
AC 2011-851: IMPACT OF AN NSF ADVANCE INSTITUTIONAL TRANSFORMATION GRANT AT A STEM-DOMINANT UNIVERSITY

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Introduction

The National Science Foundation's ADVANCE program was established to increase the representation and advancement of women in academic science, technology, engineering and mathematics (STEM) careers. Virginia Tech has used its ADVANCE funding to take a comprehensive approach to institutional transformation, incorporating activities to increase the pipeline of women preparing for academic science and engineering careers, improve recruitment and retention of women, develop women leaders, update work-life policies, and warm department climate. Prior to the conclusion of the grant, the university reviewed all activities for impact and potential sustainability. Assessment activities included tracking numbers of women at various levels across the university, individual activity evaluations, campus-wide faculty surveys, tracking of policy utilization, interviews, and focus groups. Such a mixed-methods approach combines quantitative and qualitative indicators of change and provides deeper insight into the impact of interventions on the experiences of women faculty. This paper uses feedback on the impact of ADVANCE program activities from focus groups of female engineering professors and quantitative data from faculty surveys to explore perceptions of climate and work-life balance in the college of engineering.

National Science Foundation's ADVANCE program

Women have made much progress in science and engineering over the past 30 years, but they remain underrepresented in both degree attainment and academic careers in many STEM disciplines.¹⁻³ In 2007, women earned 47% of science and engineering doctoral degrees awarded to U.S. citizens and permanent residents, up from 33% in 1989.⁴ Women's share of faculty positions has also increased over the past 30 years but at a slower rate than degree production, and representation of women in both degrees earned and academic employment varies widely by field of study. In engineering, women earned 20% of PhDs in 2006 and constituted just under 11% of tenured or tenure-track faculty and 5% of full professors in the same year.³

In 2001, the National Science Foundation (NSF) announced a new program to address the underrepresentation of women in science and engineering. Unlike previous programs that had primarily focused on individual women, the ADVANCE program addresses the institutional structures and practices that have differential impacts on women pursuing academic careers. According to the program solicitation, "The goal of the ADVANCE program is to develop systemic approaches to increase the representation and advancement of women in academic science, technology, engineering and mathematics (STEM) careers, thereby contributing to the development of a more diverse science and engineering workforce."

Fifty-three universities received five-year, multi-million dollar ADVANCE Institutional Transformation grants in five rounds of awards through 2010. These institutions have taken a variety of approaches to transformation, from a focus on hiring more women to preparing women for leadership roles, educating department heads, and revising university policies.⁵ As

grant funding for the early awards expires, these institutions are evaluating the impact of programs and prioritizing activities for continuation.⁶⁻⁸

Institutional Context

Founded in 1872 as a land-grant institution, Virginia Tech is now a comprehensive research university with the largest number of degree offerings in Virginia. A doctoral STEM-dominant institution (previously known as Research I), Virginia Tech is located in Blacksburg VA, a rural area in the southeastern United States. Like many land grant institutions, it is the largest employer and a significant economic driver in the local area. The university boasts over 30,000 students and over 104 doctoral programs in eight colleges, and generated \$396.7 million in funding for research programs in fiscal year 2009, ranking it 44th in the nation. In the most recent fiscal year (2009-10), the university received 2,472 contracts and grants to conduct research, leading to 44 patents and 45 licenses in 2009. As of fall of 2010, the institution had 1,273 full-time, tenured or tenure-track faculty members, 27% of whom were female.

ADVANCE at Virginia Tech

Virginia Tech received an ADVANCE Institutional Transformation grant in 2003 as part of the second round of grant awards. The university used its ADVANCE funding to take a comprehensive approach to institutional transformation, incorporating activities to increase the pipeline of women preparing for academic science and engineering careers, improve recruitment and retention of women, develop women leaders, update work-life policies, and warm department climate. Programs were developed and implemented with four specific outcomes in mind:

1. A change in the awareness, attitudes, and behaviors of key administrators and faculty members in engineering and the sciences regarding gender equity issues.
2. A significant increase in the percentage of women in visible positions as academic and technical leaders and as senior scholars in engineering and the sciences.
3. A significant increase in the percentage of women faculty in science and engineering.
4. A significant increase in the percentage of women in engineering and the sciences who choose faculty careers.

As the program evolved, activities were modified in response to feedback from participants, changes in leadership, and lessons learned from other ADVANCE institutions.

Activities focused on changing awareness, attitudes, and behaviors of administrators and faculty, included:

- faculty surveys to identify and prioritize issues related to department climate, work/life balance, and other contributors to faculty success;
- review of university policies related to work/life balance and creation of new and revised policies;
- an annual day-long workshop open to the university community on “advancing women” that has evolved to embrace “advancing diversity”;
- workshops for new department heads and university leaders; and

- an online compendium of “promising practices” for a productive department climate.

Programs to increase women in administrative and technical leadership roles included:

- an intensive coaching program for three cohorts of tenured women professors interested in strengthening their leadership skills,
- leadership fellowships that allowed a small number of women to spend up to a year in a self-designed intensive leadership development experience,
- seed grants for pre-tenure women faculty to jump start their research programs,
- informal lunches with current university leaders, and
- visiting lectures by senior women in leadership roles.

To increase the number and percentage of women STEM faculty, the Advance program:

- developed a brochure (adapted from another Advance institution) and presentation to educate search committee members on unconscious bias in evaluation,
- provided funding to departments to proactively invite potential faculty candidates to campus in advance of a formal search, and
- established “liaisons” in the colleges of science and engineering to provide information about university policies to visiting faculty candidates.

Seminars for Virginia Tech graduate students on preparing for faculty careers and a two-day summer workshop for a nationally-selected group of future faculty sought to encourage young women to pursue academic careers.

Measuring the Impact of ADVANCE at Virginia Tech

Assessment of the impact of Advance on the university included tracking the numbers of women at various levels across the institution, individual activity evaluations, campus-wide faculty surveys, tracking policy utilization, interviews, and focus groups. During the grant period, annual reports required by the NSF tracked the numbers and percentage of women at various positions within the institution. Participants in activities such as the graduate student seminars, annual workshops, and networking events for women faculty were asked to complete questionnaires to provide feedback on those programs. Program staff interviewed individuals who received seed grants or participated in the leadership coaching program about the impact of those programs on their careers. Tenured and tenure-track faculty across the university completed surveys in 2005 and 2008, years two and five of the grant, on their perceptions of university and department climate, leadership, work/life balance, diversity, and overall job satisfaction. Use of the university's work/life policies by both male and female faculty (primarily stopping the tenure clock and modified duties) is tracked. In 2010, program staff also conducted focus groups of female engineering faculty to obtain perceptions of changes at Virginia Tech over the course of the grant.

Quantitative Indicators: Numbers of Women

While feedback on the graduate student seminars and workshops was generally positive, it proved impossible to obtain a quantitative measure of a change in the percentage of women students in engineering and the sciences choosing to pursue faculty careers. Actual numbers and

percent of women faculty at Virginia Tech are easier to track. The number of women at the rank of professor university-wide has increased from 65 in 2003-04 to 91 in 2009-2010, an increase from 11% to 15%. This increase of women at the most senior faculty rank is significant because achieving the rank of professor is a prerequisite for many senior leadership roles in academe, including most endowed professorships or distinguished scholar designations. The number of women faculty holding endowed chairs (eminent scholars) has increased from three (3%) to eight (7%) in the same time period, although few of these individuals are in the STEM fields.

The number and percentage of women tenured and tenure-track faculty in the College of Engineering has increased from 26 (9.4%) in fall 2003 to 40 (13%) in fall 2009. With three women named interim department heads in 2010, the college of science now has two female department heads and the college of engineering has three. However, the growth in the number of women faculty in the college of engineering occurred in the early years of the grant (see Figure 1). More recently, new female faculty hires, primarily at the junior ranks, have been offset by the departure of several senior women faculty members. While these women faculty have moved into leadership roles at other institutions, perhaps indicating a positive impact of Advance, they are nevertheless a loss for Virginia Tech.

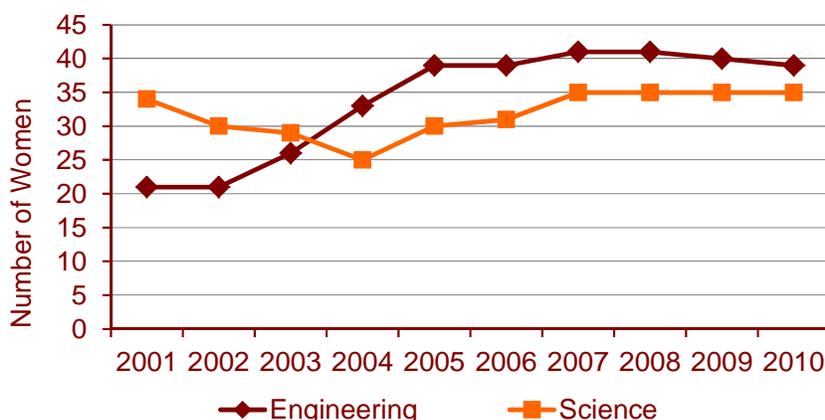


Figure 1: Female Tenured and Tenure-Track Faculty in Virginia Tech’s Colleges of Science and Engineering, 2001-2010

Quantitative Indicators: Faculty Surveys

The Advance program surveyed the faculty at Virginia Tech twice over the course of the grant. The purpose of both surveys was to assess faculty perceptions of overall job satisfaction and of various attributes of the work environment at Virginia Tech. The 2005 Work-Life Survey was a web-based instrument designed using examples from other Advance institutions (primarily the University of Michigan and University of Wisconsin) and from a review of the literature about factors that predict overall faculty job satisfaction. The final questionnaire contained 130 items organized in sections addressing the university climate, department climate, work-life and family factors, and recruiting. The survey instrument is available online at http://www.advance.vt.edu/Measuring_Progress/Faculty_Work_Life_Survey.html. An electronic version of the survey was distributed by Virginia Tech’s Survey Research Center to all tenured,

tenure-track, and special research faculty in February 2005 via an email from the university provost with an embedded, personalized link. Non-respondents were contacted through a wave of follow-up emails until there was almost no yield of additional respondents. Of the 2,015 tenured, tenure-track, and special research faculty members contacted, 1,209 completed the survey, yielding a response rate of 59%. Of these, 810 respondents were tenured or on the tenure-track.

In fall 2008, the Advance program conducted its second faculty work-life survey. In order to qualify as a pre-post measure, the 2008 Work-Life Survey was constructed to look as much like the 2005 survey as possible. The questionnaire was distributed electronically in January 2009, following procedures that were very similar to the 2005 survey. The population that received the second survey differed slightly from that of the first. There were 1,570 faculty members in the sample for the 2008 survey, including full-time instructional faculty of all ranks and instructors not in tenured lines, but special research faculty were not included. All of the faculty members receiving the questionnaire were actively employed during the spring 2008 and fall 2008 semesters. The response rate for tenured and tenure-track faculty was lower in 2008 than in 2005, with 700 tenured and tenure-track faculty respondents for a response rate of 45%.

Within the Faculty Work-Life Survey, groups of questions were combined to form “scales” representing constructs of interest regarding faculty work-life such as department climate, work/life balance, and overall job satisfaction. Scales are used in order to create more valid and reliable measures of topics of interest compared to using single question items. All scales demonstrated acceptable internal consistency reliability as measured by Cronbach’s alpha (i.e., greater than 0.70), which measures the correspondence in responses across the question items in a scale. For analyzing and portraying the survey data, responses across all question items for a scale are aggregated to represent that scale. Most questions in the survey were answered on a 4-point Likert-type scale where 1=strongly disagree, 2=somewhat disagree, 3=somewhat agree, and 4=strongly agree. Some questions were “reverse written” such that lower ratings are desirable (as opposed to higher ratings); these questions were reverse-coded prior to analysis so that for all items and all scales, higher values are desirable. Mean responses higher than 3.0 reflect positive perceptions (“somewhat agree” and “strongly agree”).

For the university overall, perceptions of department climate were somewhat positive in both surveys, with scale score means of 3.20 in 2005 and 3.16 in 2008 (not a significant difference). The ten questions on the department climate scale included, for example, “I have good relationships with my co-workers,” “I am treated with respect by other faculty members in my department,” and “My department at Virginia Tech is a good place to work.” While both men and women had somewhat positive perceptions of department climate, men in general were more positive than women (scale score mean of 3.22 for men in 2008 compared with 3.03 for women, a statistically significant difference). Within the college of engineering, perceptions of department climate were similar to those of the university overall, with scale score means of 3.15 in 2005 and 3.16 in 2008 (no significant difference), however there were statistically significant differences in perceptions of climate across departments within the college, with department level scale score means ranging from 3.00 to 3.63, as shown in Figure 2. For confidentiality reasons, it was not possible to report results by gender at the college or department level.

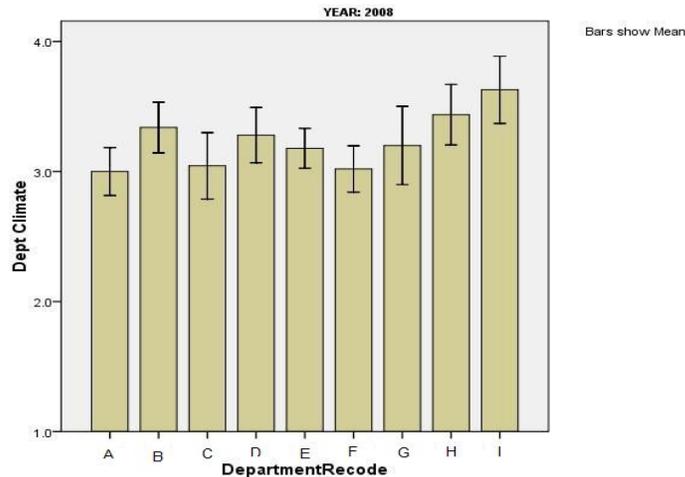


Figure 2: Department Climate Scale Score Means for Departments within the College of Engineering, 2008

Qualitative Indicators: Focus Groups

Since NSF ADVANCE grants are specifically geared toward promoting and enhancing the careers of women in academic science and engineering, program staff conducted a series of focus groups with female engineering faculty members to obtain their perceptions regarding changes at Virginia Tech over the course of the grant. All female engineering faculty members were invited to participate in a focus group via email, and follow up invitations were sent to non-respondents. Two focus groups were held in January 2010 and a third focus group was conducted in October 2010. Of the 40 women engineering faculty members invited to attend a focus group session, 13 participated for a response rate of 32%. These 13 individuals represented a wide variety of academic departments as well as personal and professional backgrounds. Focus group participants also represented the following ranks: four (31%) were full professors, six (46%) were associate professors, two (15%) were assistant professors, and one (8%) was a full-time administrator. Two focus group sessions were conducted with five participants, and the third was conducted with three participants. Each focus group was conducted on the Virginia Tech campus and was 1.5 hours in length. Focus group sessions were audio recorded and program staff created detailed transcriptions of the focus group discussions for use in data analysis.

The ADVANCE grant appears to have impacted individual women engineering faculty members quite differently. For some it has had a substantial impact, others a more modest impact, and others virtually no impact. Some of this difference appears to be based on the individual's level of involvement in programs and/or advisory groups, whether or not they received grants and/or took advantage of new work-life policies, etc., and some of it appears to be based on the faculty member's home department and the actions/involvement of her department chair.

“There seems to be a difference in to what degree different departments understand the policies and take advantage of them or know about them or that the culture is following the policies ... Advance is a really good mechanism for the people who participate in Advance, particularly the ones who go to Advance events and hear about these policies, but in a department where the majority of people don't feel a tie to Advance, or don't feel

that the activities are worthwhile, where people don't show up at any of the events, the information is not making it into the culture, haven't hit that tipping point where people understand those things.” – focus group participant

“...My biggest concern is it's still so department by department, the culture. I know our dean is very supportive of the outreach I'm doing, some non-traditional things, but how do you translate, change a culture when you're a department head that's ...” – focus group participant

“The impact was probably more for the future than it was for our first few years.” – focus group participant

The general consensus from the focus groups is that Virginia Tech is more family-friendly than it used to be. Newer faculty members with families appear to be having a different experience than their colleagues with more years of service (e.g., faculty members who started as assistant professors in the 2000s vs. faculty members who started as assistant professors in the 1990s or earlier).

“One thing that has been a change I think largely as a result of the Advance grant is I do think the focus on work-life balance and being more family-friendly. That really has changed quite a lot.” – focus group participant

“I think that that directly reflects a change in attitude. It's actually okay to have a baby, it's okay to have to do certain things that's part of your life and your kids, it's almost...it's acceptable. Whereas years ago it wasn't something that was very acceptable. I think that the desire of those in administration to keep the good people that we've got is making them understand that they need to be flexible about things. And, people are pushing, that's the other thing. Twenty years ago you wouldn't have asked these things, you would have tried to have a baby on the side...” – focus group participant

“The newer, younger faculty members are expecting...They have expectations that we did not have. And those expectations are being met, I think. Which is a good thing.” – focus group participant

Three things that were mentioned in all three of the focus groups that appear to be related to this increase in family-friendliness are improved day care, dual career hiring, and work-life policies. Although multiple participants indicated that there is still a great deal of room for improvement related to these three issues, faculty perceive advances in these areas as positively impacting the culture and climate of the university, especially those individuals who have directly benefitted from the new policies and programs. Thus, improvements in day care, the dual career hiring process, and work-life policies can be described as “high impact” initiatives.

An important contributor to the university being more family-friendly is that men (e.g., deans and department heads) have been strong advocates for improvement and change. Women focus group participants shared their belief that male advocates were instrumental in changing the conversation from one in which work-life balance issues were considered to be “women’s

issues” to one in which work-life balance issues and policies are considered to be “faculty issues,” relevant to all faculty members regardless of gender.

“I don't know that this is really in just my department, but maybe I notice this because of... meeting other faculty and faculty candidates, but one thing that I think is the case is that back with Dean [X] starting that initiative and then that being moved forward by Advance and Dean [Y] and by the Provost, is that it really made that issue of child care not just a women's faculty issue. That's the thing that always used to bother me so much about this, "Oh, that's a women's issue." It's not – it's a faculty issue. We are more likely to have men faculty that have a working spouse or partner too, so they are concerned about this as well. That's one thing it feels to me like that getting going and the action on that really elevated it to being one that was easily talked about, it's okay to talk about as a general faculty issue, and you didn't feel as a woman weird bringing it up and talking about it with men candidates that I meet with. They are eager to hear about it, really pleased that I bring it up and also bring up other work-life policies that Advance has instituted, especially the dual career office. I think that really was a fundamental shift in how we think about these things by the leadership, actions to put some resources and attention on it, especially given that those leaders have been men.” – focus group participant

Some female engineering faculty members felt that the Advance program has clearly had an impact on the institution:

“I think that the grant and the program have created a fundamental shift in the university's culture. Maybe not in every college, but certainly in engineering and science where it's been targeted. Something is really significantly different being aware of all the issues that Advance is about – work/life balance, professional development of faculty, caring about somebody once they're here ... all of these kinds of things. I think it's fundamentally different than before we had the grant. It's been a really positive thing for the university.” – focus group participant

“I really don't...and this is a stretch, but I really don't think that we would be the institution we are right now without having had the Advance money. That's a no-brainer to me. The Advance grant allowed and forced the university to make some changes that they might not have done. ... I really do see the benefits of having had the grant here.” - focus group participant

Other focus group participants, while acknowledging the impact of Advance, pointed out areas where the program has yet to reach:

“There are some department heads that I'm used to seeing at Advance events, but then there's others that don't go to anything. ... There's such a difference in our department, some are totally clued into what's going on and all the ways that you can interpret and take advantage of things, and there are others are just...” - focus group participant

“The good and the bad thing about Advance is that there have been women who have succeeded in the department who have left the university” - focus group participant

Sustaining ADVANCE at Virginia Tech

Prior to the conclusion of the grant, the university reviewed all activities for impact. Some have now been “institutionalized” into day-to-day operations, while others have been discontinued and still others have expanded to address broader definitions of diversity. The following activities receive on-going institutional support:

- Faculty recruitment: The Visiting Scholars program to foster relationships with potential future faculty candidates outside the regular search process, and a “Future Faculty” workshop for PhD candidates from underrepresented groups (women and ethnic minorities) preparing for academic careers are supported by the Office of the Provost.
- College liaisons: College liaisons in the colleges of science and engineering support faculty searches by meeting with candidates to discuss work/life policies. Liaisons also promote networking and mentoring among women faculty. The College of Engineering and the College of Science provide financial support in the form of a course release or administrative supplement for the faculty members serving as college liaisons.
- Dual Career Assistance: A program coordinator, data base, and services have permanent funding through Human Resources and the Office of the Senior Vice President and Provost. In addition, the provost provides bridge funding to assist with some dual career appointments, where appropriate.
- Stop-the-clock: An extension of the tenure clock is automatically provided for either parent for the birth or adoption of a child, and may be approved for other special personal or professional circumstances. Language explaining the policy is included in letters requesting external reviews for promotion and tenure.
- Modified Duties: Central funds are committed to provide up to \$10,000 to the department for workload reassignment of faculty members approved for a semester of modified duties to accommodate family responsibilities or other life issues.
- Child care: Each college dean and the university administration has pledged five years of annual support from discretionary private funds for a contract to a local daycare provider to expand daycare in the community. In return for this annual subsidy, the provider guarantees 60% of the 246 new slots to Virginia Tech families.
- Annual Advancing Diversity at Virginia Tech workshop: The Senior Vice President and Provost and the Vice President for Diversity and Inclusion support this annual event for the university community.
- Annual new department head orientation workshop: The Associate Provost for Faculty Affairs organizes and sponsors what has become a series of professional development workshops for new and ongoing department heads.
- Faculty networking and mentoring: The provost provides support for micro-grants for pre-tenure faculty to develop mentoring networks and leadership seminars for senior faculty.
- Administrative support: The Provost provides office space and funding for the Program Director. The Graduate School provides support for a graduate assistant assists in developing and offering a suite of programs for women doctoral students in STEM fields.
- Graduate student seminars: The graduate school and the provost provide ongoing support for a monthly seminar series for graduate students preparing for faculty careers.

Reflections and recommendations

Both the faculty work-life surveys and the focus group discussions indicate that while the Advance program at Virginia Tech has made an impact on the institution, the climate for women faculty in engineering varies across and within departments. Some departments have been more pro-active than others in encouraging faculty to take advantage of work-life policies and in creating a culture of transparency and collegiality. Additional areas for ongoing attention identified by focus group participants directly related to Advance include improvements in mentoring, especially at the associate professor level; retention of women faculty; recruiting and retaining people of color, not just women; and recognition and rewarding the contributions of women faculty (e.g., awards, endowed chairs). A university-wide initiative to improve faculty mentoring at all levels is currently underway.

Looking back over the seven years of the Advance grant, it is clear that institutional transformation doesn't happen overnight, but is an incremental process that takes time and continued investment. Persistent, effective leadership from the top is crucial. Active engagement on the part of the provost, deans, and department heads have been key to the progress made to date at Virginia Tech. Family-friendly policies are important, but will not have the intended impact unless the culture of the department ensures that faculty members are comfortable taking advantage of the policies. Perceptions matter, and different kinds of evidence are convincing to different people. Engineers like tables and graphs, but scholars in other disciplines respond to more qualitative data. Finally, institutional transformation requires changes to policies, practices, norms, and culture – and faculty norms and culture are very difficult to change.

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