

Draft Minutes
Advanced Scientific Computing Advisory Committee
Teleconference
July 15, 2014

ASCAC members present:

Roscoe Giles (Chair)	
Vincent Chan	Gwendolyn Huntoon
Barbara Chapman	Juan Meza
Jack Dongarra	Linda Petzold

ASCAC members absent:

Vinton Cerf
Vivek Sarkar
Dean Williams

Also participating:

Henri Calandra, Total SA
Christine Chalk, ASCAC Designated Federal Officer, Office of Advanced Scientific Computing Research, Office of Science, USDOE
Jeffrey Hittinger, Lawrence Livermore National Laboratory
Frederick O'Hara, ASCAC Recording Secretary
Jeffrey Vetter, Oak Ridge National Laboratory
Jim Coronas, Krell Institute
Marsha Berger, NYU Courant Institute
Jacqueline Chen, Sandia National Laboratories
John Negele, MIT

About five others were on the conference call.

The meeting was called to order by the **Chairman, Roscoe Giles**, at 11:04 a.m. EDT. The roll was called, and a quorum was ascertained. Giles welcomed the participants and reviewed the agenda.

Barbara Chapman was asked to report on the activities of the Workforce Subcommittee.

The Subcommittee's charge was one that had been sent to all of the Office of Science (SC) advisory committees. They were asked to identify disciplines that need for workforce training at the graduate or postdoctoral level to address discipline-specific workforce-development needs. The advisory committees were asked to address disciplines not well represented in academic curricula; disciplines in high demand, nationally and/or internationally, resulting in difficulties in recruitment and retention; disciplines where the Department of Energy (DOE) national laboratories may play a role in providing needed workforce development; and specific recommendations for programs at the graduate or postdoctoral levels. A letter report was requested from each advisory committee.

Scientific computation is extremely important across the national laboratories and to the R&D undertaken under SC. Experts in the use of scientific computing form the underpinning of successful research programs. The breadth of expertise required to effectively deploy available computational tools and to use them to accomplish scientific goals is greater than ever, including data analysis and visualization.

For the purpose of the report, the Subcommittee adopted the terms "training measures" and "computing sciences," which includes algorithms; applied mathematics; data analysis, management, and visualization; cybersecurity; software engineering and high-performance software environments; and high-performance computer systems.

The Subcommittee's report has some limitations. Information on the disciplines needed to support the DOE mission is not readily available. These subjects are disbursed throughout many disciplines. The data and information obtained usually cover some part of the computing sciences but are not all-inclusive. Human-resource data are typically not available for this range of subjects (some positions are categorized in the area of domain expertise).

The Subcommittee found that

1. The multidisciplinary national laboratories face workforce recruiting and retention challenges in computing sciences.
2. Insufficient educational opportunities are available at academic institutions in the areas of the computing sciences most relevant to the DOE mission.
3. There is a growing demand for graduates in computing sciences that far exceeds the supply. A larger workforce gap and the continued underrepresentation of minorities and females are anticipated.
4. The exemplary DOE Computational Science Graduate Fellowship (CSGF) Program, deemed highly effective in multiple reviews, is uniquely structured and positioned to provide the future workforce with the interdisciplinary knowledge, motivation, and experiences necessary for contributing to the DOE mission.
5. The DOE national laboratories have individually developed measures to help recruitment and retention, yet more can be done at the national level to amplify and extend the effectiveness of local programs.

In regard to the first finding (workforce recruiting and retention challenges), a letter was sent to the national laboratories asking about the areas in which they were having trouble in recruiting or retaining talent. Areas in computing sciences figured prominently in the responses, especially from the large national laboratories. They replied that there is a low number of qualified applicants, many of whom are foreign nationals; it takes a long time to fill positions; and the national laboratories spend significant effort on recruiting in this area over a long period. Additional information was solicited from the larger national laboratories. Not all national laboratories provided data. The responses indicated that there is no uniform method for recording information. It takes national laboratories twice as long as industry to fill positions in computing sciences and about four times as long when security does not permit the placement of a foreign national. Acceptance and retention rates are mostly favorable. The areas of competence sought by the national laboratories included architectures, computational sciences, cybersecurity, data-acquisition software, and high-performance and a larger-scale computing.

Jeffrey Hittinger was asked to report on national-laboratory recruitment and retention and noted that the national laboratories do not track all the disciplines specifically and they report available data in various ways. A Brookings Institute report on industry's recruiting in computer sciences was used to characterize industry's experience. The attrition rates at the national laboratories were greater than 9%. In industry, the annual attrition rate was about 12%.

Chapman thanked Hittinger for preparing this portion of the Subcommittee's report and reiterated that the national laboratories *do* face recruitment and retention challenges.

On the second major finding (the insufficiency of educational opportunities) the Subcommittee found that interdisciplinary computational science and engineering studies are emerging, but they produce an insufficient number of graduates and do not provide the full skill set needed by DOE.

Jack Dongarra was asked to comment on educational opportunities in computing science. He said that there was no uniformity among academic curricula; rather, there is a lot of experimentation in degrees, certificates, and focus areas. The Subcommittee compiled a list of PhD specialties in computing sciences, but not everything would find a home within the listed categories. A survey of the number of graduates produced in each of these programs indicated that the graduation rates are low and are not increasing in the areas of interest to the Office of Scientific Computing Research (ASCR). The area of big data and analytics is growing, and programs are emerging; however, this will be a challenging area in which to find employable prospects in the foreseeable future. Chapman summarized that there are educational opportunities, but the production rate is low. There is a long section on this in the report.

On the third major finding (the growing demand for graduates), Chapman noted that the Taulbee Survey reports state that there is very low unemployment in the United States for computing graduates. A large majority of graduates enter industry. The retirement of the current workforce is expected to increase the gap between employment openings and workforce size during the coming decade. It was widely reported that the national laboratories cannot compete with industry compensation. The Subcommittee sensed from the replies that the awareness of national-laboratories careers among graduates is low and that the current conference travel restrictions impede recruitment.

In terms of the demographics of workforce demand, the fraction of foreign nationals in the graduate population is growing steadily according to the Taulbee, National Science Foundation (NSF), and National Research Council reports. Although the number varies slightly from discipline to discipline, *in toto*, 58% of graduates in computing sciences are now foreign nationals. There is also a lack of diversity in U.S. graduates in computer science and computer engineering. There is a low number of students entering STEM (science, technology, engineering, and mathematics) programs, and a lack of diversity in STEM disciplines is widely acknowledged but not effectively addressed. The number of women in those programs is declining. As an example, at Lawrence Berkeley National Laboratory, women make up 32.9% of the STEM jobs, underrepresented minorities make up 12.9%, and other people of color make up 24.5%. The number of U.S. nationals is low and stays low. The number of females is dropping because there is a retention problem. At the same time, demand is growing. The unemployment rate in computer sciences is greater than 1%. Very few foreign nationals studying in the United States go home upon graduation.

Jeffrey Vetter was asked to comment on the fourth major finding (the Computational Sciences Graduate Fellowship Program). The Program guides the intellectual development of the participants to ensure that they have the needed skills. It includes a 12-week real-world experience at the national laboratories. It brings together personnel with diverse educational backgrounds. There is a careful selection process. It has been a successful program. Giles noted that there have been multiple reviews of this program and that all reviews have shown the success of the program. Hittinger added that the Program should/could double in size without decreasing the quality of the students.

Jeffrey Hittinger was asked to comment on the fifth major finding (recruitment and retention). Individual national laboratories have many efforts to enhance recruitment and retention, but those efforts are not coordinated. National laboratories also have (1) programs that help employees to obtain degrees and (2) postdoc programs that help attract new talent. The national laboratories can compete with industry on the front line by virtue of the fact that they form a compelling environment in which to conduct research. They do not have stock options, however. There has been a change in the funding model: no base amounts are provided; rather, funding comes through requests for proposals (RFPs). That model makes hiring and recruiting more difficult, and these effects need to be mitigated. Long-term employees (30 to 40 years) are a thing of the past. Today's workers shift careers after, say, 10 years. Mid-career recruiting needs to be bolstered. DOE needs to help universities provide a more-suitable education. It also needs to get postdocs and graduate students into the national laboratories.

Chapman said that the Subcommittee looked at the number of internships now versus 5 years ago. Data from the Oak Ridge Institute for Science and Education (ORISE) show 105 summer interns with computer-science majors in 2009 and 192 in the Computing and Computational Sciences Division in 2014. Lawrence Livermore National Laboratory reported that its program has increased 25% since 2010. Giles noted that recommendations should call for the national laboratories to unify the categorization of their human resources data.

The Subcommittee expressed a number of recommendations:

- The Subcommittee showed strong support for the CSGF program. Opportunities should be provided for more high-quality students, particularly students from underrepresented populations of demographics.
- DOE should establish new fellowship programs modeled after the CSGF program for research opportunities in enabling technologies (which have not been previously covered) in the

computing sciences as broadly defined in this report, including computer science for HPC, large-scale data science, and computational mathematics.

- DOE should expand its support for local laboratory programs and encourage greater inter-laboratory sharing of information about locally successful programs and standardized workforce-related data.
- DOE should fund a Computing Leadership Graduate Curriculum Advisory Group to spearhead participation in efforts within the Association for Computing Machinery (ACM), Computing Research Association (CRA), and NSF to develop and annually publish competencies needed by DOE at the graduate and undergraduate level (making DOE needs known and making other agencies aware of those needs).
- Working with ACM's Special Interest Group on High-Performance Computing (SIGHPC), NSF, and other organizations, DOE should provide a rich repository of its mission-oriented learning materials and engagement opportunities to attract and guide individuals toward careers in areas of DOE need. There are not a lot of students going into these fields.
- Working with other agencies and organizations, DOE should establish certificate programs to address the need for competency certification. It should also work with other agencies to fund implementation of curricular programs, particularly online programs, in the areas of DOE need.

Giles noted that two of the recommendations mention specific organizations and asked how specific the Subcommittee meant to be and how exclusive that list should be. Chapman replied that the list was not exclusive; rather, the list shows examples of organizations that have expressed an interest. Giles suggested that the recommendations should be reworded to make it clear that other organizations could contribute. Berger noted that DOE is limited in its educational mandate. The Subcommittee was looking for ways that DOE could carry out these activities. These recommendations may go beyond the norm, but the Subcommittee considered these issues important. Universities must be told what skills are needed to complete the mission. Meza stated that this opens a can of worms. One can get around the problem by using terms like workforce development. Giles pointed out that DOE *does need* education and that *the Committee* can say that even if DOE cannot. However, to him, establishing a certificate program was clearly outside the mandate. The Committee should *encourage* the establishment of a certificate program in concert with other organizations, sustain and improve existing programs addressing DOE workforce needs, and help existing academic programs meet workforce demands.

Negele stated that online programs are a huge undertaking, and there is no mandate for that. Petzold said that the word on the street is that the national laboratories are not a good place to work. The national laboratories are getting a really bad rap right now. Berger said that the field has become less attractive as a career. That is an important issue. Chapman agreed that that issue should be addressed.

Giles asked how strongly the Committee felt about the recommendation to fund curricular programs. Hittinger said that the Subcommittee had discussed that issue in the context of preparing for the exascale. Argonne National Laboratory has a good summer program in high-performance computing. There should be some online tutorials to train high-performance computing/exascale personnel. It does not necessarily need to be done by DOE. Giles said that "funding" should be changed to "support."

V. Chan noted that there are also industrial and academic contractors that have these needs as well as the national laboratories. These other groups do not have the resources for training personnel. That fact should be included in the recommendations. The national-laboratory experts should be used to train the postdocs. Giles said that the idea that this community is interconnected and that movement within it is agile should also be added to the report.

Chapman returned to the list of recommendations:

- DOE should improve the attractiveness of its opportunities with continued relocation assistance, ongoing professional development in DOE strategic areas, position rotation, and a sabbatical program for DOE employees. This assumes that there is a problem with the national laboratories' being unattractive. Berger stated that additional study was needed of the current funding model and the lack of long-term retention and commitment. Hittinger said that there are sabbatical

programs, but it is difficult to take one. Giles cautioned that the Subcommittee should make sure that these specifics are seen as examples.

- DOE should increase *awareness* of its opportunities by working with multiple universities to develop campus champions and increase support for DOE employees to visit campuses to promote opportunities within DOE. Giles said that the term “campus champions” should not be used because it is an NSF term. V. Chan asked if the national laboratories are using social media tools. Hittinger replied, yes.
- Working with other agencies, DOE should develop a strategic plan with programs and incentives to pro-actively recruit, mentor, and sustain the involvement of significantly more women, minorities, people with disabilities, and other underrepresented populations through the completion of their doctoral programs and their active participation in computer science and engineering careers.

Giles noted that the last recommendation does not have a structure that is parallel with that of the other recommendations.

Hittinger said that anywhere it says “DOE employees” the term should be changed to “national-laboratory employees.”

J. Chen urged the Subcommittee to emphasize an early career program in computing sciences.

Dongarra called attention to the fact that the national laboratories are fragmented. A unified mechanism would make them more attractive.

Giles called for a vote to accept the report. Chapman noted that the term “computing sciences” would need to be changed. She then moved to accept the report. Giles seconded the motion. The motion passed unanimously with no abstentions.

Giles thanked the Subcommittee for its hard work and hoped that its voice would be heard. He asked Chapman to make the editorial changes discussed during this meeting and to submit a final draft of the report.

Chalk stated that next meeting dates would be in August and October. If suitable dates during those months could not be found, the next meeting would be sometime in the fall.

The meeting was adjourned at 12:52 p.m. EDT.

Respectfully submitted,
Frederick M. O’Hara, Jr.
Recording Secretary
July 21, 2014