policy if minimum requirements are followed.
- Contracts must contain the applicable provisions described in Appendix II to Part 200—Contract Provisions for non-Federal Entity Contracts Under Federal Awards.

Procurement Standards

Methods of procurement

- Micro-purchases
- Small purchases
- Sealed bids
- Competitive proposals
- Sole source

These are OMB's minimum requirements, no less restrictive deviations are permitted without OMB approval.

Procurement Standards

Methods of procurement

- Micro-Purchases are under $10,000 and may be awarded without soliciting competitive quotations if the recipient considers the price to be reasonable.
- Small Purchase procedures are up to $150,000, a price or rate quotation must be obtained from an adequate number of qualified sources and no cost or price analysis is required.
- Sealed Bids must have formal advertising, publicly solicited, is a firm fixed contract and be the lowest price.

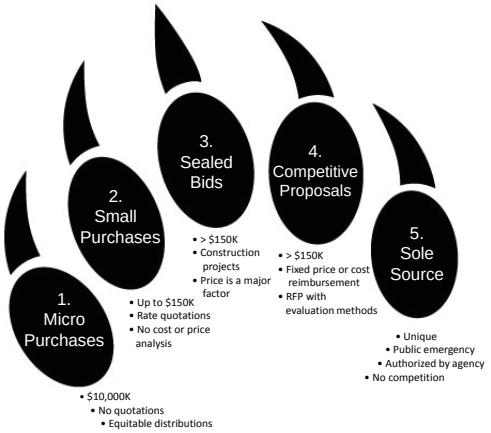
Procurement Standards

Methods of procurement

- Competitive Proposals are publicized, you must have a written method for conducting technical evaluations, and normally have more than one source submitting an offer, and is either a fixed price or cost-reimbursement type contract and must be awarded to the proposal which is most advantageous to the program, with price and other factors considered.
- Sole Source is used when the item is available only from a single source, a public emergency, solicitations and number of sources are inadequate and you have written approval from agency.

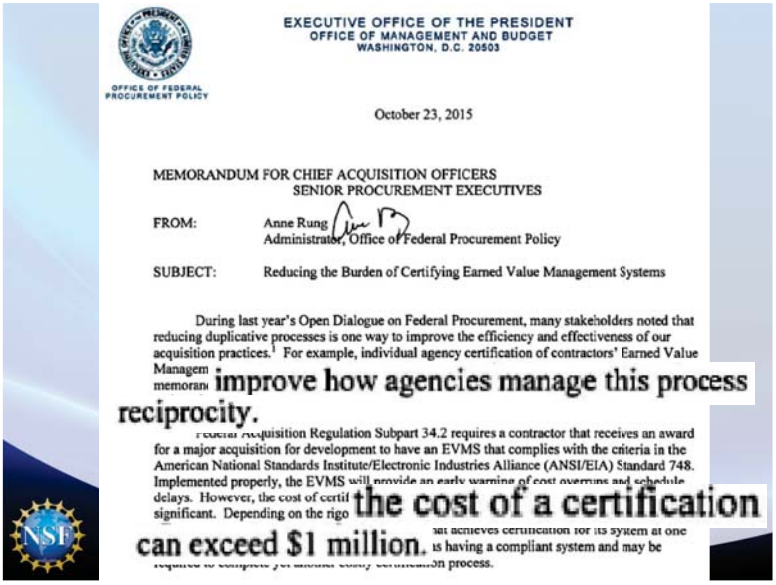
Procurement “Claw” (Sections 200.317-326)

Procurement “Claw” (Section 200.320)



NSF Earned Value Management System (EVMS) Verifications

Rebecca Yasky
Large Facilities Office (LFO)
Large Facilities Workshop
May 1-3, 2017



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

OFFICE OF FEDERAL PROCUREMENT POLICY

October 23, 2015

MEMORANDUM FOR CHIEF ACQUISITION OFFICERS
SENIOR PROCUREMENT EXECUTIVES

FROM: Anne Rung
Administrator, Office of Federal Procurement Policy

SUBJECT: Reducing the Burden of Certifying Earned Value Management Systems

During last year's Open Dialogue on Federal Procurement, many stakeholders noted that reducing duplicative processes is one way to improve the efficiency and effectiveness of our acquisition practices.[1] For example, individual agency certification of contractors' Earned Value Managem
memoran **improve how agencies manage this process**
reciprocity.
Federal Acquisition Regulation Subpart 34.2 requires a contractor that receives an award for a major acquisition for development to have an EVMS that complies with the criteria in the American National Standards Institute/Electronic Industries Alliance (ANSI/EIA) Standard 748. Implemented properly, the EVMS will provide an early warning of cost overruns and schedule delays. However, the cost of certif **the cost of a certification**
significant. Depending on the rigo
can exceed $1 million. ts having a compliant system and may be
process.

Outline

- Background
  - 2016 Large Facilities Workshop (LFW) EVMS session
- NSF Approach
  - NSF Oversight Tools
- "Pilot" EVMS Reviews
- NSF Process
  - Compliance Evaluation Review
  - Acceptance
  - Surveillance
- Summary

NSF Approach - EVMS Verifications

- National Defense Industrial Association (NDIA) EVMS Acceptance Guide
  - EIA-748 Standard 32 management guidelines
  - Tailored to NSF terminology & practices
- Independent Review Team
  - Lead by Large Facilities Office
  - External EVMS Expert(s)
- Focuses on the EVM specific systems
  - Does not perform in-depth review of the inputs
  - Utilizes the results from other NSF Oversight Reviews & Tools
- Project Oriented

Timely and Reliable Project Performance Data

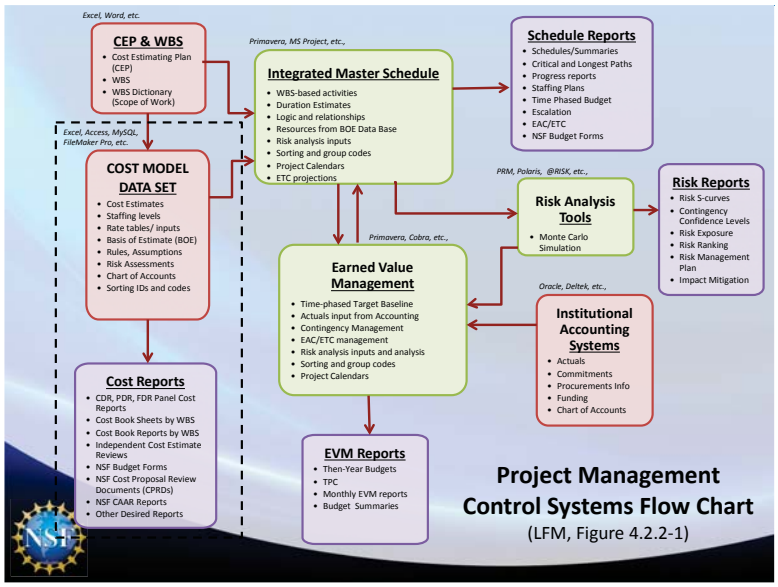
2016 LFW – EVMS Roundtable Session

- Inspector General (IG) Recommendations
  - Ensure the quality of EVM data
- Reviewed Various Federal Agency Practices
  - DMCA validation/certification (DOD, NASA)
  - Internal Validation/Certification Requirements
  - Third-party validations
  - Self & Peer validations
- Time and Money
- "Pilot" EVMS Review
  - Large Synoptic Survey Telescope (LSST)
- Path Forward: Decide whether NSF uses DCMA certification or it's own version of written "acceptance & /approval"

NSF Various Oversight Tools*

- Expert Panel Review
  - Design: Concept, Preliminary, & Final
  - Construction and Operations: Annual
- Transition to Operations Review
- Monthly Reporting
- Cost Proposal Review & Analysis
  - Independent Cost Analysis
- Business Systems Review
- Accounting System Review/Audit
- Cost Incurred Audit

* More detail in Large Facilities Manual



Project Management Control Systems Flow Chart
(LFM, Figure 4.2.2-1)

- **Business Systems Review**
- **Accounting System Review/Audit**
- **Cost Incurred Audit**

Institutional Accounting Systems
- Actuals
- Commitments
- Procurements Info
- Funding
- Chart of Accounts

CEP & WBS
- Cost Estimating Plan (CEP)
- WBS
- WBS Dictionary (Scope of Work)

Schedule Reports
- Schedules/Summaries
- Critical and Longest Paths
- Progress reports
- Staffing Plans
- Time Phased Budget
- Escalation
- EAC/ETC
- NSF Budget Forms

Integrated Master Schedule
- WBS-based activities
- Duration Estimates
- Logic and relationships
- Resources from BOE Data Base
- Risk analysis inputs
- Sorting and group codes
- Project Calendars
- ETC projections

Expert Panel Review Focus

Earned Value Management
- Time-phased Target Baseline
- Actuals input from Accounting
- Contingency Management
- EAC/ETC management
- Risk analysis inputs and analysis
- Sorting and group codes
- Project Calendars

EVM Reports
- Then-Year Budgets
- TPC
- Monthly EVM reports
- Budget Summaries

EVMS Verification Focus

Results from:
- Preliminary & Final Design Review Reports
- BSR Reports
- Cost Proposal Review

COST MODEL DATA SET
- Cost Estimates
- Staffing levels
- Rate tables/ inputs
- Basis of Estimate (BOE)
- Rules, Assumptions
- Risk Assessments
- Chart of Accounts
- Sorting IDs and codes

Cost Reports
- CDR, PDR, FDR Panel Cost Reports
- Cost Book Sheets by WBS
- Cost Book Reports by WBS
- Independent Cost Estimate Reviews
- NSF Budget Forms
- NSF Cost Proposal Review Documents (CPRDs)
- NSF CAAR Reports
- Other Desired Reports

Risk Analysis Tools
- Monte Carlo Simulation

Risk Reports
- Risk S-curves
- Contingency Confidence Levels
- Risk Exposure
- Risk Ranking
- Risk Management Plan
- Impact Mitigation

Cost Proposal Review & Analysis
- Expert Panel Reviews
- Independent Cost Analysis
- Contingency Analysis
- Indirect Costs, Financial Viability

(LFM Figure 4.2.1-1)

Additional "Pilot" EVMS Reviews

Daniel K. Inouye Solar Telescope (DKIST)

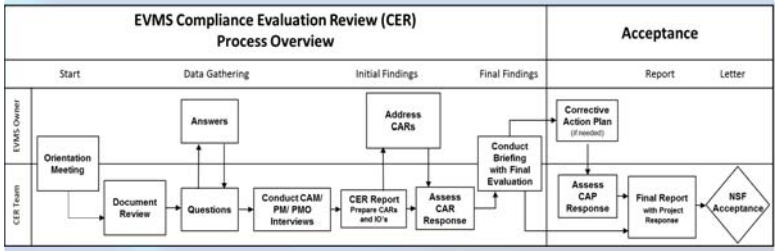
- Under Construction
- Compliance Evaluation & Surveillance Review
- Periodic Estimates at Completion (EAC) – aligned with Large Facilities Manual (LFM) to include update risk exposure
- Indirect Costs – variable at lower levels including down to work packages

Regional Class Research Vessel (RCRV)

- Final Design Review
- Compliance Evaluation Review
- Most of scope - Firm-fixed price contract with Shipyard
- Delayed acceptance after Shipyard is incorporated into the EVMS processes.
- Indirect Costs - fixed

Finalization of EVMS Standard Operating Guidelines (SOG) and LSST & DKIST EVMS Acceptance – Closure of IG Recommendations

NSF EVMS CER & Acceptance Flowchart



- Initiated during Final Design
- 4 – 8 Months
- Acceptance by Head, LFO
- Prior to Construction Funding

Abbreviations:
- *CAR – corrective action request*
- *IO – improvement opportunity*
- *CAP – corrective action plan*

Guidelines Tailored to Large Facilities Manual (LFM)

- Guideline 1: No co-mingling of funds (*LFM 3.4*)
- Guideline 9: Identification of NSF cost category elements (*LFM 4.2*)
- Guideline 14: Identify cost and schedule contingency budget per LFM 4.2 and 5.2
- Guideline 15: No management reserve & contingency held separately from the baseline (*LFM 4.2.5.1)*
- Guideline 26: CPI & SPI variances greater than 10% requires submission of recovery plan to NSF (*LFM 4.5.4*)
- Guideline 27: Periodic ETC with updated risk exposure (*LFM 4.2.5.8 & 5.2.11.4*)
- Guideline 28: Incorporate changes per award instrument (*LFM 4.2.5.5 & 5.2.11.2*)
- Guideline 32: Maintain change log and provide all change request to NSF (*LFM 4.2.5*)

Compliance Evaluation Review (CER)

EIA-748 32 Guidelines in 5 Categories

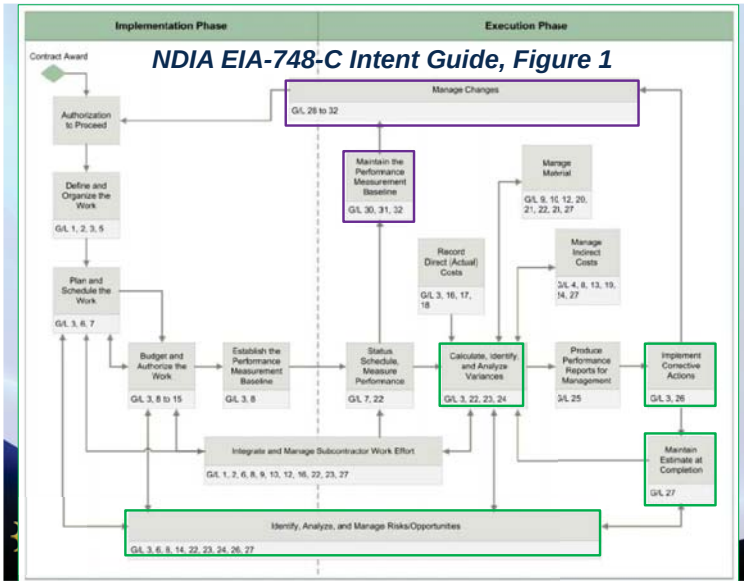
- Organization (*guidelines 1-5*)
  - Define & organize the work
- Planning, Scheduling and Budgeting (*guidelines 6-15*)
  - Develop & establish the performance baseline
- Accounting Consideration (*guidelines 16-21*)
- Analysis and Management Reports (*guidelines 22-27*)
  - Identify & analyze variances
  - Corrective actions
  - Manage risks
- Revisions and Data Maintenance (*guidelines 28-32*)
  - Manage changes
  - Maintain performance baseline

CER Report Format - sample

Guideline - EIA-748-C	NSF-Adjusted Guideline Description	Intent Met? High-Green Medium-Yellow Low-Red	References Project Procedure/ Document/ Interview	Observations/Comments/Findings
2.5d Prevent unauthorized changes	31. Prevent revisions to the project budget except for authorized changes.	High	•Contingency Management Plan – PEP App 6.3 •Configuration Control Plan - PEP Section 8 & App 8.1 •Financial Reporting Plan – PEP App 10.4 •Contingency Database •Interviews	•RCRV has a well-defined change control process, with prescribed approval levels, which RCRV uses for revisions to project budget and schedule. •Budget approval thresholds have been established. •Thresholds for approvals have not been established for schedule nor scope. •The Contingency Database program integrated with the Shipyard Office, Accounting, and Procurement is a best practice. The system is a new program and the readiness of staff to use it was not assessed. The assessment of the program implementation will be done during the first surveillance review.
2.5e Change documentation and reporting	32. Document change requests and the resultant changes to the performance measurement baseline. Maintain a change log and provide all change requests to NSF. (LFM section 4.2.5)	High	•Configuration Control Plan - PEP Section 8 & App 8.1 •Contingency Management Plan – PEP App 6.3 •Financial Reporting Plan – PEP App 10.4 •Contingency Database •Interviews	•RCRV has a well-defined web-based change control process that will be utilized by the Shipyard Representative's Office and the RCRV Project office, with prescribed approval levels, which RCRV uses for revisions to the project budget and schedule. •Change log is generated from the contingency database.

Medium: Non-critical aspects of guideline not met

Low Red: Critical aspects of guideline not met



EVMS Surveillance Reviews

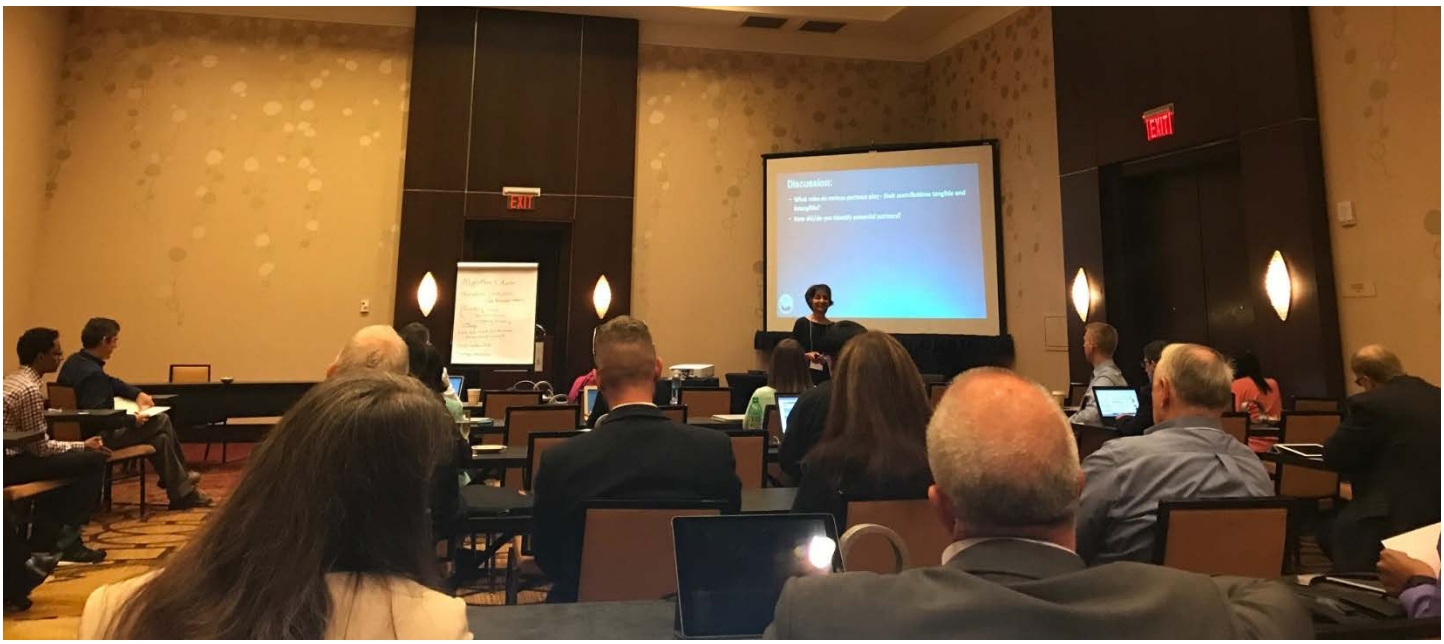
- During the Construction Stage
  - Accepted EVMS is being maintained and followed
  - Combined with verification if NSF acceptance not in place
- Part of the Annual Reviews
  - May be different frequency if determined beneficial
- Does not include a complete compliance check of the 32 guidelines
- Targeted surveillance reviews
  - Corrective actions,
  - New procedures, and/or
  - Demonstration of practice

Summary

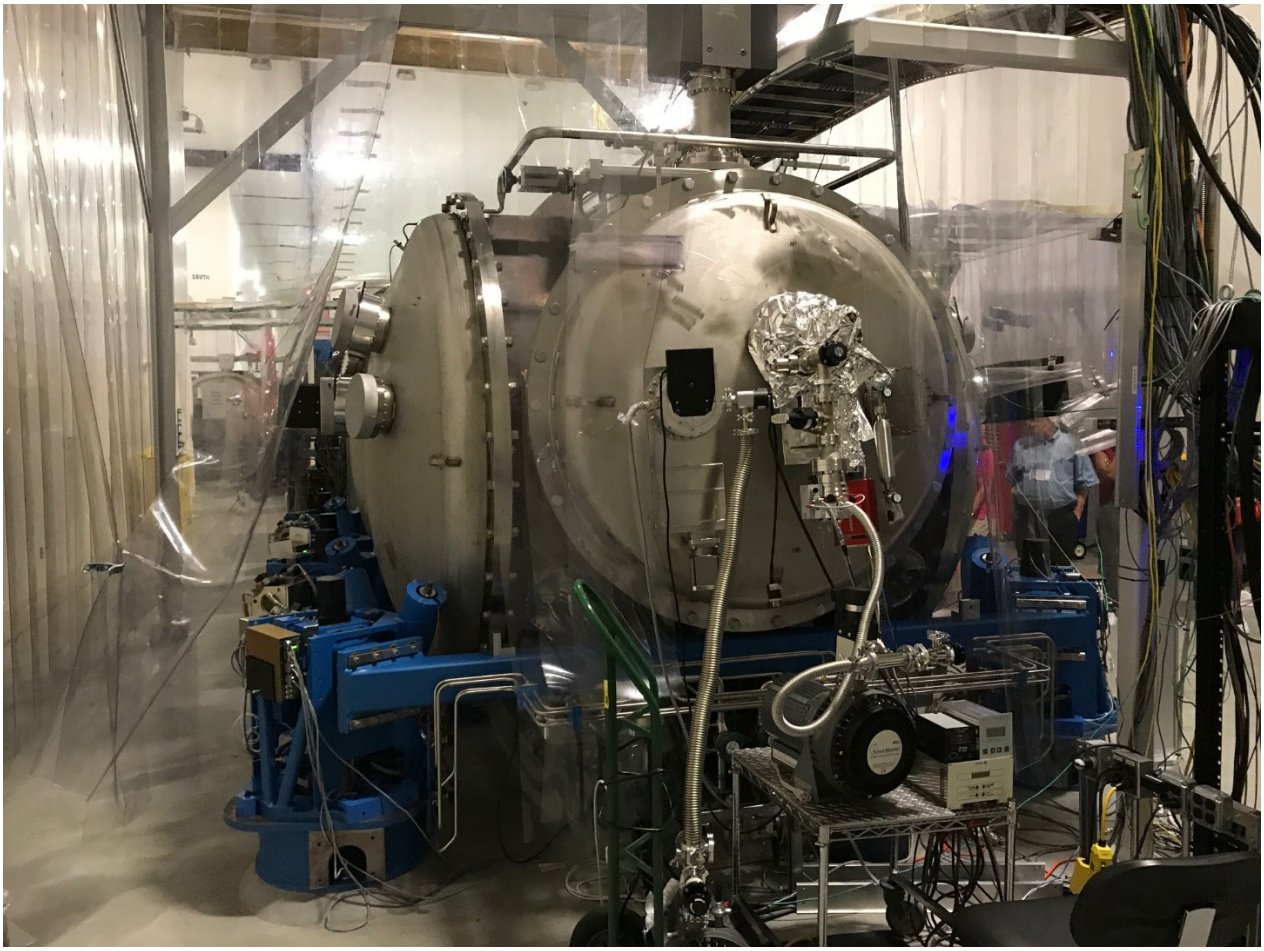
- Verification vs Validation/Certification
  - Assess system reliability
- Focuses on EVMS Systems and Processes
  - Utilizes Results from other Oversight Tools
- Lead by NSF Large Facilities Office
- NSF Acceptance
  - EVMS effectively implemented
  - Reliable project management information

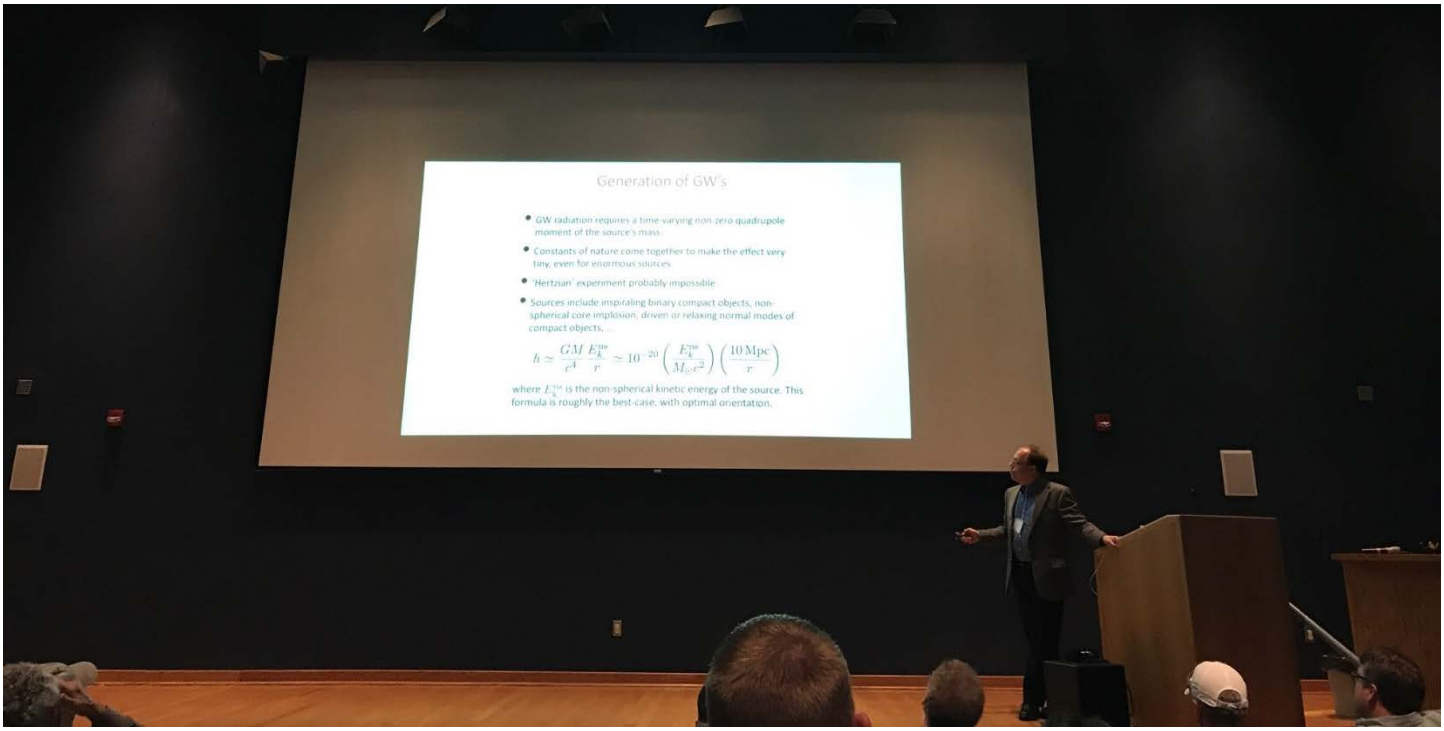
Appendix E: Photos


Knowledge Services
Capture
Share
Discover


EXIT
EXIT
Discussion:


LIGO
Advanced LIGO
Prototype
quad-suspension mirror
2015-present
LIGO
LIGO
single suspension mirror
2002-2010




Generation of GW's
GW radiation requires a time-varying non-zero quadrupole moment of the source's mass
Constants of nature come together to make the effect very tiny, even for enormous sources
'Hertzian' experiment probably impossible
Sources include inspiraling binary compact objects, non-spherical core implosion, driven or relaxing normal modes of compact objects, ...
$h \simeq \frac{GM}{c^4}\frac{E_k^{ns}}{r} \simeq 10^{-20}\left(\frac{E_k^{ns}}{M_\odot c^2}\right)\left(\frac{10\,\mathrm{Mpc}}{r}\right)$
where E_k^{ns} is the non-spherical kinetic energy of the source. This formula is roughly the best-case, with optimal orientation.