



Engineering Ambassador Network: Dissemination through an Inaugural National Workshop

Prof. Karen A. Thole, Pennsylvania State University, University Park

Dr. Karen A. Thole is the head of the Department of Mechanical and Nuclear Engineering at The Pennsylvania State University. She holds two degrees in Mechanical Engineering from the University of Illinois, and a Ph.D. from the University of Texas at Austin. After receiving her Ph.D., she spent two years as a post-doctoral researcher at the Institute for Thermal Turbomachinery at the University of Karlsruhe in Germany. Her academic career began in 1994 when she became an Assistant Professor at the University of Wisconsin-Madison. In 1999, she accepted a position in the Mechanical Engineering Department at Virginia Tech where she was promoted to Professor in 2003. She was appointed as the Department Head in July 2006 at Penn State. Dr. Thole's areas of expertise are heat transfer and fluid mechanics specializing in turbulent boundary layers, convective heat transfer, and high freestream turbulence effects. Dr. Thole has been responsible for attracting funding from such agencies at the US Department of Energy, US Air Force, United Technologies Corporation - Pratt & Whitney, Solar Turbines, Modine Manufacturing, and Siemens-Westinghouse. She has co-authored more than 100 peer-reviewed journal papers and has advised over 40 graduate theses.

Dr. Sarah E Zappe, Pennsylvania State University, University Park

Sarah E. Zappe is Director of Assessment and Instructional Support in the Leonhard Center for the Enhancement of Engineering Education at Penn State University. In her current position, Dr. Zappe is responsible for supporting curricular assessment and developing instructional support programs for faculty in the College of Engineering. In her research role, Dr. Zappe is interested in the integration of creativity into the engineering curriculum, innovation, and entrepreneurship. Dr. Zappe holds a doctorate in educational psychology specializing in applied testing and measurement. Her measurement interests include the development of instruments to measure the engineering professional skills and using qualitative data to enhance the response process validity of tests and instruments.

Ms. Melissa Marshall, Pennsylvania State University, University Park

Mr. Michael Alley, Pennsylvania State University, University Park

Michael Alley is an associate professor of engineering communication at Pennsylvania State University. He serves on the advisory board of the Engineering Ambassador Network. With Melissa Marshall and Christine Haas, he teaches advanced presentation skills to Engineering Ambassadors in workshops across the country.

Dr. Renata S. Engel P.E., Pennsylvania State University, University Park

Dr. Renata Engel is Associate Dean for Academic Programs in the College of Engineering at Penn State and has been a member of the Penn State faculty since 1990. Engel's research couples her interest in design and manufacturing with advanced materials, with a focus on computational modeling. She has also been involved in the scholarship of teaching and learning primarily to infuse design into the curriculum. For her contributions, she has received several individual and collaborative teaching awards, and is a Fellow of the American Society for Engineering Education. She has held several leadership positions in ASEE including those in the Middle Atlantic Section, and Mechanics Division. She has served on ASEE's Board of Directors, and was ASEE President in 2010-2011.

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The Engineering Ambassador Network, which was founded in May 2009 at the Pennsylvania State University, is a professional development program for engineering undergraduates with an outreach mission to middle and high school students. Three features distinguish the Engineering Ambassador programs of this Network from other outreach programs around the country that use undergraduate engineers. First, the Engineering Ambassadors in the Network use messages from *Changing the Conversation* by the National Academy of Engineering¹ to provide outreach presentations to middle and high school students on what engineers do. In effect, these presentations deliver effective messages (the marketing messages of *Changing the Conversation*) to the middle and high school students, rely on effective messengers (undergraduate engineers who are just a few years older than the target audience), and employ an effective mode of delivery (advanced presentation techniques).² Second, the Engineering Ambassadors themselves develop professionally because they receive training on the advanced presentation skills and leadership skills to carry out these presentations. Moreover, that communication training is deepened by Engineering Ambassadors actually going into middle and high schools to deliver those presentations. Third, the programs in the Engineering Ambassador Network are academically based, as opposed to being clubs as is the case with many other outreach programs that use undergraduate engineers—our contention is that grounding deepens the commitment of the Ambassadors.

In 2010, through support by United Technologies Corporation, the Engineering Ambassador program at Penn State expanded to a Network of four northeastern schools: Penn State, Rensselaer Polytechnic Institute, the University of Connecticut, and Worcester Polytechnic Institute. This Network had much success at providing the described presentations to middle and high school students throughout the Northeast. Then in August 2012, the Engineering Ambassador Network had a national workshop to add 17 pilot schools from across the United States. These pilot schools had a strong geographic diversity—from the University of Maine to Arizona State University and from the University of Washington to Georgia Tech with 13 other schools spread between. Supporting this national workshop was the National Science Foundation, the Penn State Electro-Optics Center, and the College of Engineering at Penn State.

This paper presents the activities that have taken place to scale the Engineering Ambassadors into a national network including a national workshop, an assessment of the effectiveness of the national workshop, and the future plans to sustain the network.

Introduction: Penn State's Engineering Ambassador Program

Penn State established an Engineering Ambassador Program in 2009 with an outreach mission by employing the marketing lessons from the National Academy of Engineering's *Changing the Conversation* through the partial support from the National Science Foundation (<http://www.engr.psu.edu/ambassadors/index.html>). After having

learned advanced presentation skills and the messages of *Changing the Conversation*, select undergraduate engineering students, mostly females, traveled to high school science classrooms across the Commonwealth of Pennsylvania to give presentations and show their passion for the engineering profession. The Engineering Ambassador Program grew quickly as a result of the interest expressed by the engineering students. In 2009-10, the Penn State Ambassadors visited 8 schools and spoke to more than 1000 middle and high school students. In 2010-11, they had 10 school visits and spoke to 2500 students. And in 2011-12, the Penn State Ambassadors had 11 school visits and spoke to 2900 students.

These visits benefited the middle and high school students as well as the teachers and guidance counselors.⁶ Consider the case of student Alyson Bonk, who saw two of the presentations in her high school. According to Alyson,³ that visit changed her career path. Because she learned the kinds of things that engineers did in acoustics, she switched from going to music school in New York to studying electrical engineering at Penn State (she is currently a junior). Also, because of that visit, one of her friends decided to study bioengineering instead of biology at Drexel.

Perhaps the greatest benefits of these visits, however, has fallen on the Ambassadors themselves. The Ambassadors, who were third and fourth year engineering students with strong academic records, received excellent coaching on advanced presentation skills. By giving polished presentations to large audiences, the Ambassadors gained both confidence and excellent communication skills in speaking to a range of people. Moreover, the Ambassadors have become leaders not only on campus but in their engineering internship positions.⁷

Since 2009, Penn State's Engineering Ambassador Program has grown from 12 Ambassadors (all female) to 65 Ambassadors in 2012 (more than 63 percent female). In addition, the Program now includes a three-credit elective course on advanced communications, which will be discussed later in the paper. Acceptance into the Engineering Ambassador Program has become competitive as a result of the strong interest from the engineering students. In 2012, 75 students competed for 40 open positions. The activities of the program focus on outreach and communication, which fall into two general categories:

Middle and high school outreach visits. During the visits to middle and high schools, the Engineering Ambassadors, who are relatable role models, generally provide two types of presentations. Six Ambassadors arrive at the school in the early morning and provide age and subject appropriate presentations and activities that are integrated with the science and math curriculum. Because the Ambassadors present in pairs, they present in up to three parallel classrooms at a time during the school day. The Ambassadors show how engineering is relevant to math and science by highlighting an engineering project such as developing a spinal implant. In addition, the Ambassadors start or conclude the day with a presentation about Engineering Careers in the school auditorium. The audience for this presentation usually ranges from 100 to 300 students.

On campus recruiting of prospective students and community

STEM events. The Engineering Ambassadors are active with campus recruiting as well. Each week, they provide tours of the College of Engineering facilities and give several presentations about the experiences and opportunities available to an engineering student. Tours consist of prospective students and families and range in size from five to 15 people. The audiences for the presentations average in size from 10 people for a regular, weekly event to 300 people for a major campus event. In addition, the Engineering Ambassadors are involved with promoting STEM through many local community events.

In the Engineering Ambassador Program at Penn State, students are required to enroll in a public speaking class as a part of their engineering curriculum *before* becoming an Ambassador. After being selected as an Ambassador, they enroll in an advanced communications course *during* the first semester of being an Ambassador. In the advanced communication course, the Ambassadors study innovative presentation techniques, communication strategies (written and oral) for varied audiences, and emerging web communication technologies. The outreach events of the Engineering Ambassador Program provide the context and practice forum for concepts and skills learned in the course. Attention is also given to strategies for effective leadership and networking.

Phase I: Expanding Beyond Penn State to Three Institutions in a Pilot Dissemination

Given that the Engineering Ambassador Program at Penn State develops communication skills far beyond what is typically taught, and given results of a mechanical engineering industry survey that indicated the need for engineers to have strong communication skills⁴, companies began to show interest in the Engineering Ambassador Program. One such company, United Technologies Corporation, encouraged and partially supported Penn State to disseminate the details of the Engineering Ambassador Program to their strategic university partners: Worcester Polytechnic Institute, Rensselaer Polytechnic Institute and the University of Connecticut. United Technologies provided partial support for the operation at all four institutions.

In the pilot dissemination of the program to these three institutions, Penn State faculty worked with experienced Ambassadors to create a 2.5-day communication workshop for the prospective Engineering Ambassadors and the faculty advisors at the other three institutions. The main goal of the workshop was to educate the prospective Ambassadors on how to give effective presentations using the *Changing the Conversation* messages. This initial workshop and subsequent training workshops have consisted of each prospective Ambassador performing preparation work before the workshop, receiving communication instruction, developing a presentation, receiving multiple critiques of that presentation during the workshop, and then giving that presentation before a large audience at the workshop's showcase event. Later workshops have included parallel instruction sections on advanced communication strategies for experienced Ambassadors.

Through this pilot dissemination, the teams from the three partner institutions learned how to initiate and sustain their programs. The partnership has resulted in bi-annual workshops (one focused on communication skills and the other focused on leadership skills) to train new Engineering Ambassadors as well as to share best practices such as examples of demonstrations to accompany the talks for improving all the programs. The expansion to four institutions resulted in a network that deepened the development training for all the Ambassadors and strengthened each school's outreach efforts.



Figure 1: Scenes from Engineering Ambassador events: Danielle DaSilva presenting in a high school chemistry class; Keri Wolfe addressing prospective engineering students and parents; and Danielle DaSilva coaching new Engineering Ambassadors from WPI: Emily Miner and Hannah McCallum.

Phase II: A Workshop for Initiating an Engineering Ambassador National Network

Between 2010-12, numerous faculty and department heads from across the United States inquired about the Engineering Ambassador Programs at Penn State, RPI, UConn, and WPI with the intention of emulating it at their own institutions. Given this interest, we requested and received support from the National Science Foundation to hold an inaugural national workshop to disseminate information on how to start an Engineering Ambassador Program (<http://www.engineeringambassadors.org/>).

The Engineering Ambassador National Workshop was hosted by the Penn State University on August 17–19, 2012. The workshop was coordinated by a team of faculty and students at Penn State and directed by a steering committee with members from ASME, industry, and two academic institutions. The program was advertised in ASEE's *Prism*, which has an international distribution. In addition, email listservs were used to send announcements through professional organizations including ASME, IEEE, ASCE, SWE, and WEPAN. An informational website was also created: www.engr.psu.edu/ambassadors/workshop.

The goal of the workshop was to create a pilot Engineering Ambassador program by training two to four Engineering Ambassadors at each participating institution. In selecting institutions, those chosen came from a diverse range of institutions with a high likelihood for success in scaling the pilot programs to full-fledged programs. The National Science Foundation funding was used to provide travel support and cover hotel and workshop costs for selected participants, with the goal of encouraging participation from a diverse range of schools across the country.

In addition to the four pilot schools, a total of 110 people from 17 institutions across the United States attended the 2.5-day workshop. Attending the workshop were 39 engineering undergraduates and 55 faculty and administrators. As shown in Figure 2 and Table 1, the goal of achieving diversity both in type of institution and in geography of institution were achieved. Also, as seen in the photo of participants, we achieved our goal in having a strong representation of groups historically under-represented in engineering (for example, 31 of the 39 newly trained Engineering Ambassadors were female). The workshop achieved the following outcomes:

1. All participants received an overview of the four existing Engineering Ambassador Programs;
2. All new Engineering Ambassadors received presentation training, coaching, and multiple critique sessions, to help them leave with a successful presentation in hand for a high school visit;
3. Faculty advisors discussed strategies on forming and sustaining an Engineering Ambassador program;
4. A showcase of the student's presentations at the workshop's end; and
5. An online community was created for discussions on sustainability and national assessment.



Figure 2: On the left is a map of participating institutions in the national workshop: pilot programs are in blue, and member programs are in yellow. On the right is a photo of attendees.

Table 1: Attending Institutions of the Engineering Ambassador National Workshop.

Member Schools	Pilot Schools	Pilot Schools
Penn State	Arizona State University	University of Alabama
Rensselaer Polytechnic Institute	Carnegie Mellon University	University of Delaware
University of Connecticut	Eastern Michigan University	University of Illinois-UC
Worcester Polytechnic Institute	Georgia Institute of Technology	University of Maine
	Kansas State University	The University of Texas Austin
	Michigan Technological University	University of Washington
	Milwaukee School of Engineering	University of Wisconsin-Platteville
	Morgan State University	Vanderbilt University
	Oregon State University	

Prior to arriving at the workshop, students from each pilot institution were placed in teams of two or three and asked to complete preparation assignments. These

assignments included reading excerpts from the National Academy of Engineering's *Changing the Conversation*, choosing an appropriate topic, and creating drafts of visual aids following the assertion-evidence slide design^{2, 5} using the provided templates. Experienced Engineering Ambassadors and faculty from Penn State provided feedback on the preparation assignments prior to the workshop. During the workshop, each team continued their work to create a 10 to 15 minute presentation for school outreach visits, which they presented at the conclusion of the workshop in a showcase. Experienced Engineering Ambassador mentors from the four member schools were assigned to each team. The mentors worked with the teams throughout the workshop to assist them in developing their presentation.

Assessment of the National Workshop

Pre- and post-assessments were done for those students who participated in the workshop. Students were asked a set of eleven questions regarding their level of confidence with presentation skills. The question stem asked the students, "In a presentation to middle or high school students that communicates the messages of *Changing the Conversation*, I am confident in my ability to do the following." The students were asked to rate eleven phrases using a 5-point scale from Strongly Disagree (1) to Strongly Agree (5). All item means improved from the pre- to the post survey. Using an alpha of 0.05, the averages were significantly different for 7 of the items that were assessed, as listed below:

1. Create content that will engage the audience ($p=0.02$).
2. Establish credibility with the audience ($p=0.03$).
3. Know what details to include and what details to leave out ($p=0.01$).
4. Create slides that help the audience remember the information ($p=0.01$).
5. Select an appropriate slide design: typography, layout, arrangement of details, and level of detail ($p<0.00$).
6. Deliver the content in front of a large group ($p<0.00$).
7. Hold the audience's attention for 15-20 minutes ($p<0.00$).

Faculty also participated in several sessions to discuss how to establish and manage an Engineering Ambassador program. One such session was done in "speed dating" style where faculty rotated tables to have focused discussion. Topics included the following: managing a program, training Engineering Ambassadors, coordinating outreach visits, and sustaining a program. Another session was devoted to a discussion about the vision for the Engineering Ambassador Network and how to sustain a national network. Faculty had the opportunity to ask individual questions of workshop leaders and were introduced to the website created as a forum for future collaboration and home for the Engineering Ambassador Network: www.engineeringambassadors.org. This site chronicles the ongoing development of the Engineering Ambassador Network and features participating programs and institutions. In addition, a Facebook page and Twitter account are being utilized to stay in touch, share success stories, and develop the Engineering Ambassador Network community. During the discussions with the faculty at the 17 institutions, three characteristics for Engineering Ambassador Programs were defined and agreed upon as follows:

1. Communicating messages from *Changing the Conversation*;
2. Performing outreach to middle and high schools; and
3. Learning professional development skills through academically based programs.

The faculty participants of the Engineering Ambassador Workshop were asked to complete two surveys. The first survey was administered online the week prior to the workshop; the second survey was administered on paper immediately following the workshop. A total of 22 participants completed the online pre-survey. Two primary categories of responses emerged from the data. First, participants focused on the *benefits of the Engineering Ambassador Programs to the community* of prospective and current students. Responses in this category focused on the importance of increasing interest in STEM careers by K-12 students, increasing enrollment by students from underrepresented groups, and increasing retention for current students. A second category of responses concerned the *development of skills by the Engineering Ambassadors*. Many respondents noted that a successful program will enhance skills and characteristics of the ambassadors themselves. Participants listed benefits such as communication skills, facilitation abilities, teamwork, and confidence. Other survey responses stated the needed support from the administration, representing multiple engineering disciplines, and being adaptable to different types of campuses and high schools.

Future Phases: Activities to Sustain the Engineering Ambassador National Network

Significant strides have been made in developing an Engineering Ambassador Network since the inaugural workshop. However, work to support and develop this network remains critical at this time so as not to lose momentum. Based on the outcome of the inaugural national workshop the following strategy has been employed as illustrated in Table 2.

Table 2. Progression of Activities for the Engineering Ambassador Programs.

	Near Term Activities (2012-13)	Intermediate Activities (2013-17)	Sustainable Engineering Ambassador Programs (Beyond 2014)
Workshops	3 training workshops given at institutions 1 faculty workshop given at ASEE meeting Both supported by ASME	15 workshops to be given at institutions Support requested from NSF	ASME Annual EA Conference with workshops To be supported by ASME
National Network Structure	Development of framework for National EA Network supported by ASME Supported by ASME	Framework completed and approved for implementation To be supported by ASME	Framework implemented and sustained through ASME

An immediate need was identified to ensure participating universities receive the training necessary for their own faculty advisors and prospective Engineering Ambassadors. To meet this critical need, a number of near-term activities were defined

and initial support was secured from ASME, which is the professional society for mechanical engineers. ASME has a strong interest in including the Engineering Ambassador Network in their portfolio of programs offered to students and early career engineers. ASME recognizes the opportunities that Engineering Ambassador Programs have to recruit a diverse student population for all engineering disciplines.

For developing the framework, a portion of the ASME funds have been provided to support the planning on how the national Engineering Ambassador Programs will interface with ASME. An operational structure for the National Engineering Ambassador Network will be defined such that it will ultimately be managed and sustained by ASME. The framework will include suggested staff roles to support the network, the budgetary support required to execute a successful network, and a model to ensure the training necessary for Engineering Ambassadors and their advisors can be continually disseminated. In addition, the framework will suggest membership requirements for participating institutions, keeping in mind the benefit of the program's flexibility of adapting to many different types of institutions. The funds will be used to define a structure in which the quality of the Engineering Ambassador program remains high, and offer the essential support system for participating institutions and new schools who want to start a similar program. Part of the success of the founding partner schools can be attributed the collaboration between the Engineering Ambassador advisors and the support system that ensued. The network will allow the same benefit to participating institutions in sharing materials, offering invaluable networking opportunities, and providing countless training and learning opportunities for the Engineering Ambassadors and their advisors.

The remaining ASME funds will be used to support workshops on-site at three institutions as listed in Table 2 (University of Illinois, Georgia Tech, and Morgan State) and will provide one train-the-trainer (faculty) workshop in conjunction with the ASEE meeting in Atlanta (facilities at Georgia Tech will be used).

Two critical items are still needed with funding being secured to provide: (i) intermediate support to support the training needs of the network of institutions developed during the inaugural workshop at Penn State; and (ii) long-term sustainability from the ASME after the framework is achieved for the community. These activities are in progress.

Conclusion: Sustaining a National Network of Engineering Ambassadors

The Engineering Ambassadors National Workshop and the activities leading up to the workshop have catalyzed a network of universities to join the effort to change the conversation about engineering. It is through this network that we can achieve a nationally recognized outreach program that leads to outstanding engineering students who have the professional development skills required to be engineering leaders.

The workshop showcased the existing programs, communication and leadership training for future ambassadors, and faculty preparation for launching a new engineering ambassador program at their university. The workshop led to the establishment of a national network of engineering ambassador programs. The expected outcomes of this

national network include (1) strengthening the communication skills of those students that participated in the Engineering Ambassador Program leading to a more informed public, and (2) recruiting a diverse population of students to study engineering by using the messages promoted by the National Academy of Engineering.

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