WHITE PAPER

Best Practices for Writing a Successful NSF MRI Grant Proposal

Insights for Winning HPC Cluster Funding

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Download this white paper at http://actlink.co/grant.

Introduction

The Major Research Instrumentation Program (MRI), administered by the National Science Foundation's Office of Integrative Activities, is a game-changer for universities and researchers who want to secure funding for the high performance computing solutions that drive research and discovery.

The demand for HPC continues to grow. This growing demand will make MRI grants more competitive and difficult to obtain. In fiscal year 2015, the NSF received 822 MRI proposals and awarded 167 grants. That means last year, an MRI grant proposal had a 20% chance of success. One hundred sixteen (14%) of these proposals requested budgets of greater than $1 million.

This white paper is intended to give you specific instructions and best practices for applying for an NSF MRI grant for the purpose of purchasing high performance computing solutions.

Three Key Functions of the NSF MRI Program:

- Supports the acquisition and development of high-end scientific instrumentation for research and student training
- Aims to improve research and research training
- Involves collaboration with other organizations.

Breakdown: Success Rate by Field of Study

	FY15	FY14
Biological Sciences	13%	12%
Computer & Information Science	28%	45%
Engineering	13%	20%
Geosciences	24%	32%
Mathematical and Physical Sciences	24%	25%
Social Behavioral and Economic Sciences	39%	37%

Source: NSF.gov

First Things First: Determine Your Eligibility

There are three types of MRI-eligible organizations:

1) Institutions of Higher Education

- - Ph.D.-granting institutions (awarded more than 20 Ph.D or D.Sc. degrees in combined two previous academic years)
- - Non-Ph.D.-granting institutions (awarded fewer than 20 or fewer Ph.D./D.Sc. degrees during the combined previous two academic years)
- - Non-degree-granting organizations (do not award Associate's, Bachelor's, Master's degrees or Ph.Ds. or Ds.Sc. or institutions that award all degrees outside of NSF-supported fields)

2) Not-for-Profit, Non-Degree-Granting Domestic U.S. Organizations

- 501(c)(3) tax status
- Must have an independent, permanent administrative organization (e.g., an office of sponsored research) in the United States
- May include science centers, museums, research labs, observatories or similar organizations

3) Legally Incorporated, Not-for-Profit Consortia

- Includes two or more eligible organizations
- 501(c)(3) tax status
- Must have an independent administrative structure (e.g., an office of sponsored research) in the United States

You should consult two official documents from the National Science Foundation to ensure your institution is in fact eligible to apply for an MRI.

First, you should read the **NSF Grant Proposal Guide**. The most recent edition, good for all proposals submitted after January 2017, is available online at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=GPG in html and PDF formats. The guide is required reading. It covers a wide range of topics from proposal preparation and formatting to the grant processing and review process.

The second document you must read is the most recent **NSF MRI Program Solicitation**. The NSF publishes a solicitation whenever it is ready to accept new MRI grant applications. The solicitation will include must-have information for all applicants. Make sure you're reading the most current solicitation because the guidelines may change from year to year. The solicitation for the next MRI program is available online at https://www.nsf.gov/pubs/2015/nsf15504/nsf15504.htm.

Understand Cost Sharing Requirements

Cost-sharing requirements vary depending on your institution's classification.

Ph.D.-granting institutions and non-degree-granting organizations are required to cost-share 30% of the total project cost (which is different than 30% of the amount being requested in your proposal). Non-degree-granting organizations are exempt from cost sharing requirements.

You must have your institution's commitment to cost sharing in writing. It's important to note that any manufacturer or vendor discounts you are offered may not be designated as cost sharing.

Do Not Exceed Submission Limits

After you determine your eligibility, you need to find out how many applications your institution will be submitting in the MRI competition you want to enter. Why is this necessary? A single organization or institution may only submit a total of three applications during any given MRI competition – at least one of which must be for instrument acquisition.

You want to make sure your institution doesn't exceed the limit. If you were to send three MRI proposals, the NSF can return all of the without review or comment.

Cover your bases by checking with your research office to ask about policies for handling limited competitions. Then check the NSF site's search function (nsf.gov/awardsearch/) for active and expired awards from your institution.

Determining How Much Funding to Request

Never ask for more funding than is required. Nor should you lowball your request. It is highly recommended that after you have taken all of the steps described in this white paper, you take the quote from your HPC vendor and request the amount of funding that is needed to purchase your new HPC cluster. Nothing more, nothing less.

Consider limiting your grant proposal to an amount of less than $1 million. Proposals that exceed $1 million face increased competition from the many applications for expensive lab equipment. It is highly recommended that you limit your MRI funding request, especially if this is your first, to less than $1 million.

Casting a Vision for Your Proposed HPC Cluster

Your most important job as grant writer is to cast a vision for your project that inspires the NSF to award you the funds you seek. At the outset of your proposal, say why your project is important. Be able to back it up. You should also give the worst-case scenario: what happens if you don't win the grant? What happens to the project and those who would rely on the cluster?

Make sure the science being supported by your cluster is compelling. Describing good science is the backbone of your proposal. An interdisciplinary panel will be reviewing your proposal. Write accordingly.

Defining Your Instrument

- What is the role of the HPC cluster?
- Why is the cluster needed?
- What similar clusters are already available?
- How will the cluster attract researchers?
- Who will benefit from using this HPC cluster?
- How will researchers access the cluster?

As with any academic writing, include a strong list of supporting references and cite publications. Share data about the strong current funding for the scientific research you are proposing. If you can't show that, your proposal will be found wanting.

Broad Impact: What is the Big Picture Benefit?

At the heart of the NSF's mission is to fund research projects that will have a broad impact on the world. Your proposal needs to include that big picture view. Make sure you discuss the societal benefits of your proposed HPC cluster.

Making the case for the benefits of the many research projects that will be supported by your cluster is a great start. You can also demonstrate a broader impact by working with campus diversity programs to ensure everyone has access to your cluster.

How will your HPC cluster affect training education on campus and in the community? Talk about how the cluster will attract researchers, students and minorities from around the world.

Show how the cluster will improve research. What effect will the cluster have on STEM research?

We understand it can be challenging to conjure up a broader impact. Check out these examples on the NSF site for inspiration: http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf

Give Your Cluster a Name (and a Few Heroes)

Give your cluster a name, and use it often. Make the name something that relates to your institution or organization for added effect. For example, if your university is in Dallas, Texas, consider naming your HPC cluster "Tex" or "Big D."

Provide a list of research projects that will make use of your HPC cluster. Highlight the biggest "hero" projects first – and include the most interesting details. You can devote an entire page to each of the hero projects if it's necessary to make the case for each. List all of the other research projects as well along with a brief summary of what makes each important. Talk about how much time/memory/bandwidth each project will require of the resource.

You're going to need to prove that the HPC cluster will be full all of the time – or even oversubscribed. Otherwise, it won't appear to be necessary.

Don't Forget to Share Your Proposed New Toys

NSF wants you to share. In fact, it requires that you do. Shared use of your cluster is vital to the success of your proposal.

Make sure you talk to researchers on your campus and at neighboring institutions to build a list of potential users for your cluster. Don't stop there. Graduate and undergraduate students also make nice additions to your cluster user base. The more, the merrier.

Get Institutional Support – and Get It In Writing

You'll need a letter from your institution stating that it will operate and maintain the cluster during and after the grant period.

Make sure the letter lists all MRI awards your institution has won in the last five years along with a summary of each and the status of the instrumentation from each award. Past successes, and continued use and value, go a long way toward demonstrating the validity of your current proposal.

Avoid mentioning any dollar figures here, which should be part of the proposal where you talk about the physical facilities that will be home to your proposed cluster.

Your HPC Equipment Proposal

You will need to be specific about the HPC equipment you will need, and you will also need to justify the technology you want to acquire. Many grant writers at the university level begin by consulting with on-campus IT staff, but we recommend you include at least one specific vendor quote. This is a service that Advanced Clustering is happy to provide.

Questions for Your HPC Vendor

- How many CPU core hours will you need?
- How much storage will you need?
- How much bandwidth will you need?
- Have you benchmarked your code?
- How will performance be enhanced?
- Will software be optimized?

Vendors deal with many HPC users and customers and use that experience to create the most common and useful configurations. They also work with other grant applicants and have learned what kinds of proposals get funded. They also have access to current market pricing and discounts and can also help you tailor a system that meets the specific needs of your project. Allow several weeks in your grant writing timeline to work with the vendor on your HPC cluster quote.

The NSF expects you to justify the need for the technologies you select. You can't just say you want a GPU cluster without making a clear case for why it is needed. By the same token, you're not going to be granted funding for 600TB of storage without explaining why so much storage is needed.

When including information about the HPC cluster you're proposing, remember that details matter. Core hours need to come from real data. The committee needs to see that you know the specifics of the cluster solution being sought and the practical uses for it.

If the proposal is for a new type of platform (for example, accelerators such as GPUs or Intel Xeon Phi), be able to talk about who will port the code to the new platform. What kind of speedup is expected on the new platform?

Be able to address the storage requirements of your proposed HPC cluster. How much storage will you need? If you need live storage, what is the maximum amount of storage at a time that will be needed for this project? If you need archival storage, what is the total amount of storage needed over the lifetime of the cluster?

Ask for help from your HPC vendor in making these determinations.

More Questions for Your HPC Vendor

There are other topics to cover with your HPC vendor as well:
What is the typical size of each dataset to be transferred?
Where will such datasets originate?
To where are you transferring them?
Why do such datasets need to be transferred between these endpoints?
What is the time window for transferring each such dataset?
Why does each such dataset need to be transferred during that specific time window?
How often do you expect to have such a data transfer need?

Get Physical Requirements on Paper, Too

One of the reasons we recommend you spend a good deal of time talking with your HPC vendor is to ensure your HPC consultants have all of the details about your proposed cluster. That includes the physical details. Where will your cluster be located? How much floor space, A/C, power and UPS is currently available.

Your HPC vendor will compare this against what will be needed so you can be aware of any shortfalls. You will need to talk about how you will meet any of these shortfalls, which cannot be covered by MRI funding.

This is where you need institutional support. You will need a letter of support from your institution that addresses their commitment to provide anything you need (space, A/C, power, UPS, etc.) to support the HPC cluster.

Data Matters, So How Will You Manage It?

Settling on your instrument management plan will take some time. You will also be required to share your plan for the management of all the data that will be produced by your proposed instrument.

You will need to talk about the types of data, samples, physical collections, software, curriculum materials, etc. that will be involved. What standards will you set for data formatting and content?

How will you protect privacy, confidentiality, security and intellectual property rights? How will data be archived? How will you preserve access to the archived data?

Define Your Management Plan

You are required to include a detailed management plan for your instrument as part of your proposal. Start by describing the facility where the instrument will reside. Describe how the instrument fits into the overall campus infrastructure.

Designate a project leader who will oversee all aspects of instrument management. A tenured faculty member is preferred. You should also identify a faculty advisory committee and talk about how long they are willing to serve (preferably for the duration of the project). Discuss who will help with day-to-day operations of the instrument.

Who will have access to the cluster, and who will manage all operators? When decisions need to be made about the equipment and its management, describe who will be involved and what procedures will be followed to determine the best courses of action. We also recommend you include a plan for sustainability. In other words, when the grant ends, what will you do with the equipment involved?

Checklist: Your Management Plan

- Where the instrument will reside?
- Who will have access to the cluster?
- Who will operate the equipment?
- How the instrument will be maintained?
- How will time be allocated for users?
- What will cluster operations cost?
- What will cluster maintenance cost?
- How much downtime do you anticipate?

Warranties and Service

Also make sure your HPC vendor includes warranty and maintenance costs and considerations for a minimum of three years.

Work with the vendor to get the most reasonable price possible. Ask a technology expert to review all cluster and HPC equipment descriptions to ensure you haven't missed anything important.

Keep in mind that proposals for smaller clusters at undergraduate-serving institutions are well-received by the NSF and fall into a different category of competition.

Institutions (especially smaller ones) often lack IT support and have a greater need of vendor support even after the cluster is delivered. These clusters are going to need consultative, high-touch vendor support versus a vendor that solely provides hardware with no ongoing support.

Produced By Advanced Clustering Technologies

Advanced Clustering offers customized, turn-key high performance computing clusters, servers, storage solutions and workstations to customers in the fields of aerospace, climate, defense, education, energy, engineering, finance, government, life sciences, etc. With more than 16 years of experience developing HPC solutions for universities, government agencies and industry, Advanced Clustering has advised many customers on writing successful grant proposals for HPC purchases. Learn more at advancedclustering.com.

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