

Research Cluster Development at a Predominantly Undergraduate Institution

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ABSTRACT

The University of Southern Maine (USM) designed and implemented an internal Research Cluster Seed Fund competition with the goals of building USM faculty expertise to address industry and community needs, deepening the impact of research through an interdisciplinary approach to solving problems, and leveraging external funding to sustain collaborative efforts. Through two rounds of competitions we funded five teams of faculty and students who have come together with industry and community partners to conduct research ranging from how Maine businesses should address cyber security breaches, to better management of chronic illnesses through the use of information technology. Faculty have reported that learning how to work together in an interdisciplinary team and with external partners is an evolving process that takes time. But, they are all extremely positive about what they have gained by coming together. Faculty needed assistance in setting goals and measurable objectives, and in understanding how a research cluster needs to be more than a sum of its parts. Thus, this competition was a learning process for all involved. We hope this model will continue as a way to focus and leverage USM's scholarly strengths while developing solutions to the most pressing issues facing our region.

INTRODUCTION

The complexity of current societal, global, and scientific problems often requires a wide range of disciplines collaborating across traditional boundaries to bring knowledge to bear on issues of intellectual, scientific, social, economic, environmental, and cultural importance. This complexity and the importance of interdisciplinary research is recognized by the National Academies' Committee on Facilitating Interdisciplinary Research, Committee on Science, Engineering and Public Policy (2004), as well as several federal funding organizations. Examples include the National Science Foundation's (NSF) INSPIRE (Integrated NSF Support Promoting Interdisciplinary Research and Education), which supports interdisciplinary research into complex scientific problems (NSF INSPIRE, 2014); the joint effort between NSF and the National Endowment for the Arts to develop a national agenda for funding and collaboration integrating the arts, sciences, and engineering (Harrell & Harrell, 2011); and the National Institutes of Health's Interdisciplinary Research (IR) program, which is designed to change academic research culture such that interdisciplinary approaches and team science spanning various biomedical and behavioral specialties are encouraged and rewarded (NIH, 2014).

Many universities have pushed to develop more interdisciplinary research projects, and several have developed Centers of Interdisciplinary Research, although these Centers are primarily located at research universities rather than PUIs. For many of these Centers, creating linkages between their interdisciplinary research projects and state, regional, and local public and non-profit entities is of utmost importance. Challenges include articulating the relationship between interdisciplinary research and hiring, promotion and tenure policies, and resource allocation (National Academy of Sciences, 2004). It should be noted that the National Academy of Sciences study primarily focused on major research universities. Little information is available on how primarily undergraduate institutions, such as the University of Southern Maine, are promoting interdisciplinary research.

In spring 2013, USM's Office of Research Administration and Development designed and implemented an internal Research Cluster Seed Fund competition with the goal of building USM faculty expertise to address industry and community needs, deepening the impact of research through an interdisciplinary approach to solving problems, and leveraging external funding to sustain collaborative efforts. Although this effort preceded USM's plan to transition to a Metropolitan University, the

cluster missions, visions, and partnerships align well with a primary goal of an MU, which is to become a steward of place. The purpose of this paper is to describe the process, challenges and lessons learned in developing research clusters in a predominately undergraduate institution.

INSTITUTIONAL CONTEXT

Located in the city of Portland, USM is the state's only publicly supported predominately undergraduate metropolitan university, serving approximately 8,000 students. Many students are non-traditional in that they are first-generation college students, part-time, and often older than traditional undergraduate students. Since the late 1990s, USM has been committed to strengthening both its educational mission and its targeted research portfolio.

The Research Cluster competition is funded by the Maine Economic Improvement Fund (MEIF). In 1997 the Maine Legislature (MRS Title 10, Chapter 107-C) established the Maine Economic Improvement Fund to administer investments in targeted research and development and product innovation, primarily focused on applied scientific research and related commercial development conducted by employees and students in the member institutions of the University of Maine System, the seven target areas identified by the Maine Legislature. The target areas are the

targeted technologies for which applied research and development is considered most likely to produce significant benefits to the people and economy of the State. These areas are: aquaculture and marine sciences, biotechnology, composites and advanced material technologies, environmental technologies, information technologies, advanced technologies for forestry and agriculture, and precision manufacturing. The MEIF also provides the basic investment necessary to obtain matching funds and competitive grants from private and federal sources.

As directed by Maine law, MEIF funds are annually appropriated to the University of Maine System; the Board of Trustees is responsible for administering the funds.

RESEARCH CLUSTER SEED FUND COMPETITION

Purpose

The purpose of the Fund is to seed-support the development of faculty-led multi-disciplinary research clusters that bolster and expand scholarship and innovative high-impact research across college lines and to work more effectively with the private sector, other institutions, and the community. The outcomes of funded cluster proposals are to: (a) coalesce the depth of USM faculty expertise to address industry and community needs; (b) bring greater internal and external attention to USM faculty research and scholarship,

deepening its cumulative impact; and (c) help leverage external funding for sustained collaborative efforts.

Competitive Process

We have released two rounds of internal requests for proposals to seed clusters at \$150,000 over two years. We required that proposals demonstrate faculty collaboration across two or more colleges, focus on research projects that address the needs of one or more of the state's target technology sectors, and have at least one industry partner and one community partner actively engaged in the development and sustainability of the cluster. We defined industry partners as private, for-profit companies, and community partners as other organizations that are not private, for-profit organizations. We did not specify cluster size, but suggested 3–7 individuals inclusive of industry and community partners as an initial starting point for cluster development.

The program announcement also emphasized that the development and growth of the cluster should not end when external funding proposals are submitted or funded. There is full expectation that competitive cluster proposals will include detailed strategies, developed jointly with industry and community partners, for growing and sustaining the cluster beyond the two years of funding, including pursuing external funding.

Allowable Use of Funds

All line items are allowable as long as the amounts are fully justified. Funds may be used to support nine-month faculty summer compensation, undergraduate and graduate student stipends (with graduate tuition), consultants, materials and supplies, remodeling or alteration of facilities (per university policies and procedures and approval), equipment purchases, community workshops, in-state and out-of-state travel (no foreign travel) as long as travel is directly related to the proposal project, course release (cost for a part-time faculty only), or other ways to bring a diffuse but related group of research entities into sustainable, productive collaboration. Although curriculum development is not an eligible activity in this competition, in some cases curriculum development may be a component of an application but it must be justified in the context of seeding the research cluster and meeting the needs of industry and the community partners, and should not be a major cost.

Letter of Intent

We required a letter of intent two months before the deadline for the full proposals to help us manage the external review process. Each letter of intent must include the project title, the name and title of Principal Investigator, and the names and affiliations of Co-PIs; a one-paragraph description of the proposed cluster; the

target technology sector(s); the funding request amount; project duration; the name and contact information for the person in the PI's department or college who will be the point person for financial management of the grant if awarded; and names and contact information for five individuals with expertise in the proposal's subject matter. These individuals must reside outside the state and must not have any conflicts of interest with the proposal, the PI, and Co-PIs. In the announcement we informed the applicants that we would contact these individuals to inquire about their interest in assisting us in the external reviews of the proposals and to ensure they do not have conflicts of interest. Applicants were instructed not to contact the potential reviewers and alert them of their interest in participating in the review. Applicants were also informed that we may ask them for additional names if we do not secure at least three reviewers for each proposal.

Proposal Format and Content Requirements

The program announcement included a full description of the required format and contents of a full proposal as described below. Required format included font type, font size, margins, line space, and page limit per narrative section. We encouraged applicants who were considering submitting an application to be absolutely sure that they were submitting a "cluster-

ready" application and that all of the items listed in the narrative sections were being answered completely. The content requirements included a Cover Page, a 250-word abstract, the proposal narrative (15 pages), references, budget and budget justification, biosketches using NSF or NIH formats, and letters of commitment from all partners, department chairs, and college deans. Required sections of the narrative included: Rationale and Significance; Rationale Behind Team Composition; Cluster Vision, Goals, and Measurable Objectives; Research Overview; Implementation Plan; Specific Plans for the Target Grant Application(s); Management Plan; and Evaluation Plan.

Review Process

We employed a two-stage process to review proposals. In the first stage, each proposal was reviewed by at least three vetted reviewers external to the University and with subject matter expertise partially based on information collected from the letters of intent. The external reviewers were asked to comment on the proposal's strengths and weaknesses without scoring, and were also asked to recommend whether an Internal Review Panel should further consider the proposal. Only proposals with substantial strengths and minimum weaknesses would be submitted to the second stage of review by an internal evaluation panel selected by the Provost

and the Associate Provost for Graduate Studies and Research, Scholarship and Creative Activity (APGR).

For the internal review process, we developed the following evaluation rubric, the elements of which were included in the announcement as discussion items for what would constitute competitive proposals:

- Quality of Response to Instructions (25 points)
- Quality of Rationale and Significance (15 points)
- Quality of Rationale Behind Team Composition (15 points)
- Quality of Cluster Vision, Goals, and Objectives (10 points)
- Quality of Research Overview (10 points)
- Quality of Implementation Plan (15 points)
- Quality of Specific Plans for the Target Grant Application(s) (10 points)
- Quality of Management Plan (10 points)
- Quality of Evaluation Plan (10 points)
- Quality of Budget and Budget Justification (5 points)

The rubric's evaluation elements are similar to those used by the U.S. Department of Education to inform applicants what the reviewers will be looking for in addition to emphasizing the quality of the responses. The maximum number of points a proposal could score is 125. Prior to meeting as a panel, each

member of the internal review panel was asked to score a proposal using the rubric. At the panel meeting, each applicant was provided 15 minutes to present their proposal, focusing primarily on the comments of the external reviewers. After some discussion, panel members were provided the opportunity to change the initial scores before submitting their final evaluations. Based on the average scores for each proposal, the panel recommended to the APGR a rank order of the proposals to be funded.

Award Conditions

In addition to progress and final reports, the award letter to the Principal Investigator outlined specific conditions that included: at least one submitted proposal to an external sponsor before the end of the project period with a total value exceeding twice the value of the cluster grant amount; an annual presentation of the cluster's work to the university community; published or otherwise publicly available work in some form; and participation of the PI and Co-PIs in a grant-writing seminar offered by the Office of Research Administration and Development during the grant period.

We withheld 20% of the grant amount to ensure compliance with the award conditions. The award letter also specified that overspending of the authorized grant amount would default to departmental funds, and that, in addition to

programmatic responsibility, the PI would be responsible for the financial management of the grant, including payroll, human resources and purchasing.

FUNDED CLUSTERS

Through two rounds of competitions we have received 12 proposals and funded five teams of USM faculty and students who have come together with industry and community partners to conduct research ranging from how Maine businesses should address cybersecurity breaches, to better management of chronic illnesses through the use of information technology. These clusters are engaging over 20 faculty and staff members from all four USM colleges and over 25 academic departments, along with several undergraduate and graduate students and eight external partners. Both graduate and undergraduate students are engaged as research assistants directly by the faculty in the cluster, based on student skill sets and needed expertise. Some clusters request funding for graduate student assistantships and tuition reimbursements, while others request funding for undergraduate research assistants. The clusters include:

Health Lifestyle Management Technologies. A team representing nursing, social and behavioral sciences, computer science, technology and exercise health and sport sciences are developing

and piloting a technology-based lifestyle management system. Initially, it will track and help manage weight as an indicator of chronic illnesses. The team has completed its first pilot study with data analyses ongoing and is gearing up for the second pilot. Preliminary results suggest no significant difference between pre- and post-intervention. This may be a result of sample size, as recruitment of participants was an issue. However, the cluster participants have learned much about student perceptions of facilitators and barriers to healthy eating, and they will use this knowledge to improve the second pilot. Plans to improve participation include early recruitment and implementation of strategies to foster more interaction between participants. They have also identified a National Institutes of Health–National Institute of Nursing Research program for funding to further test the system’s application to other areas of chronic illness.

The cluster has benefited from the involvement of students. Specifically, two undergraduate students were very involved in developing the healthy lifestyle website intervention which is being implemented during the second pilot study and a graduate nursing student was very helpful during recruitment of participants for the second pilot. The project PI reports that the students are learning a lot about the research process, as they are formally

members of the research team and have been included in meetings and decision-making about aspects of our project.

Digital Maine. Faculty, students, and staff throughout the College of Arts, Humanities and Social Sciences and the Muskie School of Public Service are working with computer scientists to harness digital technologies in such a way that a variety of types of research are more accessible to a much wider audience. The team is working on diverse topics ranging from the impact of a rise in sea levels, to the labor history of Maine's paper mills, through the development of new software applications and the use of geospatial technologies. Currently two subprojects are underway—one focused on envisioning sea change, and a second focused on digitizing a women's history trail in Maine. They also brought an internationally recognized digital humanities scholar to campus to offer suggestions for improvement of the cluster. The faculty team needs to work to ensure that the cluster is not simply viewed as a digitizing service, but a collaborative interdisciplinary research cluster.

The cluster has engaged several students who, in close association with the PIs, have researched the subjects, collected information, and developed a database that includes data sets with geo-tags, notes on historical contexts, digitally created art work, and digital photos of historical sites.

A photograph of *Envisioning Change* by one student assistant was featured in a recent report made by the *Union of Concerned Scientists* - a coalition of scientists dedicated to making a healthy planet and safer world. By working with classmates and people outside of USM, and with community groups with a shared goal of applying the knowledge and skills gained in class to real-world situations, these students are making good use of the opportunity afforded by the cluster to engage in experiential learning.

Web-based Systems to Support Disadvantaged Populations. This project is providing opportunities for youth campers to stay connected all year with a critical web-based support network. The pilot project focuses on Camp Susan Curtis, a Maine camp for children struggling with poverty, but long term the project will pioneer technological approaches to creating safe and enticing educational experiences for other disadvantaged populations. The project brings together USM's School of Social Work, Departments of Computer Science, Technology, and Communication and Media Studies with off-campus partners Maine College of Art, Maine Medical Center's Barbara Bush Children's Hospital, Maine's Office of Information Technology, and Poland Spring. The initial pilot in the form of a private social network did not engage the population, so they have made engagement

a top priority for the next pilot. The second pilot is currently ongoing, and a stronger sense of place has been created with virtual reality, in collaboration with a business partner. Access to campers after the summer months for data collection and assessment purposes is an issue. Faculty have begun to identify the cluster's next target population.

The cluster has engaged students to work in the areas of generating content for website development, creating online games, facilitating website migration, learning about the complexities of website security for children and participating in creation of website monitoring protocols, conducting web and stakeholder research during the project planning phase, and capturing imagery in film and video to be used in site design. The PIs believe that the students have gained valuable skills through participation in these activities. In fact, a computer science student was hired recently for full-time employment at a company in Maine that required the experience that he acquired while engaged in the project. Another student completed a final senior presentation based on the project work. The interdisciplinary synergy of this effort has demonstrated to students the value of and need for bringing together different areas of expertise toward a common goal.

Cybersecurity. Initially funded in year 1, this cluster brought together faculty from philosophy, communications, and technology to support research and education on workplace ethics and strategic communication important for data security. Midway through the first year, the cluster was folded into a larger research cluster, the Maine Cybersecurity Cluster (MCSC), which has a much larger vision encompassing all aspects of cybersecurity research. MCSC serves as a research, education, and training resource for the state, and its Academic Excellence in Information Assurance proposal is under review by the National Security Agency. MCSC also operates the Cybersecurity Laboratory, the only one of its type in Maine, as a shared and secure testing and evaluation environment for private and public entities. The National Science Foundation has notified the PI that it will fund the MCSC project to pilot an inter-institutional virtual cybersecurity collaborative learning laboratory as a shared educational environment that enables students in different locations to gain practical collaborative experience in preventing and mitigating cyber-attacks in real time.

Health Informatics. This cluster brings together faculty from computer science and public health, and partners such as HealthInfoNet and the Maine Health

Management Coalition to develop solutions for linking and analyzing big health data to improve health care delivery and quality and respond to local industry and community needs. Transformational shifts in the delivery and financing of health care have heightened the information needs of health systems, while at the same time the amount of electronic data created by the health care sector has increased exponentially. Maine is on the cutting edge for many health data developments, including having the only operational statewide Health Information Exchange, and one of the first all-payer claims data warehouses. While these and other data hold enormous promise for research and changes to clinical practice, the size, scope, and design of health data systems have created numerous challenges to data access and operability. The proposed research cluster will tackle these and other big data problems in health care delivery, financing, and population health. Representing faculty and staff from two colleges, three degree programs, and two research programs, cluster members reflect a diverse body of knowledge and an extensive theory-based and applied research portfolio with clear relevance to health informatics and health care system performance. In collaboration with external partners, the USM team intends to develop solutions that improve health care delivery and quality and

respond to local industry and community needs.

Lessons Learned

As shown in Table 1, the implementation of Round 1 enabled us to identify areas that needed to be addressed in Round 2. There were weaknesses in conceptualizing research clusters, in forming business partnerships, in visioning and goal setting, in proposal writing, in budget preparation, and in the external review process.

FACULTY PERSPECTIVE

Faculty have reported that learning how to work together in an interdisciplinary team and with external partners is an evolving process that takes time. But, they are all extremely positive about what they have gained by coming together with colleagues from different disciplines and now truly appreciate that working together is powerful—the sum is better than its parts. They also acknowledge that working with interdisciplinary groups requires extensive and constant communication in order to create unity, but the benefits far outweigh the time involved.

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University Research Management Perspective

The research clusters have succeeded in bringing together interdisciplinary groups of faculty with common interests who would not otherwise have initiated collaborative research projects. The clusters have not only received substantial financial support, but also the time and expertise of the staff in Research Administration and Advancement. We were unprepared for the

faculty's lack of expertise in setting goals and measurable objectives, and in understanding how a research cluster needs to be more than a sum of its parts. Addressing these issues required considerable time on our part and delayed the progress of the first group of funded clusters. Thus, this competition was a learning process for all involved.

Table 1
Areas addressed between Round 1 and Round 2 of the competition

Areas to be Addressed	Solution
Faculty did not understand the meaning and dynamics of a research cluster and how to develop one.	Schedule a presentation on research clusters immediately after the release of the request for proposals.
Lack of faculty experience in developing relationships with business and industry partners, which is critical to identifying initiatives that address pressing industry/community needs rather than areas of opportunities. NOTE: This continued to be an area of concern in the second round.	Schedule meetings with the Office of Advancement to help faculty make connections and develop mutually beneficial relationships with external partners.
Visioning and goal-setting are not strengths of faculty, who tended to be over-ambitious in the context of seeding research clusters. Consequently, transforming vision into reality including identifying critical resources and critical mass of faculty needed for implementation were challenges.	Schedule a presentation on research clusters immediately after the release of the request for proposals.
Lack of proposal writing skills was evident, and instructions were not followed.	Require applicants to attend grant writing workshops as a condition of award and stress the need to follow instructions during the informational session.
Budgets were incoherent and instructions were not followed.	Require applicants to work with staff at the Office of Sponsored Programs when developing budgets for their cluster proposals.
External review process was faulty in that reviewers had no appreciation of the USM environment.	<ul style="list-style-type: none"> • Restrict external reviewers' comments to the strengths and weaknesses of the proposals without scoring. • The internal review panel will consider external reviews and all other aspects related to USM, as well as relationships to industry and management. • Provide applicants the opportunity to respond to external reviewers' comments during oral presentations to the Internal Review Panel.

CONCLUSION

Although the clusters are less than two years old, we hope that this model will continue as a way to focus and leverage

USM's scholarly strengths while developing solutions to the most pressing issues facing our region.

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