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Advancing Women Faculty in Engineering through Institutional Transformation: The Iowa State University NSF ADVANCE Program in the College of Engineering

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Keywords
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Introduction and Background:

As a means to introduce the context in which the ADVANCE program at ISU is being implemented, a brief description of ISU is useful. Iowa State University of Science and Technology is a land grant institution with a 150 year history of strength in science and engineering. The university, with over 25,000 students and 1,700 faculty, has 8 colleges, the second largest of which is the college of engineering with a faculty of 190 and a student population of 5,300. Iowa State's undergraduate student population is 43% women and the faculty is 29% women in tenured or tenure eligible positions.[1] However, within the college of engineering, only 14.7% of the students are women, a fraction that has been decreasing since 1996. Compared to national data, while the trends are somewhat similar, ISU has a lower percentage of women students than the national average of 19.3%.[2] National faculty data show that the fraction of women in engineering faculty positions has increased in the last 6 years from 9 to over 11%, though remains dominated by assistant professors (almost 20%), and associate professors (13%), rather than full professors (6%).[3] However, in the College of Engineering at ISU, there is a smaller fraction (8.6%) of women faculty, recovering slightly this year after a 5 year decline. Additionally, the attrition rate for ISU women faculty in STEM fields (Science, Technology, Engineering and Mathematics) is significantly higher for women as compared to men (especially in the first three years).[4] A 2005 report from a study by the University

Committee on Women at ISU provided a more complete assessment of the status of women faculty in engineering, analyzing both numerical and anecdotal data from faculty interviews. Analyzing these data, the report articulated key issues of concern for women faculty and made suggestions for improving both recruitment and retention of women.[5] Many of the results from this study are similar to the results of the studies performed in preparation for securing this NSF ADVANCE grant for ISU, including concerns about isolation, mentoring, transparencies of policies regarding promotion and tenure, and balancing work and family.

While the focus of this paper is the ADVANCE program as it pertains to the College of Engineering, it is important to recognize that there are two other Colleges (Liberal Arts and Sciences and the College of Agriculture and Life Sciences) that have a significant number of STEM departments. Although the climate for women students and faculty in these colleges varies (indeed climates vary by department), there are some commonalities as well. It is also likely that there are significant similarities with like institutions, colleges and departments at the national level. The research findings of this study will be disseminated so that other institutions can also benefit from the knowledge gained and strategies developed.

Although the current status of women at ISU suggests that it lags behind the national average in the representation of women in engineering and science, the current environment is conducive to positive change with strong administrative commitment clearly demonstrated. A campus climate survey was conducted in 2004 that included recommendations for improvement. An implementation committee was named (a full professor in the Materials Science and Engineering department chaired the effort) and strategies were developed. Additionally, ISU's current 2005-2010 Strategic Plan demonstrates institutional support, as it has as central themes increasing diversity and enhancing the prominence of science, technology and engineering.[6]

The history of the NSF ADVANCE program at ISU:

In 2006, a team of faculty and administrators from ISU was awarded a 5 year NSF ADVANCE grant after three years of planning and preparation. The goal of the NSF ADVANCE program is to increase the participation and advancement of women in academic science and engineering careers. This aim of this goal is to contribute to the larger strategic goal of cultivating a world-class, broadly inclusive science and engineering workforce.[7] The ADVANCE award to ISU is an "Institutional Transformation" award, rather than a PAID (Partnership for Adaptation, Implementation and Dissemination) award and as such demands an innovative and comprehensive program for institution-wide change. NSF has awarded ADVANCE grants to 32 institutions in three "rounds", beginning with the first 9 in 2001. An NSF ADVANCE portal website provides a comprehensive overview with links to most ADVANCE institutions' activities as well as research literature links on topics related to women faculty in the sciences.[8]

The structure of the project:

The ADVANCE-ISU team comprises people from across campus in a variety of roles both on the team and in the ISU community. In addition to program staff, a co-PI team includes

representative researchers (both faculty and professional and scientific staff) from the social sciences and humanities, and the natural sciences. Additionally, there are faculty and administrative grant participants from three colleges (Engineering, the Liberal Arts and Sciences and Agriculture and Life Sciences.) There are also graduate students, undergraduate students and external advisors who contribute to varying degrees.

The primary goals of the project are to[9]
1. Overcome *known barriers* to women's advancement across ISU STEM fields by improving perceived levels of departmental transparency, reducing isolation from colleagues, improving quality and quantity of mentoring, and institutionalizing career flexibility.
2. Overcome *department-specific* barriers to women's advancement in STEM by working with department chairs and faculty to improve departmental and university climates for women and historically underrepresented groups and to implement best practices guidelines.
3. Institutionalize positive changes at the university level by increasing awareness among and the proportion of top administrators actively supporting institutional transformation, improving faculty work satisfaction and organizational commitment, and reducing work/family conflict.
4. Increase overall participation/advancement of women faculty in senior and leadership ranks by increasing the number of women who submit tenure packets, receive tenure and promotion to full professor, and increasing the proportion of women in university leadership roles.

The project features a multi-level approach with a variety of activities, initiatives and events, with the common theme of active collaborative participation, (a Participatory Action Model)[10]. In effect *all* people involved in creating and maintaining the climate of the university (not just administrators) are involved in defining the challenges and developing solutions. This approach focuses on transforming departmental cultures (views, attitudes, norms and shared beliefs), practices (what people say and do), and structures (physical and social arrangements) as well as university policies. Previous research indicates that by changing work-related practices, structures and cultures in ways that improve departmental climate, all faculty report higher levels of job satisfaction. While women and men report higher levels of satisfaction, women report even greater improvement than men.[11]

There have been a number of university and college-level activities to promote progress toward these goals and more are planned. These include a number of networking events and retreats for women STEM faculty to combat isolation and share experiences and strategies. Topics include unintentional bias, COACHE survey results and making a career in STEM. (COACHE is a Harvard University project – Collaborative on Academic Careers in Higher Education that strives to improve the quality of faculty work life).Additionally, ADVANCE has sponsored or co-sponsored a number of lectures and workshops. Most events also encourage the attendance of *all* STEM faculty and administrators. A national conference (held at ISU) is planned for 2008 called "Recreating Academic Work in STEM" that will focus on flexible careers and women in STEM.

ISU ADVANCE in the College of Engineering

A critical component of the transformation strategy is the work done at the departmental level with participation of all faculty (as opposed to using the traditional approach of addressing only

the women – aka the 'fix the woman' approach). In this effort, faculty in nine focal departments, three from the College of Engineering, form the core department-level working groups. A three-step process for departmental transformation includes (1) focus groups to discuss department culture, practice and structure, (2) needs assessment meetings and training sessions tailored to meet the unique needs of individual departments, and (3) collaborative problem solving sessions involving department faculty and ADVANCE program leaders.

To facilitate the work at the department level, an "ADVANCE Professor" (AP) was named in each of the first three focal departments (one in each college). The remaining departments will be phased in as the grant progresses, utilizing lessons learned in the first stage. The role of the AP is a critical component of the grant's approach because the culture of each department varies. The embedded AP is able to appropriately interpret the departmental environment to frame key questions and facilitate problem solving. This approach specifically addresses the likely response "That wouldn't work in MY department" that might result from the solutions developed externally. In other words, the AP has the "cultural sensitivity" and knowledge of departmental history to best effect change. In addition to the AP, a small departmental ADVANCE team is assembled in each focal department. This team is chosen by the AP in collaboration with the other ADVANCE personnel and the department chair. The selection is made by considering a number of characteristics of their colleagues including the level of interest in diversifying the faculty and range of influence among the faculty.

Because the ISU ADVANCE program seeks to ensure coordination and communication across different administrative units and levels of the institution about recruitment, retention and promotion of women STEM faculty, a college level position referred to as "Equity Advisor" (EA) was created (and funded 1/3 time) in the first year of the 5 year project. Three EAs, one in each of 3 designated focal colleges, including the College of Engineering, are currently in place. Each EA is a faculty member who communicates both with the ADVANCE leadership team and their college leadership. The EA serves to design, develop and implement programs, policies and practices that will help the college create an optimal environment for all faculty. The EA also integrates ADVANCE programming, discussions, and training with other college efforts in key areas: faculty recruitment and retention, promotion and tenure, managing work and life, mentoring, climate, and diversity.

ISU ADVANCE and Engineering

The first ADVANCE department in the College of Engineering at ISU is Materials Science and Engineering (MSE). In the spring of 2007, faculty in the department participated in focus group discussions and/or individual interviews with an external facilitator. Participation was voluntary, and the rate of participation was very high (82% of all MSE faculty joined a focus group). These discussions centered on departmental climate, culture and support and the level of satisfaction as perceived by faculty of different ranks and gender. A separate interview with the department chair was also conducted. The purpose of this data collection effort was to understand departmental cultures, practices and structures that support or impede, faculty scholarly productivity.

As reported by participants, these focus group interviews resulted in lively and sometimes intense discussions that frequently extended beyond the scheduled time frame. Apparently, faculty were eager to talk about their work environment. All interviews and focus groups were audio-recorded and subsequently transcribed. Transcriptions yielded more than 1000 double-spaced pages of raw data in addition to other resources used for analysis including the respective governance documents and notes from focal departmental web sites. It should be noted that the reporting methods were designed such that the confidentiality of each faculty member was protected throughout the process. This was done both to promote honest communication and the integrity of the data but also to ensure enthusiastic participation of the 2nd and 3rd round departments.

Researchers analyzed the focus group data, interview data (including department chair interviews), and the documents during Summer 2007 using a process of open and focused coding. The process of identifying individual points is called open coding.[12] (Open coding in these analyses yielded between 52 and 115 concepts from a single transcript or document. Focused coding, or the combining of similar data points and development of prevailing trends and themes, was then completed.[13] Codes and patterns from the transcripts were compared to coded governance documents and research notes, allowing for triangulation and further evidence for findings. Each researcher independently coded data and identified findings. The focus group and interview data were then re-reviewed thoroughly for examples that both confirmed and contradicted prevailing views about a given issue raised in the data. In those instances where faculty identify a salient issue and have different views on the issue, the variations are reported. The AP reviewed drafts of the department's report to ensure anonymity of respondents as well as clarity and balance of the report. The AP's suggested changes were examined in light of the data collected and incorporated into the report where warranted.

The research findings were summarized in a final report[14] and an executive summary[15] written for distribution to the faculty. The report contained nine key research findings and provides recommendations to the MSE department on how to support faculty success.[14]Through discussions and consideration of departmental culture, the departmental ADVANCE team decided to distribute only the executive summary for two reasons. First, the full report had quotations to illustrate various key findings, and although these quotations were simply exemplars and other statements from other faculty conveyed the same idea, there was concern that some faculty may conclude they knew who made the statement and inaccurately attribute a particular issue to a single faculty member. Second, and perhaps more importantly, it was felt that a two page executive summary would more likely be read in its entirety than a 30 page report. Many of these recommendations were drawn from comments and suggestions made by the faculty themselves during the focus group sessions.

Although all faculty had the executive summary and a description of all nine findings, the departmental ADVANCE team decided that faculty discussion would be most productive if the team processed the list before engaging the entire faculty. The concern was that attempting to prioritize nine items and consider plans to address them in the limited time of a faculty meeting would only lead to frustration. The prioritizing was done balancing two factors: those issues that could be addressed immediately and those that would have the most significant impact. Consequently, some issues that were considered to be very important, but very difficult to

address in the near term were lower on the list. In the fall of 2007, the faculty was assembled and presented with the prioritized list for discussion. Additionally, these issues were categorized as "Address Now", "Address Soon", "Think About later". During the meeting, faculty were encouraged to argue the selections (or order) if they did not agree. Faculty were also encouraged to contact team members if they wanted to discuss the results privately.

As a result of these faculty discussions, four of the findings were chosen as areas in which immediate and significant progress can be made. In general, these four areas include improving diversity in recruitment, mentoring, work/life balance, and balance of research/teaching and service loads. Strategies for addressing these issues were discussed and an action plan was developed by the departmental ADVANCE team under the leadership of the ADVANCE Professor. Examples of planned activities include:

- leveraging both university and college resources to develop a "best practices" document for avoiding subtle bias, especially for faculty search committees
- surveying other departments and colleges for existing resources on effective mentoring, including examining the possibility of mentoring associate professors. (Currently the department's mentoring system is informal, undocumented and limited to assistant professors).
- scheduling a faculty meeting that focuses on education about University policies related to part time tenure and dependent care leave. (In response to the faculty's acknowledged ignorance of these policies- especially those that have recently changed significantly).
- presenting regular 15 min. reviews in faculty meetings of relevant research literature on gender bias and accumulation of disadvantage.

In addition to data collection for needs assessment, faculty have also been engaged in other ADVANCE activities. The AP has presented information about the grant, the transformation process and progress reports on several occasions, including at industrial advisory council meetings and faculty retreats. One tack that has been taken is to emphasize that these efforts (to diversify the faculty) are expected to benefit the quality of the research and teaching our department engages in, citing research data that substantiates that claim. An example is a report that reveals that patents with mixed-gender authors receive 42% more citations than those of single gender teams.[16]This is critical within a departmental culture that values research performance so highly. Any effort that is considered to compromise research quality would be strongly rejected.

While the process is ongoing, some progress is already evident in affecting departmental culture and practices. An intense faculty search within the department has provided a testing ground for discussions on fair evaluation and unintended bias. Additionally, the college equity advisor has convened all college search committee chairs and presented a "best practices" report. Additionally, the AP has attended two workshops on faculty diversity and discussed with the search committee common cognitive errors in evaluating applicants.[17]

Measuring Progress:

As expected, faculty expressed differing levels of enthusiasm and interest in the project. Some of the skepticism vocalized centered around the ability to discern the impact of departmental

collaborative transformation and related ISU ADVANCE efforts when the project is complete. Others questioned why many of the "key findings" did not appear to be gender-related. Faculty members' inquiries regarding what they perceive to be findings that have little relevance to overall ADVANCE program goals is a valuable form of feedback. This feedback suggests that the departmental ADVANCE team and other leaders of the ISU ADVANCE project must frequently and consistently reiterate demonstrated links between improving overall work climate and the recruitment, retention and promotion of women faculty.[18,19] As would be expected for a major NSF research grant, the intellectual merit and broader impact of the work has been successfully argued. Additionally, formative evaluation processes have been developed and documented. Indicators of progress are listed in two categories:

Indicators of progress toward institutionalized change:[9]

- *Outcomes of institutional processes of recruitment and advancement.*
  - Number of faculty who submit tenure packets, and number awarded tenure, by gender and department.
  - Number of tenured associate professors by department and gender with years-in-rank.
  - Number of faculty hired and who leave by rank, gender, and department.
  - Cohort analyses of tenure and promotion, including to full professor.
- *Allocation of resources for science and engineering faculty at ISU.*
  - Study of salaries of men and women faculty (with controls, e.g., department, rank, years in rank).
  - Study of space allocation of STEM faculty by gender (with controls).
  - Study of start-up packages of newly hired faculty by gender (with controls).

Indicators of Increased Overall Retention and Advancement of Women Faculty in Senior and Leadership Ranks:

- *Distribution of science and engineering faculty.*
  - Number of men and women tenured and tenure-track faculty by department, rank and gender.
  - Number of non-tenured men and women faculty (e.g., Instructional, Research, Clinical, Postdoc.).
- *Distribution of science and engineering faculty in leadership positions in the institution.*
  - Proportion of STEM women and underrepresented faculty of color in leadership positions.

Many of these measures are institution wide and may not necessarily reflect the progress of a single department.

Summary

The MSE department at Iowa State University is participating in a multilevel collaborative effort as part of an NSF ADVANCE grant to produce institutional transformation that results in the full participation of women faculty. At this stage data about the department's cultures, practices and structures and policies have been collected and analyzed. The faculty is engaged in discussion of these results and developing action plans toward improving the departmental climate to enhance job satisfaction and productivity as well as gender balance. Although the activities and results

reported are specific to a single department, it is anticipated the process is transferable to and can benefit other similar departments and institutions.

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