



The Impact of Penn State Research Innovation with Scientists and Engineers (RISE) Team, a joint ICDS and NSF CC* Team Project

How the RISE Team has accelerated and facilitated cross-disciplinary research for Penn State's researchers statewide

Charles F. Pavloski
The Pennsylvania State University,
Institute for Computational and Data
Sciences
cfp102@psu.edu

Chad R. Hanna
The Pennsylvania State University,
Department of Astronomy &
Astrophysics
crh184@psu.edu

Derek M. Leydig
The Pennsylvania State University,
Institute for Computational and Data
Sciences
dml129@psu.edu

ABSTRACT

The use of computing in science and engineering has become nearly ubiquitous. Whether researchers are using high performance computers to solve complex differential equations modeling climate change or using effective social media strategies to engage the public in a discourse about the importance of Science, Technology, Engineering, and Mathematics (STEM) education, cyberinfrastructure (CI) has become our most powerful tool for the creation and dissemination of scientific knowledge. With this sea change in the scientific process, tremendous discoveries have been made possible, but not without significant challenges.

The Research Innovation with Scientists and Engineers (RISE) team was created to address some of these challenges. Over the past two years, Penn State Institute for Computational and Data Sciences' (ICDS) research staff have partnered with RISE CI experts who facilitate research through a variety of CI resources. These include, but are not limited to, Penn State's high performance computing resources (Roar), national resources such as the Open Science Grid and XSEDE, and cloud services provided by Amazon, Google, and Microsoft.

Using funds provided by the National Science Foundation (NSF) CC* program, the RISE team has had direct engagement through multiple activities that benefit research projects conducted at Penn State. In addition, the RISE team has conducted seminars, workshops, and other training activities to bolster the cyberinfrastructure literacy of students, postdocs and faculty across disciplines. The RISE team has grown as a workforce shared across investigators who have consulted on projects both large and small. We show that the RISE team has already paid substantial dividends through increased productivity of faculty and more efficient use of external funding.

CCS CONCEPTS

• **Computing Profession;** • **Applied Computational Research;**
• **Cyberinfrastructure Workforce;**

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1 INTRODUCTION

The problem of efficiently connecting researchers with the most effective computational tools available and best practices techniques in computational science is challenging. Penn State serves over 100,000 students across 24 campuses as Pennsylvania's sole land-grant institution [1]. Conducting leading research across many disciplines is one of Penn State's core missions. University-wide research expenditures reached nearly \$1B in the 2018–2019 fiscal year [2]. In response to the growing role that high performance computing is playing in Penn State research, the Institute for Computational and Data Science was established seven years ago to enable excellence in research computation.

Typical faculty research groups are unable to directly hire and support computational engineers that encourage a career path. Through initial support from Penn State's Institute for Computational and Data Sciences (ICDS), the Research Innovation with Scientists and Engineers (RISE) team was created to address this challenge [3]. ICDS RISE is a team of domain specialists, computational scientists and software engineers who can help bring the power of high-performance computing and advanced computational techniques to research projects. Combining this initiative with funds provided from the NSF CC* program, we rapidly expanded access to the RISE team to research faculty located among the 24 Penn State commonwealth campuses through RISE seed grants, seminars, workshops, and training. These funds also allow for RISE to grow in capacity and scientific disciplines.

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Table 1: Summary of ICDS co-hire survey data – 35 co-hires surveyed

Metric	Result
Average annual co-hire external funding (self-reported)	\$400,000
Average fraction of funding that requires developing research cyberinfrastructure	36%
Fraction of co-hires with long-term research cyberinfrastructure commitments	64%
Fraction of co-hires satisfied with PSU computing facilities	64%
Fraction of co-hires satisfied with abundance of CI staff to facilitate research	27%
Fraction who feels they would be more productive with additional facilitators	91%
Median/Average annual FTE which could be utilized by each co-hire	0.2/0.38

1.1 Building and Growing the RISE team

The first stage of getting the RISE team built was to assess the research faculty needs and ensure the team skills would meet research requirements. This was carried out using our faculty research governance model within ICDS via executive committees and targeted surveys of research faculty. We conducted a survey of ICDS co-hires, and our findings are as follows: Over 1/3 of the respondents had external funding that required them to develop research cyberinfrastructure and nearly 2/3 of respondents said they had long term research cyberinfrastructure commitments. While the majority (2/3) were satisfied with ICDS facilities (such as computing and network infrastructure), less than 1/3 were satisfied with the abundance of technical staff available to directly support their research and research cyberinfrastructure commitments. Among those who responded, all but one co-hire felt that they would both be more productive and would increase external funding if additional technical staff were available. On average, ICDS co-hires felt that they could each leverage more than 1/3 of an FTE per year of research cyberinfrastructure technical assistance to facilitate their research. Survey results are summarized in Table 1. We found that 91% of the respondents felt that their productivity and chances at external funding would increase if they could leverage additional CI facilitators. On average, each co-hire felt they could leverage 0.38 FTEs of technical assistance from CI facilitators each year with a median of 0.2 FTEs / year.

We then searched for Ph.D. level researchers with STEM domain knowledge and strong computational skills. The result was a collaborative, integrated ICDS RISE team that has already engaged with a host of researchers– and yet, we still had substantial unmet needs which are stifling research. For example, one researcher in PSU Kinesiology department had her research grind to a halt because no one was available to help her develop the computational side of her healthy mother zone pipeline. The RISE CC* grant allowed us to hire an engineer who could guide her group to a successful outcome.

In addition, the RISE CC* grant funded the growth of the RISE cyber-team in a way that 1) guaranteed thousands of hours of CI facilitation to faculty who would not otherwise have such resources, 2) provided thousands of hours of training and participation broadening activities, and 3) accelerated ongoing, cross-cutting CI activities already taking place between ICDS faculty and central IT staff.

It was particularly important that we also created a career path for RISE engineers as staff scientists, removing the direct burden of self-funding for their positions. What we have found is there is

a community of career scientists who want to remain in the academic domain but prefer not to follow the traditional tenure-track path. The appeal of a broad range of research areas combined with computational aspects available to them from ICDS has allowed us to create a strong, self-motivated team. Since the start of the grant (18 months), the RISE team has grown from 6 members to 11 with four more RISE positions to be advertised for hire in the next 6 months. We have also found that faculty who engage with the RISE team via the seed program tend to want to keep their RISE engineer(s) in follow on projects funded through other means. I

In general, funding for these RISE engineers comes from the researcher's budgets through a set-rate charge back model, seed grant opportunities or PSU ICDS institute initiatives. We also work with PIs to include RISE time in future proposals, which both strengthens the PI's proposal (showing PSU's commitment to have in-house expertise) and supply a future funding path to sustain the RISE team long-term past the awarded CC* grant cycle.

1.2 The Seed Grant Process

Two of the main goals of the RISE CC* project is to connect researchers throughout the Penn State campus system and encourage cross-disciplinary research. Using the seed grant approach, we have developed a process where researchers engage the RISE CC* executive team via an open call for proposals, then we issue RISE seed grants appropriately on scientific merit, with preferential treatment towards non-University Park faculty. We have found that the seed program allowed us to engage with researchers in relatively resource-poor areas of Penn State and increase their productivity. We also found that the seed grant process helped us align our hiring needs with the areas indicated in the proposed seed grant ideas. We have noticed a solid increase in the number of seed grant applicants each semester and a broader spectrum of campus representation.

The success of the RISE CC* program has inspired other Penn State institutes to mirror our seed program. The Sustainable Agricultural, Food, and Environmental Science (SAFES) institute has created a joint seed program with the ICDS RISE Team, issuing 1000 hours of RISE seed grant time over 4 research groups. These 1000 hours are in addition to the 3900 awarded through CC*. The SAFES team intends to do another round of seed grants in late 2022. In addition, the Penn State Center for Immersive Experiences (CIE), currently being formed, plans to use the RISE CC* model to engage their community, with a seed grant program starting in the fall of 2022.

2 CC* RISE IMPACTS

2.1 RISE Impacts on Research Productivity

In the first 18 months of the NSF RISE CC* program, we have awarded over 3900 hours of RISE engineer time spanning seven Penn State campuses and 17 unique research faculty groups. Although it is still too early to assess the full impact, this has resulted in one fully funded follow-on grant and multiple proposals submitted with help from RISE CC* awaiting review.

In addition, research faculty are deciding to continue their relationship with RISE engineers, post-seed grant on other research projects. The typical RISE engineer has evolved into having one long-term (over one year), research grant funded project, one-medium term (6 to 12 months) research grant funded project and rotating seed grant projects from 3 to 6 months in duration. This willingness to include RISE in grant funded proposals shows the impact that RISE has on their individual research goals. Sample testimonials from Penn State faculty working with RISE team members highlight the impact:

“Having this existing expertise that we can hire on a contract basis saves my group time and effort and makes us more productive.” – Dr. Ed O’Brien, Penn State Associate Professor of Chemistry

“RISE was the difference between success and failure in this project.” – Dr. Uday Shanbhag, Penn State Professor of Industrial and Manufacturing Engineering

We fully expect RISE’s impact on Penn State’s research mission to continue to grow with adoption and the size of the team.

2.2 RISE Impacts on Workforce Development

Typical RISE team members on average are running around 85% of their time on funded research projects or seed grants. This is the maximum load level allowed because we want to leave time for professional development and unexpected problems that arise. We have found that this balance of project / professional development time gives our engineers a solid, reasonable work environment which leads to RISE member satisfaction and retention.

We have also managed to hire during the COVID-19 era, which brings on its own challenges. We have embraced the remote and hybrid work options for our team members, which has allowed us to expand our pool of potential engineers. Our results so far have shown our engineers to be highly effective in these work modes, although we have found the development of team camaraderie is challenging. We have embraced the mentor-mentee relationship between senior and junior engineers to build a sense of teamwork. We also have a standardized process for onboarding new RISE team members which includes open zoom team chats and joint projects. New hires have reported that these approaches have given them a sense of belonging despite the remote work environment struggles of COVID. Researchers have also embraced the remote worker concept with RISE since most of our contact hours involve computational needs. There is a perceived aura of efficiency and availability with a RISE engineer using today’s remote meeting tools that would not have been practical 10 years ago.

The other advantage to expanding our hiring pool to include remote workers is that we have diversified our hiring demographics as part of Penn State’s stated goal of Diversity, Equity, and Inclusion

in our workforce [5]. For example, RISE CC* grant awardees include 9 women PIs and five people of color.

Finally, the RISE team continues to conduct seminars, workshops, and training centered around the large scope of computational needs of our research clients. This training includes:

- Introduction to JupyterLab and Google Colab
- Introduction to debugging code with TotalView (RISE Facilitated)
- A Taste of Python and Jupyter - Basics of using Python in a Jupyter environment
- New User Training - Overview of ICDS’ Roar HPC system; basis of usage, storage, compute, and job submission
- Getting Software Running on Roar - Basics of using and installing software in a shared Linux HPC environment; Lmod module system, compiling code from source, automated build systems, package managers (system and user level), software containerization
- Intermediate HPC - Basics of optimizing usage on the Roar system; compiler optimizations, code profiling (gprof) and debugging (gdb), version control, common methods of parallelization (multi-tasking, shared memory, distributed memory), performance scaling studies
- Introduction to COMSOL in an HPC environment (RISE Facilitated)

We also plan to add this year:

- A Practical Introduction to Machine Learning with Scikit-Learn
- A Practical Introduction to Deep Learning with TensorFlow

These training programs have already shown impact on our researcher’s missions by reducing the barrier on Penn State faculty, research staff and graduate students to adopt ICDS Roar and advanced computational concepts in their research.

3 SUMMARY

The commitment of Penn State to the research mission by embracing the RISE program combined with funds provided by the NSF CC* program, has begun to show profound rewards. We have shown that the RISE team through direct research engagement enhances and enables research projects conducted at Penn State. In addition, the RISE team has conducted seminars, workshops, and other training activities to bolster the cyberinfrastructure literacy of students, postdocs and faculty across disciplines. The RISE team has grown as a workforce shared with investigators who have consulted on projects both large and small and we fully expect this trend to continue.

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REFERENCES

- [1] This is Penn State from <https://www.psu.edu/this-is-penn-state>, retrieved on 7 April 2022.
- [2] Penn state research expenditures again reach record high, topping \$968 million. <https://news.psu.edu/story/590015/2019/09/30/research/penn-state-research-expenditures-again-reach-record-high-topping> retrieved on 7 April 2022.
- [3] Computational Research Consulting with RISE (Research Innovations with Scientists and Engineers) from <https://www.icds.psu.edu/computing-services/rise/> retrieved on 7 April 2022.
- [4] ICDS Co-Hires from <https://www.icds.psu.edu/about/icds-co-hires/>, retrieved on 27 May 2022.
- [5] Penn State Statement on Diversity, Equity and Inclusion, <http://equity.psu.edu/psu-diversity-statement>, retrieved on 8 April 2022