

BROADENING PARTICIPATION IN ATMOSPHERIC SCIENCE
THROUGH A PROGRAM NEEDS ASSESSMENT

by

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An professional paper submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

July 2016

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DEDICATION, ACKNOWLEDGMENT

I dedicate this paper to my family for their unwavering love and support. I thank my husband for his daily latte, his ability to make me smile when things aren't always right, and for his continual interest and support of my pursuits. I thank my parents who opened the door to science and education through sharing their love of the nature. Lastly, this is for my grandmother, who would be proud that all five of her grandchildren now have an advanced education.

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ABSTRACT

The National Science Foundation (NSF) Lower Atmosphere Observing Facilities (LAOF) Educational Deployment Program is a short-term facilities deployment program designed to strengthen STEM-related education. It provides access to eight separate research facilities for authentic instruction in the field of observational meteorology and engineering. Facilities are available for graduate, undergraduate, and K-12 education, and can be deployed to a College or University for up to three weeks.

Anomalies were found in the diversity of requested facilities and requesting Principal Investigators (PIs) in the 46 education deployments from the calendar years of 2008-2015. A needs assessment was conducted to determine actual program performance, identify performance gaps in the program, and to determine the desired program performance. The needs assessment resulted in a data-driven recommendation action plan to close the gaps that when implemented, will increase the diversity of requesting PIs and the requested facilities, thereby increasing diversity within the education program.

INTRODUCTION AND BACKGROUND

Project Background

Through a grant from the National Science Foundation (NSF), a subset of their Lower Atmosphere Observing Facilities (LAOF) are available to be requested for educationally-driven deployments at campuses across the United States through a program called the LAOF Educational Deployment Program (EDP). The EDP is a short-term facilities deployment program designed to strengthen STEM education by providing access to nine separate research facilities to educators for authentic instruction in the field of observational meteorology and engineering (Table 1). A commonly accepted definition of STEM education is:

an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy (Tsupros et al, 2009).

Facilities are available for graduate, undergraduate and K-12 education, and can be deployed to a college or university for up to three weeks at a time.

Table 1
Lower Atmosphere Observing Facilities (LAOF) Available for Educational Deployments

Ground-based Remote Sensing Facilities
NCAR High-Spectral Resolution Lidar
CSWR Doppler on Wheels (DOW)
CSWR Storm Pods
CSWR Mobile Mesonet
Colorado State University CHILL radar

Table 1 (continued)
Lower Atmosphere Observing Facilities (LAOF) available for educational deployments

Surface and Sounding Systems
NCAR Mobile Integrated Sounding System
NCAR Integrated Surface Flux System
Research Aircraft
University of Wyoming King Air

Since the program's inception in 2008 it has been managed by Earth Observing Laboratory (EOL), one of the seven laboratories within the National Center for Atmospheric Research (NCAR). In its eight years of operation, the program has not been formally reviewed or evaluated to determine if indeed the program is meeting the needs of the educational meteorology observing community relative to its program goals. This Action Research project is focused on conducting a needs assessment of the stakeholders in order to determine ways to broaden participation in the program. The motivation of this project was the identified anomalies in the breadth of the requesting Principal Investigators (PIs) and requested facilities in the 46 deployments from 2008-2015. By providing access to hands-on and engaging educational facilities that a single university routinely does not have in-house, the EDP addresses a need of the urgent call to action by the U.S President's Council of Advisors on Science and Technology "to increase the number of students graduating with STEM degrees and to meet the increasing demands for a well-educated and trained workforce supporting environmental monitoring, reinforcing the need to maximize the reach of this program to universities across the

United States” (President’s Council of Advisors on Science and Technology, 2012, p.7).

Additionally, a 2007 National Research Council report concludes that:

[NSF] ATM [now AGS] should take concrete steps to enhance the availability of collaborative tools for university instruction in observing techniques to foster continued development of cutting-edge instruments and to increase the general literacy among atmospheric scientists on the subject of instrumentation and observational data (Strategic Guidance for the National Science Foundation’s Support of the Atmospheric Sciences, 2007, p. 160).

A recent example of an educational deployment was the Embry-Riddle Aeronautical University Convective-Boundary Research Engaging Educational Experiences (ERAU C-BREESE) project. This was an 18-day Doppler on Wheels (DOW) deployment from the Center for Severe Weather Research (CSWR). ERAU C-BREESE ran from 4 – 21 May 2015 in central Florida; the project was organized and operated at ERAU by Principal Investigators (PI) Dr. Shawn Milrad, Dr. Chris Herbster (Associate Professor, Meteorology), and Robert Haley (Weather Systems Administrator, Meteorology). ERAU C-BREESE was offered as a “Summer A” (first summer term) 3-credit course aimed at ERAU Meteorology undergraduates. Eight ERAU students registered for the course (6 meteorology majors, 2 meteorology minors), with an additional 4-6 students auditing the course (ERAU C-BREESE, n.d.). Students received training from CSWR staff in order to operate the DOW, resulting in their ability to deploy the facility and collect data. Those data were then incorporated into class assignments and activities.

The intentions of assessing the Educational Deployment program are to identify ways to broaden participation of new PIs and broaden the use of less-requested facilities by identifying areas of improvement within the contextual boundaries of time, place, and

resources. The EDP offers unique access to cutting-edge technology that has the potential to attract and inspire the next generation of observational scientists, yet is not widely utilized in the atmospheric science education community.

The tools and skills learned from conducting this needs assessment have been documented in this report and will be applied to other educational programs within the laboratory, as appropriate. This experience provided me with enhanced tools and skills that will be applied to my professional career, while building stronger education programs for NCAR.

The results of the needs assessment will be summarized in a series of data-driven program recommendations. Suggested program enhancements will directly relate to the evaluation questions, program goals, and robust empirical findings and not based on anecdotal evidence (Frechtling, 2010, p. 46).

There is, of course the potential that my findings reveal that the request rate of the facilities was representative and meeting the community needs. If I find that the EDP is meeting the needs of the community, then my course of action will be vastly different with minimal programmatic suggestions, and recommend the program undergo a full program evaluation.

Research Questions

The primary action research question was “How can a needs assessment be used to broaden participation in the Lower Atmosphere Observing Facility (LAOF) Educational Deployment Program?” With this research, three main goals were to determine ways to broaden PI participation, diversify the pool of requested facilities, and

improve the planning materials on the EOL website. As this process was implemented, effective methods of conducting needs assessment were developed so they may be applied to other education programs within EOL. The secondary questions included the following:

- 1) Is the current LAOF Educational Deployment Program request rate representative of the user community?
- 2) What are barriers to new PIs from submitting a facility request proposal?
- 3) What tools and techniques can be derived from this project can be incorporated into an evaluation management plan for other educational programs?

The research questions will be addressed with a triangulated set of methods to ensure for a well-rounded data set (Table 2). Data sources that were used to support the research include interviews, surveys, review of summary reports, and meetings.

Table 2
Research Questions and Data Sources Matrix

Current/Former & Prospective User Interview & Survey	NSF & EOL Staff Interview & Survey	Review of Project Summary Reports	Journaling & Meetings
1° Question: How can a needs assessment be used to broaden participation in the Lower Atmosphere Observing Facility (LAOF) Educational Deployment Program?			
X	X	X	
2° Question #1: Is the current LAOF Educational Deployment Program request rate representative of the user community?			
X	X	X	
2° Question #2: What are barriers to new PIs from submitting a facility request proposal?			
X	X	X	

Table 2 (continued)
Research questions and data sources matrix

Current/Former & Prospective User Interview & Survey	NSF & EOL Staff Interview & Survey	Review of Project Summary Reports	Journaling & Meetings
2° Question #3: What tools and techniques can be derived from this project that can be incorporated into an evaluation management plan for other educational programs?			
			X

CONCEPTUAL FRAMEWORK

There is increasing pressure from funding agencies to evaluate the impact of STEM education programs to demonstrate their effects (Davis & Scalice, n.d.). The well-respected program evaluator, Michael Patton defines program evaluation as “determining its merit, worth or significance” (Patton, 2008, p. 5). However, before a program can be evaluated, a comprehensive needs assessment should be conducted.

Needs assessments are an integral and formative phase of program evaluation, and it has been shown that when evaluation is used throughout a project lifecycle, as in education programs, impact tends to increase (Black and Wiliam, 1998; Guskey, 2002; Stiggins, 2005). Needs assessment are formative to the project’s goals, scope, design, implementation and measurements of success (Figure 1).

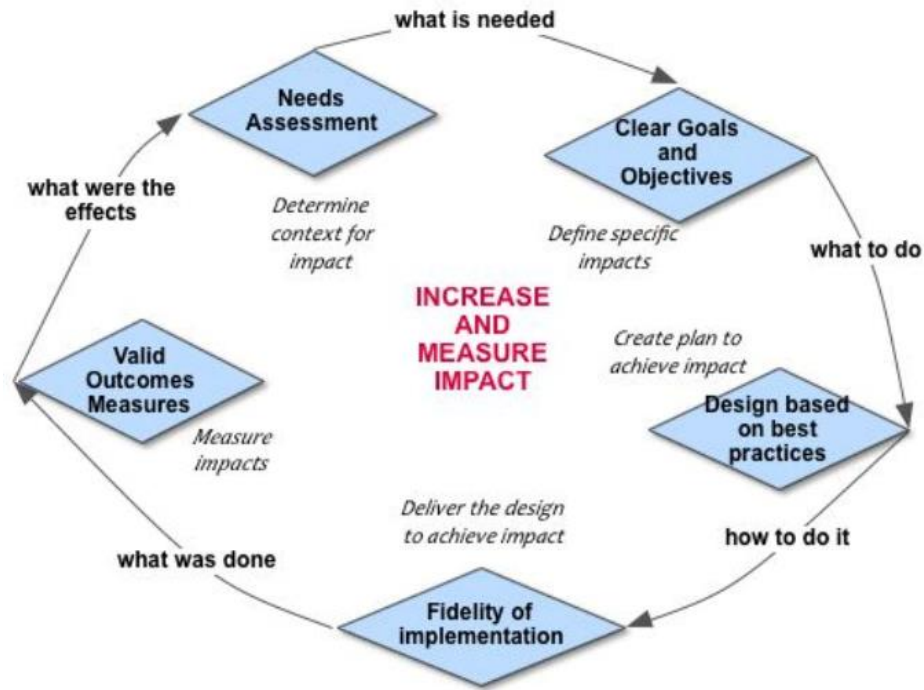


Figure 1. Five stages of a project's life cycle (Davis & Scalice, n.d.).

The terms assessment and evaluation are frequently and perhaps falsely used interchangeably; there are clear and distinct difference as well as appropriate uses (Table 3). Assessment provides information for formative program improvement, and the information gathered in the process can be used to make changes to a desired outcome. Assessment can be used diagnostically to identify areas of improvement (Angelo, T. and Cross, K.P., 1993). Evaluation is a summative process used to gauge quality, with the findings used to arrive at an overall judgment (Assessment of Student Learning in STEM Disciplines, n.d.). Once it has been determined the program is meeting the needs of the community and objectives of the program, it can then be evaluated for its merit, worth, or significance. A focused effort in both assessment and evaluation saves time and resources.

Table 3
Summary of Key Differences Between Assessment and Evaluation (Duke University Academic Resource Center, n.d.)

Dimension of Difference	Assessment	Evaluation
<i>Content:</i> timing, primary purpose	<i>Formative:</i> ongoing, to improve a situation	<i>Summative:</i> final, to gauge quality
<i>Orientation:</i> focus of measurement	<i>Process-oriented:</i> how the process is going	<i>Product-oriented:</i> what's being processed
<i>Findings:</i> uses thereof	<i>Diagnostic:</i> identify areas for improvement	<i>Judgmental:</i> arrive at an overall grade/score

A needs assessment is typically a three-phase process implemented to gather information relative to specific program goals. It includes a pre-assessment, assessment, and post-assessment (Figure 2). It should be noted that the three-phase model is a general guide, but commonly used as a framework. Each needs assessment should be unique to a situation and be tied to a set of program goals or desired performance outcome (Witkin, B.R.,1995).

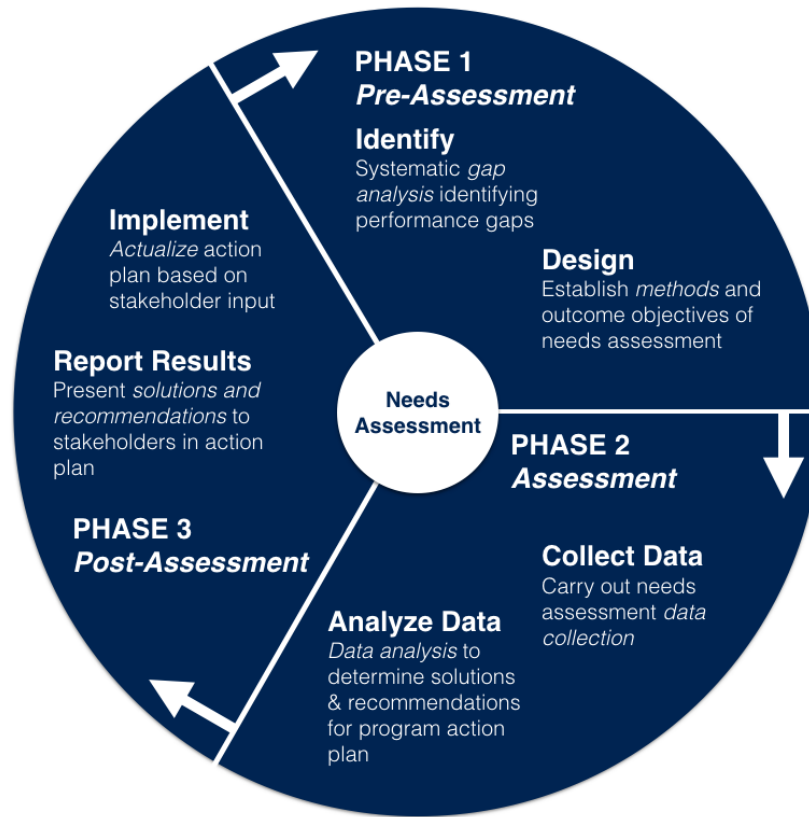


Figure 2. Three-phase process used for a needs assessment framework (adapted from Witkin, B.R.,1995).

Needs assessments are often conducted during the planning and development phases of a project, however they can be conducted at time intervals that suit the organization to determine if programs are meeting desired needs. Based on that widely accepted definition, the processes outlined in this report are indeed fulfilling a needs assessment. Once perceived program performance gaps are either deemed to be representative of the user community or are addressed and rectified, then a summative evaluation can determine the worth, merit, value, and significance.

A gap in program usage may be empirically observed, however a data-driven gap analysis is needed in order to fully support the claim. A gap analysis is the set of

techniques used to examine and describe the gap between current performance and the desired future performance (A Guide to the Project Management Body of Knowledge, 2013).

The gaps identified in the EDP were low new user request rates and low request rates for several facilities. The goals of the needs assessment were to first identify if the request rates were representative of the user community. If it is not, then the needs assessment would identify methods to increase the request rates of facilities and new users and close the gap between actual and desired performance, ultimately broadening participation of new users and facilitates.

In 2013, a theoretical review of an evaluation of the Atmospheric Science Department at the University of Utah was completed and published (Horel, 2013). The article demonstrates the need for the departmental assessment based on concerns over budgetary pressures, staff time constraints, and lack of holistically reviewing the curriculum for many years, similar to what was experienced in EOL. The Department held a day-long retreat with faculty, and undergraduate and graduate students to evaluate the goals of the program and to come away with effective changes. The group identified core cross-cutting concepts and guiding principles, with action items and concrete examples on how to achieve them. The changes were implemented in 2010 and were viewed as a first step in the evolution of the program (Horel, 2013). This model of program evaluation aligns very well with my Action Research project because it evaluated the managerial and business aspect of the department, and assessed what aspects were feasible to implement based on available resources to make to positive

changes for students. The review relied heavily on qualitative research methods from interview and conversation data.

Improving the EDP will have many benefits to instructors who use the program, as well as the intended end-user, the students. It wasn't until the early 1990's that the benefits of undergraduate research experiences were documented through research and evaluation (Seymour, 2004). At present, many research studies both quantitative (Lapatto, 2004) and qualitative (Seymour, 2004) demonstrate that authentic research experiences, for example educational deployments, provide a benefit to students by retaining and directing them into science careers.

A quantitative study of 1,135 undergraduate students from 42 institutions participated in an undergraduate research experience. The study was conducted to assess 20 potential areas of benefits and reported on their career plans. The study found that 83% of the participants planned on continuing on to postgraduate education in the sciences (Lapatto, 2004). The data was collected using an online survey consisting of 44 items, including demographics, perceived learning gains, and evaluation of the students' research program. Among the highest rated learning gains by students were "learning laboratory techniques" and "understanding the research process" (Lapatto, 2004, p. 267). In another study, data from 76 student interviews from four liberal arts colleges showed that 91% of students who participated in a research experience showed positive gains and expanded their interest in postgraduate studies (Seymour, 2004). These studies demonstrated the positive influence research experience programs have on undergraduate

science students and their choices in pursuing higher education and careers in science fields, which is also a goal of education programs within EOL, NCAR and NSF.

METHODOLOGY

As I learned through my research process, a needs assessment was used to determine, identify, and define the three main elements of the process. The motivation for the needs assessment came from an observation which led to some rudimentary data collection. It was then determined that a needs assessment should ensue to uncover details of the gap and confirm that a gap did exist. While the needs assessment was vital to identifying methods to close the gap, it was equally important to define the desired program performance goals in order to effectively close the gap (Figure 3). Going into this research project, desired program performance measures were not defined, therefore understanding the needs of the community with greater detail was important in determining the desired program performance measures.

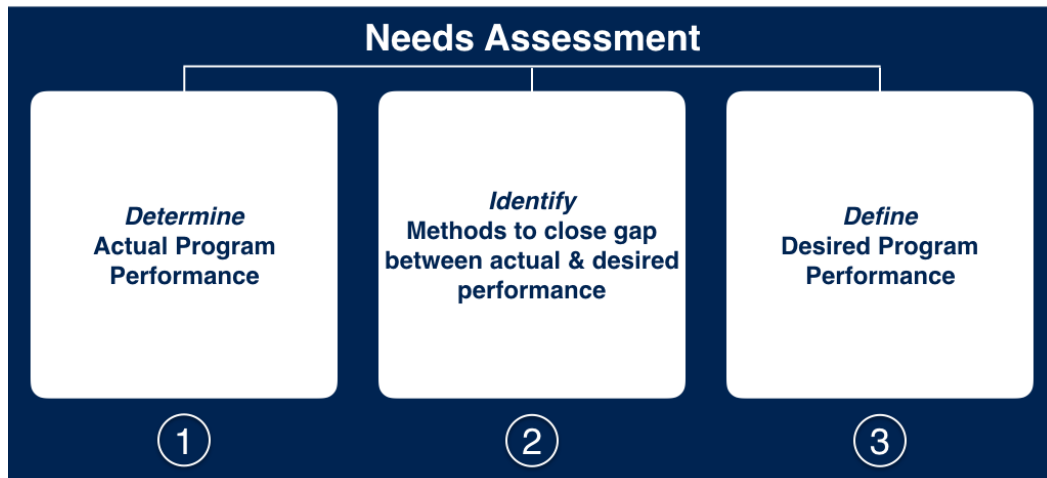


Figure 3. Process elements that were determined, identified, and defined by applying a needs assessment framework.

Many qualitative and quantitative data collection methods were used to build the needs assessment framework including analysis of project metrics, redefining of the program goals, reviewing archived project summary reports, conducting stakeholder surveys and interviews, and meeting with co-workers (Figure 4).



Figure 4. Inputs in the EDP needs assessment include qualitative and quantitative methods.

Metrics from each funded project were compiled into spreadsheets and used to confirm the hypothesized anomalies in the range of requested facilities and PIs. The spreadsheets were maintained by both the NSF Program Manager, and the EOL Assistant Director of Operations, who is also my supervisor. Both of them confirmed the data were important variables to know for long-term program monitoring. These baseline data were

vital to this needs assessment because they provided detailed information about the usage of the facilities over time, were used in discussing the status of the program with stakeholders, and will serve as a baseline measurement of success as the program moves forward.

Critical to this needs assessment was determining the current program goals in order to assess if the program was meeting them. Locating existing goals was ultimately unproductive. My supervisor estimated that all of the information was included in the program description on the EOL website, which appeared to be very limited. The previous laboratory director developed the EDP in 2008; they would have typically needed clear program goals and outcomes in order to secure funding from the NSF. The current laboratory director has held her position since 2011, and she did not have any documents regarding specific program goals. The laboratory administrator looked through her archive of documents and emails revealed very limited information. My supervisor was able to locate one Power Point presentation slide from the 2008 Laboratory Director announcing the program to an external review board, but did not list any program goals. The NSF LOAF Program Director also reviewed her archived documents and found very little helpful information, though she did offer to keep an eye-out for any additional information.

With little information regarding the program goals, I developed several that I felt captured the essences of the program and asked my supervisor and the NSF LAOF Program Director to review and comment on them. Through several iterations, five program goals were agreed upon and are:

1. To provide a subset of the NSF Lower Atmosphere Observing Facilities to educators for authentic instruction in the field of observational meteorology
2. To foster students' competencies in observational science and engineering, furthering their understanding of geoscience
3. To engage students in STEM fields by providing the opportunity for students to experience the interdisciplinary nature of science and engineering through a small-scale scientific field campaign
4. To provide the opportunity for early-career PIs to gain introductory experience with conducting a scientific field campaign while providing an impactful educational experience for their students
5. To expose a broad range of students to basic instrumentation principles and measurement science through discovery-based learning in the field of observational meteorology

Several measures of success were also identified. Triangulated data provide the best measure of program success, and thus include qualitative data from EOL staff, partner facility providers, educators, students, and quantitative data from program metrics.

Program success will be measured qualitatively by:

- Continued internal monitoring and assessment of the program by EOL staff against the objectives and goals
- PIs addressing how they accomplished each program goal in their summary report, as well as how well the deployment met their intended project goals and learning objectives as stated in their proposal

- Developing a well-designed student survey instrument, asking PIs to distribute it as to gain consistent insight into the student's experience and perceptions of their learning outcomes

Program success will be measured quantitatively by monitoring the yearly trends of:

- Educational deployment requests
- Deployments to new PIs
- Deployments to new campuses
- Diversity of deployed facilities
- Undergraduate and graduate students impacted

Establishing the program goals and measures of success were a vital first step in the needs assessment to determine if the goals were being reached and how to assess program success. Questions regarding how well the program goals were being met were asked in the prospective PI survey (Appendix A).

Reviewing archived project summary reports provided valuable historical insights, helped to determine trends, and compile a comprehensive list of lessons learned (Mills, 2014). Reviewing these reports also provided a better picture of activities that were carried out during previous Educational Deployments, and the scope of student projects as a result of their experience. A qualitative data collection method was also employed to categorize similar topics of lessons learned.

Linking research to predefined priority achievement targets was how I determined if the research criteria were met (Sagor, 2011). This action research project is focused on program performance and my criteria are to:

- Determine if the program is meeting the intended goals and objectives
- Identify ways to broaden participation among new PIs
- Identify barriers to new requesters
- Identify ways to diversify the facilities that are requested
- Identify communication gaps in the request process
- Determine what types of information EOL can provide to increase usability of the program
- Determine if requestors needs are being met
- Determine a standard format for a summary report that requestors submit within two months after the end of the project

Periodic formal and informal meetings with colleagues from UCAR and NCAR were tremendously helpful in guiding my project. Two members of my support team were quite familiar with the Educational Deployment program. While the third was not, all were familiar with NCAR and the NSF requirements. Each individual was able to provide a unique perspective to my project.

Brigitte Baeuerle – EOL Assistant Director of Operations

Brigitte is the current manager of the Educational Deployment Program, she receives the facility requests and oversees them through the review process. She has been working in EOL for over 20 years, has been my direct supervisor for the last three, and a mentor for the last six. She expects high-quality work, will challenge me if it is not, yet always supports and encourages my efforts and professional development.

Carolyn Brinkworth – NCAR Director of Diversity, Education and Outreach

Carolyn holds a Master's Degree in Education and a PhD in Astrophysics. I interface with Carolyn often on EOL-NCAR education programs and related topics. Carolyn is currently conducting the evaluation of all NCAR education programs, so she is quite interested in the results of the needs assessment.

Valerie Williams – UCAR Community Programs, Program Evaluator

Valerie specializes in program evaluation, and was an excellent brainstorming resource particularly concerning methodologies and research design. I work with Valerie on a very limited scale, however she was familiar with my project as we met several times to discuss the needs assessment and evaluation of the EDP. She has provided critical feedback and guidance on effective needs assessment strategies.

Instruments

The target audience for my research instruments was University faculty in the field of atmospheric science research, and staff from NSF and NCAR; I ensured that was reflected with an intelligent and purposeful instrument design. I collected data by means of online surveys and personal interviews. These instruments supplemented other data collection methods, providing a strong set of triangulated qualitative and quantitative data. A complementary method included first sending out the survey followed by a phone interview with a select number of participants (Mills, 2014). Data and information were analyzed, interpreted, and used to make feasible and appropriate suggested changes to the program moving forward.

In order to get broad perspective, a set of identified individuals from three designated stakeholder groups were surveyed and interviewed: 1) former PIs, 2) prospective PIs, and 3) NSF and NCAR staff. Each of these groups provided a unique perspective as to their need for instrumentation support. Individuals in the prospective PI group had previous experience in requesting and deploying a facility to their campus, they made a conscious decision to request a particular facility and investigated as to why they did so. The prospective PI group expressed interest to various NCAR staff about requesting a facility, but have yet to do so. The survey and interview helped to identify what barriers they have to moving forward with requesting a facility. The third group NSF and NCAR Staff offered a variety of interests in the program, ranging from staff who are deployed with the facility providing training for the students, to NSF staff who have a higher level of information and insight into the program.

Surveys were developed with the utmost intent to ensure a concise and brief experience for users. Surveys were tested in advance and given to selected individuals for feedback and to ensure the questions were clear, and accomplished the intended goals. Consideration of asking for people's time was given and caution was taken to not ask extraneous questions in the surveys or interviews (Hendricks, 2013). Names were requested to be included on surveys. This was so a follow-up interview could be conducted with a random selection of stakeholders to ask targeted questions to gain more detailed information. The well-respected *Questionnaire Survey Research* book provides many methods to ensure questions are clearly written so the respondents interpret consistently, the first of which is to "keep it short" and straightforward (Suskie, 1996, p.

44). The other guidelines outlined in this book proved to be very helpful as the survey questions were developed.

A targeted survey for the prospective PI and prospective PI (Appendix B) groups was developed and employed using the online tool Survey Gizmo. The sample size for the former PI group was 36 ($N=36$), while the sample size for the prospective PI group was ten ($N=10$). The link to the survey was sent out in an individualized email to each stakeholder to keep it personalized and encourage a response. Surveys were not sent to NSF and NCAR staff, data was collected through online and in-person communications

As a method to ensure valid sampling techniques, I followed up with nonresponsive individuals to my initial contact to encourage them to participate. If I relied only on data from those who elect to respond, I may have collected skewed data towards those that have a particular interest in the program (Frechtling, 2010, p. 41). I considered a response rate of 70 percent or higher as a criterion for success (Newcomer and Triplett, 2004).

The results of the surveys will be kept confidential, though not anonymous. It was assumed this group of well-educated people are familiar with the nature of this work and the goals of the survey, and are willing to provide their name for follow up interview questions (Suskie, 1996, p. 19). The survey was conducted through an online platform; therefore, the data is housed on the third-party server. The data is both visually displayed in graphs and charts, along with the numerical data. For the qualitative portions of the survey, key concepts were identified and thematically coded accordingly for

interpretation and analysis. The trends were categorized by stakeholder group, as they do have differing perspectives.

Interviewing stakeholders allowed for the opportunity to ask focused questions, probing for detailed responses difficult to accomplish in a survey. Interviews offered the opportunity to delve more deeply into topics of direct and indirect considerations a PI takes when requesting a facility as well as to the anomalies in the diversity of requested facilities. This information helped determine if in fact the current request rate of the facilities was representative of the community, and determine if the EDP is indeed meeting the needs of the community. Interviewing former requesters provided great insight and the ability to ask probing questions for detailed responses.

Interview techniques had both advantages and disadvantages. Advantages included yielding rich data, details, and insights; they permitted personal interactions with respondents; they provided the opportunity to explore topics in detail; they allowed me to clarify questions, increasing the likelihood of useful responses; and they allowed me to be more flexible in administering the interview for particular individuals.

Disadvantages included the challenges of transcribing and reducing large volumes of information to a usable format; the interviewee may have distorted responses in order to please me; and flexibility could have resulted in inconsistencies across interviews (Frechtling, 2010, p. 61). Measures such as asking pre-defined open-ended questions and having well-planned interview transcription and coding techniques helped mitigate some of these disadvantages.

Interviewing as a method for data collection assumes that the interviewee's perspectives are meaningful, knowledgeable, and will contribute to the overall success of the research project (Frechtling, 2010, p. 59). Interviews were used as a method to follow-up with stakeholders after they submitted the survey to gain deeper insight into their survey responses, and to demonstrate that interpersonal contact and relationship building are important to the research efforts and me.

Interviews were approached dynamically, utilizing both structured and in-depth interviewing techniques. Individuals from each stakeholder group were asked the same set of questions, employing the aforementioned structured approach, and as the opportunities arose, continued probing with additional questions allowed for a more unstructured and in-depth discussion to unfold (Appendices C & D). A concerted effort was given to ask the same set of questions during each interview to obtain comprehensive data. On average, interviews with each stakeholder lasted 20 minutes, again being sensitive to his or her time and schedule, and with their permission I recorded the audio of each interview.

I interviewed each of three stakeholder groups, though only recorded interviews from two stakeholder groups, to gain perspectives from multiple angles. They were conducted after the survey was completed. As part of the survey process, stakeholders were informed in the header of the survey that a follow-up interview might be requested of them. This request method helped support random sampling; most people will not decline a meeting if asked directly, though some may decline an interview out of convenience if asked in a survey if they would be willing to participate in an interview.

As far as interviewing the NSF staff, I took a more formal approach, and scheduled a meeting during a time when they were visiting the laboratory. Interviewing NCAR staff was relatively straight forward as we work in the same facility and interviews were not recorded.

Keeping data organized was a paramount concern, and was handled with great care. Audio files were initially saved on my mobile device and the file named accordingly, and uploaded as needed to my computer to keep enough room available on my mobile device. My computer was backed-up up to the local server daily. Audio recordings were transcribed and digitally stored on my computer and backed-up in the same manner.

Interview data was compiled, deconstructed and coded, and then reassembled into common themes based on category codes. Coded data of descriptive statistics such as means, frequencies, etc. were placed in spreadsheets so they could easily be sorted with other data such as the type of requested facility and archived summary reports of previous projects. The reassembled data was then analyzed and interpreted to reveal critical information (Hendricks, 2013). The data were graphically represented to communicate it most effectively. It was then reviewed by colleagues to confirm clarity. A summary description of the data was included with each graphical display (Hendricks, 2013).

Prior to collecting data via instruments, I secured an Institutional Review Board (IRB) exemption letter from Montana State University, as to show my research was of sound nature and not harmful to humans (Appendix E).

DATA AND ANALYSIS

The survey was sent to 33 former PIs and 11 prospective PIs. I received 20 survey responses from the former PI group for a response rate of 60% and received six responses from the prospective PI group for a response rate of 55%. While this is a lower response rate than I had hoped for, I still considered it an acceptable percentage. Many papers and articles agree there is no simple answer to what is an acceptable response rate. Some people have been willing to go on the record with a numerical answer, with a range from 25%-75%. The supporting evidence for a 60% response rate was to avoid bias by the happiest and unhappy respondents (Kiess, H. O., & Bloomquist, D. W., 1985).

Phone interviews were conducted with five former PIs and one prospective PI. Interviews were recorded and transcribed; data was then thematically coded and categorized by common themes that were repeated throughout the interviews. The following data are a compilation of both stakeholder groups unless otherwise noted. Themes were deemed relevant by me because I found them to be very insightful to this case study and provided critical insight to how the EDP is implemented and perceived from a teaching faculty's perspective.

A few common themes emerged after coding and categorizing the qualitative interview data. Data was categorized into four themes 1) Program overview, 2) PI perception and understanding of the program, 3) faculty and university factors, and 4) user-perspective program enhancements.

These data provided insight into why certain facilities were requested, potential barriers for new requesting PIs, at what point in a teaching career an educational

deployment is advantageously incorporated into a teaching pedagogy, the relation of research-focused universities to others as far as facility request tendencies, as well as many enhancements to planning materials from the user's perspective. Gaining detailed insight into the user community will allow for better and targeted outreach mechanisms to potential new users.

An important element to consider while assessing if the EDP is meeting the community needs is that current data are only from the stakeholder groups who knew about the program. Locating and surveying Potential PIs who have not been in contact with NSF or NCAR staff was out of the scope of this project. Continued efforts will be made to reach a wider audience and broaden the participation of the program.

Program Overview Data

The data extracted from the summary reports were further tabulated into spreadsheets with information such as the project name, deployment dates, requesting PI, associated institution or organization, requested facility/facilities, project cost, and how many students and general public were impacted by the project. In order to conduct the needs assessment, it was vital to know the current baseline metrics, they provide supporting data from which to base survey and interview questions.

From 2008-2015, there were a total of 46 educational deployments in the continental United States and Hawaii, averaging 5.6 deployments per year. In 2014, three deployments were declined due to lack of educational design in the proposal, and lack of remaining funding for the year (Figure 5). If projects cost less than the suggested \$25,000 per deployment, then more educational deployments can be funded in a given year, as

seen in 2013. However, with special consideration, an educational deployment can be funded at significantly more than the suggested amount. Therefore, fewer projects can be funded that year, as the case was in 2014 (Figure 8).

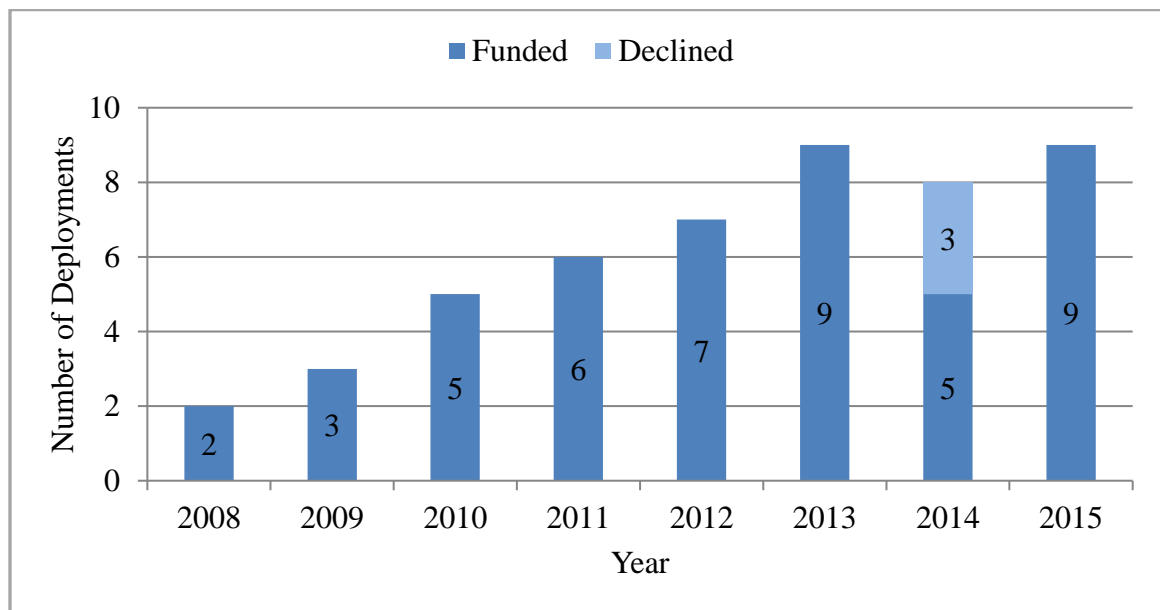


Figure 5. Distribution of funded and declined facility requests from 2008-2015, 46 were funded and three were declined, ($N=49$).

The educational deployment spreadsheet metrics maintained by the EOL Assistant Director of Operations and the NSF Program Manager were valuable in this needs assessment to determine yearly trends, and what was seen here is a relatively stable increase in the number of yearly submitted facility requests. The Summary Report submitted by PIs post-project provided data that were used to enhance planning materials on the website to develop a *Lessons Learned* and *Best Practices* webpage.

Distribution of Requesting PIs and Universities

The distribution data of new-versus-repeat requesting PIs of the deployments, as well as the distribution of deployments to new or repeat institutions or organizations

demonstrate lack of diversity largely by the requesting university, and to a lesser degree the requesting PI (Figure 6). The data show that 27 (59%) of the deployments were to new universities or organizations, and 19 (41%) of the deployments were to the same university or organization. Of the 46 deployments, thirty-three deployments (72%) had PIs requesting a facility for the first time. The remaining thirteen deployments (28%) were to PIs who had previously conducted an educational program. To show that new PIs and universities were made aware of the program, the data would need to show increases in the request rates of new university requests and new PI requests.

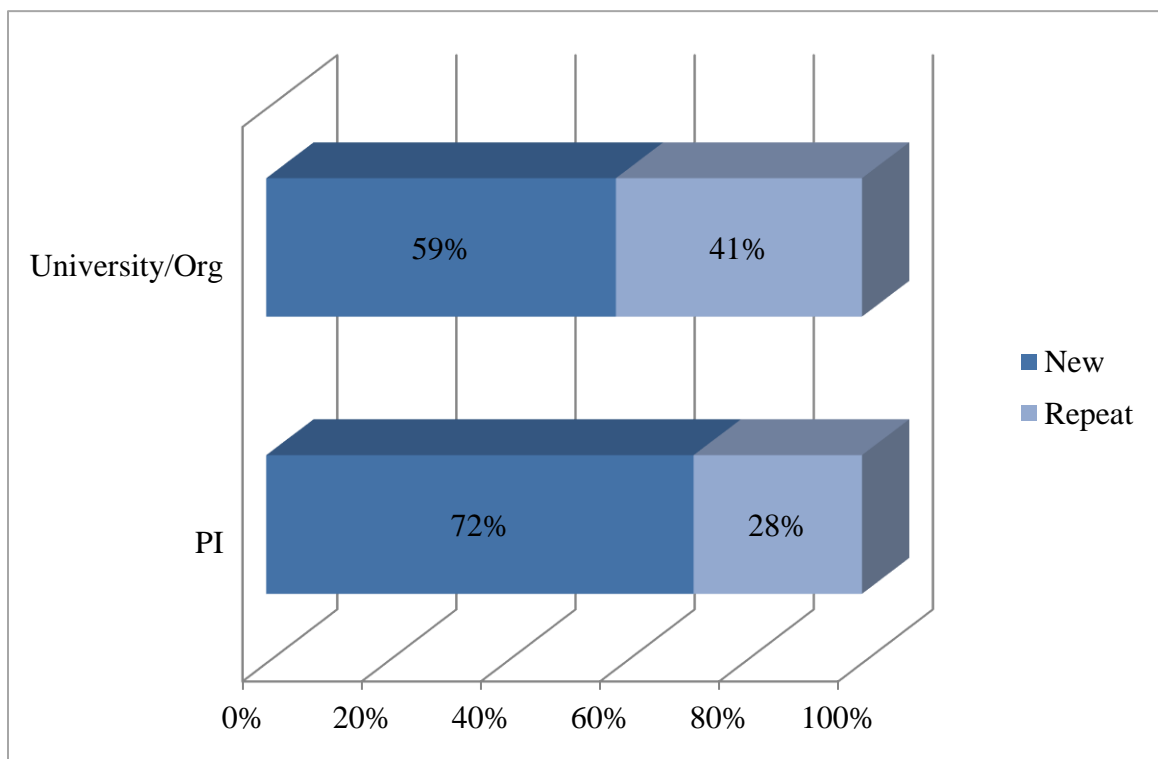


Figure 6. New versus repeat PIs and universities/organizations of educational deployments from 2008-2015, ($N=46$).

Broadening the PI pool and locations of deployment would indicate the educational deployment program is more widely recognized as a feasible method for instructional practices within the community. The current numbers show that a small number of the same PIs have made multiple requests for facilities, and that facilities are deployed to the same University quite frequently. This suggests that within a University a PI familiar with the EDP might encourage another department colleague to request a facility, increasing the chances of another deployment to that school. Closer examining of the former PI list suggests that several have an established a relationship with the DOW Facility Manager, which potentially suggests why the DOW is requested so frequently.

This relatively small group of requesters and universities that repeatedly request facilities suggests that communication efforts about the availability of the facilities is not effective, therefore certainly not meeting their needs because many universities are simply unaware of the program. This information was reinforced when I facilitated a break-out session on instrumentation support at the October 2015 UCAR Members Meeting, a meeting of representatives from the 100+ member universities that comprise the UCAR consortium. I had nine members request my table due to the discussion topic. Of the nine, only two of them had heard about the EDP. This indicated to me that UCAR, EOL and NSF's outbound communications about the program are not meeting the needs of the community. Methods to rectify this issue were discussed and included increasing the frequency of announcements in the Members Newsletter, wider advertising on the UCAR websites, increasing the level of detail of planning materials on the EOL website,

and sharing information about the program more frequently during staff visits to campuses.

Requested Facilities

The data show that the CSWR DOW is requested 80% of all of the aggregate time of all facility deployments, while the other available facilities are requested at a fraction of the that (Figure 7). The NCAR Mobile Integrated Sounding System (MISS) and the NCAR GPS Atmospheric Upper-Air Sounding System (GAUS) and have each been requested three times (15%), the NCAR Integrated Surface Flux System (ISFS) has been requested three times (15%), the NCAR Integrated Surface Flux System (ISFS) has been requested twice (4%), the University of Wyoming King Air (UWKA), the Colorado State University CHILL radar, and the CSWR Storm Pods have each been requested once (2%), and the High-Spectral Resolution Lidar (HSRL) has never been requested, while the DOW has been requested 37 times (80%) a clear outlier.

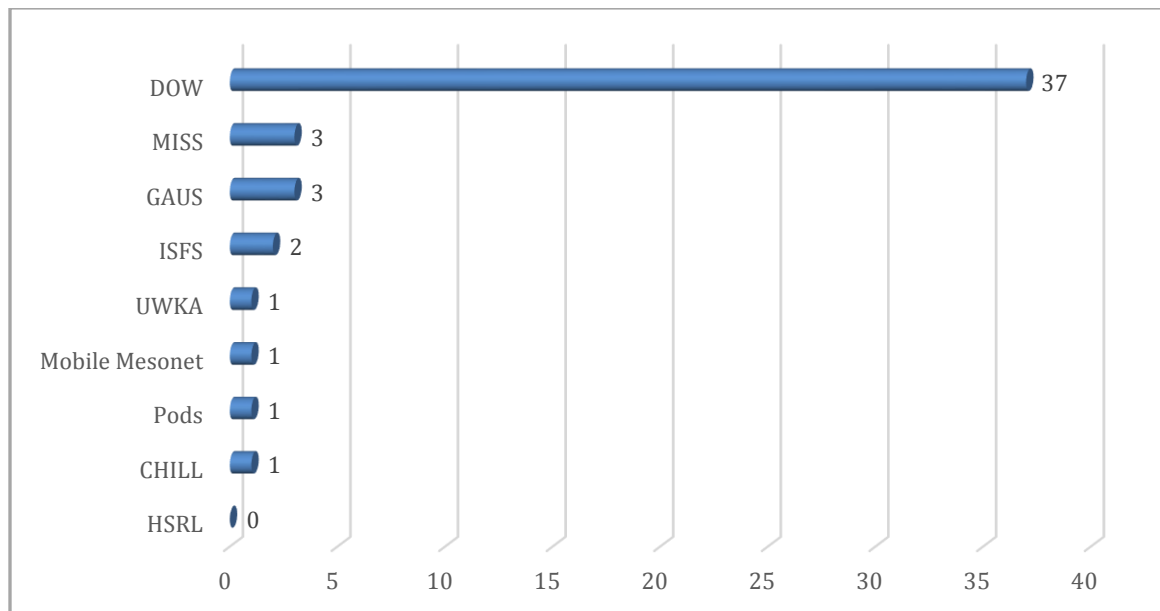


Figure 7. Number of times each facility was deployed for an educational deployment from 2008-2015, with three deployments requesting more than one facility, ($N=49$).

The low requests rates of all the facilities except for one were addressed in several questions in the survey and during the interviews in an effort to potentially reveal answers. A few hypotheses of the high request rate of the DOW included 1) lack of outgoing communication by NCAR about the range of available facilities, 2) a high level of interest in the DOW because of the high profile nature of the facility (for many years the DOW were showcased on the Discovery Channel's Storm Chasers TV series), 3) a high number of radar meteorology courses taught at the university level and 4) a particular school may already have access to facilities similar to the other requestable facilities and the DOW fills a gap in their observational and experiential needs for the students. If the latter two were true and the 80% rate is representative of the needs of the community, the plan of action will be based on that outcome. If the needs assessment shows the needs of the community are not being met, the plan of action will be a specific series of suggested programmatic changes based on this research.

Annual Budget Analysis

The yearly budget of the educational deployment pool is a small percentage of the larger NSF LOAF Deployment Pool, a sum of money allocated for field research deployments. The available funding for educational deployments started with an "exploratory" budget of \$50,000 in 2008 and has increased three times in \$50,000 increments over the last eight years. The first increase to \$100,000 was in 2009, it increased again to \$150,000 in 2011 and lastly in 2013 to \$200,000. In the eight years of the program, five years had spending slightly exceeding the yearly budget (Figure 8).

Any remaining funds from each year are absorbed back into the larger NSF LOAF Deployment Pool which is available for scientific research deployments.

It should be pointed out that since September 2015, the GAUS was removed from the educational deployment pool, which is why it was omitted from the survey data. However, it was included in the metrics and summary reports of previous projects. It also has changed the number of requestable facilities from nine to eight.

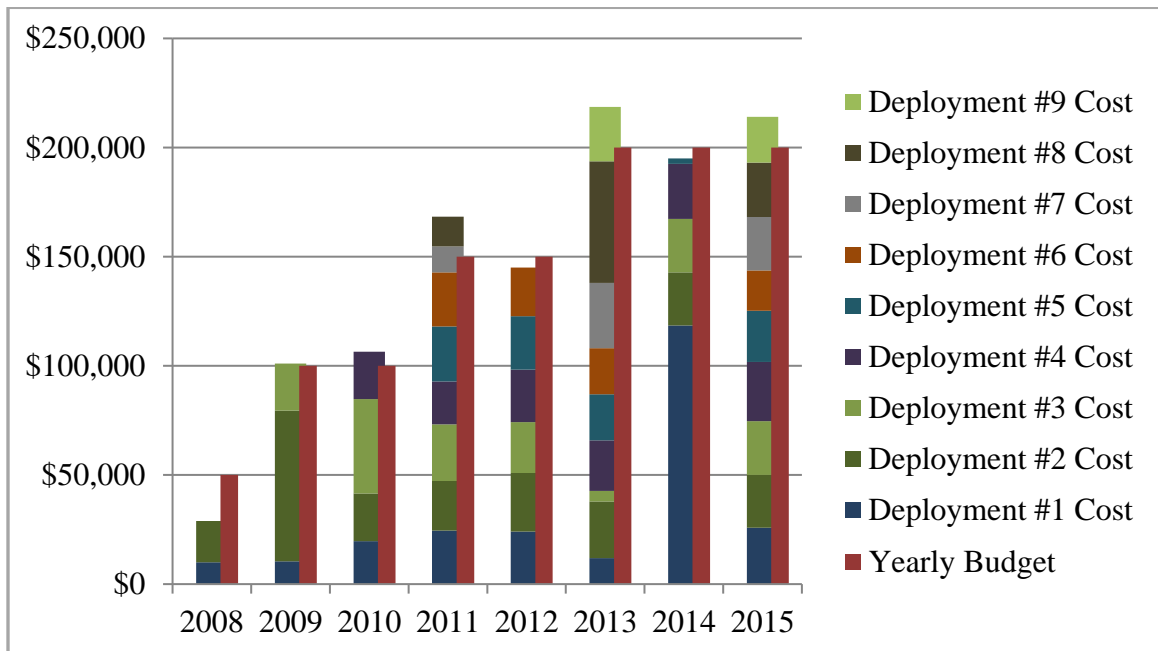


Figure 8. Combined yearly costs of educational deployments vs the yearly budget from 2008-2015, ($N=46$).

The number of annual educational deployments clearly shows an upward trend in requests, indicating increased awareness of the program in the community, though still not broadly recognized. In 2014, three requests were denied. One was denied because it was not well thought out scientifically, and the other two were denied due to lack of remaining funds.

The data of yearly costs of the deployments suggest there is room for improvement for exploiting the maximum yearly budget. If the yearly deployments costs were maximized each year, it could be used as a case to NSF to further increase the yearly budget. Despite the occasional divergence from the suggested \$25,000 cost per educational deployment, the average cost of the 46 deployments over the eight years is impressively \$25,700. This can be attributed to well-planned cost estimates by the Facility Manager prior to each deployment.

The yearly budget was not optimized in 2008, probably due to it being the first year of the program. From 2009-2015 the yearly costs were within a 10% variance of the annual budget, indicating the budget was close to being optimized. This would suggest the budget was meeting the needs of the community, at least to those who were aware of the program through that timeframe. A better indicator would have been a consistent slight over-spending each year, demonstrating a high demand for the program. As community needs are better established through the needs assessment, it would be expected to see a full exploitation of the yearly budget.

Looking ahead, if there is a significant increase in the number of requests and increased utilization of the yearly budget, and even more telling, an increase in the number of competing requests that are denied, that would indicate more PIs and more universities are aware of the program. It was suggested by my supervisor that the yearly allotted budget is about as high as it will be in the foreseeable future. With limited staff and resources available, it is not feasible to expand the program beyond its current capacity, though continued development and improvement of the program is welcome.

Awareness of Available LOAF

The data show that 84% of former and prospective PIs were aware that the DOW was requestable for educational deployments and only 49% of them knew the HSRL was requestable. The latter of which is not representative of the how frequently it has been requested since it has yet to be requested. Of the remaining six facilities, the awareness of their availability was moderate from 41% to 65% (Figure 9).

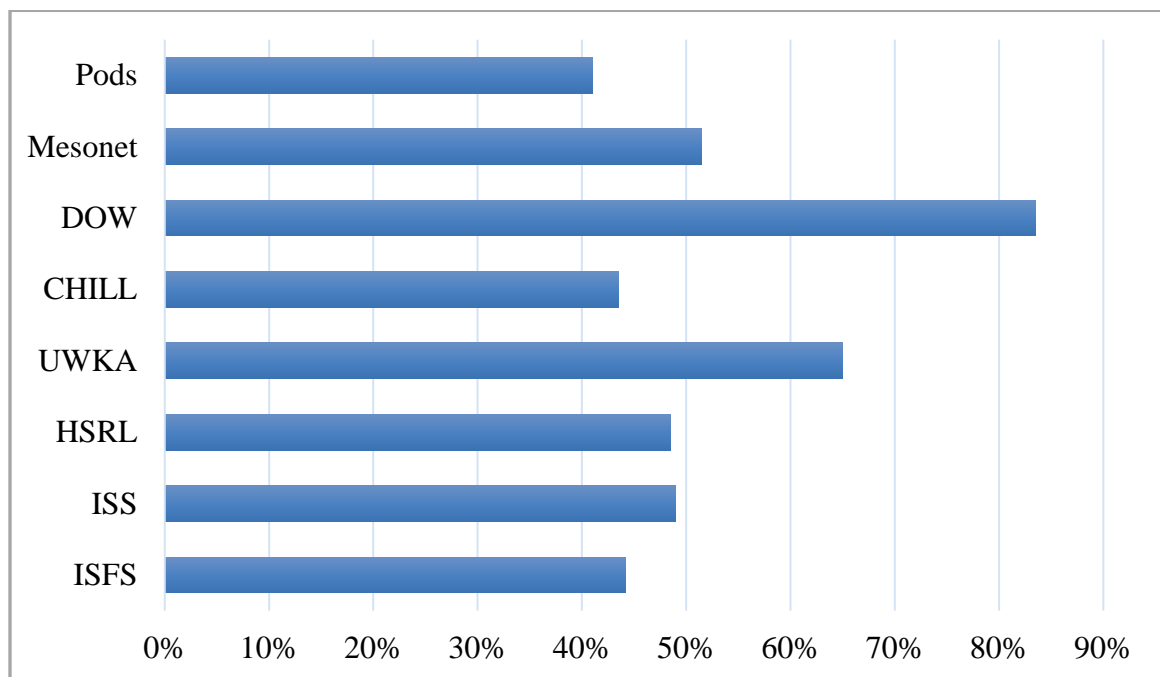


Figure 9. Percent of facilities former and prospective PIs were aware of for educational deployments, (N=26).

Existing Facilities Available On Campuses

The data regarding observing facilities that are available on campuses shows that most former PIs have a variety of instruments already available to them (Figure 10).

Weather balloons and tethersondes are most widely available to faculty on campus available for their use, 50 % and 33% respectively, while a smaller percentage of former

PIs indicated they have surface flux towers, trace gas sensors, soil sensors, or wind profilers available to them. Nine respondents indicated they had access to other facilities including lidar and profiling radar, multi-angle snow camera, micro-rain K-band radar, disdrometer, surface observing systems, mobile mesonet and unmanned aircraft system, radiometer, sonic anemometers and precipitation sensors.

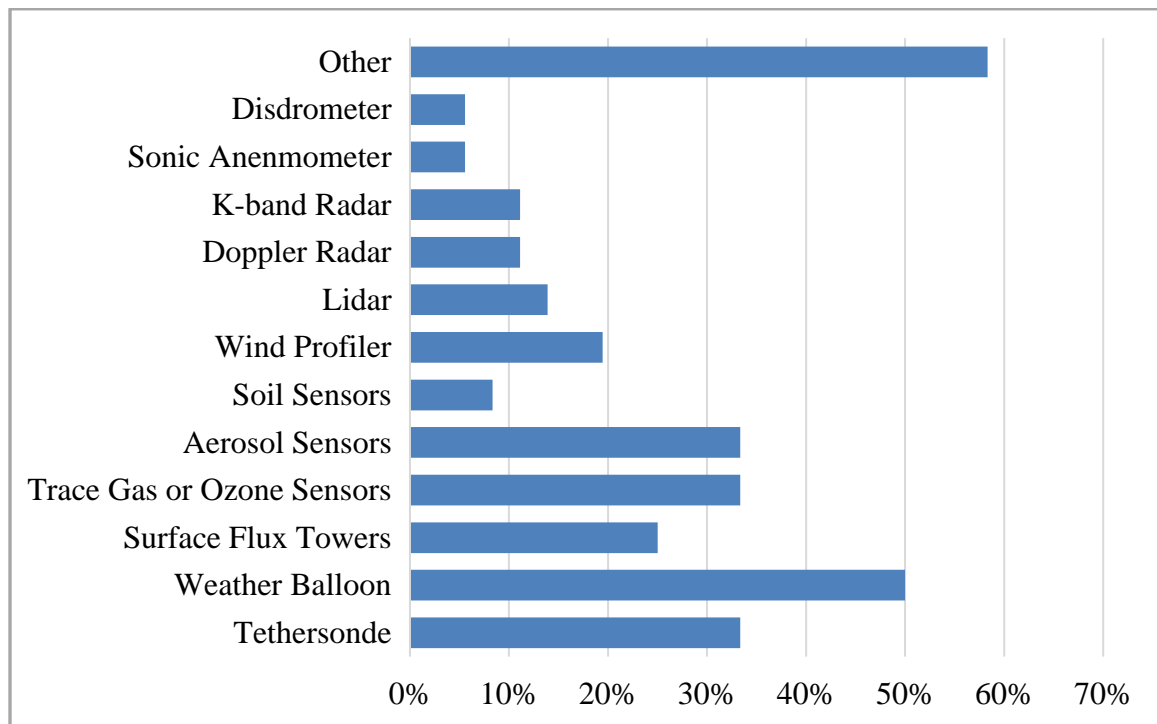


Figure 10. Distribution of other observing systems former and prospective PIs have available to them at their campus, ($N=26$).

Program Goals

Data from the survey suggested the EDP is largely meeting its five program goals (Figure 11). When asked to what extent survey participants felt the program was meeting each of its goals, the responses ranged from *Strongly Disagree* to *Strongly Agree*. One outlier response of *Strongly Disagree* that a program goal was being met was present. No one *Disagreed* that any of the five program goals were being met. The

opportunity to talk with the individual who selected *Strongly Disagreed* was not available. While that could be his sentiment, perhaps it was an erroneous selection since it did not align with his other responses.

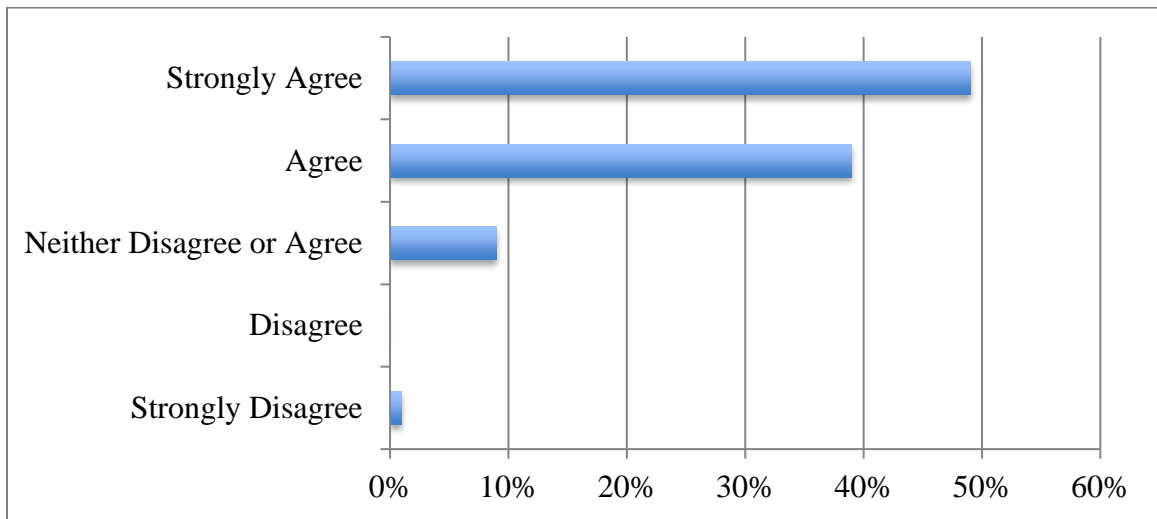


Figure 11. Summary of survey responses to how former PIs felt the EDP was meeting each of the five program goals, the prospective PI group was not asked this question ($N=20$).

Most respondents indicated they felt the EDP was meeting the five program goals, and had positive constructive feedback in the open-ended questions, though none provided additional comments after selecting a *Strongly Disagree* or *Disagree* response. A few constructive comments included “More information about procedure of operating the requested facility and using data collected during / following deployment would be beneficial. Currently, requesting a deployment seems to be primarily for those groups/instructors that have had prior use of facilities” and “One thing I would suggest however is to make it a little clearer on how to apply for these programs.” These comments were compiled for suggested program enhancements.

PI Factors

There was conflicting data about when the best time in a teaching career would be to request a faculty. It was suggested that tenure-track and early-career faculty might not be the target audience for the EDP as they most likely have a full teaching load while also still establishing their teaching materials and pedagogy. Conversely, it was suggested by Julie Lundquist, faculty member at the University of Colorado in the Atmospheric and Oceanic Science Department:

If you targeted new faculty, three to four years into tenure-track, that's the time when people are thinking about ways of being more innovative in their teaching practices, and that's a good time to hit people with the information about this program (personal communication).

Faculty have to carefully consider the effort it entails to have a faculty on campus for up to three weeks and what the reward would be in the end. “We all want to do great things for the students but we have to budget our time and find out what the deliverable and product will be in terms of our assessment for tenure-track” as quoted by Dr. Michael Bell of the University of Hawaii, Manoa. It was made clear that not only early-career faculty need to become more aware of the EDP but experienced faculty may be looking to expand on their teaching pedagogy as well.

Additional factors that influence the EDP that come directly from the faculty and university include previous experience with an observing facility and its data. Several faculty that were interviewed and surveyed had previous experience with radars and radar data which makes DOW requests more feasible to integrate into coursework. Dr. Bob Rauber, Radar Meteorology professor at University of Illinois Urbana-Champaign, and three-time former PI for DOW educational deployments says:

There are two main tools they can show mesoscale structure of storms one is a radar the other is a satellite, radar is by far more important and a more broadly used tool in atmospheric science from those reasons the radar facility is better (personal communication).

Other considerations faculty have to give when looking to request a facility is the likelihood of a proposal being funded with respect to how much time they put into writing a strong proposal and potentially developing a new course that would be based on the facility being on campus for several weeks. Another comment from Dr. Rauber in support of the DOW for educational deployments:

The DOW are also cost-effective compared to the other facilities. I'd like to bring the University of Wyoming King Air here for three weeks but that is over the allotted budget, the costs are going to be much higher and the likelihood that it will be funded are much lower (personal communication).

University Factors

Another factor that directly affects the type of facility that is requested are the courses taught at a college or university. Radar meteorology is widely taught at the undergraduate and graduate school level. As suggested above by Dr. Rauber, radars are a main way to study mesoscale storm development, and radar data is easily attainable and easy to understand for students, which make it an effective learning tool. Dr. Lundquist also suggested that data from weather balloons, a sub-system of the ISS, are easy for students to comprehend, which helps students make the transition to more complex data from the other ISS systems.

Some of the most useful data from the interviews came in the form of user perspective insights. This unique perspective of former PIs is based on their experience

with the online material, the request process and the experience of having a facility deployed to their campus.

Program Enhancements

Several PIs included suggestions for improving ways to reach the community more effectively. These suggestions included highlighting the EDP on the UCAR/NCAR websites more frequently so it can be found easier, and posting an announcement in the UCAR Updates newsletter at three strategic points 8-9 months in advance of a semester throughout the year. There was no indication of needed online resources for PIs in support of the observing systems, the sentiment is that there is plenty of online information and if there is a specific question the Facility Manager can be contacted. It was also suggested to reach out to communities at smaller and more targeted conferences. Matthew Kumjien, former PI and professor at The Pennsylvania State University said:

Advertising a bit better at smaller, more targeted conferences such as American Meteorological Society (AMS) Symposium on Boundary Layers and Turbulence, the AMS Conference on Radar Meteorology, and the AMS Conference on Mesoscale Processes and highlight the particular set of instruments that would be relevant for that conference (personal communication).

As far as enhanced online planning materials, it was suggested that the costs of facilities and other expenses were more transparent on website so a requesting PI can determine what they can select to stay within budget; provide resources and materials for public outreach portion of EDP, especially targeting grades 4-6 which research has shown to be very formative; provide example of how to teach at different k-12 levels, as it's challenging to come from a university perspective and focus material to the correct age range during outreach events; provide clearer guidance for repeat requestors; and

highlight lessons learned from previous educational deployments in one easy-to-find location.

A prospective PI suggested to post data and variables for each facility so potential PIs can see the types of data products from each facility to determine if they can be integrated it into their coursework. Faculty are open to trying new facilities, but need more information.

Another positive outcome of the personal interviews was that I was able to ask former PIs if they would be willing to serve as a mentor or advisor to a new PIs who might have trepidations about how to effectively incorporate a facility into their coursework. All of the former PIs that I spoke with were willing to be on such a list, which is another support tool to help broaden participation in the EDP.

Several program enhancements were suggested, but with the understanding there are only so many resources available. Two different prospective PIs mentioned to me, one during the phone interview and the other informally during the UCAR Members Meeting, the idea of faculty buyout time because time concerns are a huge constraint when considering bringing facility to campus. Dr. Minghui Diao, Assistant Professor at San Jose State University said:

I would love to see buyout time for early-career faculty PIs. I already have a large teaching load and would love request a facility if part of the budget justification would allow for me to buyout a partial class for a semester. That would provide a lot of reassurance because I would need to contribute a lot of time with the deployment, the data, and the students to be sure it is a strong program (personal communication).

Streamlining request process also was discussed in several interviews as a way to enhance the program. It was suggested to have one point of contact so requests do not

“fall through the cracks”, as experienced by one former PI. There was also a call to standardize deadlines for proposal submission by Dr. Bell:

I would advocate for a standard deadline so you know that what projects are coming in and they can be reviewed together. Otherwise it's just a rolling thing and you don't know what other projects are coming down the pike. But there still needs to be some flexibility in the proposal process because if you're pitching a new course to your university you need to have more lead-time than the standard 6 to 8 months. There is also the risk of not guaranteeing that you have the facility each time for the course and it's not necessarily repeatable (personal communication).

These web-based and program changes will be shared with EOL and NSF staff who manage the EDP, they will provide guidance on what programmatic changes should be implemented at this time.

INTERPRETATION AND CONCLUSION

My claim is that a needs assessment can be used to broaden participation in an education program. A data-driven needs assessment is viable and valid method to improve program performance and broaden participation. The needs assessment helped to identify gaps between current performance and desired performance, provide data to guide the subsequent decisions that will lead to the desired results, as well as identify the needs of the user community, which are reflected in the desired performance measures. When combined with the implementation of the suggested recommendations, these efforts, in theory, will increase the diversity of participant and the facilities that are used leading to the broadening of participation in the program and increasing the use of a subset of LOAF. Complete results of the efforts will not be known until approximately one year after the implementation of the suggested program recommendations. The

broadening of participation in the program will help to support the development of a diverse and well-prepared workforce.

Through this research I have attempted to identify if the current EDP request rates of new users and of the facilities are representative of the community. The desired performance of the program is to have request rates that are more illustrative of the user community. Measures to bring the current request rates in parallel with the desired request rate would close the gap. This research has helped to identify and describe the user community and its needs, which represent the desired performance of the program.

Conducting routine assessments of the program will help to identify new and innovate ways to reach a wider audience. Effective ways to improve, expand and strengthen programs are always needed and welcome.

Facilities Request Rate

Comparing data of what facilities have been requested to interview data of facilities are most suitable to support undergraduate and graduate level courses show that the high request rate of the DOW is a somewhat likely representation of the community.

Based on interview data from two former PIs, they indicated that Radar Meteorology courses account for a significant portion of meteorology course taught at the university level, and that radars are essential for studying storm structure. While there are two available radars in the deployment pool, only one is mobile and able to be deployed to campuses, the CHILL radar can be accessed remotely for classroom instruction. The mobile aspect of the DOW makes it much more desirable because it provides hands-on, inquiry-based experiences for students. Radar technology has been available for quite

some time, therefore most faculty in meteorology or atmospheric science would have been exposed to radar technology and data in their academic career.

Four of the eight available LAOF (MISS, Mobile Mesonets, ISFS, and Pods) are focuses on studying low-level and boundary layer structure. There seems to be fewer undergraduate and graduate level courses focused on boundary layer structure, and therefore a reduced need and request rate for them. There is room to expand the current request rates of these facilities to better match the user community. A comprehensive study of the scope of undergraduate and graduate level courses offered in atmospheric science and meteorology would help support this initial finding.

Requesting the one aircraft that is available in the EDP pool poses challenges because of the high costs of a deployment. Interview data suggested that PIs are hesitant to request the UWKA because of the high risk of the proposal not getting funded. A deployment of the UWKA would use a considerable portion of the available funding and requests are reviewed more critically.

Despite PIs knowing the HSRL is available, it has yet to be requested. Interview data suggests that it could be from lack of experience with the instrument. It is the newest addition to the EDP pool and a relatively new technology that university staff might not have used before, and may be unsure of how to use the data in a pedagogical fashion. Increasing this request rate to once a year would be more representative of the community, as there is faculty that can operate the HSRL, perhaps with support and guidance, and incorporate it into their coursework. It is a new technology that is being

taught in universities not only in meteorology courses but physics and optical engineering as well.

The facilities that PIs have available to them on their campuses also plays a role in the request rates of the LAOF. Respondents listed several other sensors they have access to that are not available in the EDP deployment pool, such as tethersondes, soil sensors, k-band radar, and a disdrometer, indicating a LAOF deployed to their campus would complement their other measurements. Twelve percent of survey respondents indicated they already have access to a Doppler radar, which is a relatively low percentage and supports the high request rate of the DOW. Approximately 15% of respondents indicated they have access to a lidar, which does not support the zero request rate of the HSRL. Almost 20% of respondents indicated they have access to a wind profiler, which suggests why the request rate of the ISS is low. Approximately 25% of respondents indicated they have access to surface flux towers, and some of the instruments that may accompany such systems such as trace gas, ozone, and aerosol sensors and sonic anemometers. These systems tend to be less expensive which make them more feasible for universities to own and operate themselves.

PI Request Rate

A survey of the user community shows the request rate of new PIs is not representative of the current request rate. Currently, 28% of the PIs are repeat requestors, meaning over the seven years of the program there have been only 33 first-time

requesters. There are clearly a larger number of faculty in atmospheric science and engineering departments who are able to bring a facility to their campus. The interviews conducted for this research identified many areas for targeted announcements regarding the program to reach new PIs with the intention of gaining new PIs requesting facilities through the EDP.

Currently the UCAR is a consortium of more than 100 member universities in North America that offer programs in the atmospheric and related Earth systems sciences, with one or more member representative at each university (Figure 12). Given the number of member universities alone, the current request rate of new PIs and universities should expand to be more representative of at least the UCAR member community. The EDP is open to any U.S. college or university, regardless of UCAR membership status; therefore, the user community is even larger than that of the UCAR member base.

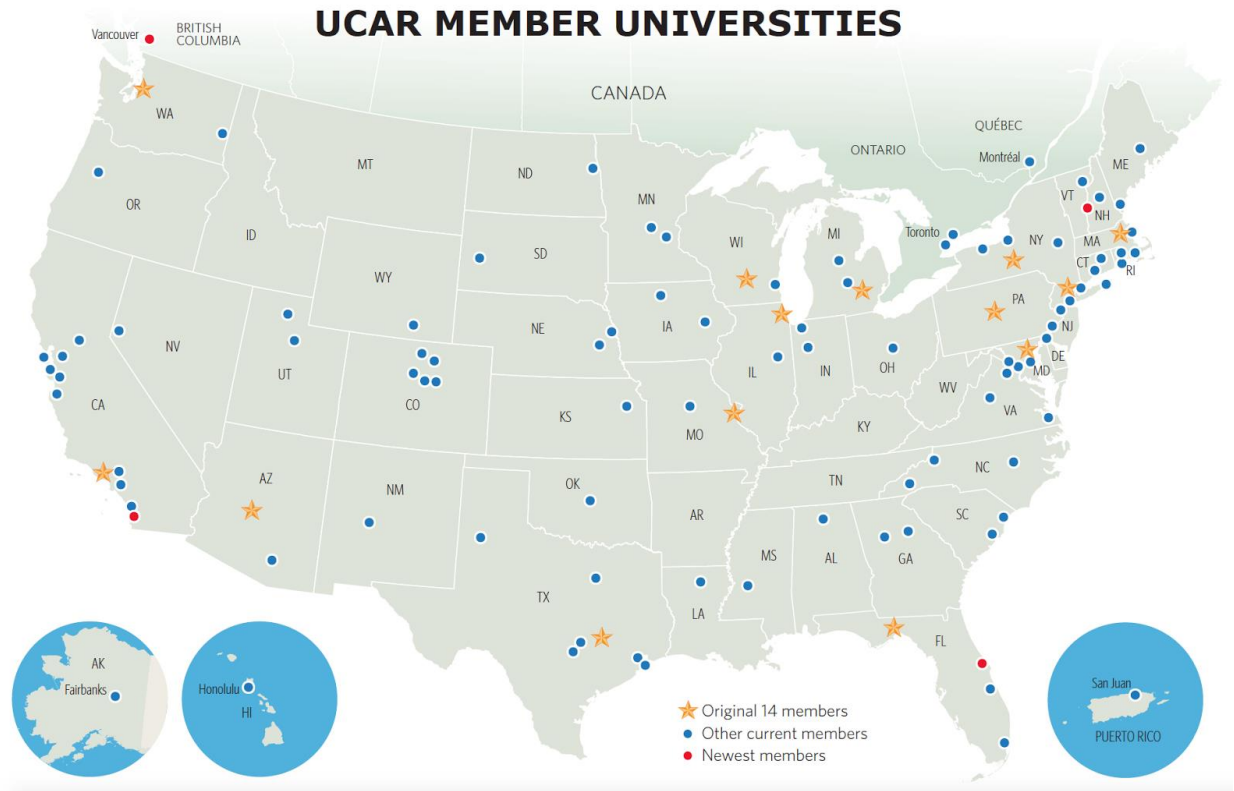


Figure 12. Distribution of over 100 UCAR Member Universities across North America (UCAR Membership, n.d.).

Several PIs mentioned the difference between a research-focused institution and non-research focused institution, as determined by the Carnegie Classification of Institutions of Higher Education (Carnegie Classification of Institutions of Higher Education, n.d.). It was difficult to discern whether or not to target advertising efforts to a research (R1, R2, or R3) or other institution. It is most likely that faculty at research institutions have the experience with research facilities and data, therefore are more adept at integrating a facility into their teaching pedagogy. They probably also have less time to focus on incorporating a facility into their course work due to other obligations such as their research. Faculty at other universities may not have the experience with observing

facilities needed to effectively incorporate a facility into their teaching practice.

However, they may have the time and interest to pursue a deployment.

In summary, from my research I have found that the request rate for PIs is not reflective of the user community, and gaps do exist. Steps can be taken to increase new PI request rates and broaden participation in the program. The request rate of the facilities is more closely reflective of the needs of the user community, however there are still gaps between current performance and desired performance. Measures can be taken to close that gap and increase the request rate of several of the facility to expose more science and engineering students to these unique observational systems.

VALUE

This research project provided not only great value to me for my professional development, but to the continued development of the NSF LAOF Educational Deployment Program. As we work in a world that is increasingly constrained by time and resources, it's is critical that effective and resourceful program assessment methods are established as a means to continually look for ways to improve processes.

Data-driven Recommendation Action Plan

Based on the data gathered during this research effort, the recommended action plan is to address the following:

- Website enhancements, including:
 - Examples of how facilities were used for past educational deployments
 - Develop a frequently-asked-questions page
 - Develop a comprehensive list of lessons learned and best practices

- Develop an “à la carte” menu of costs for effective estimating and planning
- Provide examples of data products from each facility
- Provide specific guidance to repeat requestors
- Provide list of resources on how to best reach k-12 audiences during outreach events
- Refine the request process and workflow
- Request/encourage PIs to provide a project management plan and/or deployment plan (including decision making trees) to force them to think about details
- Extend the application deadline to eight months in advance of a deployment to allow and encourage adequate planning time and preparation for facility on campus
- Announce in the (emailed) UCAR Updates newsletter three times a year, eight months prior to the start of each summer, fall and winter semester
- Consider a proposal deadline three times a year so proposal can be reviewed together and funding can be distributed more fairly throughout the year
- Target smaller, more specific conferences to announce and distribute information about the program
- Assign a single point of contact to manage communications the various stakeholders
- Institute a standard summary report in order to collect a standard set of data for continued evaluation

- Consider developing a standard student survey instrument that can be distributed by faculty, to evaluate student learning outcomes and impact of the program
- Compile a list of former PIs who are willing to serve as “education mentor” to those who may need some support as a first time requester, kept privately but shared as needed

This method of performing a needs assessment to close gaps between actual and desired performance can be applied to other programs with which I work. Additionally, having a greater understanding about how a needs assessment compares to a program evaluation is critically important. With so much discussion of and emphasis on program evaluation it’s vitally important to understand the difference between the two and know when to apply each method.

As I conducted this research, I found myself looking for additional data and metrics about the EDP such as the distribution of graduate and undergraduate courses the facilities are directly integrated with, the distribution of the course topics that facilities are requested for such as radar meteorology, boundary layer meteorology or atmospheric measurements courses. I’m also interested in comparing these results with the American Metrological Society (AMS) list of schools that offer degree programs in atmospheric and related oceanic, hydrologic and other science (Listing of Colleges and Universities Offering Meteorology and Atmospheric Science Courses, n.d.) to further assess the scope of the community.

With ongoing reviews to determine that the program is in fact representative of the community, indicating it is meeting the needs of the community, the program can

then undergo a program evaluation to determine the worth, merit, value, and significance. A program evaluation will include the development of an instrument to survey of impact and outcome of the students, and a comprehensive implementation survey of PIs.

Professional Value

Professionally, the process of understanding when to conduct a needs assessments and carrying it out have been fruitful. Conducting an action research study has proved to be very valuable to me in understanding the processes involved in a research project, as well as provide me with a broader understanding of the terminology used in educational research. I am able to better communicate with my peers on such topics of educational research, needs assessments, and program evaluation. Additionally, this research complements my Project Management Professional (PMP) certification in the area of requirements management.

Talking with PIs gave me the greatest insight into the needs of the community and how to effectively reach a broader target audience. Connecting with the PIs in this manner provided the personal interaction and professional networking that digital communication simply cannot provide. This element was perhaps the most beneficial to me because it not only provided great insight into the program but established an initial relationship with members of the user community who I plan to work with in the years to come.

As more programs are looking to broaden participation and have limited resources to do so, developing effective methods for needs assessment is an effective tool and one which I will implement in the future. It was a great way to personally connect with the

user community and show that I am interested in their needs and taking steps to address them. A needs assessment was also effective to gain insight into the program and I recommend it for someone taking on a new role in managing a program and looking for ways to enhance it. I learned so many subtleties of the community that I was previously unaware of that will only help with my professional development.

I'd like to collect data for approximately 12 months after the recommendations are implemented to fully assess their impacts. Once they are analyzed, I will consider writing a journal article to be submitted for publication. I would be thrilled and honored to have my work published, and it would be an excellent addition to my curriculum vitae.

REFERENCES CITED

- A Guide to the Project Management Body of Knowledge (PMBOK® guide)—Fifth Edition. (2013). Newtown Square, PA: PMI.
- Angelo, T and Cross, K.P. 1993. Classroom assessment techniques a handbook for college teachers. Jossey-Bass A Wiley Imprint, San Francisco, CA.
- Assessment of Student Learning in STEM disciplines. (n.d.) A Duke University ‘Teaching IDEAS workshop’ presented by Ed Neal, Ph.D. Director of Faculty Development, Center for Teaching and Learning, University of North Carolina.
- Black, P. and Wiliam, D. 1998. Inside the Black Box: Raising Standards Through Classroom Assessment. Phi Delta Kappan, 80, 139-148.
- Carnegie Classification of Institutions of Higher Education. (n.d.). Retrieved April 24, 2016, from https://en.wikipedia.org/wiki/Carnegie_Classification_of_Institutions_of_Higher_Education
- Davis, H., & Scalice, D. (2013). Defining and Measuring Impact for Ourselves. Retrieved November 10, 2014 from <http://www.techforlearning.org/Scalice-DavisDefiningImpact-Final.pdf>
- Davis, H., & Scalice, D. (n.d.). Defining, Enhancing, and Documenting Impact of STEM Education and Public Outreach Projects Through a Quantitative Collaborative Impact Analysis Evaluation Method. Retrieved December 7, 2015, from http://www.aspbooks.org/a/volumes/article_details/?paper_id=37494
- Duke University Academic Resource Center. (n.d.). The difference between assessment <http://arc.duke.edu/documents/The%20difference%20between%20assessment%20and%20evaluation.pdf>
- Educational Deployments (n.d.). Retrieved March 15, 2015, from <http://www.eol.ucar.edu/educational-Deployments>
- ERAU C-BREESE (n.d.) Retrieved 3 October, 2015, from <https://www.eol.ucar.edu/node/8511>
- Frechtling, J., & Mark, M. (2010). *The 2010 user-friendly handbook of project evaluation*. Arlington, VA: National Science Foundation, Directorate for Education and Human Resources, Division of Research and Learning in Formal and Informal Settings.
- Guskey, T.R. 2002. Professional Development and Teacher Change. *Teachers and Teaching: Theory and Practice* 8(3/4).

- Hendricks, C. (2013). *Improving schools through action research: A reflective practice approach* (3rd ed.). Upper Saddle River, N.J.: Pearson.
- Horel, J. D., Ziegenfuss, D., & Perry, K. D. (2013). Transforming an atmospheric science curriculum to meet students' needs. *Bulletin of the American Meteorological Society*, 94(4), 475-484.
- Listing of Colleges and Universities Offering Meteorology and Atmospheric Science Courses. (n.d.). Retrieved April 24, 2016, from http://www.ametsoc.org/AMSUCAR_CURRICULA/index.cfm
- Kiess, H. O., & Bloomquist, D. W. (1985). *Psychological research methods: A conceptual approach*. Boston: Allyn and Bacon.
- Mills, G. (2014). *Action research: A guide for the teacher researcher*. (5th ed.). Upper Saddle River, N.J.: Pearson.
- Needs Assessment Information. (n.d.). Retrieved April 02, 2016, from <http://www.adprima.com/needs.htm>
- Newcomer, K., and Triplett, T. (2004). Using Surveys. In *Handbook of Practical Program Evaluation: Second Edition*, edited by J. Wholey, H. and K. Newcomer. San Francisco, CA: Jossey-Bass.
- Patton, M. Q. (2008). *Utilization-Focused Evaluation*. Thousand Oaks, CA.: Sage Publications.
- President's Council of Advisors on Science and Technology, 2012: Report to the President, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering and Mathematics*.
- Sagor, Richard. (2011). *The action research guidebook: a four-stage process for educators and school teams*. Thousand Oaks, CA.: Corwin.
- Seymour, E., Hunter, A. B., Laursen, S. L., & DeAntoni, T. (2004). Establishing the benefits of research experiences for undergraduates in the sciences: First findings from a three- year study. *Science Education*, 88(4), 493-534.
- Stiggins, R. J. (2005). From Formative Assessment to Assessment FOR Learning: A Path to Success in Standards-Based Schools. *Phi Delta Kappan*, 87(4).
- Strategic Guidance for the National Science Foundation's Support of the Atmospheric Sciences. (2007). Washington, D.C.: National Academies Press.

Suskie, L. (1996). *Questionnaire survey research: What works* (2nd ed.). Tallahassee, Fla.: Association for Institutional Research.

Tsupros, N., R. Kohler, and J. Hallinen, 2009. STEM education: A project to identify the missing components, Intermediate Unit 1 and Carnegie Mellon, Pennsylvania

UCAR Membership. (n.d.). Retrieved April 24, 2016, from <http://president.ucar.edu/governance/members/universities-representatives>.

Witkin, B. R. (1995). *Planning and conducting needs assessments: A practical guide*. Sage.

APPENDICES

APPENDIX A
FORMER PI SURVEY

Educational Deployment Survey | Former PIs
Greetings!

You are receiving this survey because you have previously requested a facility through the NSF Lower Atmosphere Observing Facilities (LAOF) Educational Deployment Program.

I am conducting a research project to determine if the LAOF Educational Deployment Program is meeting the needs of the community. You have a unique perspective that I am very interested in understanding and which will help shape the program in the coming years. Your participation in this survey is voluntary, though not anonymous. I am asking for your name so I can contact you in the next few weeks to ask a few follow-up questions, your name or specific project name will not be linked to any data in my report.

The survey should take approximately four minutes, and I would very much appreciate your input and feedback!

If you have questions, please email me: rockwell@ucar.edu

Kind regards,
Alison Rockwell
EOL Education and Public Outreach Coordinator
o. 303.497.8758

1. What is your name?
2. How did you initially hear about the NSF Educational Deployment Program?
 - Industry Conference
 - Colleague
 - NSF/NCAR or Facility Personnel
 - Newsletter
 - Social Media
 - Other - Write In
3. What aspect of requesting/deploying the facility did you find most helpful?
 - Ease of the request process
 - Available online information
 - Accompanying facility staff
 - Other - Write In
4. Of the following NSF facilities, which are you aware that can be requested?
 - NCAR Integrated Surface Flux System (ISFS)
 - NCAR Integrated Sounding System (ISS)
 - NCAR High Spectral Resolution Lidar (HSRL)
 - University of Wyoming King Air (UWKA)

- CSU CHILL Radar
- CSWR Doppler on Wheels (DOW)
- CSWR Mobile Mesonet
- CSWR Storm Pods

5. In order to assess if the Educational Deployment Program is filling gaps in observing facilities already available to you, please indicate which of the following instruments, if any, you currently have available to you on your campus:

- Tethersondes
- Weather balloons/GAUS
- Surface flux towers
- Trace gas or ozone sensors
- Aerosol sensors
- Soil sensors
- Wind profiler
- Other - Write In

6. What type of supporting online information would enhance the educational deployment learning experience for your students?

- Videos about basic instrumentation
- Examples of how facilities are used in real-world research project
- Online interactive educational instrumentation resources
- Other - Write In

7. What type of supporting online information would have made the experience better for you?

- A more streamlined online request process
- Examples of how others used the facilities and resulting data in their course activities
- A mentor to help integrate the facility into your coursework more effectively
- Other - Write In

8. If you are to submit another facility request, how likely are you to request a different facility?

Very Unlikely	Unlikely	Neutral	Likely	Very Likely	Not applicable
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9. If you were to request a facility again, what information would be helpful to you to encourage the request of a different facility?

- Examples of how a particular facility was used in a class
- More detailed information about how to operate the facility
- I don't plan to request a facility for educational purposes again
- Other - Write In

10. What are barriers to you from requesting a different facility?

- Time to integrate a new facility into your coursework
- Knowing what facilities are available
- Lack of confidence on integrating new facility and data into coursework
- Lack of information on the facility provider website
- Comfort level with using a different facility
- Comfort level with using a different type of data
- Other - Write In

11. If you were to request another facility, which would you select?

- NCAR Integrated Surface Flux System (ISFS)
- NCAR Integrated Sounding System (ISS)
- NCAR High Spectral Resolution Lidar (HSRL)
- University of Wyoming King Air (UWKA)
- CSU CHILL Radar
- CSWR Doppler on Wheels (DOW)
- CSWR Rapid Scan Doppler on Wheels (DOW)
- CSWR Mobile Mesonet
- CSWR Storm Pods

12. To what extent do you agree the LAOF Educational Deployment Program is meeting its goal *to provide a subset of the NSF Lower Atmosphere Observing Facilities to educators for authentic instruction in the field of observational meteorology?*

Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
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13. To what extent do you agree the LAOF Educational Deployment Program is meeting its goal *to foster students' competencies in observational science and engineering, furthering their understanding of geoscience?*

Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
----------------------	----------	------------------------------	-------	----------------

14. To what extent do you agree the LAOF Educational Deployment Program is meeting its goal *to provide opportunity for students to experience the interdisciplinary nature of science and engineering through a small-scale scientific field campaign?*

Strongly disagree Disagree Neither agree or disagree Agree Strongly agree

15. To what extent do you agree the LAOF Educational Deployment Program is meeting its goal *to provide the opportunity for early-career PIs to gain introductory experience with conducting a scientific field campaign while providing an impactful educational experience for their students?*

Strongly disagree Disagree Neither agree or disagree Agree Strongly agree

16. To what extent do you agree the LAOF Educational Deployment Program is meeting its goal *to expose students to basic instrumentation principles and measurement science through discovery-based learning in the field of observational meteorology?*

Strongly disagree Disagree Neither agree or disagree Agree Strongly agree

17. Do you have any comments that you'd like to share regarding the LAOF Educational Deployment Program goals?

18. At the recent UCAR Members Meeting, and from the preliminary results of the NCAR Diversity, Education, and Outreach Coordinator's survey to all members, there was a clear call for instrumentation support.

Is the program meeting your needs for instrumentation support? Please explain.

19. Is there anything else that you would like us to know about how to enhance the LAOF Educational Deployment Program and encourage diversity of requested facilities?

20. Will you be attending the AGU 2015 Fall Meeting in San Francisco and be willing to meet with me to discuss some of your ideas and comments in more detail? If so, please provide your email address and I will contact you to set up a meeting time and location.

- If yes, please provide your email. Please enter an 'other' value for this selection.
- No

APPENDIX B
PROSPECTIVE PI SURVEY

Educational Deployment Survey - Prospective PIs
Greetings!

You are receiving this survey because at some point you have indicated interest in the NSF Lower Atmosphere Observing Facilities (LAOF) Educational Deployment Program, or instrumentation support in general, to a UCAR/NCAR staff and they have shared your information with me.

I am conducting a research project to determine if the LAOF Educational Deployment Program is meeting the needs of the community. You have a unique perspective that I am very interested in understanding and which will help shape the program in the coming years. Your participation in this survey is voluntary, though not anonymous. I am asking for your name so I can contact you in the next few weeks to ask a few follow-up questions, your name will not be linked to any data in my report.

The survey should take approximately three minutes, and I would very much appreciate your input and feedback!

If you have questions, please email me: rockwell@ucar.edu

Kind regards,
Alison Rockwell
EOL Education and Public Outreach Coordinator
o. 303.497.8758

1. What is your name?
2. How did you hear about the NSF Educational Deployment Program?
 - Industry Conference
 - Colleague
 - NSF/NCAR or Facility Personnel
 - Newsletter
 - NSF or UCAR/NCAR website
 - Social Media
 - Other - Write In
3. Of the information you have seen or heard about the program thus far, what elements have been most useful?
 - Talking with NCAR or NSF staff about the program
 - Available online information
 - Communicating about the program with someone who has previously requested facilities for educational uses
 - Informational flier or brochure
 - Other - Write In
4. Of the following facilities, which are you aware that can be requested? Please select all that apply.

- NCAR Integrated Surface Flux System (ISFS)
- NCAR Mobile Integrated Sounding System (MISS)
- NCAR High Spectral Resolution Lidar (HSRL)
- University of Wyoming King Air (UWKA)
- CSU CHILL Radar
- CSWR Doppler on Wheels (DOW)
- CSWR Mobile Mesonet
- CSWR Storm Pods

5. If you were to request a facility from the list above, please give a brief explanation as to why you would choose that facility over others?

6. In order to assess if the LAOF Educational Deployment Program is filling gaps in observing facilities already available to you, please indicate which of the following instrumentation, if any, you currently have available to you on your campus:

- Tethersondes
- Weather balloons/GAUS
- Surface flux towers
- Trace gas or ozone sensors
- Aerosol sensors
- Soil sensors
- Wind profiler
- Other - Write In

7. What type of information would be helpful and increase the likelihood that you would submit a request proposal?

- A streamlined online request process
- Examples of how others used the facilities and resulting data in their course activities
- The ability to contact previous requestors who are willing to share ideas and experiences
- A direct contact in the NCAR Earth Observing Laboratory
- Other - Write In

8. What type of supporting online information would enhance your students' learning about instruments and measurements? Please check all that apply.

- Videos about basic instrumentation
- Examples of how facilities are used in real-world research project
- Online interactive educational instrumentation resources
- Other - Write In

9. What barriers or hesitations have you encountered while considering a facility request for an educational deployment? Please check all that apply.

- Perceived time to learn how to operate facility

- Knowing what facilities are available
- Understanding how to integrate the facility and data into coursework
- Lack of information on the facility provider website
- Comfort level with integrating the data into coursework
- Unclear request process
- Understanding of how the program operates
- Other - Write In

10. In regards to your response in the previous question, please provide a brief explanation?

11. To what extent do you agree the LAOF Educational Deployment Program is meeting its goal *to provide a subset of the NSF Lower Atmosphere Observing Facilities to educators for authentic instruction in the field of observational meteorology?*

Strongly disagree	Disagree	Neither disagree or agree	Agree	Strongly Agree
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12. To what extent do you agree the LAOF Educational Deployment Program is meeting its goal *to foster students' competencies in observational science and engineering, furthering their understanding of geoscience?*

Strongly disagree	Disagree	Neither disagree or agree	Agree	Strongly Agree
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13. To what extent do you agree the LAOF Educational Deployment Program is meeting its goal *to provide opportunity for students to experience the interdisciplinary nature of science and engineering through a small-scale scientific field campaign?*

Strongly disagree	Disagree	Neither disagree or agree	Agree	Strongly Agree
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14. To what extent do you agree the LAOF Educational Deployment Program is meeting its goal *to provide the opportunity for early-career PIs to gain introductory experience with conducting a scientific field campaign while providing an impactful educational experience for their students?*

Strongly disagree	Disagree	Neither disagree or agree	Agree	Strongly Agree
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15. To what extent do you agree the LAOF Educational Deployment Program is meeting its goal *to expose students to basic instrumentation principles and measurement science through discovery-based learning in the field of observational meteorology?*

Strongly disagree	Disagree	Neither disagree or agree	Agree	Strongly Agree
-------------------	----------	---------------------------	-------	----------------

16. Do you have any comments regarding the program goals?

17. At the recent UCAR Members Meeting, and from the preliminary results of the NCAR Diversity, Education, and Outreach Coordinator's survey to all members, there was a clear call for instrumentation support.

Is the program meeting your needs for instrumentation support? Please explain.

18. Currently 28% of the current or previous PIs of educational deployments have been awarded two or more educational deployments.

In an effort to diversity the requesting PIs, is there anything that you would like to share about how to encourage and engage new PIs?

19. Will you be attending the AGU 2015 Fall Meeting in San Francisco and be willing to meet with me to discuss some of your ideas and comments in more detail? If so, please provide your email and I will contact you to set up a meeting time and location.

- If yes, please provide your email. Please enter an 'other' value for this selection.
- No

APPENDIX C
FORMER PI INTERVIEW QUESTIONS

Interview Questions
Group: Prospective PIs

1. Why did you request that facility that you did?
Probe - Did you have previous experience with that type of technology?

2. Would you request the same facility again? Why or Why not?
Probe - did you select the facility that you did because it fit into the course that you are teaching the best?
Probe - What is the topic of that course? Would exposure to another facility broaden the experience and understanding of that topic for your students?

3. Do you currently have facilities available to you on campus?
Probe – What are they?
Probe – would you foresee requesting a facility that would fill the gaps to those observing facilities?

4. What are barriers to you from requesting a different type of facility?
Probe - did you select the facility that you did because it fit into the course that you are teaching the best?
Probe - What is the topic of that course? Would exposure to another facility broaden the experience and understanding of that topic for your students?

5. As a previous requestor, what ways do you see the program could be enhanced?

6. What kinds of online materials would help support *you* with the integration of the facility into your class?

7. What kinds of online materials would help support *your students* with understanding the importance of research facilities (instrumentation) and data collection?

8. What was your experience with the request process?
Probe - Do you have recommendations to streamline it?

9. How long did you know about the program before acting on submitting a proposal?
Probe - what kept you from submitting a request sooner?

10. From your perspective, what suggestions do you have, if any, for EOL to encourage new requesters?

11. In what ways can we reach early-career professors?

12. How would feel about submitting a standardized summary report within the required 1-month of the project closing?

13. Would you be willing to be contacted by educators who are interested in requesting facilities for educational deployment and have questions about how you integrated the facility and data into your classes?

APPENDIX D
PROSPECTIVE PI INTERVIEW QUESTIONS

Interview Questions
Group: Prospective PIs

1. How did you hear about the Educational Deployment program?
2. Are you familiar with the available facilities? (NCAR ISFS, NCAR ISS, NCAR HSRL, CSWR DOW, CSWR Pods, CSWR Mesonet, CSU CHILL, UWKA)
3. If you were to request one of these facilities which one would you choose?
Probe - why?
4. Do you currently have facilities available to you on campus?
Probe – would you foresee requesting a facility that would fill in the gaps to those observing facilities?
5. How long have you known about the program?
Probe - What are barriers to you from submitting a request?
Probe - Time, Perceived experience with the facility and type of data?
6. What kinds of online materials would help support *you* with the integration of the facility into your class?
7. What kinds of online materials would help support *your students* with understanding the importance of research facilities (instrumentation) and data collection?
8. From your perspective, what suggestions do you have, if any, for EOL to encourage new requesters?
9. In what ways can we reach early-career professors?

APPENDIX E
IRB EXEMPTION LETTER

INSTITUTIONAL REVIEW BOARD

For the Protection of Human Subjects

FWA 00000165



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MEMORANDUM

TO: Alison Rockwell and Walt Woolbaugh

FROM: Mark Quinn *Mark Quinn CJ*

DATE: November 3, 2015

RE: "Program Improvement through Applying a Framework of Evaluation" [AR110315-EX]

The above research, described in your submission of **November 3, 2015**, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.