2022 Cyberinfrastructure for NSF Major Facilities Workshop Report

Getting Together, Working Together

June 13, 2022

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Preferred citation: E. Deelman, I. Baldin, S. Barnet, G. B. Berriman, D. Brower, R. Casey, S. Chaudhry, L. Christopherson, C. Clark, B. Dobbins, M. Gohsman, K. Kee, M. Livny, A. Mandal, R. Mayani, A. Murillo, J. Nabrzyski, A. Olshansky, V. Pascucci, S. Petruzza, L. Pottier, Information Sciences Institute, C. Romsos, M. Rynge, E. Scott, A. Shepherd, J. Schopf, K. Vahi, C. Vardeman, N. Virdone, and J. West, 2022 Cyberinfrastructure for NSF Major Facilities Workshop Report, DOI: 10.5281/zenodo.6643902

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This work was conducted by CoE CI Compass and supported by the National Science Foundation (NSF) under grant number OAC 2127548. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the funding agency.

Executive Summary

The 2022 Cyberinfrastructure for Major Facilities (CI4MFs) workshop brought together cyberinfrastructure (CI) professionals working within the NSF Major Facilities (MFs), those that are contributing to the national CI ecosystem, and the NSF program directors that support research and development in CI and fund MFs.

The workshop was organized by CI Compass, the NSF Cyberinfrastructure Center of Excellence, dedicated to the advancement of CI in MFs and beyond. The Mission of CI Compass is to "provide expertise and active support to cyberinfrastructure practitioners at NSF Major Facilities in order to accelerate the data lifecycle and ensure the integrity and effectiveness of the cyberinfrastructure upon which research and discovery depend." An important part of that mission is to build a community around CI for MFs. Thus, CI Compass organized a community meeting with the theme of "Getting Together, Working Together". The theme was designed to emphasize the importance of a community and of collaboration particularly, as individuals and communities were trying to emerge from a global pandemic. At the time of the report, the pandemic had lasted more than two years and the mask mandates during gatherings were yet to be lifted in many parts of the country. The workshop was hybrid, with 32 participants traveling to Southern California and 85 participating online. For many on-site participants, this was the first in-person professional meeting since mid-March 2020, which marked the transition to remote workplace.

The topics for the workshop were solicited through a survey of MF CI professionals in Fall 2021. From the survey, four main topics emerged: 1) most pressing MF CI challenges and how to best address them, 2) leveraging clouds for MF CI, 3) best practices for making MF data FAIR (Findable, Accessible, Interoperable and Reproducible [1], and 4) enhancing the CI workforce, including exploring organizational resilience during disruptive events.

The workshop included a mix of communication modes, including presentations, panels, whole-group brainstorming, and smaller breakout sessions. Each session was organized by MF participants and CI Compass team members. Video and notes were taken throughout.

Many of the discussions focused on the issue of workforce development. It was clear that the "people" element of CI was viewed as playing a critical role in translating NSF's investments in computing, network, and storage advances and services into impact on MF science. Other **key findings and recommendations** are summarized below.

Key Findings - CI Challenges
• MFs are facing several technical CI challenges (heterogeneity, scale, complexity, capacity, interoperability) and do not often have enough resources and expertise to track and take advantage of the rapidly evolving CI landscape.

- Although a multitude of services are available in the NSF CI ecosystem, the inability to discover them during CI planning, constant churn of these services, mismatched scale, and MFs' requirements for stable, long-term, sustained support for these services are some impediments to adoption.
- MFs are acutely aware of the advantages of collaborations and sharing of CI best practices between facilities, and they recognized that forums enabling such collaborations (e.g. CI4MFs workshops) are extremely useful. However, lack of time, resources, misalignment of incentives, and the inability to recognize long-term benefits of collaborations were identified as factors hindering more effective collaborations.
- There is an ongoing tension between maintaining operations and adding new technology when it comes to deciding where to invest available resources.
- Retention and training for CI personnel were the most significant socio-technical challenges faced by MFs.

Key Findings - Cloud Adoption

- There are tangible benefits to using clouds: the potential to transform MF operations to be scalable, the possibility of using generalized systems, and reducing legacy technical debt.
- Challenges when migrating to the cloud include: the need to adapt in-house data management systems to make effective use of cloud storage, adoption of general cloud services and concepts and de-siloing of their services, changes in the cost model (e.g., data ingress/egress), training the workforce on cloud technologies.
- Positive impacts of moving to the cloud are leveling of the playing field for users in terms of data access and computing (not needing to own resources), and the ability to quickly provision resources for urgent tasks.
- Negative impacts of moving to the cloud are: data sets may be very expensive for end users to access; data access agreements can change with no or little notice, and end users with poor data connections may not be able to use this approach.

Key Findings -- FAIR Data

- MFs are aware of the FAIR principles in general and are implementing FAIR in the data lifecycles.
- Sometimes, it can be hard to determine what exactly is considered FAIR, how best to implement FAIR, and the amount of effort required for the implementation.
- For MFs, it is not clear which standards were worthwhile to invest in and participants wanted to learn about standards that would be beneficial to their data lifecycles.

Key Findings - Workforce Development

- Workforce is a critical component of modern CI and the challenges in that area keep growing, especially with the pressure from industry.
- MFs are eager to find optimal ways to improve training, diversity, and knowledge sharing for the purpose of strengthening the workforce.

- CI managers sometimes do not receive enough training or organizational support when having to deal with difficult situations.
- DEI (diversity, equity, and inclusion) means different things to different people; so, it is important for organizations to be clear about what it means to them and how it specifically resonates in their organizational culture.

Key Findings - Organizational Resilience

- MFs are complex organizations where CI professionals manage complex instruments, and physical and cyberinfrastructures. The pandemic highlighted issues with conflicting policies and poor communication surrounding policy and work-from-home dynamics.
- The pandemic underscored the important role of CI professionals within the MFs. It also highlighted the disparity in investments in physical infrastructure versus investments in building a resilient workforce through recruitment and retention, onboarding of personnel (especially virtual), and managerial training.

Based on the findings and discussions, the workshop participants made the following recommendations:

Recommendations - CI Challenges

- MFs need to carefully consider different deployment choices for their CI: what to move to the cloud, when to use hybrid infrastructure, how to integrate Bring your Own Devices (BYOD), what services to be leveraged from other providers (NSF CI ecosystem, commercial).
- There should be a continued CI community-building effort around cross-cutting CI topics, including the organization of CI4MF workshops and topical working groups to facilitate collaboration and sharing of best practices on cross-cutting topics.
- The NSF CI ecosystem of shared services, such as those provided by Advanced Cyberinfrastructure Coordination Ecosystem: Services & Support (ACCESS), and their associated costs and expectations should be cataloged and advertised broadly across the MF community to raise awareness.
- NSF should continue to fund MF community-focused centers, which can provide expertise for wide-ranging issues including identity management, cloud technologies, etc.
- MF CI developments are largely people-driven, not hardware-driven. Hence, funding CI personnel in grants should be prioritized.

Recommendations - Cloud Adoption

- When designing cloud solutions, MFs should consider adopting a hybrid approach, where some services and data are kept locally, and a cloud mirror/copy are used for disaster recovery, for scaling, and for users who explicitly want to compute in the cloud.
- MFs should consider using Internet2's direct cloud connections to manage data transfer costs.

• MFs should explore leveraging the use of free tiers, NSF-funded clouds, use of cloud credits, and prototyping on on-premise hardware to enable efficient, cost-effective solutions.
Recommendation - FAIR Data
• CI Compass should consider creating a Topical Working Group to share ideas and approaches toward FAIR data amongst the MFs.
Recommendations -- Workforce Development
• Since hiring and retention will continue to be significant issues, MFs should make renewed efforts in workforce development by providing the CI personnel a career path, and enhanced training. • For managers to succeed, organizational leadership should make manager training and development a priority and should provide resources to make this possible. • To enhance DEI, organizations should outline specific, measurable DEI goals, and should commit to making DEI a standing topic in day-to-day discussions. • To improve the staff training, a set of possible solutions can be explored: forming a training committee, providing “lunch and learn” sessions, and creating a showcase of CI work across different MFs, among others.
Recommendations - Organizational Resilience
• MF CI managers need to provide feedback, leadership, and make tough decisions, but be flexible when setting policies such as return to work. • MF CI managers should make sure to recognize and reward personnel that went above and beyond during disruptive events (such as the pandemic) and recognize that honest mistakes happen. • MF CI managers should listen to employees and provide good reasons and rationale behind policy decisions. • CI staff should be open with management about the concerns, both personal and professional, which they may have during disruptive events.

We also took the pulse of the community by asking participants to fill out “CI Calling Cards” (Appendix D) by answering three questions: about their recent biggest CI accomplishment, useful remote work practices, and their vision for the future of MF community. The Calling Cards revealed a wide range of accomplishments: successes around CI, engagement with the community, providing services, leading and managing people and efforts, receiving recognition, and simply doing good work on a day-to-day basis. Participants also provided several tips for adapting to remote work during strict COVID mandates, including beautifying the home-work space and being sure to move around from time to time, to having fewer and shorter meetings, to capitalizing on electronic tools, such as chat, for facilitating work more easily.

Overview and Goals

The 2022 Cyberinfrastructure of Major Facilities Workshop was organized by CI Compass[1], the NSF Cyberinfrastructure Center of Excellence that provides expertise and active support to cyberinfrastructure practitioners at NSF Major Facilities.

The goal of this workshop was for Major Facilities (MFs), members of the cyberinfrastructure (CI) community, and the National Science Foundation (NSF) to share best practices, discuss opportunities, and brainstorm solutions to the challenges the community faces today and in the future. The theme of this workshop, “Getting Together, Working Together”, was chosen to emphasize the need for collaboration and for building a community to address both technical and social challenges faced by the broader MF community.

The workshop topics were solicited from the MF CI community during Fall 2021. Workshop topics included overcoming CI challenges, cloud adoption, FAIR data [1], workforce development, and organizational resilience during the pandemic. The workshop builds on prior meetings in 2017 [2] and 2019 [3]. The workshop included a mix of talks, panels, and break-out sessions. The community was also invited to propose lightning talks, which were organized thematically to fit into the appropriate sessions, including two sessions dedicated to the NSF CI ecosystem.

Each session during the workshop was organized by a CI Compass member and a collaborator from a Major Facility. Of note was the “March Toward the Clouds: MF Perspectives” panel session, which was led by Brian Dobbins, National Center for Atmospheric Research (NCAR), and Karan Vahi, CI Compass, and was conceptualized and organized by the CI Compass Cloud Topical Working Group. See the charter[2] for more information about the group.

All presentations[3] were recorded and were made available online and notes during the presentations and discussions were taken. This report summarizes the findings from the workshop and recommendations made by the participants.

[1] https://ci-compass.org/
[2] https://ci-compass.org/assets/459078/2021_cloud_infrastructure_working_group_charter.docx.pdf
[3] https://ci-compass.org/news-and-events/events/cyberinfrastructure-for-nsf-major-facilities-2022/

Workshop Structure and Activities

The workshop took place over two days, both in-person and online using the Whova platform and Zoom. For a detailed agenda, please see Appendix C. The session speakers, session hosts, and lightning talk presenters were a mix of in-person and virtual attendees. All talks were heard by in-person and virtual participants, in addition to providing mechanisms for questions and answers. Each session had two note-takers and an in-person microphone host.

Figure 1: In-person participants in Redondo Beach, CA, March 1, 2022.

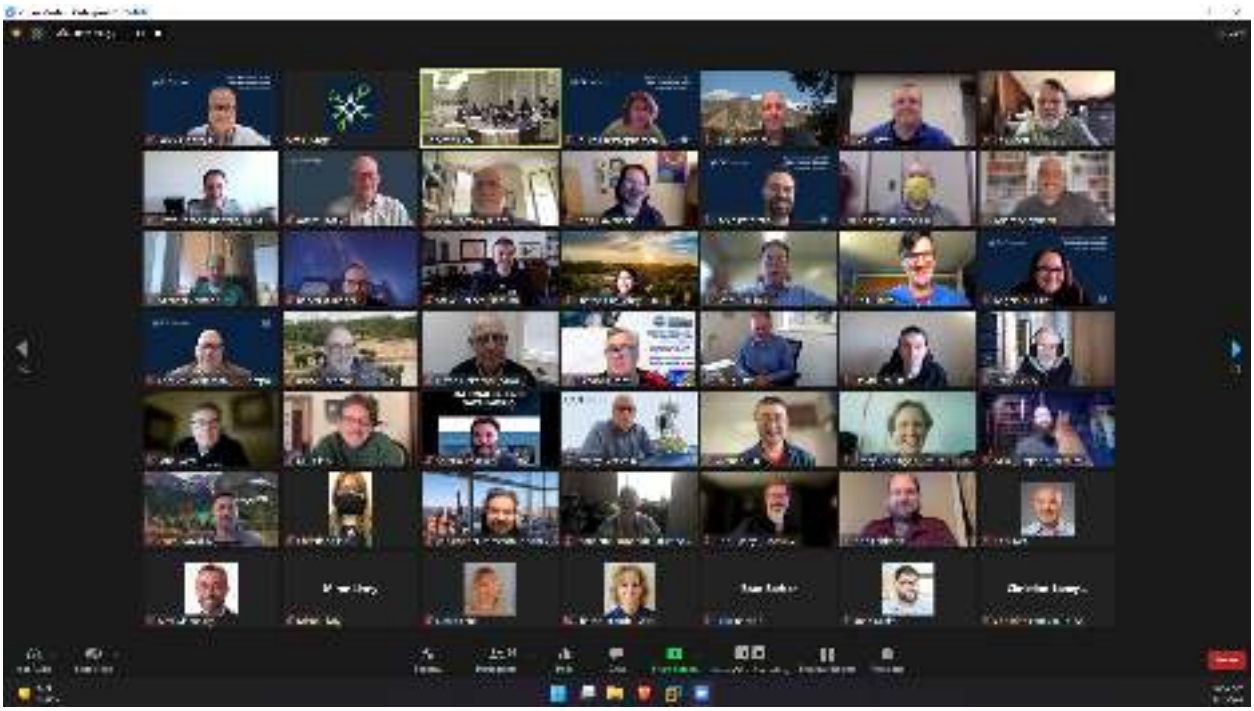


Figure 2: Select remote participants on Zoom, March 1, 2022.

Three of the sessions (Resilience, CI Challenges, and Workforce Development) included in-person and virtual breakout groups. This proved to be a logistical challenge as it required in-person and virtual responsibilities for breakout moderators, breakout note-takers, and breakout floaters. There were approximately 38 times when people were committed to one of these roles over the two days. See the *Appendix A: Workshop Contributors* for a list of names.

The main workshop sessions included the following topics (in order of discussion):

- Developing Resilience and Managing Uncertainty during the Pandemic,
- Making the Major Facilities Data Lifecycle FAIR to Provide Artificial Intelligence (AI)-Ready Data,
- Cyberinfrastructure for Major Facilities: Challenges and a Path Forward,
- The March Toward the Clouds: MF Perspectives, and
- Developing and Retaining a Vibrant Team of Workers.

The workshop also included a keynote talk, “Democratizing Science Through Advanced Cyberinfrastructure”, given by Manish Parashar, Director of the NSF Office of Advanced Cyberinfrastructure, and lightning talks about the NSF CI ecosystem. Please see *Appendix C: Agenda* for more details on the lightning talks.

During selected sessions, the organizers conducted polls that were geared towards understanding the participants’ perspectives on a particular topic.

On day one of the workshop, the “Developing and Retaining a Vibrant Team of Workers” session organizers asked participants to post workforce development challenges on a virtual bulletin board, Padlet, and vote

on the challenges they would like to tackle. On the second day, the breakout groups were organized around the suggested topics.

Figure 3: An image of the brainstorming board used to define breakout sessions for the workforce development breakout session.

In addition to the active discussions that occurred among participants at the hotel, remote participants flooded Zoom chat during sessions with questions and comments, exhibiting strong interest in session topics.

Social engagement activities included ice breakers in Whova, a reception and social coffee hour for in-person participants in California. Virtual participants had lively discussions during the breaks each day.

Figure 4: Example Ice breaker.

The workshop also included an online "*Best Home Office Companion Photo Contest*", recognizing that our pets were our absolute best companions during the pandemic and that they deserve our thanks!

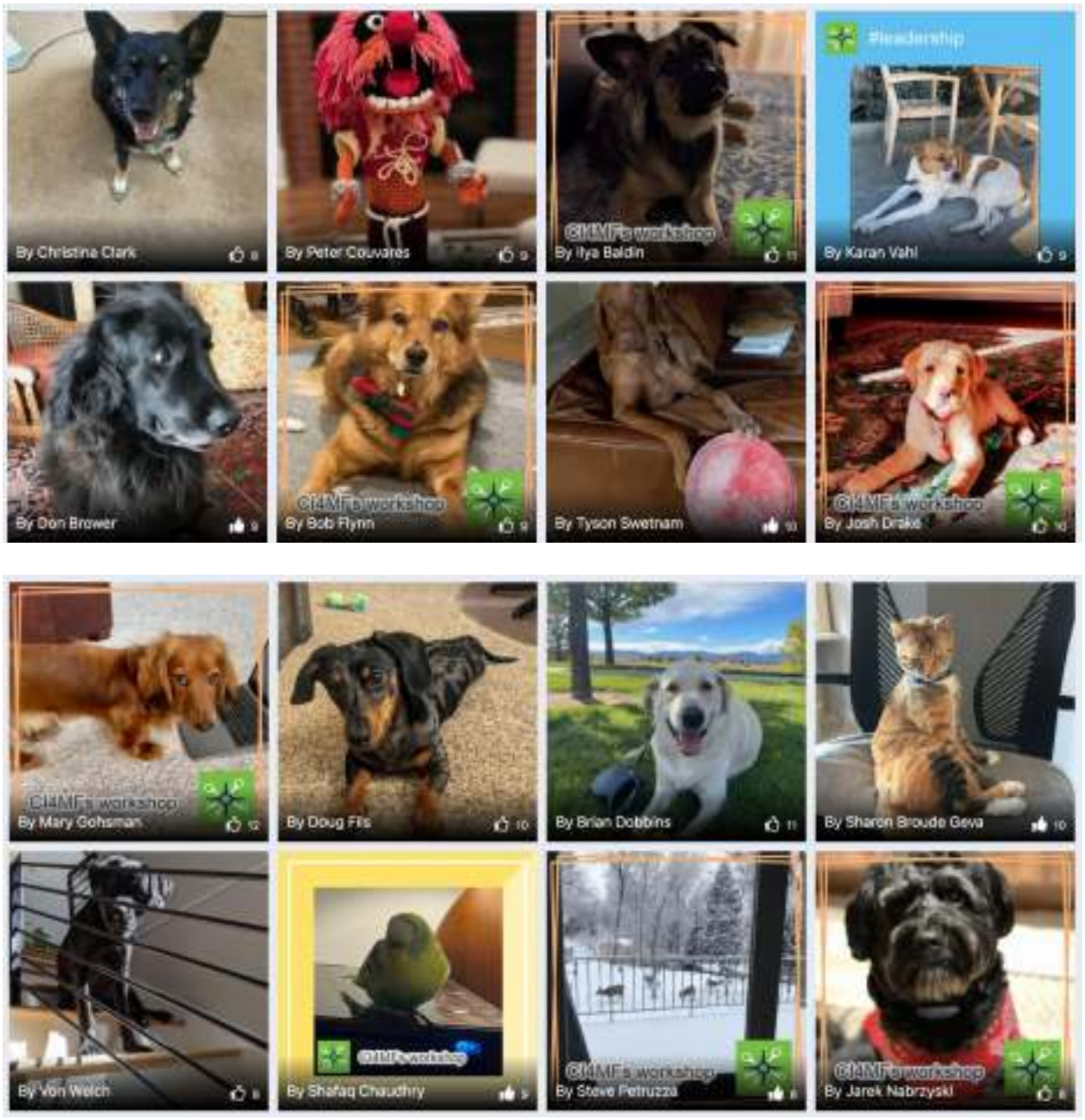


Figure 5: Selected photo contest entries.

Opening and Keynote

Ewa Deelman, the Principal Investigator (PI) of CI Compass, opened the workshop. She stressed the importance of CI in the NSF MFs. She explained that the theme for the workshop “Getting Together, Working Together” was meant to reinforce the importance of community and collaboration. MFs enable basic research in a variety of science and engineering areas, from ocean science to astronomy, ecology, seismology, atmospheric research, hazard engineering, and many others. These facilities deliver data, modeling, computational, and physical capabilities to the broad science and engineering community – researchers, students, educators, and the public. The MFs differ in the types of data captured, scientific instruments used, data processing, and analyses conducted.

However, they have something in common. These MFs rely on complex and ever-changing CI to transform raw data into more interoperable and integration-ready data products that can be visualized, disseminated, and transformed into insights and knowledge. Deelman put forward that excellence in CI will advance scientific discovery and engineering that MFs enable. She went on to describe the activities of CI Compass: engagement with the facilities in the area of the MF data lifecycle [4], facilitation of topical working groups that work on pressing MF CI needs, sharing of best practices, undergraduate student fellowship programs, and community events such as the biennial CI for MFs workshop.

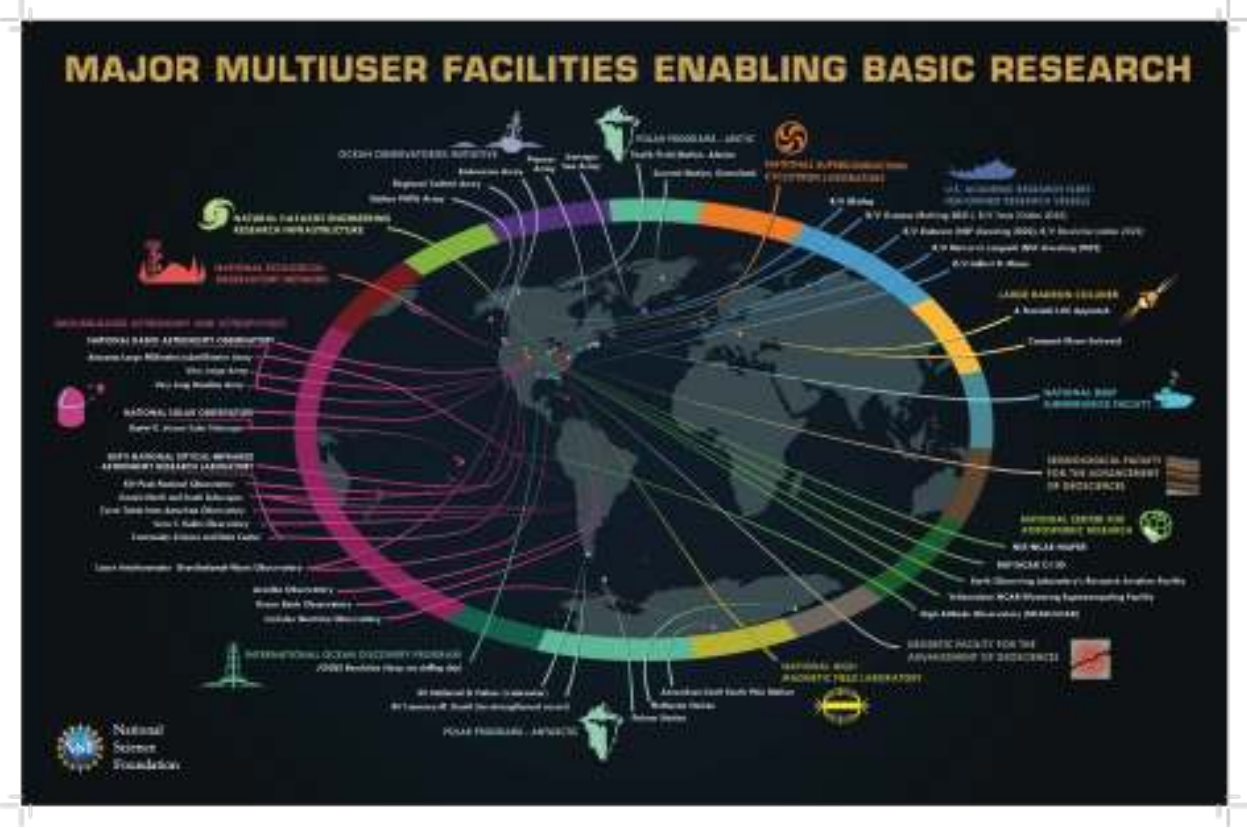


Figure 6: NSF graphic showing the list of the Major Facilities around the globe [5].

The keynote by the Director of the NSF Office of Advanced Cyberinfrastructure (OAC), Manish Parashar[4], focused on the challenges and priorities for MFs in developing scalable, sustainable, and transformative CI that helps MFs achieve their science goals. CI is a key component of any modern MF, however, most MFs find it challenging to keep up with the CI state of the art, and maintain robust, secure, scalable, and performant CI. The major questions in decomposing this problem were:

- What metrics can be used to capture CI expectations across the entire CI lifecycle?
- How can CI considerations be infused across the different MF lifecycle stages?
- How to instill an evolutionary mindset around CI at MF conception?
- How best to align MFs with NSF's existing broader investments into shared CI resources, services, and expertise?
- What approaches can NSF use to incentivize the sustainable development of MF CI?

Special emphasis in the talk was placed on maintaining and growing the CI workforce across the NSF ecosystem—one of the major pain points for MFs in building and maintaining their CI. MF CI must be looked at holistically—infrastructure, software, data, and, critically, people who develop and maintain this CI. Strengthening the CI professional workforce is key to achieving this goal.

The NSF vision for the national CI ecosystem outlined during the talk presented a systematic approach to addressing these problems. The vision is driven in part by the "Missing Millions'' report [6], recently compiled for NSF. The report highlighted several key problems with scaling the national CI ecosystem to include a more diverse set of researchers so they can take advantage of these resources in service of their science goals—problems like resource discovery, cumbersome allocation processes, and the lack of agile and scalable support responsive to local needs.

The presented NSF vision emphasized looking at CI development holistically, supporting translational research, balancing innovation and sustainability, coupling the discovery and innovation cycle, and improving usability. Realizing this vision will take time, however, multiple efforts are on the way that show how these problems can be tackled:

- PATh[5] - a shared or private Access Point to place and manage workloads across multiple CI facilities and allocations, to improve usability across different platforms
- Multiple solicitations that focus on developing the CI workforce:
    - CyberTraining (NSF 22-574)
    - Research Coordination Networks: Fostering and Nurturing a Diverse Community of CI Professionals (RCN:CIP, NSF 22-558)
    - ACCESS (replacing XSEDE/XMS) - CI Coordination services

Taken together, these are part of the overarching NSF strategy to make CI a first-class design and planning requirement for MFs, to avoid the pitfalls and limitations of some of the existing CI services, carefully (and realistically) plan effort profiles for CI, democratize access to the CI, and help MFs effectively address societally important problems they are designed for.

[4] https://youtu.be/J_WqStGz5hE

[5] https://path-cc.io/

Cyberinfrastructure for Major Facilities: Challenges and a Path Forward

The NSF Major Facilities face several technical challenges in the acquisition, processing, storage, and delivery of vast, heterogeneous, and dynamic data to the communities of scientists they serve. Some examples include tracking and managing technological changes across the lifecycle of the facilities, employing automation to streamline data acquisition, processing and operations, integrating and interoperating with community standards for data management, developing robust and secure CI that meets the needs of facility users, and operating and sustaining CI solutions over time. In addition, several unique socio-technical challenges also arise while operating an MF CI in terms of organizational culture, staffing, training, and knowledge transfer.

In this session, organized by Robert Casey, of Incorporated Research Institutions for Seismology (IRIS) / Seismological Facilities for the Advancement of Geoscience and EarthScope (SAGE), and Anirban Mandal, of CI Compass, participants discussed current and future MF challenges during all phases of MF CI lifecycle: design, construction, enhancements, and operations, and how different MFs can address them or can be best prepared for the future. The panel discussion portion of this session was anchored by experts representing several MFs, who provided unique perspectives on MF CI challenges and opportunities from the lens of the MF they represented. The panel presentations were followed by an open and collective discussion on the topic within the MF CI community.

Panel Discussion

The panel presentations included:

- Gordon Bonan represented a collaboration between the National Center for Atmospheric Research (NCAR) and the National Ecological Observatory Network (NEON) Major Facilities. He discussed challenges in widening access to portable climate models and data in a cloud-based environment, which will benefit users from both MFs.
- Ken Feldman represented the Academic Research Fleet (ARF) and Rolling Deck to Repository (R2R) facilities. He presented unique CI challenges with respect to research vessels, e.g. limited bandwidth, availability of science party data on shore, managing data distribution rules governed by multiple entities, maintaining CI updates, etc.
- Dan Stanzione represented the Leadership Class Computing Facility (LCCF). He introduced the Frontera project as Phase 1 of the LCCF and described CI challenges in discovering users' needs for facilities, collaboration challenges with respect to mismatched timelines, the time-intensive nature of collaborations in MF CI topics, and the importance of cost-benefit analysis to adopt new technologies in MF CI enhancements.
- Lauren Clay represented the National Hazards Engineering Research Infrastructure (NHERI) and spoke from the perspective of a social science researcher/user for the NHERI DesignSafe CI. She

presented CI challenges with respect to FAIR data, regulatory challenges for data publishing, and challenges in managing permissions for sensitive data sets.

- Patrick Brady represented the Laser Interferometer Gravitational-Wave Observatory (LIGO) and the Scalable Cyberinfrastructure to support Multi-Messenger Astrophysics (SCiMMA) community. He presented lessons from a collaboration between astronomy facilities. He also discussed sustainability challenges and the importance of training in best practices for software development.
- Philip Gates represented the International Ocean Discovery Program (IODP) Major Facility and the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES) Resolution vessel. He discussed challenges in organizational visibility, supporting users who bring their own devices on board the research vessels, bandwidth limitations, data protection, and discovery of shared services.

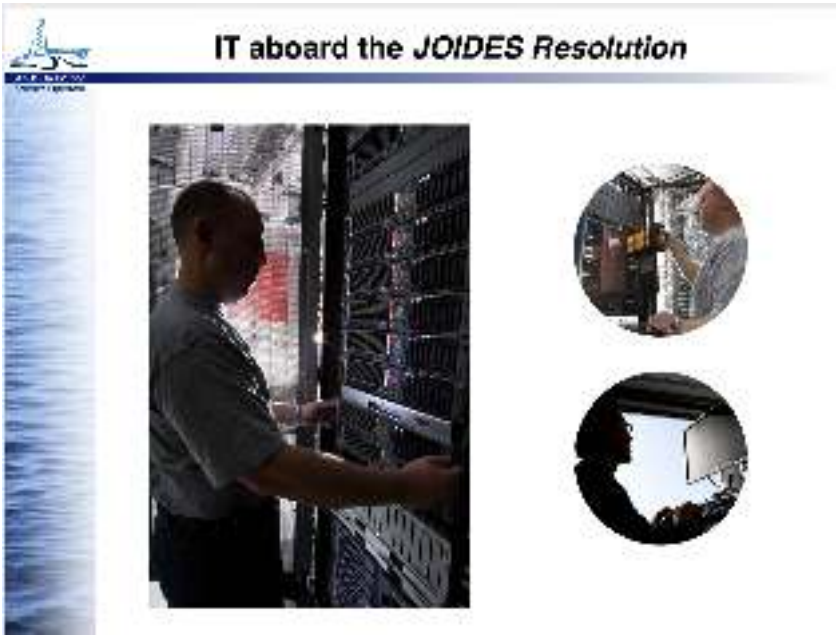


Figure 7: Challenges of working on IT challenges aboard ship. From Philip Gates' slides.

Key Findings

Technical Challenges

MFs are facing several technical challenges with rapid technological shifts, including growing heterogeneity in hardware, increasing data volume and velocity, and the complexity of CI software that operate on MF data. MFs are not able to keep abreast of and take advantage of this rapidly evolving CI landscape to support their needs. Sometimes, adequate planning for CI is not undertaken earlier in the design phase of an MF lifecycle. Some MFs that operate research vessels face challenges in offloading data to the shore to enable rapid access to the science party data, offering bandwidth, and supporting heterogeneity of devices brought on board by researchers. There are challenges in the interoperability of software across MFs that are related, e.g. between several astronomy facilities. It is hard to develop software in an MF that can then be used or integrated into other software developed in another related MF. Identity Management for users of MFs and for tracking data and service usage inside MFs remains a significant challenge. When it comes to the adoption of cloud technologies for MFs, it was noted that cloud adoption remains use case dependent. While it is important to understand the applicability of cloud technologies for addressing CI issues in some MFs, it is also important to recognize that the cloud is not a blanket CI solution for all MFs.

Impediments to the adoption of the NSF ecosystem of CI services

There are a multitude of shared services available in the NSF CI ecosystem, but they undergo constant churn based on funding cycles, which makes it difficult for MFs to adopt them. MFs need support for stable, long-term services, and guarantees and mechanisms for how these services will be sustained/maintained in the long run. Sustainability and maintenance of NSF CI services, most often implemented as individual projects lasting 3-5 years and rarely coordinated, remain an impediment to adoption by MFs. Participants also noted that mismatched scale and overheads, between what the NSF shared services offer and what MFs need to support their CI, are sometimes impediments to adoption. For example, MFs might need access to significant storage space over a long period of time, at a time scale which might be longer than what current services in the NSF CI ecosystem offer. It was noted that identifying the sweet spots when leveraging NSF shared CI services is the key to the successful adoption of these services.

Challenges in collaboration

The participants recognized that coordination, collaboration, and communication challenges are tremendous. There is a definite need to share success stories and lessons learned (especially what did not work) and it was observed that forums like NSF CI For MF workshops and working groups for cross-cutting topics are extremely beneficial for knowledge sharing and collaborations. The community recognized the importance of sharing/disseminating technology best practices. It was also noted that there is a lack of incentives for individual MFs to interact and share lessons learned among colleagues. Participants also noted that there is not always available effort to devote to collaborations. MFs often lose sight of the Return on Investment (ROI) of such collaborations in the long-term. There were some discussions about the need for agencies to fund personnel from multiple MFs to work together on specific common CI issues, which would then lead to coordination and synchronization on architectural decisions. This will also have an added benefit of cross-training of CI personnel. However, with personnel shortages, this may approach may not be immediately feasible.

Balancing adoption of new technologies vs. maintaining operations

Several challenges were discussed with respect to balancing the adoption of new technologies and maintaining the operations and mission focus of the MFs. It was noted that operational disruption and unavailability of CI personnel time are the biggest impediments to adopting new CI in the MF context. There is also ongoing tension between maintaining operations and adding new technology when it comes to deciding where to invest available resources. MFs don't often have time to explore new technology that can be applied to their CI, preferring instead to use what has worked in the past, favoring operational continuity. MFs also sometimes respond rapidly to immediate needs without an analysis of the potential for facility-wide impacts, which can later lead to the accrual of technical debts.

Socio-technical challenges

Hiring CI personnel was recognized as the most significant socio-technical challenge faced by all MFs. Managers tasked with hiring for MF CI positions are in competition with industry and often at a disadvantage when it comes to salary and benefits. For the same reason, retaining people is also hard as personnel seek more lucrative opportunities or new challenges in other sectors. It was also noted that flat budgets at MFs make it difficult to respond to changing market dynamics and retain key technical staff. For many MFs, the CI staff need to work in remote locations (e.g., research vessels, telescope sites, etc.) and sometimes need to stay there for months, which dissuades job candidates. A related challenge was noted in the area of workforce training, and it might be beneficial to consider such activities within the core technology needs

for a MF. It was also noted that, as a community, we will need to work harder to bring in and train a diverse population of CI professionals.

Recommendations

- MFs need to carefully consider, preferably in the design and enhancement phases, different deployment plans that include effort profiles and timelines for their CI: what to move to the cloud, what part of the CI services need to be deployed on hybrid infrastructure, how to integrate devices and resources from scientists/users of a facility, what services can be leveraged from other providers (NSF CI ecosystem, commercial), etc. Such decisions need to be driven by the individual use cases, the effort profiles and the specific mission and workflows of each MF.
- Forums like NSF CI For MF workshops and working groups with participants from multiple MFs for cross-cutting CI topics are extremely beneficial for knowledge sharing and to build new collaborations. A key recommendation was to continue the organization of such activities, workshops, and working groups to facilitate collaboration and sharing of best practices. Community building around and engagement on common CI issues affecting MFs need to be supported and encouraged.
- The MF CI community needs awareness and cataloging of available shared services from the NSF CI ecosystem. A key recommendation was that these services and the associated effort (adoption and operation), costs, timelines, and expectations should be documented and advertised broadly across the MF community to raise awareness. Another recommendation was for NSF to publicize a list of large CI projects/organizations/services supported by NSF so that new projects are aware of them at their inception. Major Facility CI teams should identify potential shared services that can be leveraged.
- The participants also recommended the continuation of MF community-focused centers, which can provide expertise for a wide-range of issues including identity management, distributed computing, cloud technologies.
- One impediment to effective collaborations between MFs is the mismatch of motivations between the facilities. One recommendation was that MFs will need to carefully delineate the importance of a particular CI issue and the corresponding balance between effort and benefits achieved when entering into a collaboration to make the collaboration fruitful.
- While problems are in most cases unique to each facility, MFs need to take advantage of amortized benefits when it comes to common problems that they can solve together. Again, forums such as the CI4MF workshops should facilitate the identification of common CI services that can be tailored to different MFs through a layered software stack.
- Since hiring and retention will continue to be significant issues, MFs should make renewed efforts in workforce development by providing CI personnel who are motivated (and feel rewarded) by the research and the academic culture of the MFs (and not just the paycheck) a career path, and enhanced training. To democratize access to MF science, the MF CI community should involve underrepresented institutions and communities in their events, workshops, and working groups. MF CI developments are largely people-driven, not hardware-driven. Hence, funding CI personnel in grants should be prioritized.

The March Towards the Cloud: MF Perspectives

Adoption of cloud computing for part or all of MF operations is a major decision that the leadership of various MFs increasingly face. Many MFs were in existence before the term “cloud computing” was coined. These facilities are largely in a continuous mode of operation, collecting, harmonizing, and curating data, and making it available to their respective scientific communities. As a result, they have built a considerable amount of infrastructure - often custom built - to serve their needs and mission. Adoption of cloud technologies for operations provides attractive benefits in terms of increased availability and durability of data and an opportunity for the MFs to rethink their overall CI infrastructure stack, as well as their software engineering and DevOps practices on how to best leverage the cloud. At the same time, there are significant challenges to this adoption/migration, including the need to continue with their current mandate and mode of operations, increased and uncertain and changing costs as well as staff training requirements. The discussion in this session was anchored by a panel of experts who talked about the experiences of their MFs in using the cloud so far, followed by a larger discussion with the community of the collective opportunities and challenges facing the MF community in the adoption of the cloud.

Panel Discussion

The panel presentations included

- Bob Flynn, from Internet2, presented “What Do You Need to Ask Yourself when You Move to the Cloud?” Drawing on his experience working with research organizations that use Internet2 services, Bob briefly exposed participants to the different sorts of considerations that should be addressed when deciding on a move to the cloud.
- Chad Trabant, from Incorporated Research Institutions for Seismology (IRIS) presented, “Migrating two Major Facilities from on-premise data centers to a common cloud platform mid-merger.” Chad discussed how Seismological Facility for the Advancement of Geoscience (SAGE) and Geodetic Facility for the Advancement of Geoscience (GAGE) have been working on developing a common cloud platform for managing data. Moving to the cloud provided SAGE/GAGE with a way to consolidate certain operations to a single implementation and service.
- Jeff Gladstein, from the Woods Hole Oceanographic Institute (WHOI), presented “OOI Approach to the Cloud.” He briefly outlined the Ocean Observatories Initiative’s (OOI) current data collection and dissemination statistics, and then covered the types of feasibility questions OOI has considered in approaching the decision to move to the cloud. Jeff concluded by outlining OOI’s strategy moving forward, which focuses on developing proofs of concept for various needs and then assessing their ability to meet those needs.
- Benedikt Riedel, from IceCube Neutrino Observatory, presented “IceCube in the Cloud.” He discussed what IceCube is currently doing with regard to cloud computing and then focused on the

barriers to successful adoption, giving weight to the human factor when making significant organizational changes.

- Brian Dobbins, from the National Center for Atmospheric Research (NCAR), presented “The March with the Clouds: NCAR.” He walked participants through NCAR’s process for assessing when a given process/service is well suited for a move to a cloud and discussed how cloud services can complement existing on-site services. He also discussed the benefits of using container technology, and outlined how NCAR is weaving containers, cloud, and on-site services together to best satisfy their needs.
- David Halstead, from the National Radio Astronomy Observatory (NRAO) presented “Surging into the cloud and Grids: Insights into keeping up with the processing workload for the Very Large Array Sky Survey.” David focused on NRAO’s data processing needs and provided a brief overview of their analysis of different options, such as Amazon Web Services and HTCondor.

Figure 8: Panel Participants in a Hybrid Format.

Figure 9: Slide by Chad Trabant on Motivations for Moving to the Cloud.

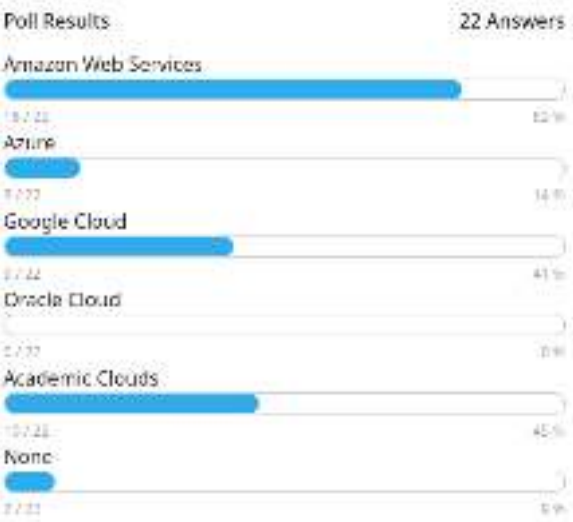
Cloud Session Poll Results

During the session, the workshop participants were also posed the following polling questions

Q1: Why is your organization most interested in the cloud? (Check all that apply.)

Q2: What do you see as the biggest impediment to your organization/group adopting cloud more widely?

Q3: Which of these clouds are you using in your operations currently?



Key Findings

Overall, the session was highly engaging and informative. The findings are organized along the following subtopics:

Motivations for MFs to move to the cloud

Some of the tangible benefits that the participating MFs described included the opportunity to transform their operations to be highly scalable and cost-effective with the right understanding of the underlying costs (FinOps). With the right technical re-architecting in the move to the cloud, there are possibilities of using generalized systems and reducing legacy technical debt. From an end user perspective, moving to the cloud has the potential of making access to large datasets effective, giving them the ability to do the computation against those datasets in the cloud itself. Also, some large-scale computing needs may not necessarily be met by in-house computational resources with the same level of scalability that the cloud offers.

Challenges when moving to the cloud

Some challenges that MFs face when rearchitecting for the cloud is the need to adapt their in-house data management systems to make effective use of cloud storage, adoption of general cloud services and concepts and de-siloing of their services. The MFs also indicated a need for workforce development and associated training of staff to understand and leverage cloud concepts and associated technologies. An overarching concern was how to manage the costs incurred by running the MF operations in the cloud. For most of the MFs, the high egress costs (incurred when users download MF's data that is hosted in the cloud to their local resources) and long-term storage costs represent a significant budget challenge. A lot of MFs have datasets on the order of petabytes and the lifetime of these datasets is often measured in decades. MFs often serve tens of millions of data requests per month in their normal operations, which in a cloud deployment incurs charges in terms of API requests and volume of data downloaded. These different aspects of costs also highlighted the need for MFs to understand and leverage the advances in the new field of continuous and rapid cost management (FinOps). Some panelists also indicated that GPU computing costs on the cloud can be expensive. Observations were also made that cloud contracts often take time to finalize at an institutional level, and the duration of contracts often does not align with the length of a typical NSF contract. For example, Amazon Web Services (AWS) contracts are typically 4 years while NSF grants are for 3 years. There was also discussion of CloudBank,[6] an NSF-funded project that assists small-scale groups with cloud contracts and managing overall costs. However, CloudBank does not cater to MFs, which can be orders of magnitude larger than typical research groups.

Impacts of Cloud Adoption on MFs

Some positive impacts of moving to the cloud are leveling the playing field for users, as users can do processing in the cloud in contrast to first downloading datasets and doing computations on local resources (although there are costs associated with processing in the cloud) and reducing the long-term reliance on researcher-owned equipment. The move to the cloud also enables on-demand usage whereby researchers are able to run urgent analysis when local campus or high-performance computing (HPC) resources may

[6] https://www.cloudbank.org/

not be available or are oversubscribed. Negative impacts include additional costs, the possibility of unpredictable costs, and the requirement for the development of new skills in both MF staff and the user community that will often need to make substantial changes to well-established workflows.

Recommendations

The participants recommended several strategies that can be used when deciding whether and how to adopt cloud as part of an overall CI strategy:

- When designing cloud solutions, MFs may consider adopting a hybrid cloud approach as a first step, where some services and data are kept locally, and a cloud mirror/copy are used for disaster recovery, for scaling, and for users who explicitly want to compute in the cloud.
- Using Internet2 direct connections is another mechanism for making the cloud viable for large-scale science.
- Use containers to enable deployment of MF services on both local and cloud resources (an area in which the national NSF CI ecosystem, including the Stampede2 and Frontera projects, have made significant strides).
- Leverage cloud credits that commercial cloud providers often offer new users but pay attention to the expiration date of the credits. Be careful in setting the start date of these credits, and work with the cloud providers to explore if the credits can be split to ensure they last longer. Leveraging existing funded NSF agreements with significant cloud components, such as Frontera and CloudBank, is another avenue available to MFs that may be especially relevant to jumpstart exploratory or prototype activities.

Making the Major Facilities Data Lifecycle FAIR to Provide AI-Ready Data

The presentations and subsequent discussion touched on many issues related to FAIR, data management, and AI-ready data. Charles Vardeman from CI Compass introduced the session, and his talk was followed by these presentations:

- Don Brower, representing CI Compass, gave “An Overview of FAIR Data and the MF Data Lifecycle”, reviewing the FAIR principles and their importance to all stages of the data lifecycle.
- Charles Vardeman, from CI Compass, discussed “WikiData: A Knowledge Graph for the Earth Sciences”, explaining the importance of WikiData, a central document-oriented knowledgebase that contains linked data about various topics, objects, and concepts, including those in life sciences.
- Adam Shepherd from the Woods Hole Oceanographic Institute (WHOI), and Doug Fils, from the Consortium of Ocean Leadership, talked about “ESIP Schema.org cluster: Utilizing the Schema.org Vocabulary for FAIR Earth Science Data”, a community effort that is adopting and extending for science the schema.org standard for embedding metadata into HTML pages to enhance data findability.
- Christine Laney, from the National Ecological Observatory Network (NEON), discussed “NEON’s First Data Release: Challenges and Opportunities to provide FAIR Data” and the phases of the release process for NEON data and the documentation provided to the community so that scientists can accurately interpret the data.
- Giri Prakash, from the Oak Ridge National Laboratory, in his talk about “AI Strategies for Improving Data Management Components and Preparing AI-ready Data that meets FAIR and Data Provenance” discussed how the US Department of Energy (DOE) Atmospheric Radiation Measurement Facility (ARM) addresses its data management challenges. He also spoke about creating an AI-backed data recommender and data discovery system to assist people with finding relevant data products.
- Bruce Berriman (Caltech/IPAC), Chair of the International Virtual Observatory Alliance (IVOA) Executive Committee, talked about “Applications of FAIR Principles in Astronomy”. IVOA promotes community standards that are in wide adoption that support FAIR principles. This alliance, formed in 2002, is a good example of a community working toward data and metadata interoperability.

Following the presentations, a survey was administered asking participants to answer questions related to their experiences with FAIR data and to assist with driving the post-presentation discussion.

Figure 9: Slide from Christine Laney's (NEON) presentation about different data distributed to the community.

FAIR Data Poll Results

The first question asked participants "Are the FAIR data principles a consideration for your MF?" Of 21 respondents, 62% stated "yes," and 24% stated "yes, but not by me."

Participants were asked, "Which FAIR principle(s) do you think would be most helpful to you?" Results of this question were evenly distributed, indicating that no one FAIR principle seems to be more helpful than another.

Participants were asked, "Which FAIR principle are you furthest along in implementing?" Participants indicated that they were furthest along with Findable and Accessible, while Interoperable and Reusable were implemented the least.

When asked, "How would you evaluate your progress towards being FAIR?," 41% of participants stated they were making very good progress, while 23% stated they had made very little progress.

When asked "What pain points have you experienced in FAIR?", the majority of participants (63%) indicated that there was a lack of time prioritizing FAIR, but other pain points were also indicated, including lack of personnel who understand FAIR. A follow-up question indicated that many participants needed more time and better tooling to help with FAIR implementation.

Key Findings

Overall, participants were aware of the FAIR principles and had the desire to improve the "FAIR-ification" of their data. While participants clearly indicated the willingness to implement FAIR, they questioned how to determine what exactly is considered FAIR and questioned how best to implement FAIR. For example,

participants asked, "how much is enough?" when it comes to FAIR implementation. Workshop participants also asked questions about which standards were worthwhile to invest in and wanted to learn about standards that would be beneficial to their data lifecycles. Concerning standards, participants described one difficulty with standards was how new standards development took more time than expected.

There was also discussion on the cyberinfrastructure required to facilitate FAIR. As data portals are common places for data, these portals may provide an index of available data, API access and can share records with other data-aggregation sites for searching. The data pipelines that are developed to collect, process, and share data are challenging due to the complexity of the data and cyberinfrastructure at MFs. Additionally, these pipelines require ongoing support and investment.

Recommendations

Since FAIR data is a cross-cutting concern and general approaches may be common to all MFs, the participants saw the usefulness of creating a Topical Working Group to share ideas and approaches toward FAIR data amongst the MFs. Potential areas of focus for the Topic Working Group include:

- Ways to adapt FAIR to existing systems and data.
- Sharing FAIR experiences and best practices for implementation.
- Identifier and DOI assignment strategies.
- Handling and identifying time-series data.
- Items that are related but not needed for FAIR (e.g. reproducibility).

Developing Resilience and Managing Uncertainty during the Pandemic

The Resilience session focused on the challenges brought about by COVID-19 as well as the solutions and lessons learned in response. Participants discussed how to manage uncertainty so that the MF community could cultivate organizational resilience and put in place better preparation for future crises and disasters. The session started with three presentations:

- Kerk Kee, of CI Compass and CI4Resilience, provided a brief discussion of organizational resilience.
- Cassie Hayes, of CI4Resilience, presented a talk entitled "No Hitting the Pause Button: Leveraging Advanced Cyberinfrastructure and Developing Organizational Resilience for NSF MFs in the Pandemic Era," and discussed the findings from the CI4Resilience project in terms of pandemic response strategies and the pandemic-sensitized mindset.
- Shafaq Chaudhry, of Arecibo Observatory, discussed "Resilience in Major Facilities" and in particular the crises faced by the Arecibo observatory that led to its collapse.

Figure 10: A slide from Shafaq Chaudhry's presentation "Resilience in Major Facilities"

Following the presentations, in-person and virtual breakout sessions were organized where participants were challenged to identify (a) the most enduring and/or impactful challenges during the pandemic, (b) the most promising solutions to these challenges, (c) ways in which MFs can cultivate organizational resilience as a foundational quality of the workplace/workforce of MFs, and (d) how MFs can best manage uncertainty going forward.

Breakout Session Discussion

To ensure that each question received sufficient discussion, questions were rotated in different orders for different breakout groups. The discussion questions were open-ended in nature to encourage broad contributions. Examples of questions include, “What were the most difficult challenges your organization faced during the pandemic? (e.g., technical challenges, CI-related challenges, operational challenges)”, “What strategies did your organization implement in response to the pandemic and/or any other organizational crisis?”, “Crisis and disasters often create a high level of uncertainty for people. What has kept you up at night during times of uncertainty?” Toward the last 10 minutes of the session, all groups were encouraged to move to the wrap-up question, “What are the main findings in challenges, and what are the main recommendations as far as strategies go?” Then the facilitator and scribe in each group synthesized three main findings and three main recommendations.

The Resilience Session breakout discussion can be categorized into three main discussion topics: Organizational Challenges, Individual Challenges, and Continuity of Operation Plan (COOP)/Organizational Readiness.

Topics discussed relating to organizational challenges included the need for new training/skill development, the problem of inconsistent policy and poor communication surrounding policy, work-from-home dynamics, including team bonding difficulties, and some possible solutions. Further problems were identified, such as the baseline tendency to change jobs, industry competition on salary, tendency to invest in physical infrastructure rather than workforce, onboarding problems, and problems with accelerated retirements.

Topics discussed relating to individual challenges included lacking knowledge on the well-being of others, COVID-19-related deaths in the family, uncertainty from dynamic developments, Zoom fatigue, increase in the frequency of meetings, and the challenges it creates with managing work time, and the necessity of self-care.

Organizational readiness topics included decision-making concerns, such as determining the funding agency’s priorities and concerns, and determining the urgency of certain tasks over others (e.g., systems to protect human life, early warning systems), while actionable items included implementing and maintaining disaster recovery mechanisms for retaining data, effective external communication, and implementing and maintaining Pandemic Response Teams for MFs. Other organizational readiness items included internal reporting and chain-of-command readiness exercises and utilizing individuals with official spokesperson roles when external communication is needed.

Key Findings

Based on the discussions, these key findings were distilled:

- MFs are complex organizations where CI professionals manage complex instruments, and physical and cyber infrastructures. The pandemic highlighted issues with conflicting policies and poor communication surrounding policy and work-from-home dynamics.
- The pandemic underscored the important role of CI professionals within the MFs. It also highlighted the disparity in investments in physical infrastructure versus investments in building a resilient

workforce through recruitment and retention, onboarding of personnel (especially virtual), and managerial training.

Recommendations

In response to organizational challenges, different management philosophies or leadership strategies were discussed, including:

- MF CI managers need to provide feedback, leadership, and make tough decisions, but be flexible when setting policies such as return to work.
- MF CI managers should make sure to recognize and reward personnel that went above and beyond during disruptive events (such as the pandemic) and recognize that honest mistakes happen.
- MF CI managers should listen to employees and provide good reasons and rationale behind policy decisions.
- CI staff should be open with management about the concerns, both personal and professional, which they may have during disruptive events.

Some possible solutions discussed for industry competition included offering professional development resources, giving people a sense of intellectual ownership for the projects that they are working on, offering a more flexible work culture than industry, and creating a feeling of belonging in the organization. Some possible solutions discussed for the tendency to invest in physical infrastructure rather than workforce include assessing tasks to prioritize and focus on what tasks/activities add value and assessing staffing to determine which skills make sense to have in-house and which do not.

Some possible solutions to individual challenges were discussed, including being mindful that scientists are humans and need to be human, and as such, should also recognize individual differences in each other. Taking time to take a break can also help relieve some of the challenges with self-care. Organizations can help by providing counseling, offering flexibility and time off, offering resources and space to boost morale, and managing tasks with a better division of labor so that people can have more focused work.

Developing and Retaining a Vibrant Team of Workers

At the 2019 NSF Workshop on Connecting Large Facilities and Cyberinfrastructure, participants discussed many challenges they faced regarding recruitment, retention, training, and compensation of staff [2]. Based on the needs expressed at that workshop, the CI CoE Pilot[7] (Pilot) team conducted interviews with a small sample of MF managers and sent a survey to their staff. The goal was to investigate needs and challenges further, so the Pilot team could determine how CI Compass, if funded, could be of better service. At the conclusion of the Pilot, the team hosted a small, virtual workshop to discuss these matters further [7].

During both activities and in other meetings, events, and communication forums, the MF community has been able to identify priorities or challenges that are important to solve, but there are few opportunities for the community to come together to work on solving them. The goal of this session was to provide an opportunity to make a beginning on outlining potential solutions to frequently discussed challenges.

On day 1 of the workshop, participants were asked to identify challenges that met the following criteria (mostly related to keeping the scope manageable):

- The challenge should be potentially solvable within a year's time (or less);
- It should be important to the participant to solve; and
- It should be feasible to solve given the collective resources at the workshop participants' disposal and should be solvable with the other workshop participants' help.

Participants were asked to list their challenges on a virtual bulletin board and then vote on the challenges. On day 2, the challenges that received the most votes and were deemed the most feasible to tackle were selected for further discussion. They were:

- Building management skills within MFs, particularly in difficult situations (e.g., COVID).
- Conducting a diversity assessment in terms of CI staff across MFs: What has worked? What has not?
- A training program especially for MF CI professionals.
- A "fellows" program for CI staff to job swap and cross-train at another MF.
- A central location for posting MF jobs.
- A showcase of CI developments (for knowledge sharing and as a form of training).

[7] https://cicoe-pilot.org/

- A curated list of CI job descriptions, titles, and salaries.

Then breakout groups were formed for each challenge and participants were asked to choose the breakout group that had the challenge that most interested them. To guide the brainstorming, workshop participants were asked to consider the following questions:

- What is the nature of the problem you are trying to solve?
- Who is ultimately responsible for this challenge (i.e., what party is the most appropriate "owner" of this challenge) and who is most affected by its solution?
- Why is it important to solve?
- How could it be solved?

Figure 11: In-person breakout discussions.

For the **Building management skills, particularly in difficult situations (e.g., COVID)** challenge, participants' discussions summarized the problem as follows: many MF CI staff who fill managerial positions are:

- often placed into that role with little or no manager training/experience,
- put under a lot of pressure to adapt to these roles with little or no support, and
- they must continue to focus on achieving significant science outcomes (same as before assuming the management position) but now with the added uncertainty of trying to fulfill the requirements of a new role for which they were given little/no training/support.

Why was this challenge important to solve? Poor management can limit the productivity of the team and contribute to employee turnover. It is important that MFs are advancing science and not falling behind because of management/staffing difficulties.

Some of the potential solutions or requirements that need to be in place for the challenge to be solved include:

- Organizational leadership should believe it is important to have their managers succeed and should communicate the value of well-trained, successful managers to the rest of the organization. The organization needs to make the professional development of managers a priority and provide resources to make this possible.
- Participants felt that some of the key skills and abilities managers should possess include the ability to hire people with diverse expertise and backgrounds, span science and technology themselves, and understand and communicate the value/impact they and their staff bring to the organization.
- The groups also discussed different forms of training that could be developed, from creating community/interest groups for managers to share knowledge and expertise among one another, to manager mentoring programs, to elementary ideas such as offering articles and other training resources on good management in a central location.

The group that discussed **Conducting a diversity assessment across MFs: What has worked? What hasn't?** explained that most staff working with CI in MFs tend to be white men. A more diverse workforce brings new perspectives and knowledge bases to bear on CI problems and can reduce "group think." These participants emphasized the importance of making diversity a more regular topic for discussion at organizations, so that the discussion is not something set aside, almost an elephant in the room, that can cause staff to feel wary when the subject is broached. Staff should feel comfortable with what would hopefully be a more everyday discussion topic, less politically and culturally charged, because it has become routine and ordinary to explore this topic. They also said that "DEI" (diversity, equity, and inclusion) means different things to different people; so, it is important for organizations to be clear about what it means to them and how it specifically resonates in their organizational culture. Instead of encouraging staff to rally around an amorphous, general notion of a "more diverse" workplace, this group of participants felt it was important for organizations to outline very specific and clear objectives they'd like to attain. For example, instead of a goal of "hire more women and people of color next year," organizations should identify ways to remove potential bias during the application review and interviewing, craft job postings to appeal to a broader set of candidates, define a number or percent of the staff that would ideally include more women and minorities, and identify a strategy for meeting diversity goals (for example, targeting specific minority-serving institutions from which to recruit).

The group that tackled **A training program and development of open training materials for MF/CI professionals** identified helpful resources (e.g., training materials and programs) and successful practices already existing in the community. They cited the current efforts of Academic Research Fleet (ARF) with its committee specifically designated to support the development of staff. This committee encourages staff to reflect on CI problems they have faced—dissecting the problem and determining ways to perform better next time. GAGE also has lunch seminars where scientists present on science topics to help CI professionals strengthen their science knowledge.

The discussion around **A "fellows" program for CI staff to job swap and cross-train at another MF** cited the following reasons why this could bring benefit to an organization:

- Staff can exchange perspectives and learn new techniques.
- One MF can get a glimpse of different kinds of practices at another MF that could be beneficial if integrated into their own work practices.
- For MFs that require staff to spend extended periods of time away from their homes and regular place of work (e.g., on a ship or at the South Pole), cross-training may reduce the need for staff to be away longer to participate in some pre-training needed before the expedition officially begins.

For the challenge (or need) of **A showcase of CI developments**, participants defined the problem as follows: MFs face similar technical challenges but infrequently collaborate and so tend to operate in silos; they may be implementing the same solutions over and over (i.e., reinventing the wheel each time) instead of sharing their knowledge and lessons learned. This is an inefficient and slow way for the MF community to conduct the business of CI.

It would be more cost effective both in terms of time and labor to share the knowledge instead and provide a way that MF staff from one MF can learn from the experience of staff at MFs. A showcase that demonstrates how MFs have solved common problems could provide a means to do this.

Participants discussed two main ways a showcase could be created. It could either be some form of an online portfolio with photos, diagrams, technical documentation, and a narrative that details the work performed; or a periodic live (virtually and/or in-person) show-and-tell where MF staff present their work, and the community is able to ask questions and discuss the details. Both ideas have their merits. The two of them together could be a very strong approach to knowledge sharing among MFs.

For the challenges of **A central location for posting MF jobs** and **A curated list of jobs and salaries**, the participants focused on existing resources and their potential for use to satisfy these needs (e.g., NSF's Research Infrastructure Communities of Interest[8]), and existing tools and resources that could be mimicked or harnessed for use in the CI/MF community (e.g., salary data offered by certain universities and organizations, encouraging users to contribute salary information as is done in sites such as Glassdoor).

All the challenges discussed at the workshop deserve more attention, and participants were encouraged to participate in a workforce development working group facilitated by CI Compass that would meet periodically to continue outlining solutions and begin implementing them. Interest in the group was strong but hasn't yet been launched.

Key findings

- The following workforce development issues were important to this community and should be explored further: training, diversity, establishing knowledge exchange programs, and establishing a central hub for CI job postings and other human resource information.
- CI managers sometimes do not receive enough training or organizational support when having to deal with difficult situations.
- Diversity, Equity, and Inclusion (DEI) means different things to different people; so, it is important for organizations to be clear about what it means to them and how it specifically resonates in their organizational culture.

[8] https://researchinfrastructure.forumbee.com/

- Participants were eager to find optimal ways to improve training, diversity, and knowledge sharing for the purpose of strengthening the workforce; further work is needed to help MFs collaborate on defining strategies and sharing best practices in the area of workforce development and retention.

Recommendations

- For CI managers to succeed, organizational leadership should make manager training and development a priority and should provide resources to make this possible. Some examples of possible initiatives could include:
    - Forming an interest group for managers to share knowledge and expertise with each other.
    - Creating a manager mentoring program.
    - Offering articles and other training resources on good management in a central location.
- To enhance the diversity of the organization's culture, organizations should outline specific, measurable goals about achieving greater diversity, and should commit to making diversity a routine topic in day-to-day discussions.
- For improving the training of all staff, several suggestions were offered:
    - Form a training committee at the organization that will oversee and ensure the professional development needs of staff are met.
    - Consider providing "lunch and learn" type sessions where staff that are CI-focused as well as those that are science-focused can share their expertise and knowledge with their colleagues.
    - Create a showcase of CI work across different MFs. Ideas included:
        - An online portfolio with photos, diagrams, technical documentation, and narrative that details the work performed.
        - A periodic live, virtual and/or in-person, show-and-tell where MF staff present their work and the community is able to ask questions and discuss the details.

Calling Cards

Prior to the workshop, participants were asked to complete a Calling Card that was used to help participants meet each other virtually before the workshop and to facilitate conversations about topics of mutual interest between participants during the workshop. The Calling Cards asked participants to briefly answer three questions:

- Please tell other participants about your biggest recent CI (including workforce development) accomplishment?
- Given that many of us work in remote teams, is there some practice that you use that you think works particularly well in such settings (e.g., make sure to have 10 mins breaks between Zoom meetings, use Slack for informal/social group discussions, etc.)?
- NSF Major Facilities (MFs) have increased collaborations with each other and NSF CI Centers of Excellence (e.g., Trusted CI, CI Compass). Looking into the future, what is your vision for the “MF as a community” in the next 5 years?

Figure 12: Calling submitted by Brandi Murphy, UNOLS.

Participants submitted 86 Calling Cards. One of those 86 was created by the individual who analyzed the Calling Cards and reported on them in this section of the report; that Card was removed from the analysis. Of the remaining 85 Cards, 33 were contributed by the staff at MFs and Mid-scale projects, 29 were from the CI Compass team (of those 29, 6 were from student interns and 4 were from student workers, 8 were from the staff at Trusted CI, 3 were from NSF representatives, and 12 were from other members of the larger NSF/CI community (e.g., ESnet, Globus, Internet2).

Question 1: Please tell other participants about your biggest recent CI (including workforce development) accomplishment?

Figure 13: Keywords in the participant responses to Question 1: Biggest CI accomplishment.

The most frequently mentioned accomplishments can be grouped into the following themes:

- Performing **CI** work (mentioned 24 times), either deploying, migrating, developing, upgrading, prototyping, or refactoring code. For example, one MF staff person reported that he had "*transitioned [their] x-ray user facility to remote user operations during the pandemic while maintaining a data collection rate of ~400 TB/year.*" The Daniel K. Inouye Solar Telescope (DKIST) got their data center "*ready to receive [the] first operational data streaming from the telescope."* Another individual reported that getting older applications to "*work in new environments is [his] biggest accomplishment, especially some of those old Python 2 programs that have slowly become obsolete.*" A participant from SCiMMA reported that he has been leading the "*creation of a Kafka-based publish-subscribe messaging system…for distributing low-latency information for multi-messenger astrophysics.*"
- Participating in the **community** in some way (20), including joining the community, initiating a new community group or participating in one, partnering with someone from the community, or performing some sort of outreach to members of the community. An individual from NSF explained that he organized "*NSF LFO's outreach activities to the Major and Mid-Scale Research Infrastructure Communities.*" An MF representative wrote, "*I'm really proud of the UNOLS community for coming together to engage with ResearchSOC.*" Another individual reported that he "*regularly attended [the] CI Compass Identity Management Working Group and NSF Large Facilities Security Team meetings.*"

- **Providing a service** (18) to another entity within the community. All accomplishments of this type were mentioned by CI Compass, Trusted CI, or other members of the broader NSF/CI community. For instance, one CI Compass team member reported "*collaborating with users of Major Facilities to aid with their workflow execution of their experiments;*" and a member of the broader community cited "*serving over 100 clients of the SGCI with technical, usability, workforce development, and sustainability consultations.*"
- **Leading** some effort (10), such as serving as a PI on a grant or overseeing a new project. A participant from the NASA Exoplanet Science Institute cited being the PI of the Montage Image Mosaic Engine which is widely used in astronomy. It is considered a "*benchmark application in the development of CI.*" A CI Compass team member explained that she was "*very proud and excited to co-direct the Student Internship Program.*"
- **Managing** personnel (e.g., creating staff positions, increasing staff size, transitioning staff to a new way of working, or maintaining cohesion among staff during some change) or operations (e.g., improving operations, physically moving the operation, wrangling the budget to better support operations) (8). For instance, one individual reported converting the "*hardware budget into full time professional CI staff positions by shifting computing architecture to more fully utilize global distributed high-throughput computing resources*."
- **Initiating or planning** something (7), such as *"getting the NSF funded Partnership for Advance Throughput Computing (PATh) project off the ground,"* developing *"an Information Security Program Plan to strengthen [the] organization's security posture,*" or completing the planning *"of a coordinated effort to integrate the SAGE and GAGE data centers into a cloud-based system."*
- Simply **doing good work** (5), such as supporting "*faculty, students and staff,*" being engaged with work with MFs, and participating in the CI Compass student internship program.
- **Receiving a recognition** of some sort (5), such as having work cited. The Montage Image Mosaic Engine has been cited "*over 1,000 times in CI papers since 2014*"), getting a paper published, receiving the E&I cloud Leadership Award for Lifetime Achievement, obtaining funding "*to build a prototype antennae for the Next Generation Very Large Array telescope,*" or getting a mid-scale facility proposal awarded.
- Being **successful over time** (4), such as 5-years of Jetstream and moving into Jetstream2, continuing the *"growth and adoption of Globus data management services (194K+ users,1600+ institutions, 80+ countries) with self-sustaining operations model,"* and *"over 19 years of experience in scientific data management, discovery, metadata and data interoperability, FAIR data principles, data citation, computing-as-a-service, and enabling open science by adapting AI/ML capabilities in scientific data center operations."*

Question 2: Given that many of us work in remote teams, is there some practice that you use that you think works particularly well in such settings (e.g., make sure to have 10 mins breaks between Zoom meetings, use Slack for informal/social group discussions, etc.)?

Most answers to this question fell under three main themes for recommendations, tips, or lessons learned:

- Comments related to human **behavior** included ensuring you take breaks (mentioned 14 times); trying to listen more and talk less (5); staying on topic (2); being inclusive, understanding, and respectful (7); seeking the solace of a pet (2); moving or standing periodically (6); ensuring there are times set aside for "*deep work*" undisturbed (4); making the home work space cozy in some way (3); having some sort of staff report-out/update/stand-up to stay checked in with distributed team members (6); and including some sort of social element to online communications (6). One

individual said that they start weekly meetings with a "*human 'question of the day'*" such as "*what is something interesting on your desk and why?*" This person felt this helped to replace "*the in-person watercooler talk*" while also getting "*everyone to chime in at least once during the meeting.*"

- Recommendations related to **meetings** included keeping meetings short (13), having fewer meetings (3), starting and stopping the meeting on time (3), meeting at times that are optimal for the most people (3), and others such as taking "*15 minutes prior to a meeting to review past notes and prep talking points*" and joining the meeting early to make sure everyone can access the Zoom room and any documents easily.
- Most comments related to the use of **technology** praised the use of a chat program (30). Others included (13) extolling the virtues of video conferencing software while one encouraged using it less. Ten (10) hailed the use of different collaboration/work-sharing tools such as Google Docs, GitHub, Microsoft Teams, Visual Studio Code, Excalidraw, and Trello. Eight (8) discussed using a variety of tools—whatever was most appropriate for the given situation—rather than trying to force one tool to fit all needs. Two recommended keeping the camera on in video conferencing, while two others encouraged understanding when you need the camera off.

Figure 14: Word cloud of answers to Question 2: Successful remote work practices.

One comment that did not fall into these three themes, but was particularly interesting, was from a staff person at Trusted CI who explained that it is hard for her to "*sit and concentrate in Zoom meetings once [she's] hit a few hours in,"* so she has started knitting *"as a way to keep [her] hands occupied"* which she said keeps her calm and allows her to focus more on the conversation—a testimony to Zoom fatigue and a creative way to cope with it.

Question 3: NSF Major Facilities (MFs) have increased collaborations with each other and NSF CI Centers of Excellence (e.g., Trusted CI, CI Compass). Looking into the future, what is your vision for the "MF as a community" in the next 5 years?

Visions for "MF as a community" most frequently discussed four main themes:

- Greater knowledge sharing and communication (27 mentions).
- More cross-facility collaboration (17).
- Sharing resources (including workers) or accessing some common set of services and resources (17).
- More collaboration between MFs and others in the broader NSF/CI community (15).

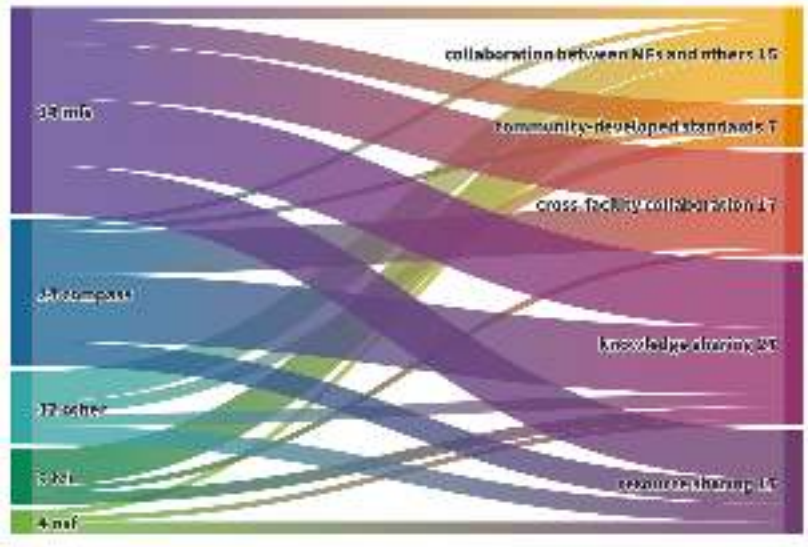


Figure 15: Answers to Question 3: Vision for the future MF community.

These four themes show that the participants at this workshop believe that a viable MF community must necessarily work together and share with each other. **Reciprocity** across all members of this community is important, and should involve other groups in the broader NSF/CI ecosystem, such as NSF, Trusted CI, CI Compass, ESnet, Jetstream, SGCI, SCiMMA, Internet2, and all the other groups the reader of this report will see in the Calling Cards in Appendix D.

Achieving this vision may not be easy. There were also 8 mentions of the need for tools that will foster knowledge sharing, communication, and collaboration, and 2 pleas for breaking down barriers to knowledge sharing and collaboration.

One suggestion for a tool that could enable greater knowledge sharing was a *"Service Catalog of CI which has been vetted and documented to remove obstacles for adoption."* A suggested sample entry could focus on "How to integrate federated InCommon IdM." The workshop itself was mentioned by some as one possible way to help facilitate knowledge sharing and collaboration, but it was also noted that this shouldn't be the only way the community works to establish more cohesion. A shared Slack was also suggested, and given the popularity of chat programs seen in answers to Q2, this would appear to be a worthy suggestion

to try. Other suggestions included an online knowledge hub and using common standards made available in a common location *"to facilitate a more interoperable data landscape."*

In summary, the Calling Cards from this workshop reveal a wide range of accomplishments achieved over the past year: successes around CI, engagement with the community, providing services, leading/managing/planning people and efforts, receiving some sort of recognition, and simply doing good work on a day-to-day basis which adds up over time. Participants also provided several tips for adapting to remote work during the COVID-19 pandemic, including beautifying the home-work space and being sure to move around from time to time, to having fewer and shorter meetings, to capitalizing on electronic tools, such as chat, for facilitating work more easily. Reciprocity is the big theme going into the future. Participants believe and hope the future will include more reciprocity across all members of the community in order for the community to thrive. Workshops like this one are a good start, but more is needed according to the Calling Cards.

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Appendix C: Agenda

Day 1

Breakfast	
Workshop Welcome Ewa Deelman	The talk will provide a brief introduction to CI Compass, the NSF CI Center of Excellence hosting the workshop and will provide an overview of workshop goals and logistics.
NSF's Perspectives on cloud Computing Manish Parashar	
Lightning Talks Host: Jarek Nabrzyski	Brian Dobbins: Enabling Earth System Science in the cloud Often when we talk about Major Facilities and the cloud, we're talking about replacing existing internal use with cloud capabilities, but NSF-funded centers like NCAR provide community models for public research by a wide external community. This talk will focus on using the cloud to democratize access to sophisticated modeling and analysis capabilities, vs replacing existing hardware, and how this helps us as a MF and a community leader in earth system science. Lee Ellett: Activities of the Cyberinfrastructure Working Group (CIWG) of the ARF
Brainstorming: Developing and Retaining a Vibrant Team of Workers, Setting the Stage for Day 2 Laura Christopherson Mats Rynge Jarek Nabrzyski	In 2019, at the last workshop held for major facilities on the topic of cyberinfrastructure -the 2019 NSF Workshop on Connecting Large Facilities and Cyberinfrastructure -discussed many challenges faced by major/large facilities with regard to recruitment, retention, training, and compensation. (See the workshop report here: https://facilitiesci.github.io/2019/). Based on the needs expressed at this workshop, the CI Compass Pilot team conducted interviews with a small sample of MF managers and sent a survey to their staff. The goal was to investigate needs and challenges further, so the Pilot team could determine how CI Compass, if funded, could be of better service. At the conclusion of the Pilot, the team hosted a small, virtual workshop to

	discuss these matters further. The report from that workshop can be found here: https://zenodo.org/record/5523235#.Yd2gpxPMIqu We all have been able to identify priorities or challenges we'd like to solve but sometimes it is not easy to work on developing solutions and designing a way to implement them because we are all so busy and separated throughout most of the year. The 2022 CI4MFs Workshop provides an opportunity to make a beginning on devising solutions and CI Compass sees its role as bringing everyone together and helping to facilitate this process. Your Homework: In this session we will identify the challenges the group feels are most important to solve and that are the most feasible to solve, and begin generating ideas to solve them. So today we are giving you homework. When you have a moment, we ask you to identify a workforce development challenge that you think is: ● potentially solvable within a year's time (or less); ● that matters to you, that is important to you to solve; and ● is feasible to solve with the people at this workshop and the collective resources at our disposal. Then jot down your name and your challenge on the Padlet we've created for this. Simply click the plus (+) sign in the lower right corner of the window in Padlet to create your challenge. Review other participants' challenges and vote on them if they interest you and you want to work on solving them. To do this, click on the heart in the challenge boxes that interest you. Please do this by lunch time tomorrow. (Laura has listed 2 challenges as examples to get the creative juices flowing.) Tomorrow: Then we will take the challenges that received the most votes and were the most feasible, and tomorrow we will break out into groups to make a beginning on solving them. We know it may not be possible to find the perfect solution by the end of the workshop. That's okay. The point is to make a solid start. The hope is that we can continue this work—with specific goals and milestones planned—beyond the 2022 workshop for anyone who is interested in participating. Another Resource: Please also see this recently published report on this issue: Blatecky, A., Clarke, D., Cutcher-Gershenfeld, J., Dent, D., Hipp, R., Hunsinger, A., Kuslikis, A., & Michael, L. (2021). The missing millions: Democratizing computation and data to bridge digital divides and increase access to science for underrepresented communities. National Science Foundation. https://www.rti.org/publication/missing-millions

Break	
NSF Ecosystem Lightning Talks Host: Ilya Baldin	Jim Basney and Von Welch: Trusted CI Support for Research Infrastructure CI This talk will focus on Trusted CI activities of interest to the CI developers at the MFs and other large projects that make up the CI Compass community. For example: our annual challenge topics (secure software engineering and operational technologies), the OSCRP, ScienceDMZ security, science gateway security, cyberinfrastructure vulnerabilities alerts, and software assurance training. Jason Zurawski: EPOC Assistance for Team Science The Engagement and Performance Operations Center was established in 2018 as a collaborative focal point for operational expertise and analysis and is jointly led by Indiana University (IU) and the Energy Sciences Network (ESnet). EPOC provides researchers with a holistic set of tools and services needed to debug performance issues and enable reliable and robust data transfers. This talk will discuss some of the approaches EPOC has used to assist scientific innovation, and how we can help others that may require assistance with data mobility tasks. Frank Wuerthwein: The Prototype National Research Platform (PNRP) This novel, national scale, distributed testbed architecture includes: a high performance subsystem to be deployed at SDSC that integrates advanced processors (NVIDIA HGX and Xilinx FPGAs) in a composable low latency rack-scale PCIe environment, attached to national Research and Educational (R&E) networks at Tbit/sec bandwidth; additional highly optimized subsystems each constituting 288 NVIDIA A10 GPUs to be deployed across the University of Nebraska, Lincoln (UNL) and the Massachusetts Green High Performance Computing Center (MGHPCC); a minimum of 1 PB of high performance disk storage to be deployed at each of the three sites to establish a Content Delivery Network (CDN) providing access to data anywhere in the nation within a round trip time (RTT) of ~10ms to be available through a set of eight optimally positioned 50TB Non Volatile Memory (NVMe)-based network caches; and an innovative system software environment enabling both centralized management of the nationally distributed testbed system. Additionally, the system architecture will remain open to future growth through additional integration of capabilities to be achieved through a novel bring your own resource program. The science drivers of PNRP includes four of the NSF Major facilities, one

	of the AI Institutes, and a number of campus scale instruments in microscopy and genomics.
Developing Resilience and Managing Uncertainty during the Pandemic Kerk Kee Cassie Hayes Shafaq Chaudhry	Being resilient is about how we respond to adversity. This session will identify the challenges brought about by COVID-19 as well as the solutions and lessons learned in response, and discuss how to manage uncertainty so the MF community could cultivate organizational resilience and put in place better preparation for future crises and disasters. NSF funded MFs often have unique work culture and logistical constraints during the pandemic. In response, members of CI compass quickly put together an EAGER proposal to study how MFs responded to the pandemic (see www.CI4resilience.org), which also signals the need to treat pandemic preparation for organizational resilience as one of the priorities going forward. In this short presentation followed by a breakout session, participants will identify (a) the most enduring and/or impactful challenges during the pandemic, (b) the most promising solutions to these challenges, (c) ways in which MFs can cultivate organizational resilience as a foundational quality of the workplace/workforce of MFs, and (d) how MFs can best manage uncertainty going forward.
Lunch	
Making the Major Facilities Data Lifecycle FAIR to Provide AI-Ready Data Charles Vardeman Donald Brower	Given the rise in the application of AI/ML within cyberinfrastructure services and application of knowledge informed machine learning to science models, how can the major facilities be better prepared for this transition by leveraging FAIR data principles to create AI-ready data. ● Donald Brower: FAIR Data and the MF Data Lifecycle CI-Compass ● Charles Vardeman: Wikidata: A Knowledge Graph for the Earth Sciences Panelists ● Doug Fils and Adam Shepherd: ESIP Schema.org cluster: Utilizing the Google Knowledge Graph for FAIR Earth Science Data ● Christine Laney: NEON's First Data Releases: Challenges and Opportunities to Provide FAIR Data ● Giri Prakash: AI Strategies for Improving Data Management Components and Preparing AI-ready Data that meets FAIR and Data Provenance

	• Bruce Berriman: Application of FAIR Principles in Astronomy
Virtual Office Hours	Office Hours are a chance for you to speak with CI Compass team members about any questions you might have or to brainstorm ideas for collaborating.
Reception for In-Person Participants	

Day 2

Breakfast	
Cyberinfrastructure for Major Facilities: Challenges and a Path Forward Anirban Mandal and Robert Casey	The NSF Major Facilities face several technical challenges in acquisition, processing, storage, and delivery of vast, heterogeneous, and dynamic data to the communities of scientists they serve. Some examples include tracking and managing technological changes across the lifecycle of the facilities, employing automation to streamline data acquisition, processing and operations, integrating and interoperating with community standards for data management, developing well-informed, robust and secure CI, and operating and sustaining CI solutions over time. In addition, several unique socio-technical challenges also arise while operating an MF CI, in terms of organization culture, staffing, training, and knowledge transfer. In this session, we will discuss current and future MF challenges in terms of MF CI design, enhancements, and operations, and how different MFs can address them, or can be best prepared for the future. We will hear from panelists representing several MFs on this topic. We will also have breakout sessions to brainstorm MF CI challenges and potential solutions.
Break	
The March Toward the clouds: MF Perspectives Karan Vahi and Brian Dobbins	Most of the NSF-funded Major Facilities have been in existence before the term cloud Computing was even coined. These facilities are largely in a continuous mode of operation, collecting, harmonizing and curating data, and making it available to their respective scientific communities. As a result they have built a considerable amount of infrastructure - often custom built - to serve their needs and mission. Adoption of cloud computing for operations provides attractive benefits in terms of increased availability, resilience and durability of data and, an

	opportunity for the Major Facilities to rethink their overall CI infrastructure stack, as well as their software engineering and DevOps practices on how to best leverage the cloud. At the same time, there are significant challenges to this migration, including the need to continue with their current mandate and mode of operations, increased costs, and training requirements. This session will be highlighted by a panel of experts who will talk about their MF experiences of using the cloud so far, followed by a larger discussion with the community of the collective opportunities and challenges facing the MF community in adoption of the cloud. ● Bob Flynn: What Do You Need to Ask Yourself when You Move to the cloud ● Chad Trabant: Experiences on coming up with a project plan and strategy to move operations for 2 Major Facilities to the cloud ● Jeff Glatstein: OOI Approach to the cloud ● Benedikt Riedel: IceCube Processing on the cloud ● Brian Dobbins: The March With the clouds: NCAR ● David Halstead: Surging into the cloud and Grids: Insights into keeping up with the processing workload for the Very Large Array Sky Survey (VLASS)
Lunch	
Virtual Office Hours	Office Hours are a chance for you to speak with CI Compass team members about any questions you might have or to brainstorm ideas for collaborating.
Brainstorming: Developing and Retaining a Vibrant Team of Workers Laura Christopherson Mats Rynge Jarek Nabrzyski	By now you will have listed a challenge on Padlet that you'd like solve—one that you are interested in making a beginning on at this workshop. You will have also voted on your fellows' challenges. Breakout rooms will be created for the challenges that received the most votes and were potentially the most feasible to solve. Now you will enter a breakout room for a challenge you'd like to focus on today. When you enter that breakout room, please start by introducing yourself to your fellow participants and stating why you want to solve this particular challenge. Then brainstorm ideas/solutions. No idea is too crazy for today's session. Go wild. Don't discuss or write ideas off based on feasibility. We'll discuss feasibility and implementation down the line. Today is purely for ideation. A note-taker will jot down your ideas. Feel free to edit the notes alongside the note-taker.

	We will float around from room to room to help in case you get stuck but you own this process, so make it yours! And please be sure to give everyone in your breakout group a chance to voice their ideas. Then we'll call you back at 15 or 20 minutes until the end of the session. Pick one person from your group who will provide a brief summary of your ideas to the entire group of workshop participants. We will record all ideas and then invite you all to continue to participate in solving these challenges by joining our Topical Working Group on the subject.
NSF Ecosystem Lightning Talks Host: Anirban Mandal	Pascal Paschos: Collaboration Support in the OSG Fabric of Services The Open Science Fabric of services under the NSF PATh grant delivers support and facilitation to several midsize/midscale science collaborations that use the NSF distributed Cyberinfrastructure and Major Facilities for storage and computing. This talk aims to provide a high-level description of service delivery and management that fosters the path to discovery. Alex Szalay: Computing for Mid-Scale Science Projects There are more and more mid-scale science projects, usually centered around a single unique instrument, whose computational needs are quite different from either of the Big Science patterns or those of the individual PIs. These projects can easily generate petabytes of data, but want to process and analyze these opportunistically, wherever it is cheapest. We discuss this emerging new pattern and their cyberinfrastructure. Jeremy Fischer: Jetstream2: Accelerating Cloud Computing via Jetstream A quick introduction to the NSF-funded Jetstream2 cloud: a look into the resources and use cases. Tyson Swetnam: CyVerse: Cyberinfrastructure for Data Driven Discovery
Closing Remarks Ewa Deelman	
Social Coffee Hour	Social time to talk with workshop participants and organizers

Appendix D: Cyberinfrastructure Calling Cards

CI Accomplishment

Converted hardware budget into full time professional CI staff positions by shifting computing architecture to more fully utilize global distributed high-throughput computing resources. Setup HTCondor + Linux Kernel cgroups to dynamically execute low-latency sky-map calculations for transient gravitational wave events on O(1,000) cores with sub-second scheduling latency.

Remote Work

Make an extra effort to give everyone a chance to talk during a zoom call to compensate for the lack of body language signals that someone quiet has something to say.

MF Community

Look for efficiencies of scale to provide common operational services across multiple NSF Major Facilities, e.g., why should every MF separately negotiate with Google for Workspace or GitLab for a DevOps platform?

Stuart Anderson
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LIGO at Caltech

https://www.ligo.caltech.edu

CI Accomplishment

Moving a major infrastructure (hubzero) across institutions while maintaining team cohesion and improving operations in the process. Serving over 100 clients of the SGCI with technical, usability, workforce development, and sustainability consultations.

Remote Work

We start a weekly meeting with a human "question of the day." It is something like, "What is the best bite of food you ate and why?, What is something interesting on your desk and why?" This replaces the in-person watercooler talk and gets everyone to chime in at least once during the meeting.

MF Community

A large scale coordinated virtual workforce that replaces small islands of isolated research software engineers.

Michael Zentner
Sustainable Scientific Software Division
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UC San Diego, SDSC

sciencegateways.org

hubzero.org

CI Accomplishment

Recent work includes involvement with the Urban Flooding Open Knowledge Network (UFOKN) https://ufokn.com/ which is part of the NSF Convergence Accelerator. I also work on tooling to support structured data on the web (https://gleaner.io/). I am also involved in the EarthCube Office GeoCODES work.

Remote Work

As a remote worker for years, recent events have not changed many of my remote collaboration approaches. Things like Slack, Jitsi, GitHub issues and projects have become all the more important. Good integration with a calendar services (which ever you use) is always a nice thing and seems all the more important.

MF Community

As we move toward addressing "Accessible" and "Interoperable" elements of FAIR, governance will be all the more important. Community approaches to things like shared data models and other cross domain common views will be all the more important and bring open and expressive governance principles and practices to the front.

Doug Fils
Data Manager
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Ocean Leadership

https://oceanleadership.org/

CI Accomplishment

Our team works hard to provide reliable and useful infrastructure in support of our science mission. Recent examples include migrating our ship/shore communication over to a higher-performing third-party service as well as the strong effort to move our entire workforce to work-from-home in 2020.

Remote Work

Make sure you are taking breaks that involved some kind of movement, such as stretching and walking.

Use communications platforms that provide a sense of presence for your teams.

MF Community

Starting and maintaining formal efforts that provide opportunities to develop shared resources would be good to continue.

Philip Gates
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Texas A&M University

International Ocean Discovery Program
https://iodp.tamu.edu

CI Accomplishment

One of our biggest CI accomplishments is ongoing - we're doing the first large-scale production runs of our climate model in the cloud, in a partnership with SilverLining, AWS and NCAR. It's not been without its challenges, but it sets the stage for some neat things in the future.

Remote Work

I definitely try to minimize meetings whenever possible; I feel most people find the number they've had skyrocketed with work-from-home. When I do need to schedule them, I try to avoid lunch meetings, and try to make them half an hour if possible, to give people more time back!

MF Community

*In terms of cyberinfrastructure, I think it's only expanding in complexity, and nobody can tackle everything well - there's **plenty** to learn from each other. But cross-MF collaboration like that requires explicit effort, and time is always short. I think we can work to improve that, via workshops like this, for everyone's sake.*

Brian Dobbins
Software Eng
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NCAR

National Center for Atmospheric Research
https://ncar.ucar.edu/

CI Accomplishment

Implementation of Virtual Desktop Infrastructure on R/V Roger Revelle for instrumentation systems.

Remote Work

Using Slack for informal discussions has been invaluable given the remote nature of technical staff on research vessels.

MF Community

I would like to see the ability to exchange staff between facilities for short periods of time to share solutions and experiences.

Lee Ellett
Manager
Shipboard
Technical Support
eellett@ucsd.edu
Scripps Institution
of Oceanography

Affiliated Organization
URL

CI Accomplishment

I am an Earth system scientist studying the connections between the atmosphere, biosphere, and hydrosphere. I am a principal developer of the Community Land Model (CLM), which is the land component of our Community Earth System Model (CESM). I work with observations to constrain and improve models and their forecasts at climate timescales.

Remote Work

Not scheduling back-to-back meetings; breaks between meetings; making sure all participants contribute to discussions

MF Community

Solutions to the climate problem require broad collaboration among scientists, academics, and stakeholders with a diversity of expertise (e.g., atmospheric science, computational science, ecology, hydrology, social sciences, etc.) and with a diversity of backgrounds. Breaking down barriers to collaboration and participation is essential moving forward.

Gordon Bonan
Senior Scientist
bonan@ucar.edu
National Center for Atmospheric Research

National Center for Atmospheric Research
https://ncar.ucar.edu/

CI Accomplishment

Co-PI of DesignSafe Natural Hazards Engineering Research Infrastructure Cyberinfrastructor Platform. Developed first parallel shallow water model ADCIRC.

Remote Work

Given that many of us work in remote teams, is there some practice that you use that you think works particularly well in such settings

Limiting meetings to no more than an hour. Have someone take notes or record the meeting if possible. Try to engage all participants.

MF Community

NSF Major Facilities (MFs) have increased collaborations with each other and NSF CI Centers of Excellence (e.g., Trusted CI, CI Compass). Looking into the future, what is your vision for the "MF as a community" in the next 5 years? I have no opinion on this.

Clint Dawson
Professor
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University of Texas at Austin

University of Texas at Austin
www.oden.utexas.edu

CI Accomplishment

I'm new to the CI community within an NSF Major Facility, but I'm looking forward to the many challenges, including maintaining effective communication across local and remote locations.

Remote Work

I think it's important to stay flexible with communication methods, whether it's Teams, Slack, phone, or something else. Not only are there personal preferences, but, depending on the goal, each has strengths and weaknesses.

MF Community

Continuing to leverage evolving technologies should help increase reach and clear impediments to involvement.

David Kratz
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IODP, Texas A&M University

International Ocean Discovery Program
https://iodp.tamu.edu

CI Accomplishment

PI of the Data Handling and Analysis Infrastructure for Gravitational-wave Astronomy project that support LIGO-Virgo-KAGRA CI development and operations. Leader of SCiMMA conceptualization project assessing needs for CI to support mulit-messenger astrophysics.

Remote Work

All in for everyday work. Strategic planning is considerably more difficult without the ability to interact in-person for extended periods and without the time to develop relationships outside of business communication.

MF Community

Support the users by promoting an ecosystem of cyberinfrastructure that with fewer barriers to interoperability, access, and agility in response to new use cases.

Patrick Brady
Professor
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University of Wisconsin-Milwaukee

LIGO & SCiMMA
www.ligo.org
www.scimma.org

CI Accomplishment

The Engagement and Performance Operations Center, a joint project between Indiana University and ESnet, has worked with over 100 groups in the last year alone, assisting with everything from helping data transfer faster to redesigning data architectures to strategic planning.

Remote Work

EPOC has always been a distributed team, but with the lack of travel we've become much more intentional about interacting with our partners

MF Community

The MF Community is expanding it scope to work with many more researchers at smaller institutions - which is right in EPOC's wheelhouse to help out with.

Dr. Jennifer Schopf
Director, Engagement and Performance Operations Center (EPOC)
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EPOC
Engagement and Performance Operations Center

https://epoc.global

CI Accomplishment

Over 19 years of experience in scientific data management, discovery, metadata and data interoperability, FAIR data principles, data citation, computing-as-a-service, and enabling open science by adapting AI/ML capabilities in scientific data center operations.

Remote Work

Currently working with distributed teams from three different time zones. Slack and Teams works for virtual meetings and collaborations.

MF Community

I would like to see a community developed CI model for assessing if data is AI-ready and share best practices within the data providers.

Giri Prakash
Earth System Informatics and Data Discovery Section Head
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ORNL

OAK RIDGE National Laboratory

ARM

ARM Data Center

https://arm.gov/

CI Accomplishment

Continued growth and adoption of Globus data management services (194K+ users,1600+ institutions, 80+ countries) with self-sustaining operations model. Recent user facility highlights, use of Globus for COVID-19 protein imaging at Advanced Photon Source, preservation of data from Arecibo Telescope, and management of data from DKIST at National Solar Observatory.

Remote Work

I have worked in distributed team for over 15 years now. Slack continues to be a useful tool: social channels especially as new team members have joined, the Hangout feature for a higher bandwidth communication with low overhead for setup, and encouraging time blocks for deep work and not being always available on IM.

MF Community

Community of practitioners who share ideas, solutions, and recommendations on CI for facilities allowing reuse and less silos. Leveraging expertise and services to solve crosscutting concerns allowing MF's to invest in their focus area for their users. The Campus Champions is an exemplar of such a community that has demonstrated huge value.

Rachana Ananthakrishnan
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University of Chicago

Globus
globus.org

THE UNIVERSITY OF CHICAGO

Argonne

CI Accomplishment

Transitioning our x-ray user facility to remote user operations during the pandemic while maintaining a data collection rate of ~400 TB/year.

Remote Work

Allow for some unstructured time during Zoom meetings. This doesn't completely replace those spontaneous in-person hallway conversations (which can actually be quite productive), but it's a start.

MF Community

An extended support system where we can informally share ideas and brainstorm together about CI problems large and small.

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Cornell University

CHESS
CORNELL HIGH ENERGY

Cornell High Energy Synchrotron Source
www.chess.cornell.edu

CI Accomplishment

I have recently started working with CI Compass and interested on learning more new things about Major facilities.

Remote Work

I think Slack is the best forum for sharing ideas and platforms like Zoom is used for calls and a break of 20 mins is required for a person to improve mental ability.

MF Community

I hope to learn more from working with the NSF CI Compass and provide better suggestions to grow along with the community.

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Indiana university-IUPUI

CI Compass
ci-compass.org

CI Accomplishment

I hope to soon count a completed systems test for RCRV Vessel 1 (R/V Taani) CI as an accomplishment, but we're not there yet.

I am happy to report however, that we've begun to deploy CORIOLIX version 1.0 in quarter 1 2022! R/V Endeavor will be the first ship online with V1.

Remote Work

My core team has 3 members, we each have unique roles and responsibilities as expected, but we have been scheduling one day a week - as a sprint day - to work on outstanding collaborative project components. On these days, we block-out or minimize other engagements. It's not perfect but it works.

MF Community

My hope is that in 5-years time we, the Academic Research Fleet, are working with the COE's on the topics and problems (FAIR data, service catalogs, etc.) that come after the essential security work at hand now.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

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Oregon St. Univ.

Oregon State University

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CI Accomplishment

New to the MF community, I recently developed an Information Security Program Plan to strengthen our organization's security posture. I am looking forward to meeting and collaborating with you all.

Remote Work

While working remotely I found it helpful to keep an always-on voice connection with team members so we can hear and converse with others in the group. We could each be working on our own independent assignment while also keeping the channel open to hear and participate in conversations.

MF Community

Vision for "MF as a community": A friendly forum to ask questions, share answers, and learn new things about research happening in the wider scientific community.

Brad Barber
Cybersecurity
Policy Analyst
bb@.tamu.edu
IODP

JOIDES Resolution Science Operator
https://iodp.tamu.edu

CI Accomplishment

PI of the Montage Image Mosaic Engine. It is widely used in astronomy. It is also widely used by the CI community as a benchmark application in the development of CI. It has been cited by over 1,000 times in CI papers since 2014.

Remote Work

Have regular breaks between Zoom meetings. Use Slack for fast communication. In general, be mindful of people and give them a break - many have had a difficult time.

MF Community

Many facilities and disciplines share common problems, such as fast access to big data, and management of big data. We need to share expertise and best practices.

Bruce Berriman
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Caltech/IPAC-NExScI

Caltech
NExScI
https://nexsci.caltech.edu/

CI Accomplishment

NRAO just obtained funding to build the prototype antennae for the Next Generation Very Large Array telescope: The first of ~260 dishes, each of which can produce over 300Gbps of data for correlation. More information at: https://ngvla.nrao.edu/

Remote Work

NRAO has always had a distributed workforce with 18 locations in the Americas. The Pandemic has helped formalize the way we work at a distance. Co-authoring and shared on-line workplaces is essential to avoid using E-mail or IM as documents or record for capturing status and objectives

MF Community

Each Major Facility has unique CI challenges, and understanding the value added by a center of excellence is essential. For example the VLA Sky Survey will generate over a PetaByte of information that must remain accessible to the community in perpetuity: https://public.nrao.edu/vlass/

David Halstead
CIO
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NRAO

National Radio Astronomy Observatory

CI Accomplishment

An engagement with Ohio Supercomputer Center to complete the Higher Education Community Vendor Assessment Toolkit (HECVAT), which included EDUCAUSE's users community group. It was very rewarding bringing the right people together to help OSC complete the task, so they can focus on supporting academic researchers.

Remote Work

Trusted CI is a pretty friendly group with our own informal traditions. We have had to postpone face-to-face meetings since the pandemic began. However, many of us hop on meetings a few minutes early just to catch up and socialize. It's not an especially novel idea, but it keeps us connected until we can hang out again.

MF Community

Trusted CI is committed to addressing the security needs of the NSF MFs and we have been fortunate to engage with many individual facilities. My vision is for Trusted CI to build relationships with all the facilities so that we are on their short list of contacts regarding securing research science.

Jeannette Dopheide
Sr. EOT Coordinator
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Trusted CI / NCSA

TRUSTED CI
THE NSF CYBERSECURITY CENTER OF EXCELLENCE

trustedci.org

CI Accomplishment

Architected and ready to Deploy a 3 node hyper converged Proxmox Cluster with fully redundant 1 TB usable RAM, 66 TB usable SSD storage, and 10 GB network backbone.

Infrastructure as Code: Deployed Debian 11 configuration management for the data center via Ansible and a single git repository.

Remote Work

Breakout Rooms in Zoom for smaller group discussions.

MF Community

I'd love to see a Service Catalog of CI which have been vetted and documented to remove obstacles for adoption. e.g. How to integrate Federated Incommon IdM for you MF.

John Haverlack
IT Manager
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UAF / U.S. ARF

Affiliated Organization
URL

CI Accomplishment

I am very honored to be a part of the Student Internship Program at CI Compass. I recently started researching the NCAR and found many interesting facts about it.

Remote Work

During the past few years, I figured that changing your workstation occasionally can help you be more motivated. In addition, I also try to schedule meetings early in mornings, because that is when I feel most motivated.

MF Community

I hope that in the next five years there can be more research conducted on MFs. Expanding opportunities for high school students to research MFs would be amazing, since a lot of high school students are interested in research.

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CI Compass
ci-compass.org

CI Accomplishment

I am very proud and excited to be part of the CI Compass Student Internship Program 2020. Surrounded by a group of caring and helpful instructors and professors, I started gaining hands-on research experiences about facilities and cyberinfrastructure.

Remote Work

The most beneficial strategy for me is to take good advantage of Slack. It is usually hard to find a slot and make a zoom appointment, but it is easy to leave messages and questions on Slack. Being concise with those messages is another crucial strategy of mine.

MF Community

With increased collaborations, NSF Major Facilities (MFs) will eventually become a diverse yet tighter community. Different thoughts from unique perspectives will meet here. And this will make the MF community grow even faster.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Ryan (Yuzhe) Wang
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Junior CS Student
University of Southern California

CI Compass
ci-compass.org

CI Accomplishment

I am excited to conduct research on the data lifecycle within Major Facilities and improve my technical skills in my internship with CI Compass.

Remote Work

I like to join Zoom meetings 2-5 minutes prior to the the start of the call to ensure there are no technical difficulties. If there's a lot of information I have to send, I will use email. If there is a smaller message that needs a quick reply, I will use Slack.

MF Community

I envision NSF Major Facilities (MFs) to share and discuss their findings with other researchers to enhance productivity and encourage scientific breakthroughs.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Christy Ko
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CI Accomplishment

My biggest CI accomplishment would probably be being able to participate in CI-Compass Student Internship Program. It has so far been both very interesting and fun and I feel like I've already learned a lot. I'm excited to see what we'll be learning next!

Remote Work

In such settings, I believe that making sure to have breaks in between meetings to prevent zoom fatigue and take some time for myself. Using slack is also nice to have quick chats and discussions with other students and learn more about them.

MF Community

In the next 5 years, I hope that as a community strong collaborations continue to occur and that everyone is able to share information, hardships, and accomplishments with one another. I also hope that the student internship program continues to grow and develop!

Khushi Choudhary
Student Intern – CI Compass
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University of Southern California

CI Compass
ci-compass.org

CI Accomplishment

I just started working with CI Compass! My partner and I have been researching RCRV while also receiving training in Python, Research and Software Development best practices, and learning more about the technology space.

Remote Work

I think it's important to always have a "screen break" from time to time. With everything being virtual, it's important to get away from the screen in order to focus.

MF Community

I think it would be great if the community continues to share their interests with MF facilities with an emphasis on best practices, innovation, and applicability. Those who are involved with CI Compass and NSF are well-versed, intelligent people. It would be great to hear more about how they approach CI problems from a technical perspective.

Mia Patel
Student Intern – CI Compass
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CI Compass
ci-compass.org

CI Accomplishment

I have been greatly enjoying the CI-Compass internship. Every week I am exposed to a new skill or area of knowledge which is a lot of fun. I am hoping to continue to learn more about technology and CI.

Remote Work

I feel that with remote work the most important part is communication. It is important to respond to messages and be proactive at setting up meetings and zoom calls. Personally, I feel that it is essential to video call and see each other's face in order to feel that you are working as a team.

MF Community

I hope the the MF community will continue to make scientific discoveries. Furthermore, I hope that there will be collaboration and support between the MFs.

Edward Lin
Student Intern – CI Compass
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University of Southern California

CI Compass
ci-compass.org

CI Accomplishment

I'm a social scientist who studies the socio-technical dimensions of infrastructures. I am proud of working on projects such as examining organizational capacity for cyberinfrastructure, how CI tools can increase resilience in MFs, and how the CI community self-organizes.

Remote Work

Encourage use of chat in Zoom for extra context and side conversations/comments on what's happening synchronously. I also like online project management tools like Trello to keep up with tasks (versus messy email chains).

MF Community

Hopefully a sustainable community in which resources are shared openly and adapted to specific situations, in order to increase both technological and workforce resilience

Cassandra Hayes
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Texas Tech University

Texas Tech CoMC:
https://www.depts.ttu.edu/comc/

CI Accomplishment

Getting the NSF funded Partnership for Advance Throughput Computing (PATh) project off the ground.

Remote Work

Every team member sends a daily report to the entire team on the day work and effort distribution.

MF Community

Sharing of CI talent, software technologies and computing capacity facilitated by NSF centers and institutions and founded on mutual trust

Miron Livny
Professor
University of Wisconsin-Madison

Partnership to Advance Throughput Computing
https://path-cc.io/

CI Accomplishment

Completing the planning phase of a coordinated effort to integrate the SAGE and GAGE data centers into a cloud-based system.

Remote Work

Maintaining regular contact with direct reports and maintaining information exchange.

MF Community

MFs of the future should work as a community towards common standards for data access and exchange to foster cross-disciplinary science.

Jerry Carter
Director of Data Services
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IRIS

https://www.iris.edu/hq/

CI Accomplishment

Managing the of both UNAVCO and ShakeAlert into modern CI.

Remote Work

Adopt a full remote work ethos. Asynchronous work, shorter meetings, asynchronous communications (Slack etc.).

MF Community

As MF's migrate to CI and adopt common data and metadata standards, I think the community will be essential for sharing our resources from data to meta-data and even human resources.

David Mencin
Director - Data Services
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UNAVCO/CU-Boulder

EarthScope Consortium

UNAVCO

www.unavco.org

CI Accomplishment

The most exciting CI development of the last few years is the emergence of "data federations" that operate like global content delivery systems for science. There are multiple concepts that seem to be on a path to convergence. I'll talk more about this in my lightning talk.

Remote Work

I have worked in remote work mode for decades. The pandemic has really been a net plus because it has legitimized practices that I've lived for so long that I can't remember what it was like before.

MF Community

The most difficult challenge in creating a sense of community is time and information flow. The annual NSF Cyberinfrastructure for NSF Major Facilities Workshop is an ideal forum to bring the community together,have that information flow, and allow people to decide based on what they learn here, who to form stronger ties with.

Frank Wuerthwein
Director - San Diego
Supercomputer Center

SDSC San Diego Supercomputer Center

OSG

https://www.sdsc.edu
https://opensciencegrid.org
https://cms.cern

CI Accomplishment

My work is to help others make big accomplishments in the cloud. My own biggest recent accomplishment was receiving the E&I Cloud Leadership Award for Lifetime Achievement in recognition of my community building work. It may not be public by the time of the workshop, but it was really nice to be recognized.

Remote Work

I was in my previous position at Indiana University in May 2020 when our CIO said we would not be returning to the office for quite a while. I went out and bought a treadmill and built a desktop for it. I now take all my meetings walking. A full day of meetings might mean 10+ miles. Of course I'm a bit of a slouch on low-meeting days.

MF Community

I'm new to the MF community. I confess I didn't know that MF was a specific category. So go easy on me when I show my ignorance. My professional super power is community building, so I'm happy to see if there is a way I can help this community make more and better use of the cloud.

Bob Flynn
PM, Cloud Infrastructure and Platform Services
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Internet2

https://internet2.edu

CI Accomplishment

Recently, our team deployed a declarative workflow platform for recording all processing steps in transforming researcher-submitted datasets into archive-ready datasets.

Remote Work

Slack expedites our team's collaborations on curating datasets, but also help us feel connected as a team through it's video calls. One thing we have learned is that any decision making that may impact standard operating procedures needs to be elevated to a team meeting to ensure everyone gets equal opportunity to weigh-in (vs. chat text they might've missed).

MF Community

Knowledge sharing about successes and failures on technical implementations. Akin to the Thoughtworks Radar for MFs

Adam Shepherd
Technical Director
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BCO-DMO

https://www.bco-dmo.org

CI Accomplishment

I am most proud of the CI Compass team and how well we work together even though we have not met in person for a very long time, and some of us on the team never met each other in real life. I am however looking forward to being able to meet fully in person.

Remote Work

I think it is very tiring to be living on Zoom all day. Keeping meetings to 50 minutes to make sure we have some time between the meetings is helpful, although sometime it is hard to stop an important discussion. My various projects have been using Slack a lot, and in some projects we have social channels, which help us connect better on a personal level.

MF Community

I think we can and must continue to grow the community in order to support science and engineering. We should think of how we can share data, develop CI capabilities and services in a way that they become seamless to use. We should strive capture the imagination of diverse students so that we grow our CI talent pool as well. As a community we have a lot to offer!

Ewa Deelman
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CI Compass, USC ISI

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ci-compass.org

CI Accomplishment

I am proud to be one of very few social scientists of cyberinfrastructure and science gateways, including in the diverse MF community. The opportunity to work in this interdisciplinary space allows me to research solutions to solving important socio-technical problems.

Remote Work

Use breakout rooms on Zoom combined with Google Doc to facilitate small group discussions that generate rich discussions and engage meeting participants in interactive sessions.

MF Community

There will be a thriving platform/hub where MFs can share lessons learned, strategies, and best practices to help each other, succeed in their own endeavors, so we can learn from each other's experiences.

Kerk F, Kee
Associate Professor
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Texas Tech University

CI Compass
ci-compass.org

CI Accomplishment

I am a social scientist who studies cyberinfrastructure and science gateways. My most recent work involves developing a framework for measuring organizational capacity during CI diffusion, and analyzing and identifying influencers in CI/SG communities.

Remote Work

Zoom breakout rooms and chat can be effective. Google docs/slides are helpful for coordinating work efforts, and Slack can be effective for offline discussions.

MF Community

Improved communication, coordination, and cooperation. Improvement in risk mitigation and disaster resilience. An expanded community, a motivated and effective workforce, and to echo Kerk, a hub where MFs can share lessons learned, strategies, and best practices to help each other.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Alex Olshansky
Research Assistant
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Texas Tech University

CI Compass
ci-compass.org

CI Accomplishment

I am helping with our new student internship program! It is very exciting to pair students with major facilities and to help them conduct research on the MF data lifecycle.

Remote Work

I have not found a practice that I think alleviates Zoom fatigue or yields better meetings. I think Slack and chat tools run the risk of people misunderstanding. There are no proxemic or prosodic cues in chat. Smileys help but can sometimes be too goofy. I really have not found a good way to bridge the physical distance.

MF Community

I like Kerk's answer. So ditto on that. I also would add that I'd like for anyone in the MF community to know that I am available to help in whatever way I can. As the evaluator for CI Compass, I want everyone to know they can come to me and give feedback. I want Compass to be successful in supporting MFs. So honest feedback is welcomed and it will always be just between us.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Laura Christopherson
Chameleon
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RENCI, University of North Carolina at Chapel Hill

CI Compass
ci-compass.org

CI Accomplishment

I am very happy with the new and existing engagements with Major Facilities on a variety of CI issues, and how CI Compass is making a difference in this area.

Remote Work

I think not having meetings span the full hour really helps to get a breather. Slack helps, but I hate the notifications, which if you turn off, defeats the purpose; it's a double edged sword for me. I feel that one advantage of things being remote is the opportunity to attend many events, which wasn't possible before. Events are more open.

MF Community

I think these are still early days of the "MF community". We are seeing the willingness and active participation of different MFs around different CI issues: cybersecurity, cloud, IdM etc. Moving forward, I envision seamless sharing of best practices and leveraging of efforts across facilities and the broader CI community.

Anirban Mandal
Associate Director
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CI Compass, UNC Chapel Hill

CI Compass
ci-compass.org

CI Accomplishment

Consulting, education, and creation of Demonstration Examples for multi-institutional Identity management. Visiting researchers use their logins and passwords from their home institution and don't need separate accounts at the MF.

Remote Work

Slack works - it helps a lot with Email Hell.

MF Community

I can imagine opportunities for MF staff to physically or virtually embed themselves at other facilities for a couple weeks or more to absorb a range of practices. Ice Cube might pose special challenges.

Erik Scott
Engineering and External Engagement
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CI Compass, UNC Chapel Hill

CI Compass
ci-compass.org

CI Accomplishment

I am very proud and excited to co-direct the Student Internship Program, which provides undergraduate students experience with both technical skills and research experience related to major facilities and cyberinfrastructure. I hope these experiences will inspire the students to consider a future career in CI and MFs.

Remote Work

I use different methods of communication for different contexts. Sometimes a quick Zoom call and sometimes a quick Slack will work best. Short 30-minutes meetings work well for check-ins, while 2-hour working meetings work best for longer discussions. It all comes back to context and considering what is the right method for what needs to be accomplished.

MF Community

I am hopeful for a diverse and collaborative community that shares information, data, lessons learned, and best practices; and a growing student internship program that contributes to the development and success of our CI and MF community.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Angela Murillo
Co-Principal Investigator - CI Compass
Assistant Professor
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Indiana University

CI Compass
ci-compass.org

CI Accomplishment

I enjoy learning from the CI Compass teams' expertise! My background and focus on communications ensures I am always learning new facets of challenges, solutions, and communities.

Remote Work

Working remotely enables us to connect with skilled and talented professionals all over the country - and world. I continue to remind myself that so many more things are possible when we work together beyond our physical locations. Long Zoom sessions can be tiring, but I remind myself of the opportunities they provide (and take walks on my breaks to stay alert!)

MF Community

I hope to continue reporting and sharing about CI Compass' work with the varied NSF Major Facilities. The cyberinfrastructure of these facilities is vital to their data storage, security, and ability to share it with the science community around the world. Communicating their and our work across social media channels grows the community.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Christina Clark
Communications Specialist
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CI Compass, Center for Research Computing at the University of Notre Dame

CI Compass
ci-compass.org

CI Accomplishment

I have been so proud to be part of the team, especially being able to help its communications grow! Seeing it start from just an idea to becoming something fully realized has just been incredible.

Remote Work

Hybrid and remote work has really changed how I think about career balance. For me, it has given me a new flexibility that I really appreciate and I'm glad to be able to then afford that to my team. I think finding creative ways to engage is more important than ever, though! I think using LinkedIn or GChat are now daily essentials, whereas before they were just "nice to haves."

MF Community

I'm excited to see the conversation grow between MFs and the CI Compass team, especially on our communications channels, like Twitter and LinkedIn!

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Joanne D. Fahey
Director of Research Communications
CI Compass, Center for Research Computing at the University of Notre Dame

CI Compass
ci-compass.org

CI Accomplishment

Consulting with Major Facilities on choosing Workflow Management Systems, and member of a working group tasked with identifying key areas of interest for MFs in adoption of Clouds.

Remote Work

I prefer shorter meetings, consisting of smallest set of concerned members. Slack works well for communication and tasks not requiring a lot of discussions. Overall, I prefer Slack over Email.

MF Community

Increased collaboration between NSF Major Facilities (MFs) and NSF CI Centers of Excellence is a great idea. In the coming years are the needs of the Mfs become clearer, I think we will see more open sourcing of the policies, best practices, source codes used by the MFs over developing proprietary components in isolation.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Rajiv Mayani
Senior Research Programmer
mayani@isi.edu
CI Compass, USC/ISI

CI Compass
ci-compass.org

CI Accomplishment

Re-factoring the OSG OSPool to the central manager deployed in high-availability mode between to Kubernetes clusters, and scaling to support 50k compute slots. This setup allows not only increased scalability, but we can do easy upgrades without users noticing.

Remote Work

My personal preference is a hybrid model, with a tilt towards working from home. This works really well for me as many of my projects are remote anyways, so being in the office just to Zoom/Slack provides no benefit.

MF Community

I think forcing a community is not going to work. There must be real incentives for people to come together, such as common platforms, tooling or projects like CI Compass.

Mats Rynge
Senior Computer Scientist
rynge@isi.edu
CI Compass / USC-ISI

CI Compass
ci-compass.org

CI Accomplishment

Working through identity management and data sharing issues with SAGE/GAGE collaboration.

Remote Work

Like many, we adopted a 'COVID puppy' who is now a sweet full-grown mix named 'Iris'. Working from home I get to take her for walks around the neighborhood to clear my head.

MF Community

A community that is more efficient in leveraging best practices, joint outcomes and economies of scale from each others' endeavors to build an inter-meshed CI that acts as a 'cloud' of instruments, networks, computing, and storage and other types of capabilities.

Ilya Baldin
Director, Network Research and Infrastructure
ibaldin@renci.org
RENCI/UNC Chapel Hill

CI Compass
ci-compass.org

CI Accomplishment

Engaged in Cloud Provider Analysis, Cloud Migration Risk Assessment, Workforce Development, and Internship Program

Remote Work

Zoom helps me interact more with colleagues from other institutions, but often occupies 10 hours a day, it is so easy to schedule these meetings. To have some real work time, I lock some blocks on my calendar.

MF Community

A community able to learn from each other through sharing of best practices on every level of operations, service delivery, and workforce development. The opportunity to learn from each other could serve as an incentive to meet on a regular basis, maybe once a year.

Jarek Nabrzyski
Director, Center for Research Computing at the University of Notre Dame
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CRC
CENTER FOR RESEARCH COMPUTING
https://crc.nd.edu

CI Accomplishment

Providing services for visualization and analytics for massive scientific data including solutions that can be deployed in Jupyter Notebooks, Web portals, and cloud computing environments. Large scale data movements with streaming capabilities with flexible tradeoffs between quality, performance, and resource used.

Remote Work

The last two years allowed to appreciate how teamwork can be expanded geographically and people perform at their best when trusted and empowered with independent work. Remote training activities also expand our reach to a broader community and allow sharing knowledge in ways previously considered unattainable.

MF Community

The MF community encompasses incredible talent and supporting a commitment to sharing accomplishments, best practices, and lessons learned will increase the ability to accomplish their mission.

Valerio Pascucci
Director, Center for Extreme Data Management Analysis and Visualization,
Professor, Scientific Computing and Imaging Institute, University of Utah,
pascucci@sci.utah.edu

CI Compass

NSDF
National Science Data Fabric

CI Accomplishment

It is my pleasure to support faculty, students and staff who are working to improve CI in their institutions!

Remote Work

When I am responsible for a remote meeting I like to join a few minutes early to make sure I have the access I need (host for Zoom) for sharing documents and muting people. And to assist any others joining the meeting.

MF Community

I am looking forward to hearing where institutions are headed in the next five years! Operations need to be aware of the plans and progress in order to identify new support tools or roles that are needed.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Mary Gohsman
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University of Notre Dame CRC

CRC
CENTER FOR RESEARCH COMPUTING
https://crc.nd.edu

CI Accomplishment

Collaborating with users of Major Facilities to aid with their workflow execution environments and execution of their experiments.

Remote Work

With remote work I have reduced the time I spend commuting every week. I have found that speeding this time to exercise in the mornings makes me more productive for the rest of the day.

MF Community

I would like to see NSF Major Facilities to communicate and collaborate better and more closely with each other, sharing their experiences and lessons learned.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

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PhD Student
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Information Sciences Institute

USC Viterbi
https://www.usc.edu/
https://www.isi.edu/

CI Accomplishment

Collaborating with major facilities and other science communities on adoption of FAIR data principles, knowledge graphs and AI assisted science.

Remote Work

Zoom, excalidraw and the Visual Studio Code Live Share feature provide a reasonable environment for collaborative code development.

MF Community

That "MF as a community" continues to grow and share best practices within the MF community but also with broader scientific communities.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Charles F Vardeman II
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University of Notre Dame

CI Compass
https://ci-compass.org/

CI Accomplishment

Presenting on FAIR and data management. It is an important means to enabling data reuse.

Remote Work

Remote work helps a lot with clarifying processes and documentation! And this is a good thing, especially with remembering and sharing how to do things.

MF Community

I would like to see more collaboration and identification of similar processes and workflows.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Don Brower
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University of Notre Dame

CI Compass
https://ci-compass.org/

CI Accomplishment

Working on improving reporting processes for the Open Science Grid to help speed up user support response times.

Remote Work

Take 15 minutes prior to a meeting to review past notes and prep talking points. Use slides and drawings for technical discussions.

MF Community

In the next 5 years, I hope that new and exciting research opportunities open up for students who are looking to grow their research skills and technical abilities.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Ryan Tanaka
Research Programmer
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USC Information Sciences Institute

CI Compass
https://ci-compass.org/

CI Accomplishment

Participation in the Student internship Program and member of the Cloud Computing Working Group that focuses on helping Major Facilities Cloud migration effort.

Remote Work

I tend to privilege shorter meetings, for example 30 minutes with a clear agenda and goals defined before the meeting. Carefully select meeting participants so people are not attending too many meetings.

MF Community

In the next 5 years, I hope that the Major Facilities community will keep growing and disseminating good practices, with the end goal of establishing high-quality standards and practices among facilities.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Loïc Pottier
Computer Scientist
lpottier@isi.edu
CI Compass, USC

CI Compass
ci-compass.org

CI Accomplishment

Constantly moving applications to new frameworks or new environments. Getting them to work in new environments is my biggest accomplishment, especially some of those old Python 2 programs that have slowly become obsolete.

Remote Work

Communicate more with Slack. Less distractions from others outside organization, that email enabled.

MF Community

Exchange of resources between facilities. Now that many organizations are working remotely, being able to share resources would really help to build stronger relationships and facilities.

Doug Ertz
Engineering Manager III
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UNAVCO

UNAVCO
www.unavco.org

CI Accomplishment

Found Trusted CI, the NSF Cybersecurity Center of Excellence, and ResearchSOC, providing cybersecurity services to five major facilities.

Remote Work

Variety is helpful, video conferencing intermixed with audio calls, and various collaborative writing, drawing, etc. We don't do in-person interactions homogeneously and monotony results if we try to do report interactions using just one medium.

MF Community

As was any organization, Major Facilities need to understand what they do that is their mission and unique contribution, focus on that, and leverage everything they can find for everything else. A community can help address that "everything else."

Von Welch
AVP, Information Security
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Indiana University

TRUSTED CI
THE NSF CYBERSECURITY CENTER OF EXCELLENCE
trustedci.org

ResearchSOC
researchsoc.iu.edu

CI Accomplishment

*I don't spend much time working directly in CI, but I'm really proud of the UNOLS community for coming together to engage with ResearchSOC (starting *soon*) to help our distributed facility come together with shared goals.*

Remote Work

I love the zoom lifestyle. Most of my work is with remote colleagues anyway and video chats have normalized seeing faces instead of just hearing voices on a phone. And I love getting to pet my dog in between meetings. She gets me through the rest of my day, but isn't allowed at the office.
I've moved my "office" into my dining room so I can be close to my coffee pot and lunch since most of my meetings end up being midday to span the most U.S. time zones.

MF Community

Just the phrase "MF as a community" sounds like a dream doesn't it?

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Brandi Murphy
Technical Services Manager
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UNOLS

CI Accomplishment

Lead the CICompass Cloud Computing Working Group that focuses on helping Major Facilities Cloud migration effort.

Remote Work

With remote work, the number of meetings have exploded. I actively try to have at least have couple of days in a week, where there are minimal meetings so that I can get my actual work done.

MF Community

With the increased interactions, I hope MF's recognize the importance of adopting and embrace building upon proven open source technologies, thereby reducing the temptation to build everything from scratch in house.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Karan Vahi
Senior Computer Scientist
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CI Compass, USC

CI Compass
ci-compass.org

pegasus.isi.edu

CI Accomplishment

Supporting major facilities in their data management and visualization challenges.

Remote Work

I discovered that many meetings could last less than one hour... Meetings online are often more efficient and easy to schedule. I will certainly keep doing that.

MF Community

Sharing knowledge and good practices across major facilities can speed up the productivity and growth of each of them. We need more tools and channels to make this connections happen.

Steve Petruzza
Research Associate
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Scientific Computing and Imaging Institute
University of Utah

CI Compass
https://ci-compass.org/

National Science Data Fabric

CI Accomplishment

Lead the computing-focused efforts for IceCube, mainly cyberinfrastructure, but also data analysis techniques

Remote Work

For my team and I remote work is ideal. We go to the office/server room as needed but otherwise we have more flexibility now in how to do things.

MF Community

The MF community feels very siloed. There are some science relationships, but there is no clear "community" around operating or building facilities.

Benedikt Riedel
Computing Manager
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IceCube, UW-Madison

https://icecube.wisc.edu/

CI Accomplishment

Transition towards tokens in all aspects: replacing X509 for data transfer and HTCondor, and moving to centralize auth with OAuth2 SSO with Keycloak.

Remote Work

Slack use is critical, since many discussions don't need a meeting, or can be asynchronous.

MF Community

I would like to see more collaboration for the "MF as a community," to really make it a community instead of a short once-a-year status meeting.

David Schultz
Research CI Manager
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IceCube, UW-Madison

https://icecube.wisc.edu/

CI Accomplishment

We're presently working on the deployment of Jetstream2 after a successful 5 years of Jetstream1.

Remote Work

Using Slack for more than just work helps build some of the camaraderie that's often difficult with remote work. Trying to limit the number of meetings a day is often crucial both to productivity and mental health.

MF Community

As an NSF-funded service provider, we'd like to work hand in hand with major facilities wherever possible. We think there's opportunities for all of us to collaborate more.

Jeremy Fischer
Manager, Jetstream Cloud
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Indiana University

https://jetstream-cloud.org/

CI Accomplishment

In January, Trusted CI launched the Framework Cohort to engage with 6 NSF Major Facilities that have committed to adopting and implementing the Trusted CI Framework. The Trusted CI Framework helps organizations establish and refine their cybersecurity programs from a mission-oriented, programmatic, and full organizational lifecycle perspective.

Remote Work

Using Zoom's "Raise Hand" feature for larger meetings helps ensure that everyone gets a chance to ask questions and give input, in the order in which they raised their hands.

MF Community

One aspect of "MF as a community" that I envision is a trust group across the NSF Major Facilities for sharing cyberinfrastructure vulnerability information and coordinating security incident response, perhaps enabled by REN-ISAC and/or ResearchSOC. Similar trust groups (e.g., XSEDE) have proven their value to the participants over the years.

Jim Basney
Research Scientist
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NCSA Cybersecurity

TRUSTED CI
THE NSF CYBERSECURITY CENTER OF EXCELLENCE
trustedci.org

CI Accomplishment

- Developed the Identity Management Working Group for CI Compass and Trusted CI
- Aligned the OSG/PATh security program with the Trusted CI Framework

Remote Work

Start and end meetings punctually and allow time between meetings for real life. Collaborative note taking and document editing via Google Docs using the suggest mode is fantastic.

MF Community

Help all MF meet cybersecurity basic hygiene goals and start proactively addressing cybersecurity threats at a foundational level

Josh Drake
Sr Security Analyst
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Trusted CI
ResearchSOC

TRUSTED CI
THE NSF CYBERSECURITY CENTER OF EXCELLENCE
trustedci.org

ResearchSOC
researchsoc.iu.edu

CI Accomplishment

I have only recently started working with Trusted CI and ResearchSOC. The best accomplishment so far is starting my journey to learn about Trusted CI and this great community.

Remote Work

Try not to book meetings without breaks between them. Note taking and document editing via Google Docs live during meetings is very useful to help all participants stay of the same page during meetings.

MF Community

The MFs continue to build relationships with each other and supporting organizations like Trusted CI and ResearchSOC. They increase sharing within the community of their experiences developing useful policies, procedures, and defenses against cyber-threats, and through that sharing find support.

Michael Simpson
Senior Security Analyst
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Trusted CI
ResearchSOC
Indiana University

TRUSTED CI
THE NSF CYBERSECURITY CENTER OF EXCELLENCE
trustedci.org

ResearchSOC
researchsoc.iu.edu

CI Accomplishment

Got the Daniel K. Inouye Solar Telescope (DKIST) Data Center ready to receive first operational data streaming from from the telescope.

Remote Work

My teams hold a standing daily meeting (stand-up) and converse over multiple slack channels - we also have occasional informal get togethers after work.

MF Community

I can see a loose collaboration between MFs can be started with a standard pub/sub event driven messaging collaboration on a small scale could lay the groundwork for a more integrated system in later year

Robert Tawa
DKIST DC PM
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National Solar Observatory

NSO
NSO.edu

CI Accomplishment

Part of a CI team that recently purchased equipment for a new Oregon State University (OSU) OOI data center and migrated the original Rutgers University OOI data center to OSU.

Remote Work

The OOI CI team is highly distributed from Oregon and Washington to New Jersey, New Hampshire and Massachusetts. To coordinate and collaborate on projects we have daily 30 min stand-up meetings and communicate throughout the day using Slack and MS Teams.

MF Community

I think the Trusted CI 2022 Framework cohort is a great way for MFs to develop their cybersecurity programs and share lessons learned. My hope is that the relationships that develop through this cohort experience will continue well beyond 2022 as we look to address issues related to, for example, cyber security, making data FAIR, and the assessment and adoption of emerging technologies.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Craig Risien
CI Systems Project Manager
craig.risien@oregonstate.edu
Oregon State University

https://oceanobservatories.org/

CI Accomplishment

Prototyping new cloud optimized storage solutions for our GNSS archive.

Remote Work

Utilize multiple tools for synchronous (Slack, Teams, .etc) and asynchronous (Email, Jira, Trello, .etc) communication.

MF Community

Help facilitate collaboration between our facility and other MFs.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Henry Berglund
Data Products Manager
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UNAVCO

www.unavco.org

CI Accomplishment

Leadership of three separate design teams for the GAGE/SAGE common cloud architecture. Also, regularly attended CI Compass Identity Management Working Group and NSF Large Facilities Security Team meetings.

Remote Work

Good practices for remote teams: 1) demonstrate patience with asynchronous communications, 2) expect that some attendees will show to a Zoom meeting 5 minutes late, 3) be gracious in letting others have the floor, 4) listen more, talk less, 5) schedule predictable meeting times, 6) don't schedule too many meetings.

MF Community

I see Major Facilities moving toward greater transparency, interoperability, and sharing. Less redundancy and more coordination of infrastructure and standards development. A wealth of resources and technologies for new facilities to benefit from.

Rob Casey

Deputy Director,
Cyberinfrastructure
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IRIS/SAGE

https://iris.edu

CI Accomplishment

OOI recently re-architected its systems and upgraded all software during a data center move across country to OSU - with no downtime.

Remote Work

The OOI CI team has been remote and geographically dispersed since its inception. More recently, the introduction of Slack and shared environments (like Google docs) along with program wide management tools (ticketing) has made working remotely very effective.

MF Community

In the next 5 years, the ability to research and adopt standards and best practices (for MFs) from a common location will be key to building a cohesive community.

Jeffrey Glatstein
Senior Manager of
Cyberinfrastructure
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Woods Hole Oceanographic
Institution

www.oceanobservatories.org

CI Accomplishment

We recently published our second data release - a snapshot of all of our available data, annotated with one DOI per data product and stored and made available (for most products) for the lifetime of the observatory.

Remote Work

Respect is key, as is assuming positive intent. Our team works really well, based on a strong sense of trust. Patience, hand-raising, listening, etc. are all really helpful.

MF Community

Being able to easily find, communicate, and collaborate with experts on new projects at other MFs would be wonderful (e.g., shared Slack channels?)

Christine Laney
Data Scientist
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NEON

https://www.neonscience.org

CI Accomplishment

Release of a Trusted CI whitepaper on Science DMZ security: Ishan Abhinit, Hans Addleman, Kathy Benninger, Don DuRousseau, Mark Krenz, Brenna Meade, "Science DMZ: Secure High Performance Data Transfer," December 2021
https://hdl.handle.net/2022/27007

Remote Work

Camera on when feasible for interactive meetings

At least 5 minutes of break time between Zoom meetings
Limit webinar meeting sessions to 90 minutes
<insert 10 minute break>
continue

MF Community

My vision: In the next 5 years Trusted CI will...
...have engaged with all MFs and enhanced their cybersecurity programs through facilitating adoption of the Trusted CI Framework
...be supporting active, ongoing collaboration among all the MFs on cybersecurity best practices

Kathy Benninger
Trusted CI Framework Expansion Team
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Trusted CI/PSC

www.trustedci.org

CI Accomplishment

We established a project to create a cloud platform common for all of the data management needs of two Major Facilities (SAGE and GAGE). The operators of these facilities, IRIS and UNAVCO, are merging in the near future. Our work involves porting long-running facility code to cloud-appropriate, creating common sub-systems whenever possible, all while in the midst of a corporate merger.

Remote Work

Along with many of the usual practices, we have found the full embrace of cloud-hosted calendar invites (e.g. Google) to iron out the logistics: include the meeting link, deal with time zones, provide clarity on invitee status, links to meeting notes, etc. A lot of time can be wasted on those little details.

MF Community

We envision increased effectiveness through sharing of solutions between MFs, being either common services offered by Centers of Excellence (or other NSF-supported projects), or the myriad of options available commercially. This may also be an avenue to inform NSF of common challenges and requested solutions.

Chad Trabant
Deputy Director & Chief Architect
chad.trabant@iris.edu
IRIS Data Services

the IRIS CONSORTIUM

Working closely with: UNAVCO

https://www.iris.edu/

CI Accomplishment

CyVerse has re-written its Discovery Environment (DE) with a more modern touch and look. DE now uses Kubernetes for interactive development environments (IDE). This allows researchers and educators to bring their own IDE to the DE workbench and connect to our iRODS data store using a custom Container Storage Interface.

Remote Work

I encourage our team to minimize Zoom on-camera time. We converse daily over SLACK, keep our weekly team meeting to under 15 minutes, and monthly all-hands meetings to 45 minutes.

Less time in meetings, less emails internally, more time for work.

MF Community

My vision for the MF community is for researchers to adopt more containerized workflows, cloud-native applications and data types, which create opportunities for seamless data-proximate computing (widely distributed, locally managed) across MF.

Tyson L Swetnam
Research Assistant Professor
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University of Arizona

CYVERSE

https://cyverse.org

CI Accomplishment

We recently hosted our first (entirely-remote) undergraduate student intern, who assisted in development of our data usage metrics.

Remote Work

Embracing our team's new remote, asynchronous work schedules, and refraining from imposing strict expectations on their work/life balance has been important. Ensuring we all report out in stand-ups during team meetings helps keep everyone apprised of each other's work and any touchpoints between subprojects.

MF Community

Building capacity and capability across facilities including technologies, human resources, and lessons learned to facilitate a more interoperable data landscape that effectively supports new cross-disciplinary science.

Danie Kinkade
Co-PI, Director
BCO-DMO
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BCO-DMO

https://www.bco-dmo.org

CI Accomplishment

In December 2021, I completed a Trusted CI engagement with members of the Jupyter community to create documentation for better securing Jupyter deployments.

Remote Work

I have found Slack to be more useful than walking into someone's office for a face-to-face conversation. The persistence of Slack chats allow me to review history for important information that I may have forgotten otherwise.

MF Community

As a Trusted CI member, I hope that we will have assisted all of the Major Facilities in adoption of the Trusted CI Framework, and help security personnel with implementation details.

Terry Fleury
Research Programmer
tfleury@illinois.edu
NCSA Cybersecurity

TRUSTED CI
THE NSF CYBERSECURITY CENTER OF EXCELLENCE
trustedci.org

CI Accomplishment

I organise NSF LFO's outreach activities to the Major and Mid-Scale Research Infrastructure Communities.

https://researchinfrastructureoutreach.com/knowledge-gateway/

Remote Work

1) *It's okay to finish a meeting early.*
2) *Don't have a meeting for something you could do via email.*
3) *Start on time.*
4) *Have a good microphone and camera.*
5) *Have a stand up desk*

MF Community

Some tools provided by NSF to help improve collaboration and communication among Research Infrastructure Communities

https://researchinfrastructureoutreach.com/
https://researchinfrastructureoutreach.com/workshop/
https://researchinfrastructureoutreach.com/coi-portal/

2022 Cyberinfrastructure for NSF Major Facilities Workshop

Richard Oram
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Organization
Website

CI Accomplishment

Co-PI of EPOC (jointly with Indiana University) and member of the ESnet Science Engagement Team. Our groups have assisted in over 225 engagements since funding began in 2018, published several "Deep Dive" reports on how technology can be better selected to improve scientific outcomes. Our success is best measured by the trust the community places with us to assist with these critical tasks.

Remote Work

As 15+ year 'remote' employee, I had an easier time adjusting to remote work than others, but have struggled with encouraging "smaller bites" with my colleagues. For instance, a 4hr zoom meeting is almost never justified, if we can all do some planning and thought, and come together in more focused collaboration in shorter bursts.

MF Community

EPOC's focus in the CI ecosystem is, and has always been, understanding the "end to end" aspects of a scientific workflow with a focus on the network and the tools that leverage it. MFs will always have components that are distributed (instrumentation, computation, users), thus ensuring networks are performing adequately, and users have an understanding of how they can leverage the resources, is critical.

2022 Cyberinfrastructure for NSF Major Facilities Workshop

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ESnet / EPOC

Energy Sciences Network (ESnet)
https://fasterdata.es.net

Engagement & Performance Operations Center (EPOC)
https://epoc.global

CI Accomplishment

Globus services encompass file transfer, sharing, indexing, and search, and the linking of those and other activities into data automation pipelines. These services, in use at more than 1000 institutions, are operated sustainably by UChicago thanks to user subscriptions. Please talk to us about how we can help your MF!

Remote Work

Slack for sure. And Github. And Zoom. The occasional in person sprint. I find myself communicating more, in some ways, that before the pandemic, because I don't need to walk down the hall to find someone.

MF Community

I believe that MFs will increasingly learn to outsource important elements of their cyberinfrastructure in ways that increase reliability, reduce costs, and promote interoperability. I believe that we have shown the value of this approach for data automation, with Globus. Where else can be MF community leverage commonalities?

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https://www.globus.org

CI Accomplishment

Supporting scientists and staff in transition to working from home, while deploying new tools and procedures to support remote operations, data collection, and analysis.

Remote Work

Daily meetings with our core group have been critical in maintaining team cohesiveness, with chat rooms helping facilitate collaborative work throughout the day.

MF Community

A collaborative source of knowledge, expertise, and technical resources.

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Cornell High Energy Synchrotron Source
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CI Accomplishment

PI for the MSRI Network for Advanced NMR, a collaboration among UConn, UW-Madison, and UGA. Once fully functionally we will provide access to 20+ high-field NMR spectrometers, including the first two open-access 1.1 GHz instruments in the US.

Remote Work

We recently purchased an OWL 360° camera, speaker, mic for use with Zoom. It's proving to be popular, especially for hybrid meetings where multiple people are in a physical conference room. Slack has helped lighten our email burden among team members, but we've been less successful getting our broader user community to use it.

MF Community

I imagine a PaaS resource like NMRbox.org, but more general. NMRbox provide hundreds of software packages for biomolecular NMR, hardware to run them on, and secure/shareable storage. Software versions are snapshotted and VMs with old versions can be spun up on demand.

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Network for Advanced NMR
usnan.org

CI Accomplishment

Last year, I worked with a team at Trusted CI to interview scientific projects developing their own software and then responded to the needs we identified by publishing Trusted CI's Guide to Securing Scientific Software.

Remote Work

Personally, it's hard for me to sit and concentrate in Zoom meetings once I've hit a few hours in, so I've started knitting as away to keep my hands occupied, which calms me and lets me keep my mind more focused on the conversation.

MF Community

I would like to see the Major Facilities continue to improve their cybersecurity postures and increase alignment with Trusted CI's Framework, a programmatic approach to building a cybersecurity program.

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CI Accomplishment

I have been the Chief Architect for the Scalable Cyberinfrastruture for Multi-Messenger Astrophysics (SCiMMA) collaboration, leading the creation of a Kafka-based publish-subscribe messaging system, Hopskotch, for distributing low-latency information for Multi-Messenger Astrophysics

Remote Work

We have mostly moved away from Zoom telecons, including for stand-ups, relying on Slack for threaded discussions with short *ad hoc* telecons as required. We do still use Zoom for sprint review, planning, etc, but we are not afraid to end before the allotted time!

MF Community

Quicker relationship-building between mid-size collaborations/ teams making intermediary tools (eg, SCiMMA) and the major facilities will maximise the value of the major facility output:

- More visibility into the technical roadmaps
- Major facilities mutually agreeing standards where practicable

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SCiMMA
https://scimma.org

CI Accomplishment

Our Midscale Research Infrastructure grant was awarded earlier this month! In preparation for the award (and as a result of other growth), the size of our organization has increased from 88 people when I became director in 2016 to almost 190 now.

Remote Work

We use Slack a lot. I like the #GetMeaCoffee add-in, as it has allowed people to get to know each other as we have grown, despite being physically dispersed.

MF Community

We are new, so I don't have a vision yet. We have already benefited greatly from assistance from another MSRI project here at Michigan. Their project is very different from ours, but their guidance in terms of what to expect in terms of reporting, etc. has been very helpful.

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CI Accomplishment

Helping develop the FACE Strategic Plan and the NSCR Blueprint; Co-charing the NAIRR TF.

Remote Work

Avoid packing meeting back to back; keep meetings to the point (ending early is always good); leverage alternate technologies (e.g., Slack, chat) as appropriate; turn off the camera when you need to.

MF Community

Increased use of shared services and national resources; increased interoperability and composibility of data and data-products; emphasis on equity of access and FAIR principles; an integrated community of CI professionals across MFs.

Manish Parashar
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Affiliated Organization
nsf.gov

CI Accomplishment

Helping create and manage NSF's Campus Cyberinfrastructure program

Remote Work

- *try not to be late to a meeting, even if you have to cutoff the previous zoom.*
- *make room for breaks*
- *try not to stray off topic*

MF Community

Deeper exchange of knowledge and experience. More effective leverage of available services and community shared resources. Starting to build evolving CI into future operational plans.

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