Organizational Change Strategies to Support the Success of Women Scholars in STEM Fields: Categories, Variations, and Issues

Ann E. Austin, Sandra Laursen, Anne-Barrie Hunter, Melissa Soto, Dalinda Martinez

Paper presented at the Annual Conference of the
American Educational Research Association

New Orleans, Louisiana
April 10, 2011

Please address correspondence to:

Ann E. Austin, Professor

419A Erickson Hall

Michigan State University

East Lansing, MI 48824

aaustin@msu.edu

Tel: 517-355-6757

Organizational Change Strategies to Support the Success of Women Scholars in STEM Fields: Categories, Variations, and Issues

Ann E. Austin, Sandra Laursen, Anne-Barrie Hunter, Melissa Soto, Dalinda Martinez

Abstract: Relative to fields such as medicine and law, women have remained persistently underrepresented in science, technology, engineering and mathematics (STEM) in higher education. The National Science Foundation's ADVANCE Program seeks to catalyze systemic and organizational approaches to change that will enhance women's participation and leadership in STEM. This paper examines the change strategies selected by nineteen institutions that were awarded ADVANCE Institutional Transformation grants in 2001-2004. Our analysis reveals patterns but also significant variation in the range of ways in which strategic approaches are conceptualized and implemented. Future research will examine how these strategies and their variations depend on the institution's context.

The nation and world face daunting challenges that necessitate the expertise, insight, wisdom, and creativity of many individuals in science, mathematics, and engineering. Yet higher education institutions—where much scientific and engineering work is done, and where the next generation of scientists, engineers, and faculty members is prepared—continue to grapple with the underrepresentation of women in STEM fields (science, technology, engineering, and mathematics). While women's representation in STEM is improving, this development is slow and not consistent across fields (DeWelde, Laursen, & Thiry, 2007). For example, the proportion of women with Ph.D.s is almost equal to that of men in the life sciences, agriculture, chemistry and geosciences, while underrepresentation of women is more problematic in physics, computer science, and engineering. In mathematics, women earn just 27% of the doctorates, despite receiving almost half of the bachelor's degrees awarded in the field (NSF, 2007). While the pool of Ph.D.-holding women constrains the representation of women on STEM faculties, the gender disparities continue to increase at the faculty level: Women constitute 36% of all faculty members, but only 22% of the faculty in the physical and related sciences, and 9% in engineering (NSF, 2003, p. 266). In engineering, mathematics and statistics, earth sciences, chemistry, physics, and astronomy, women constitute only 5% of full professors and 4.2% of department chairs (Niemeier & Gonzales, 2004).

Initial hiring is not the only problem (Marschke et al. 2007). Women who pursue graduate education and take faculty positions in STEM fields face continuing challenges: a climate that is often experienced as chilly or unwelcoming; overt as well as subtle harassment; exclusion from opportunities to collaborate and to take leadership roles; expectations of a single-minded focus on work; the need to meet significant tenure expectations that often coincide with child-bearing years; and prejudice against scholars who delay entering the academic workplace (Bystydzienski & Bird, 2006; Committee on Maximizing Potential, 2007; MIT, 1999; Rosser, 2004). The negative climate generated by these factors leads a number of female faculty in STEM fields to

leave academe (Rosser, 2004). Others remain but report lower job satisfaction as they manage these challenges on a daily basis (Bilimoria, et al., 2006; Callister, 2006). These challenges and issues have an impact on the talent pool and pipeline of scientists available to address societal problems. Furthermore, since current faculty serve as role models for potential future faculty, the availability of female faculty influences the choices of young female scholars considering careers in academe. For these various reasons, the country needs to find ways to increase the diversity of the workforce in science and engineering.

For some time, strategies to address these concerns focused on "fitting women into existing science and engineering departments, program, and laboratories" (Bystydzienski & Bird, 2006, p. 3). In more recent years, however, awareness has increased of systemic and organizational factors that thwart the success of women in STEM fields (Wylie, Jakobsen, & Fosado, 2007). In response to the concerns about underrepresentation of women in STEM fields, the National Science Foundation launched its ADVANCE Program, seeking to "catalyze change that will transform academic environments in ways that enhance participation and advancement of women in science and engineering" (NSF, 2001). Since 2003, the NSF ADVANCE Program has supported universities in their implementation of projects to increase the recruitment, retention, and success of women in STEM fields.

This paper draws on the first year of work on a three-year project, funded by a National Science Foundation ADVANCE PAID grant, in which our research team is taking a cross-institutional, analytical, and synthetic approach to learning about the organizational strategic approaches and best practices that support the success of women scholars in STEM fields. The three-year project is focused particularly on how organizational characteristics relate to transformation processes—that is, how specific strategies work within specific contexts.

The overall study addresses this question: *What has been learned about the effectiveness and long-term viability of organizational change efforts to create institutional environments that are conducive to the success of women scholars, particularly in STEM fields?* The sub-questions are:

a) What strategies and processes have worked well (and which have not) in creating institutional environments that are conducive to the success of women scholars, especially in STEM fields? Have some strategies worked particularly well in regard to specific goals?

b) Why have these strategies and processes worked well? Why did some not work well?

c) How does a university's organizational culture and other institutional characteristics relate to the initial choice and ultimate effectiveness of the strategies and processes used?

d) In institutions where change strategies and processes have resulted in significant outcomes in terms of creating environments that are conducive to supporting the career progress of STEM women faculty, what can be learned about effective theories of change and effective strategies and processes? That is, what lessons or "best practices" can be learned from ADVANCE programs that have had an impact?

The first year of research has been devoted to learning about the strategic approaches used by the first nineteen universities that received NSF ADVANCE Institutional Transformation (IT) grants in 2001-2004 to create institutional environments conducive to the success of women in STEM fields. The research in subsequent years will examine more closely how institutional contextual characteristics relate to the choice and effectiveness of various strategic approaches. Drawing on the first year's work, this paper uses an organizational systems perspective to identify and

categorize the types of strategic approaches used at these nineteen institutions. Second, we are interested in the different ways in which institutions can conceptualize and implement particular strategic approaches, depending on specific institutional contexts, needs, and goals. Thus, this paper highlights two of the many strategic approaches used by various institutions, using them as exemplars to emphasize that an overall strategic approach can be used in very different ways. Strategic approaches need to be understood within specific contexts. Third, the paper briefly outlines some working hypotheses and lessons emerging from the research on strategic approaches to creating environments conducive to the success of women scholars in STEM fields.

Review of Related Literature

Several years after the early rounds of ADVANCE Institutional Transformation awards, publications are providing insights about the processes used and outcomes of ADVANCE grants across institutions. Two recent books contribute to knowledge of institutional strategies to improve the representation and experience of female STEM faculty. These volumes are very useful contributions that offer readers a range of ideas, but they were not designed as systematic, comprehensive, and comparative studies of the change strategies used across all ADVANCE institutions in the first two rounds of awards. Bystydzienski and Bird's edited book *Removing Barriers: Women in Academic Science, Technology, Engineering, and Mathematics* (2006) discusses reasons for underrepresentation of women in STEM fields, problems female scholars encounter, and barriers to their progress, and offers suggestions for addressing the barriers. Among other remedies, the chapter authors call for more collaborative and relationally-oriented departments, more family-friendly policies, flexible options for how faculty work is organized, mentoring opportunities, and more attention to graduate student experiences.

Collectively, the chapters in Stewart, Malley, and LaVaque-Manty's *Transforming Science and Engineering: Advancing Academic Women* (2007) offer an overview of key elements and principles guiding intervention strategies used at various institutions. This book provides examples from a number of ADVANCE institutions, but does not take a systematic or cross-institutional analytical approach. Sturm (2007) takes a more process-oriented view with her close analysis of a particular leadership strategy, but her analysis is restricted to a single institution.

Papers by Bilimoria, Joy, and Liang (2008) and by Fox (2008) have offered categorizations of activities used in ADVANCE IT grants. Bilimoria and coauthors (2008) view some activities as addressing key transition points in the career trajectories of women STEM faculty: activities to increase the number of women who pursue advanced STEM education and academic careers; those to promote their recruitment as university faculty; and those to enhance their success in achieving tenure, promotion, and advancement to leadership positions. Other activities address the climate in which women faculty work by building awareness and changing practices of male colleagues as individuals, within departments and workplaces, and across institutions at large. Fox (2008) groups activities by the institutional level at which they operate: institutional structures, faculty composition, internal networks, and external support. More process-oriented analyses of particular institutional cases by Sturm (2006, 2007) and Plummer (2006) suggest the importance of particular types of leadership roles and communications styles. While these prior analyses are helpful input into our three-year study, they do not yield the detailed insights into the "hows" and "whys" of institutional transformation that our overall study seeks. In fact, Bilimoria et al, recommend that future research pursue more contextually-focused questions, and Fox (2006) argues that more must be learned about how organizational characteristics relate to

transformation processes. Thus, in our three-year study, we seek to learn how specific strategies work within specific contexts.

<h2 style="text-align:center">Theoretical Framework</h2>

This paper is grounded within a systems perspective that recognizes higher education institutions as complex organizations composed of multiple, loosely coupled, interconnected sub-systems (Birnbaum, 1988; Bolman & Deal, 1991; Cohen & March, 1991; Weick, 1976). A systems approach has led scholars studying organizational change to emphasize that successful change efforts are nonlinear, require multiple levers of change, and benefit from efforts to connect an array of strategies (Eckel, Green, & Hill, 2001; Kezar, 2001; Senge, 1990). Thus, in studying organizations seeking to enhance the success of women scholars in STEM fields, we have not been content to learn only about the major strategic approaches used by organizations to encourage organizational change that benefits women STEM scholars; we also are alert to seek out the multiple and diverse variations of these respective strategies.

Several change models offer useful perspectives for studying higher education institutions. Among the most useful are cultural models (emphasizing the role of values within an organization and the existence of multiple organizational cultures), social cognition models (emphasizing the role of sense-making and interpretation), and political models (recognizing the implications of organized anarchy, shared governance, and the presence of competing goals) Eckel, Green, & Hill, 2001; Kezar, 2001). Recognizing the importance of using several theoretical perspectives to understand organizational processes, Bolman and Deal (1991) offer a multi-frame model of organizational analysis. Their model integrates four main perspectives in organizational theory—structural, human resources, political, and symbolic—and draws on all four perspectives as frames ("lenses that bring the world into focus") (p. 11) through which to understand organizational issues. In this study, we used Bolman and Deal's model to guide our investigation of effective change strategies within specific institutional contexts. Each perspective is explained below.

Structural Perspective: The structural perspective recognizes the importance of formal rules, policies, management hierarchies, organizational arrangements, and relationships within organizations. Thus, using this frame has alerted us to strategic approaches that address such issues as the structure of faculty appointments, the organization of faculty work within various units (e.g., within departments, colleges, or across the institution), the rules or guidelines pertaining to who has the opportunity (or who is assigned) to serve on which committees, and the processes of tenure and promotion.

Human Resources Perspective: This frame for organizational analysis emphasizes the importance of examining demographics, experiences, needs, and feelings of the people involved in an organization. The human resources perspective has led us to identify strategic approaches that affect faculty work life, faculty roles and professional development, and incentive and reward structures.

Political Perspective: The political frame emphasizes issues of power and scarce resources as important elements to note when seeking to understand or analyze organizational issues. Guided by this perspective, for example, we have been alert to how universities use governance processes to affect the culture, climate, and careers of women STEM faculty, the extent and ways (if at all) institutional leaders at various levels have been involved in the change process, the role

of various institutional committees, and the formal as well as informal political strategies utilized by ADVANCE leaders.

Symbolic Perspective: The symbolic frame focuses attention on issues of meaning within an organization. Of particular interest from the symbolic perspective are the cultures of an organization, including the rituals, stories, heroes, and myths, and the process through which sense-making occurs within the organization (Eckel, Green, & Hill, 2001). Working within this frame, we have been alert to ways in which universities have used symbolic efforts to enhance the working environment for women faculty and to support their career advancement. For example, symbolic strategic approaches might include efforts of leaders to talk about the institutional culture and climate as it relates to women and the contributions of women faculty, or to convey the institution's commitment to a welcoming and supportive environment for women. Another strategic approach might include the use of symbolic opportunities (e.g., awards, such as distinguished faculty awards or other prestigious awards; research allocations; major institutional events) to highlight institutional commitment to advancing women.

Bolman and Deal's model, while not a theory, suggests frames or lenses through which to examine organizational processes and phenomenon; each frame helps researchers focus on specific aspects of organizational change. In our work, the Bolman and Deal model guided us in examining the extent to which the strategic approaches that fostered environments more conducive to the career progress of STEM women faculty were structural, human resource-oriented, political, or symbolic—as well as how the strategic approaches related to the structural, human resource, political, and symbolic aspects of the institutional context.

In summary, our work is situated within the theory and literature on organizational change and within the small body of existing research on strategies to attract and retain women scholars. Our work builds on this body of research to produce a more detailed analysis of the range of strategies and variations used to create environments that enhance the success of female STEM scholars.

Methods and Data Sources

The study focuses on the nineteen institutions that received National Science Foundation ADVANCE Institutional Transformation (IT) grants in the first two rounds (years 2001-02 and 2003-04). Projects funded in Rounds 1 and 2 have had a number of years to develop, implement, and refine their change strategies. Our mixed-methods approach has included seeking, gathering, and engaging in close content analysis of the project annual reports, final reports (where available), and other relevant documents from each of the original nineteen ADVANCE institutions.

Our research team of four has analyzed documents for each institution, using a rubric to guide coding and categorization. After initial coding by one reader, consistency and inter-rater reliability were addressed through a second reading by a different researcher, followed by further analysis and discussion of each case by the full research team. Following the document review, teams of two researchers interviewed by telephone at least one project leader at each institution to verify the completeness of information the team gathered, to check and revise as needed the interpretation the team reached about the strategies used, and to clarify the context, strategies, and impact at each institution.

Following the document analysis and institutional interviews, the research team wrote a Narrative Summary of the ADVANCE Project at each of the 19 institutions, with attention to leadership, key elements in their overall approach to fostering institutional change, relevant elements in their institutional context, the scope of the project, project elements, outcomes, and research team observations. Additionally, the Research Team created a Change Strategy Grid to highlight, by institution, the strategic approaches used to enhance the success of women.

We are currently in the midst of analyzing the variation within each strategic approach in terms of purpose, target audience, and elements of the strategy. The research to date was reviewed favorably in December, 2010, by an Advisory Board of eight well-known scholars and institutional leaders whose expertise, as a group, included both research and practice on issues for women in higher education and in STEM fields specifically, and on organizational change in higher education.

Analysis and Results

In this section we discuss the results of our analysis of the strategic approaches used by universities awarded ADVANCE grants to foster organizational change. We also highlight two strategic approaches to provide examples of the variations that are possible within any given approach.

Strategic Approaches Categorized within Organizational Frames

The strategic approaches used by ADVANCE institutions can be categorized in various ways. Bolman and Deal's framework draws attention to the different purposes various strategic approaches can play in an effort to change the environment for women within a university. Here we summarize types of strategic approaches within each frame—structural, human resources, political, and symbolic. Some strategic approaches could reasonably be listed under another category; the categories are intended primarily as a way to organize the strategic approaches that institutions are using and to stimulate thinking about the possible ways to move forward organizational change, not to serve as a rigid or mutually exclusive labeling device. Furthermore, the list presented is extensive, but additional strategic approaches may become apparent as the three-year study continues. Each type of strategic approach can be conceptualized and implemented in various different ways, as illustrated in the next section.

Structural Strategic Approaches

Structural strategic approaches emphasize identifying and improving formal policies and organizational arrangements. Three structural strategies are identified in the analysis to date:

- Analysis, creation, revision, and tracking of tenure and promotion policies: These efforts typically involve reviewing and revising policies to make them more transparent and flexible. Some institutions also created new policies pertaining to tenure and promotion, such as Tenure Clock Extension Policies.

- Analysis, creation, revision, and tracking of policies related to work/life issues: These efforts usually pertain to consideration, creation, or modification of various work/life policies. Such policies may relate to such issues as modified duties related to personal or family needs, parental or family leave, and/or dual career hires.

- Tools and training related to recruitment, retention, and support for women faculty: Some ADVANCE institutions have developed tool kits and training materials for department

chairs or search committees pertaining to best practices in recruitment or best practices in retention.

Human Resource Strategic Approaches

Strategic approaches that are situated within a human resources perspective address the demographics, experiences, needs, and aspirations of the faculty members.

- Pipeline Professional Development: Workshops that address faculty's professional needs at specific points in their career are fairly popular at ADVANCE institutions. Typical targets are faculty members at early career (as they are striving to achieve tenure) and mid-career (who are balancing multiple responsibilities and interested in achieving promotion). The rationale for these workshops is to provide faculty members with the information and tools they need to progress successfully from one rank to another.

- Mentoring and Coaching Programs: Providing mentoring or coaching for early and mid-career faculty is also a common strategic approach. These programs can take a variety of forms, including individual consultants who work individually with female scholars preparing for promotion, group mentoring arrangements, and meetings to provide clarity about job expectations or tenure and promotion processes. This strategic approach may also include the preparation of handbooks to guide mentors and specific training sessions to prepare mentors for their roles.

- Professional Development Skill Workshops: ADVANCE institutions often provide workshops to faculty with the purpose of developing specific skills (e.g., writing and research, negotiation, conflict resolution).

- Career and Life Stage-Oriented Grants or Funding: These strategic approaches recognize the specific challenges that confront faculty members at critical points in their careers or life experiences. Some universities offer funding to top off start-up packages to ensure that female STEM faculty members are well-supported as they enter the institution and start their research programs. Other forms of this strategic approach includes grants for mid-career faculty to help them complete work necessary for promotion to full professor, and funding to help faculty members at various career stages to continue or resume their work in the face of time demands from personal circumstances (e.g., the birth or addition of a new family member, personal or family-related ill health). Support for released time, travel funding, and research activity may be part of career and life stage-oriented grants.

- Networking and Support Groups: Some institutions offer opportunities for women faculty to connect with others who have similar interests, questions, or career challenges, and/or with more senior colleagues. These opportunities are less formal and structured than mentoring and coaching programs. Lunches, social hours, and support groups for pregnant faculty are examples of this strategic approach.

- Support for Personal Needs: Efforts to help faculty members care for young children are part of the strategic approach of some universities. These efforts may include establishing committees to compile and distribute information about child care options, arranging for child care services on campus, and/or providing private lactation facilities for faculty who are nursing mothers.

Political Strategic Approaches

Strategic approaches in this conceptual category emphasize issues of leadership, power, and resource allocation and how these issues can be deployed in support of the intended change.

- Leadership Development for Deans, Department Chairs, and Committee Chairs: A number of ADVANCE institutions recognize the important roles played by deans, department chairs, and committee chairs (e.g. search, tenure and promotion committees) in impacting the recruitment and retention, as well as the lives, work, and career progress, of faculty members. Thus, leadership development is a fairly common strategic approach. This approach includes seminars for new department chairs, professional development workshops for department chairs on issues of equity, bias, and diversity, workshops targeted to search committee chairs, and coaching and regularly scheduled retreats for department chairs.

- College-Level Equity Advisors: Some universities have focused on colleges as locations for strategic intervention. College-Level Equity Advisors typically have responsibility for monitoring recruitment and promotion processes within the departments in the college, ensuring that mentoring is provided to early career faculty, and bringing attention to issues of concern that could interfere with the recruitment and retention of women colleagues.

- Institution-Level Policy or Action Committees: Such committees sometimes receive a name such as Commission on the Status of Women or Committee on Gender Equity Issues. They often gather and disseminate data, bring issues to the attention of senior administrators or the campus as a whole, and sometimes take a lead on educating campus stakeholders about equity and diversity issues.

- Institutional Data-Gathering and Dissemination: Many ADVANCE institutions intentionally develop or expand a plan for gathering and disseminating data relevant to the recruitment and retention of women STEM faculty (or women faculty more broadly). Climate studies are a popular strategy for providing baseline data to frame campus-wide discussion and to use as a benchmark against which change can be measured.

Symbolic Strategic Approaches

Symbolic approaches to fostering organizational change emphasize issues of meaning in the organization.

- Publicity and Communication: Publicity provides information but it also plays the symbolic roles of attracting attention, bringing an issue into the minds of members of an organizational community, and signaling issues of value and importance to the community. Websites, podcasts, printed materials, speeches and comments from senior leaders can play a strong symbolic role, emphasizing the importance of a culture that supports the success and advancement of women colleagues in STEM fields.

- Awards: A number of ADVANCE institutions use leadership awards to honor women in the community. These awards carry a symbolic message throughout the institution about the value of the colleague being honored, and the leadership and other important roles played by women in the institution.

- Events: Some institutions use major on-campus conferences and symposia as avenues for symbolically highlighting the importance of diversity and inclusion or raising concerns about bias, as well as for disseminating information and fostering networks.

- Visiting and In-House Scholars: A number of ADVANCE institutions use visiting scholars are part of a human resource strategic approach. The visiting scholars are often asked to interact with or mentor early career STEM faculty. At the same time, the presence of distinguished visiting scholars on campus can also be a symbolic strategy, showcasing talented and accomplished female colleagues as a way to encourage early-career STEM faculty and to remind senior administrators of the importance of supporting institutional colleagues so they too can be successful.

Variations within Individual Strategic Approaches

Information on the range of strategic approaches being used at ADVANCE universities to encourage the recruitment, retention, and success of women in STEM fields provides other institutions with ideas that may be useful in their own circumstances. However, strategic approaches can be conceptualized, developed, and implemented in a variety of ways. Our three-year study is motivated by an interest in how effective strategic approaches relate to institutional contexts. Given this interest, which we believe will lead to findings that deepen knowledge about institutional transformation to advance women scholars, we are now examining each of the strategic approaches highlighted in this paper more closely. We seek to understand the variations in purpose, models, audience, and affordances and limitations associated with each strategic approach, and to identify questions that an institution considering the use of a particular strategic approach would find useful to consider within its own context.

Here we highlight two of the human resource strategic approaches to illustrate the nuances and variability within such strategic approaches. Our continuing work in the coming year involves similarly close analysis of each strategic approach as well as case studies at five ADVANCE institutions, where we will study the relationships between strategic approaches taken, their impact, and elements of the institutional context and culture.

Example 1: Faculty Professional Development Workshops

Over half of the Rounds 1 and 2 ADVANCE Institutional Transformation projects offered some form of performance-focused professional development. These workshops or trainings aimed to improve faculty members' ability to effectively and efficiently perform their jobs and to manage the multiple demands on them. However, workshops can vary in a number of ways. For example, the focus of workshops can vary across a range of topics, including specific aspects of faculty research, teaching and service duties, or general skills helpful in conducting these duties (such as professional writing and speaking; managing people, time and money; or negotiation and conflict resolution; or career planning).

The audiences for workshops may vary also. They may focus on female faculty or both men and women. They may be designed for faculty members in specific disciplines or at particular career stages, or, in contrast, for faculty members from a variety of disciplines and career stages. Workshops also may vary in terms of being "one-off" single offerings, or long-term arrangements focused on a steady cohort of participants.

These possibilities mean that using "workshops" as a strategic approach to change requires considering the purposes to be served within the particular context. A design that meets the goals

and needs in one context will not necessarily be appropriate and effective in another. Choices about design relate to the impact intended. For example, workshops designed to focus on a particular group (such as early career STEM women) can convey a symbolic message to this group that they are valued by the institution. On the other hand, workshops that mix faculty members from across career stages have the advantage of fostering networking across the institution and informal mentoring. As another example, one-off workshops are useful for drawing attention to a sponsoring project such as ADVANCE and attracting the initial interest of attendees pertaining to particular topic, but they do not usually foster deep-level learning; on the other hand, workshops designed for long-term cohort groups are more likely to create deeper collegial connections and foster in-depth learning. Our point is that a strategic approach, such as the use of workshops, offers many variations to an institution and is likely to be most effective if used with careful attention to the intended goals within the specific institutional context.

Example 2: Grants to Individual Faculty Members

Nearly 80% of ADVANCE IT institutions in Rounds 1 and 2 employed a change strategy that involved the distribution of funds to individual faculty members. Yet this strategic approach to facilitate change also can take many forms. For example, such grants vary in the purposes that they support. Grants may help faculty members advance their research (e.g., by providing seed grant funds), address work-life issues (e.g., by providing financial support during critical life junctures), or engage in career development (e.g., by providing money to facilitate collaborations). Grant awards also vary in amount, ranging from very modest to fairly substantial. The audiences that institutions target with grants also vary. Some ADVANCE grants target only women, while others provide support for both male and female faculty members; some target faculty at specific career stages, while others are open to faculty at all career levels. Application processes vary too; some institutions have competitive processes and others have informal, rolling application processes.

Depending on the institutional context (including organizational priorities, traditions, and change goals), grants can be structured in different ways to foster particular institutional change goals. For example, grant opportunities can target early career faculty if a goal is to "jump start" the success of new women faculty members. Grants targeting established faculty can be used to move forward careers that have "stalled" or confronted barriers that have slowed career advancement (perhaps after a period of university administrative service or if a research path has "dried up"). An institution wanting to foster the valuing of women scholars might use an annual celebration of grant awardees as an avenue to highlight to the community the successes and talents of distinguished members of the community. As a strategic approach to creating institutional environments that more fully support the recruitment, retention, and success of women STEM faculty, grants to individual faculty members can be conceptualized and implemented in various ways.

Discussion

This paper uses Bolman and Deal's lenses for analyzing and understanding organizations as a conceptual framework for organizing the kinds of strategic approaches used by the universities that received the first two rounds of ADVANCE Institutional Transformation Grants from the National Science Foundation. The analysis and results reported in this paper focus on four categories of strategic approaches to creating environments conducive to the recruitment, retention, and success of female STEM faculty. Our study also emphasizes the importance of

considering institutional context in the process of selecting strategic approaches to fostering organizational change. To support this argument, we highlighted two of the approaches to show the variability associated with each strategic approach. Associated with each strategic approach are many options and possibilities for framing change efforts specific to an institution's context, including its goals, challenges, and circumstances.

In the coming year, we will probe each strategic approach more closely in order to present its affordances and limitations. We also will conduct intensive case studies at five ADVANCE institutions in order to explore the relationship between institutional culture and context and the choice and impact of strategic approaches to fostering change. The data analysis for Year 1 of the study—including document review, interviews, the writing of case narratives, and the analysis of strategic approaches as reported in this paper—have led to several working hypotheses, which we will explore as the project continues. We list several of our key working hypotheses here as a bridge from this paper into our future work:

- A number of strategic approaches are available to institutional leaders committed to the goals of the recruitment, retention, and success of women STEM faculty. Projects based on an early articulation of a theory of change get a faster start-up and can use available resources more strategically. ADVANCE leaders should think through what the overall goals of the project are at the specific institution, what strategic approaches they think will move the institution toward those goals, and why they think those strategic approaches are appropriate for the particular institution.

- Choosing strategic approaches should be linked to the framing of the problem to be addressed. The ability to frame the problem helps leaders to figure out how to address it. If you know clearly what problem you are trying to solve, you are more likely to find a solution. Adopting a set of activities or strategic approaches without a plan for what they are helping to achieve is not an efficient or effective way to move forward a change agenda. Doing a set of activities is not enough; one must understand how these strategic approaches combine to address a systemic problem.

- Approaching a problem with multiple strategies or interventions typically is more effective than taking a single approach. Organizations are complex systems. Change strategies must be comprehensive, strategic, and persistent.

- Attention to an institution's culture and history is important is the selection of strategic approaches to change. Strategic approaches need to "fit" an institution's culture.

Scientific and Scholarly Significance

The study results will help universities benefit from the substantial efforts and funding that have been invested in ADVANCE Institutional Transformation projects to date, both by the National Science Foundation and by individual institutions and their leaders and faculty. The findings should contribute to the considerations and decision-making of institutional leaders and change agents within institutions seeking to develop their own plans to attract and retain women scholars in STEM fields, female STEM faculty wishing to understand the strategies that may help their careers or that may make their departments and institutions particularly attractive as workplaces, and scholars studying gender issues or organizational change in higher education.

References

Bilimoria, D., Joy, S., Liang, X. (2008). Breaking barriers and creating inclusiveness: Lessons of organizational transformation to advance women faculty in academic science and engineering. *Human Resource Management* 47(3), 423-441.

Bilimoria, D., Perry, S. R., Liang, X., Stoller, E. P., Higgins, P., & Taylor, C. (2006). How do female and male faculty members construct job satisfaction? The roles of perceived institutional leadership and mentoring and their mediating processes. *Journal of Technology Transfer, 31*(3), 355-365.

Birnbaum, R. (1988). *How colleges work.* San Francisco, CA: Jossey-Bass.

Bolman, L. G., & Deal, T. E. (1991). *Reframing organizations: Artistry, choice, and leadership.* San Francisco, CA: Jossey-Bass.

Bystydzienski, J. M., & Bird, S. R. (Eds.). (2006). *Removing barriers: Women in academic science, technology, engineering, and mathematics.* Bloomington, IN: Indiana University Press.

Callister, R. R. (2006). The impact of gender and department climate on job satisfaction and intentions to quit for faculty in science and engineering fields. *Journal of Technology Transfer, 31*(3), 367-375.

Cohen, M. D., & March, J. G. (1991). The process of choice. In M. W. Peterson, E. E. Chaffee, & T. H. White (Eds.), *Organization and governance in higher education: An ASHE reader.* (4th ed., pp. 175-181). Needham Heights, MA: Simon and Schuster.

Committee on Maximizing the Potential of Women in Academic Science and Engineering, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. (2007). *Beyond bias and barriers: Fulfilling the potential of women in academic science and engineering.* The National Academies Press.

De Welde, K., Laursen, S., & Thiry, H. (2007). *SWS Fact Sheet: Women in Science, Technology, Engineering and Math (STEM).* Sociologists for Women in Society. Also published in *Network News: The Newsletter for Sociologists for Women in Society,* 23(4), 14-19.

Eckel, P., Green, M. & Hill, B. (2001). Riding the waves of change: Insights from transforming institutions. *On Change V: An occasional paper series of the ACE Project on Leadership and Institutional Transformation and the Kellogg Forum on Higher Education Transformation.* Washington, DC: American Council on Education.

Fox, M. F. (2008). Institutional transformation and the advancement of women faculty: The case of academic science and engineering. In J. C. Smart, ed., *Higher education: Handbook of theory and research*, vol. 23, pp. 73-103. New York: Springer.

Kezar, A. (2001). Understanding and facilitating organizational change in the 21st century: Recent research and conceptualizations. *ASHE-ERIC Higher Education Report, 28* (4). San Francisco: Jossey-Bass.

Marschke, R., Laursen, S., Nielsen, J., & Rankin, P. (2007). Demographic inertia revisited: An immodest proposal to achieve equitable gender representation among faculty in higher education. *Journal of Higher Education* 78(1), 1-26.

MIT (1999). A study on the status of women faculty in science at MIT. *The MIT Faculty Newsletter,* special edition XI, 4. http://web.mit.edu/fnl/women/women.html

National Science Foundation (NSF). (2001). *ADVANCE: Increasing the participation and advancement of women in academic science and engineering careers.* Program announcement. NSF 0169. http://www.nsf.gov/pubs/2001/nsf0169/nsf0169.htm

National Science Foundation, Division of Science Resources Statistics (NSF). (2003). *Women, minorities, and persons with disabilities in science and engineering: 2002.* Arlington, VA: National Science Foundation. NSF 03-312. http://www.nsf.gov/statistics/infbrief/nsf07312/

National Science Foundation, Division of Science Resources Statistics (NSF). (2007). *Women, minorities, and persons with disabilities in science and engineering: 2007.* Arlington, VA: National Science Foundation. NSF 07-315. http://www.nsf.gov/statistics/wmpd

Niemeier, D., & Gonzales, C. (2004). Breaking into the guildmasters' club: What we know about women science and engineering department chairs at AAU universities. *NWSA Journal 16* (1), 157-71.

Plummer, E. W. (2006). *Institutional transformation: An analysis of change initiatives at NSF ADVANCE institutions.* Ph.D. Dissertation, Virginia Polytechnic Institute and State University.

Rosser, S. V. (2004). *The glass ceiling: Academic women scientists and the struggle to succeed.* New York: Routledge Press.

Senge, P. M. (1990). *The fifth discipline: The art and practice of the learning organization.* New York: Doubleday.

Stewart, A. J., Malley, J. E., & LaVaque-Manty, D. (Eds). (2007). *Transforming science and engineering: Advancing academic women.* Ann Arbor, MI: The University of Michigan Press.

Sturm, S. (2007). Gender equity as institutional transformation: The pivotal role of "organizational catalysts." In A. J. Stewart, J. E. Malley, & D. LaVaque-Manty, eds. *Transforming science and engineering: Advancing academic women,* Ch. 16, pp. 262-280. Ann Arbor: University of Michigan Press.

Weick, K. W. (1976). Educational organizations as loosely coupled systems. *Administrative Science Quarterly, 21*, 1-19.

Wylie, A., Jakobsen, J. R., Fosado, G. (2007). *Women, work and the academy: Strategies for responding to "post-civil rights era" gender discrimination,* New Feminist Solutions. New York: Barnard Center for Research on Women.