

SGCI Incubator and its Role in Workforce Development: Lessons Learned from Training, Consultancy, and Building a Community of Community-Builders for Science Gateways

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ABSTRACT

Workforce development is an important topic in distributed computing. While traditional curricula in engineering and computer science focus primarily on disciplinary technical expertise, facilitating research cyberinfrastructures requires a diverse set of non-discipline-specific skills including usability, business planning, and community building. Science gateways, digital platforms that facilitate the use of complex research and computing resources, are an increasingly popular form of cyberinfrastructure. The Science Gateways Community Institute (SGCI) was funded in 2016 by NSF to support the creation, use, and maintenance of effective, efficient, and reliable science gateways. SGCI's Incubator provides training, short-term consulting, and community-building measures that support workforce development and professionalization of computational solutions. We present some strategies and lessons learned from four years of science gateways engagement relevant to workforce development.

CCS CONCEPTS

• **Social and professional topics** → **Computing occupations; Adult education.**

KEYWORDS

SGCI, science gateways, incubator, training, usability, cyberinfrastructure, community building

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1 INTRODUCTION

Workforce development in academia takes place in many forms, sometimes within traditional curricular activities and often through extra-curricular training. Workforce development opportunities often arise from needs and gaps in the academic workforce landscape, and needs are recently starting to be addressed through large-scale initiatives such as the Science Gateways Community Institute (SGCI) [10], the Virtual Residency Program (VRP) [14] and international Research Software Engineer (RSE) Associations [5]. Career paths for facilitators, research software engineers, and science gateway creators are often not well defined and are beyond the career paths conventionally promoted in academia. However, these career paths are crucial in assuring the sustainability of research and computing cyberinfrastructures to accelerate science. Raising awareness for novel career paths and establishing pipelines for training requires a change in academic culture [13]. Starting points for such long-term change include training, consulting, and community building.

The SGCI Incubator contributes to workforce development and changing academic culture in the following three ways: (i) the SGCI “Focus Week” (formerly “Bootcamp”) is a one-week onsite intensive workshop where participants create their own roadmap for a sustainable science gateway via sessions with experts, hands-on exercises, and group work [11]; (ii) the consultancy of the Incubator is designed to support science gateway projects with consulting expertise for a short period of time, typically up to three months, with the goal of addressing sustainability challenges for gateway projects. Consultants have expertise in usability, sustainability and marketing, cybersecurity, and other areas; and (iii) the challenges for creators of specific science gateways are manifold, and the expertise needed for well-designed science gateways is very diverse. On-campus teams and distributed teams with a range of expertise are beneficial for creating effective, efficient, and reliable

science gateways. Community builders bringing together such experts and/or educating about science gateways lead to communities that exchange knowledge about challenges and existing solutions.

2 BACKGROUND

Facilitating research computing, software contributions, and community building activities are generally not factors in career advancement or workforce development in academia. Academic evaluation criteria typically include grants and awards, publications and citations, and quantity of advised and graduated students. In the last 10 years, multiple initiatives have been concerned with workforce development for facilitators, research software engineers, and gateway creators - whether they are staff or faculty at academic institutions or national labs. VRP, the Campus Research Computing Consortium (CaRCC) [2], and CyberAmbassadors [3] focus especially on training of facilitators in high-performance and distributed computing environments. The Extreme Science and Engineering Discovery Environment (XSEDE) [1] has successfully established the model of campus champions to help researchers on their campus gain access to XSEDE resources, and to receive support via such champions for effectively working with high-performance computing on a national scale. Additionally, XSEDE supports developers in connecting their science gateways to XSEDE resources; in 2016, 77% of XSEDE users were accessing and using XSEDE resources via science gateways. In this case, the mixture of on-campus support and the support of science gateways has shown a great impact.

The national RSE Associations aim at workforce development and career possibilities, especially in the landscape of research software. The UK RSE [6] developed into an official society and has paved the way for career paths in the UK. The US-RSE [8] has gained traction in the last year and has attracted over 300 members. The European Commission published a report [4] emphasizing that a viable career path for RSEs is crucial to sustain research software and research computing. Science gateways are a subgroup of research software, and raising awareness around the lack of career paths for RSEs, and the need for sustainability of research software, is important for the science gateway community. SGCI has launched a program for gateway ambassadors to build a community that supports researchers and developers in setting up collaborative environments for increasing the usability of research computing infrastructures. One idea is to bring diverse experts together for collaborations on science gateways and to support the sharing of expertise between projects. By aiming at teams on campus [9] and in distributed settings, projects could save money and benefit from knowledge generated via diverse collaborations and from lower learning curves on the experts' side. Such initiatives could open the door for more workforce development on important, yet not necessarily traditional, academic positions.

3 COMMUNITY- AND EXPERIENCE-DRIVEN ADAPTIONS OF THE FOCUS WEEK

SGCI's "Focus Week" is a five-day intensive workshop offered twice a year to teams who want to address the sustainability of their gateways. By working closely across teams throughout the week, participants have an opportunity to learn from each other's experiences and challenges. SGCI is in its fourth year of offering this

experience, with six full cohorts and two additional short versions having been offered. Over the years, SGCI has received feedback on how to better design the pace of the workshop. With 240 attendees, the Focus Week instructors have been able to adjust the curriculum to fit the community's needs. During the very first Focus Week session, which was known as the "Science Gateways Bootcamp", the curriculum was broken down into three key areas: long-term sustainability strategies, technology best practices, and core business strategy skills. Over time, teams provided feedback that has led to iterative revisions of the workshop. Initially the approach was to fit a wide spectrum of technical topics into only a few hours of teaching time. Being too high-level for a core technical audience, and too low-level for a management audience, the focus has changed to short sessions on best practices. The instructors provide tactical exercises that gateway managers use to determine if they need to improve their cybersecurity or usability, for example. The instructors have also designed a new session, called "Brain Trust", based on an exercise that was experienced by one of the lead instructors at a conference. Requests from participants inspired this activity for time to work on their problems.

4 NOVEL APPROACHES FOR MANAGING CONSULTANCY PROJECTS

Science gateway teams can apply for SGCI short-term consulting, which provides advice on or assessments of gateways. SGCI uses a customer relationship management system to track applications and teams requesting services. As some teams have multiple needs, they can select as many services as needed from the following: Hands-on, custom software development (Extended Developer Support); Business & sustainability planning (Incubator); Project management (Incubator); Technology, including selection, licensing, operations (Incubator); Cybersecurity (Incubator); Usability (Incubator); Graphic & user-interface design (Incubator); and Community engagement (Incubator). Teams need to provide a short description of what they would like to achieve by using the services of SGCI. Additional information on how they would utilize the services and the reason for their request is optional in the application. SGCI consultant contact the team to set-up an initial meeting to share information around the requested services, and the timeline of the engagements. After this call, consultants are assigned to the engagement based on availability.

4.1 Incubator Services

Currently, the top three requested services are Usability, Business & Sustainability, and Cybersecurity. Usability engagements make-up 43% of all active/completed engagements, 17% are Business & Sustainability, 15% are Cybersecurity, and 25% making up the other services offered by the Incubator. Through SGCI's Usability consulting, gateway clients receive usability evaluations and high-level usability strategy advice by graduate and undergraduate student interns who are part of an innovative program in User Experience (UX) Design at Purdue University [12, 15]. Over the course of the past 3 years, more than 30 usability consulting engagements have been completed. Across these consultations, there are a small number of usability issues that commonly arise which also have clear,

Table 1: Common usability issues and potential solutions

Issue	Potential Solution
Users are confused about what to look at when they first encounter a gateway	Use visual hierarchy to tell users where to look
Users are overwhelmed by content	Avoid large blocks of text, and use visual hierarchy to guide attention to text meaningfully
Users are lost in the website	Provide clear visual cues to help users answer where they are, where they have been, and where they can go

easily implementable solutions. Table 1 lists 3 of the most common usability issues and potential solutions for each.

For Business and Sustainability requests, consultants work with project leaders and teams interested in launching a new initiative or exploring new opportunities for existing ones. Consultants assess and advise gateways in understanding the behaviors and attitudes of their user base, explore existing or new markets, and explore a range of ways to create sustainable funding sources. For Cybersecurity requests, SGCI has partnered with Trusted CI: the NSF Cybersecurity Center of Excellence (CTSC) [7] to provide cybersecurity services for science gateways. Given the multifaceted nature of a science gateway, security plays an essential role in keeping the overall system safety and science trustworthy. Service includes training and guidance on software assurance, identity management, log analysis, incident response, and situational awareness for gateway teams. These engagements are SGCI's most popular engagements.

4.2 Workplan

SGCI consultants and clients collaboratively establish a workplan that articulates the expectations of the engagement, including specific deliverables and timelines. We have refined some best practices for creating these kinds of workplans, including the following requirements we have put in place. The first requirement is to have the gateway team identify a publication, if there is an existing publication, to include on a “cite us” page on the gateway. This is one metric-tracking tactic for the client to track how actively their community is using their gateway. The second requirement asks that the gateway cite SGCI in a relevant future publication written by the gateway team, if they share their experience or the results of the engagement. The third requirement is to share the number of authenticated users the gateway receives during the engagement. This metric allows SGCI to track the total number of users the community is serving at large, and see if there is a trend of increased usage based on the changes the gateway team is making from the recommendations of each engagement. The fourth requirement is to identify SGCI on an appropriate acknowledgment page on the science gateway. SGCI asks these items from each gateway team to help spread awareness about the services SGCI provides, and encourage best practices among gateways. Hence, they receive the appropriate amount of recognition for their work. The consultant(s)

and client review and approve the workplan together before officially starting each engagement. While the workplan is not a formal contract, it does help track the engagement's progress and provides a listing of the total work SGCI offers to the team.

4.3 Engagement Wrap-up & Evaluation

Once an engagement has wrapped up, the consultant will provide the gateway team the final deliverables. The team will maintain the products developed by the consultant, such as security procedures, or make the appropriate adjustments suggested by the consultants, such as improving designs based on a usability assessments or act upon the business plan developed with advice from the consultant. If the client requests another service from SGCI, the lead contacts the client to identify the timeline for the next engagement. After each engagement, the lead puts the gateway PI or lead in contact with SGCI's evaluation team. Here each team is asked to provide feedback on their experience during the engagement and overall satisfaction. This information helps SGCI track the approval rating of the engagements and evaluate where service needs to be improved.

5 FROM ON-CAMPUS TEAMS TO GATEWAY AMBASSADORS

The creation of a successful science gateway needs diverse expertise: from technology to usability to community engagement. Aside from training and consultancy engagements, one of the possibilities to address such needs is to connect experts of different fields in “on-campus” teams. We use this term broadly and include also distributed teams that have members collaborating on projects additional to the core features in technology and the domain area to which the science gateway belongs. The advantage of such teams is that expertise is shared between projects, departments, and institutions and can lead to cost share and lower learning curves for the experts working on diverse projects. There are quite some successful teams US-wide [9], e.g., at the Center for Research Computing (CRC) at the University of Notre Dame or the HUBzero[®] team at San Diego Supercomputing Center. They often have different roots and concepts but all have in common that they need an evangelist to be successful. With a collection of information about different successful models of teams, our first goal was to support building such teams by reaching out to campuses. The outreach involved presenting the concept on campus and helping clients to make the first steps to set up such teams. While we had some successful meetings at universities, we quite soon realized that this is not scalable with one person running this program via SGCI and the number of universities and national labs we needed to visit to achieve a critical mass for changing academic culture. Thus, we started to concentrate on giving talks at conferences and meetings of projects and initiatives with similar goals such as the VRP or the Campus Champions. While we still also support on-campus visits, the main focus changed to the SGCI ambassador programs. The vision for the gateway ambassadors is similar to the Campus Champions, with ambassadors building a community on campus or in their distributed team to connect users and developers of science gateways with technologies, concepts, and knowledge. The gateway ambassadors have monthly webinars/calls to exchange

and share ideas, knowledge and actions?with both positive and negative results. The community of gateway ambassadors is not large yet, but the goal is to grow this community on a large scale so that building communities and teams to present the vision of SGCI is not a scalability problem.

6 SUMMARY AND OUTLOOK

We have presented some lessons learned from almost four years offering services, training, consultancy, and community-building measures to support users and developers of science gateways and promoting alternative paths of workforce development for distributed computing careers. SGCI will continue to gather feedback on the different actions and consultancies to keep the services community-driven and tailored to the users' needs. We are planning to conduct interviews with clients in addition to gathering feedback during future Focus Weeks. These interviews will lead to valuable information about strengths and weaknesses of the consulting services and emerging pain points, and will provide a chance to adapt the services to the science gateway ecosystem. Training is a cornerstone for workforce development, and the feedback from the Focus Weeks will significantly influence training going forward. The community building measures enacted by gateway ambassadors will continue to improve the sustainability of science gateways, and will continue to highlight the importance of non-traditional career paths for science gateway creation and research software development.

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