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Abstract

Women are underrepresented on college and university faculties in the science, technology, engineering, and mathematics (STEM) fields. To increase their representation and involvement requires not just supporting the advancement and success of individual women but system-wide identification and removal of gender biases in institutional policies and processes. This need for a system-wide approach to gender equity is the premise behind the US National Science Foundation's ADVANCE Institutional Transformation (IT) program and the projects it has supported.

Our research team has examined the work and experiences of ADVANCE IT grantees in order to understand their approaches to this type of organizational change. We focus on the strategies ADVANCE leaders have used to create institutional environments that support women scholars, the effectiveness of these strategies, and their role as part of a comprehensive change plan. These strategies are neither singular nor universal; rather, they work best when combined to work at multiple levels and on multiple levers of change and when adapted to the institution's particular context. Examples from our practical resource, the StratEGIC Toolkit, illustrate how institutions can be strategic in

selecting and adapting a portfolio of change interventions to advance the careers of STEM women on their campuses.

ADVANCing the Agenda for Gender Equity

By Sandra L. Laursen, Ann E. Austin, Melissa Soto, and Dalinda Martinez

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In recent years, women's representation in the science, technology, engineering, and mathematics (STEM) fields has grown at the undergraduate level, with STEM degrees earned by US women reaching parity in some fields and making notable progress in others. Yet the faculty with whom these undergraduates interact in classes and labs are much less diverse: Across the STEM fields, women represent only a third of US faculty.

This underrepresentation of women as scholars and teachers in the sciences has outsized economic and symbolic importance. Because faculty lead research programs that drive the world's innovation engines, women's absence on STEM faculties means their potential scientific and technical contributions go unrealized or unrecognized in addressing the world's pressing challenges.

Moreover, most STEM professionals pass through colleges and universities en route to STEM degrees and careers. As developing scientists learn scientific and practical skills in the classrooms and research laboratories, they are also socialized into ways of working and interacting with colleagues that will shape their behaviors and attitudes for life.

When women are absent from these spaces as colleagues, mentors, and role models, opportunities are lost to inspire young women to pursue science and engineering, to foster their talents, and to strengthen all young scientists' skills in working in diverse teams and appreciating varied ways to approach problems. A STEM workforce that does not match the nation's demographics means we are not discovering and developing all the available scientific talent that can help to solve important global problems

So how can universities create environments that support the success of women scholars in STEM disciplines? Increasing the representation and involvement of STEM academic women requires not only efforts to support the aspirations, advancement, and success of individual women but also system-wide efforts to identify and remove organizational constraints that lead to gender biases in institutional policies and processes. This need for a system-wide approach is the premise of the US National Science Foundation's ADVANCE Institutional Transformation (IT) program, as well as similar efforts in other countries.

Our research team has examined the work and experiences of ADVANCE IT grantees as examples of institutions that have tackled these problems in a systemic fashion and achieved some success. We studied the approaches to organizational change taken by these institutions, focusing on the following questions:

- What strategies have been used to create institutional environments that encourage the success of women scholars?
- Which strategies work and which don't? Why?
- What strategies should be included in a change plan?

A key premise of our study is that universities are complex and multi-faceted, and change efforts must acknowledge that complexity. Interventions to enhance gender equity must be selected and tailored to address specific challenges in particular institutional settings—one size most certainly does not fit all.

Moreover, no single strategy suffices: Multiple levers of change, deployed at multiple levels of the institution, are needed to develop an effective change portfolio. Our goal is to provide information that will help institutions select a portfolio of interventions that they can adapt to their own situations and contexts and that together will advance the careers of STEM women on their own campuses.

The Research Study

We focused our study on the first 19 ADVANCE IT institutions, those which received grants in the first two rounds of funding (2001-2004). While many were large public research institutions, private institutions were also represented, as were smaller research- and undergraduate-focused institutions. Distributed geographically, they were diverse in institutional mission and culture.

By the time our study started in 2010, the ADVANCE project teams on each campus had had time to design, implement, refine, and evaluate programs; to review, adjust, and publicize policies or develop and implement new ones; and to observe the effect of their work on campus practices and norms such as hiring, promotion, policy use, and departmental and institutional climate. Their grants were

finishing, so they had also grappled with issues of sustaining the activities they had initiated and the gains they had achieved.

Our study relied primarily on qualitative methods: document analysis, interviews, and case studies. First we reviewed an extensive collection of annual reports and other documents from each campus ADVANCE team. We wanted to understand the nature of each project's activities, its leaders' rationale for choosing this set of activities, and the way the work was organized. We then interviewed a leader from each campus ADVANCE team, using our document review as the basis for exploring leaders' views of the successes and failures of these activities, individually and combined, and the ways they had adjusted or replaced their initial ideas with others.

With the help of our advisory board, we chose five institutions of different institutional types and in different geographic and cultural locales for in-depth case studies. After they all accepted our invitation to participate, we conducted five 2.5-day site visits in 2011-2012, gathering a total of 115 interviews with 171 people. A typical visit included about 25 interviews and focus groups with 30 to 45 individuals, including the leaders and evaluators of the project and many deans, department chairs, and faculty who had participated in the local ADVANCE program. We debriefed with the ADVANCE leadership team at the end of each visit to share some of our observations and invite their reactions.

In analyzing this large body of data, we considered both the particular interventions used and how they were combined to advance gender equity in specific institutional settings. For example, we categorized the different interventions to identify patterns in the frequency and nature of their use across the 19 institutions, noting which were common across the set of institutions but also variations in their implementation. We looked at the combinations of interventions chosen by each ADVANCE IT project and how these addressed the local problems of women's representation and advancement that each had identified. Then we summarized our findings and observations for each institution. By slicing the data set in these two ways, we identified important interventions that contribute to advancing gender equity in higher education, but we also recognized contextual factors that may influence an institution's choice of certain interventions or their success in a given setting.

As our analysis continues, we are examining not just the content of ADVANCE IT projects but also how any particular set of interventions is collectively managed and run. Interventions are linked through project philosophy, communication choices, and leadership style. Examples include constructing and building rapport on the leadership team, communicating with diverse stakeholder groups, and using national and institutional research data strategically. While these cross-cutting processes are often hard for institutions to identify themselves, we consider them crucially important in accomplishing meaningful change.

Strategic Interventions that Address Gender Equity

Our analyses revealed 13 main types of interventions that ADVANCE institutions commonly applied to change institutional structures, practices, and cultures.

1. *Faculty professional-development programs* that address the skills, knowledge and competencies all faculty need to have to succeed
2. *Grants to individual faculty* that provide support for scholarly projects, learning, or continuing professional work in the face of personal challenges or transitions
3. *Mentoring and networking activities* that help faculty build supportive relationships with senior colleagues or peers
4. *Development of institutional leaders*—especially deans, chairs, or department heads who administer policies and set the tone in organizational units—in leadership skills and equity awareness
5. *Inclusive recruitment and hiring* practices that broaden search pools and reduce bias in evaluating candidates for faculty positions
6. *Equitable processes of tenure and promotion* that increase clarity and transparency and ensure fair evaluation of candidates for advancement
7. *Strengthened accountability structures* that are used to monitor institutional progress and to verify that policies and practices, once put in place, are followed
8. *Flexible work arrangements* that enable faculty to adjust their job duties to accommodate personal demands
9. *Practical family-friendly accommodations*—such as child care facilities and lactation spaces—that support faculty families
10. *Support for dual-career couples* that helps institutions attract and retain talented faculty members with academic or professional partners
11. *Strategies for improving departmental climate* that address collegiality, communication, and transparency of decision-making in the department—the work environment that has most influence on the everyday experience of faculty members
12. *Visiting scholars* and the ways they can be used to raise awareness, provide mentoring and role modeling, and demonstrate women's successes

13. *Enhanced visibility for women and women's issues*, including celebrating women's accomplishments, highlighting the underrepresentation of women in STEM and its causes, and informing stakeholders of the ADVANCE effort.

It may seem surprising that the strategies are not targeted solely at women or to the STEM disciplines. Many address the needs of men and women in all disciplines: transparency of job expectations; accommodations to reduce work/life conflicts; and the need for strong professional skills, supportive networks, and a positive workplace environment. Institutions find that addressing this full range of issues helps improve the retention, success, and morale of faculty across career stages and across the institution. However, many of these issues affect STEM women especially strongly or are exacerbated by women's low representation in many STEM units.

For example, research has repeatedly demonstrated that men and women alike exhibit a strong and pervasive bias in their evaluations of male and female job candidates: Evaluators' unconscious bias leads them to judge women as less scientifically competent, less skilled as leaders, and less committed to the job. This "unconscious bias" derives from psychologically efficient mechanisms of organizing information, but it has a pernicious effect as judgments of individuals are influenced by social stereotypes, or schemas, around gender, race, ethnicity, nationality, and other personal characteristics.

Schemas of women as "nurturing," "compassionate," and "soft" conflict with those of scientists and engineers as "rigorous," "analytical," and "forceful" in arguing their ideas. Experiments show that identical *vitae* labeled with a male or female name are interpreted differently as the mind conflates gender stereotypes evoked by the name with the individual record.

Thus, educating all those who serve on search committees, evaluate tenure and promotion cases, review or nominate for faculty awards, and write recommendation letters about unconscious bias can increase the fairness of all evaluation procedures. But such training has the potential to make a particularly strong impact on the hiring and advancement of STEM women.

Likewise, policies and practices that offer flexible work arrangements and family-friendly accommodations may most often serve faculty members who are mothers, but they also benefit fathers and faculty members who are caring for aging, ill, or disabled family members. Policies to attract dual-career couples affect women because they are more likely than their male colleagues to be partnered with another academic or professional partner and to take a partner's job satisfaction into account when making their own employment decisions. But men too may accommodate their partners' careers in making such decisions. Faculty development programs, individual grants, and mentoring and networking

activities benefit all faculty, even while they provide a particular boost to women in fields where, as a minority, they are often excluded from the informal old-boy networks that provide important information, advice, and social connections.

Building a Change Portfolio

None of these interventions are magic bullets, but each can advance gender equity in its own way: by enhancing individual women's success, by scrutinizing and optimizing institutional processes for greater equity, by providing people with the language and tools to understand and articulate the value of diversity, or by promoting habits of mind and behavior that change organizational cultures and norms over time. While people often want to identify a few interventions that will bring results quickly, both the literature on change and our own study confirm that change initiatives benefit from a comprehensive and patient approach to improving gender equity.

Analyzing the current situation is a key first step in developing a change plan. Which interventions are appropriate for a specific institution depends on the problems that leaders identify and choose to solve.

Institutional data may be used to examine faculty composition, advancement, and salaries by gender and by rank, the composition of applicant pools for faculty positions, and the demographics of those who receive promotions or awards or who hold leadership positions. Climate surveys may be carried out to assess faculty job satisfaction and engagement, while interviews and focus groups offer insight into the needs and concerns of specific groups, such as STEM women or faculty of color.

This self-assessment can be valuable in its own right: In addition to pinpointing specific gender disparities on their own campus—and ruling out others—some ADVANCE institutions discovered gaps in their systems for institutional data collection and reporting. They took steps to eliminate these gaps and to ensure that appropriate constituencies receive and review the data on a regular basis.

Moreover, since universities are complex organizations with many loosely connected parts, using multiple well-chosen interventions is likely to be more effective than using one alone. For example, the impact of policies that enable faculty to adjust their professional duties to meet personal responsibilities is greater when these policy changes are coupled with efforts to cultivate a culture that de-stigmatizes such use. While deans, department chairs, faculty, and staff in the human resources office must all understand the policies, simply knowing them is not enough: Faculty members must feel that it is risk-free to use such policies and that they are encouraged to do so.

When combined in mutually reinforcing ways, these interventions can reach multiple levels of the institution and act upon multiple levers of change within university systems, structures, and personnel. They are most powerful when applied in a system-focused manner rather than piecemeal.

Overall, our analysis reveals a set of key principles for selecting interventions for an institutional change initiative to address gender equity:

An intervention can achieve different goals, depending on how it is structured and which institutional needs it is designed to address.

For example, small grants are often chosen to support individual women's growth and development, but institutions might target different groups with different goals: to help early-career faculty get a fast start with their research programs, to provide a scholarly boost to mid-career faculty, or to enable senior faculty to explore new career possibilities such as administration.

Hunter College's Sponsorship Program for early-career STEM women faculty, which coupled a sizable research stipend with a year-long program of mentoring and professional development, had a large positive impact on a relatively small number of participants. In contrast, the University of Colorado Boulder targeted associate professors with modest grants that enabled them to pursue a change in scholarly direction or resume research after a period of intensive institutional service or family responsibility.

While intervention by means of grants fits academic culture well, the aims and beneficiaries of specific programs differed, as did the resources and infrastructure required to support them. Evaluation data suggest that in general, small grants yielded not only research benefits for individuals but improved morale and generated political good will for the ADVANCE program in grant recipients' units.

The same intervention can achieve multiple goals, depending on how it is designed.

Continuing with the small-grants example, several campuses offered a small-grants program to provide research support to early-career faculty. But by requiring that the grants be collaborative, Utah State University fostered beneficial connections to colleagues, in the process providing early-career scholars with informal mentoring and generating more positive perceptions of departmental climate.

Another example: At Kansas State University, a mentoring program was designed to foster early-career STEM women's interactions with distinguished scholars in their fields, helping to reduce professional isolation, foster collaborative research, and build useful professional networks. Because

many of these visiting scholars were women, their visits to campus were also used to celebrate STEM women's accomplishments.

Each design choice offers different affordances. For example, mentoring might take the form of hotline coaching, casual peer networking sessions, or year-long cohort-based mentoring programs. These forms do not all offer the same advantages, nor do they require the same investment. Thus the design choices are influenced by both the specific objectives and other constraints such as the availability of expertise and resources.

The same general goal can be addressed in multiple ways.

Institutions variously sought to help newly hired STEM women faculty succeed through professional-development activities, small research grants, or mentoring activities. The choice depended on how faculty success was defined within a particular faculty work context, what needs of new faculty were seen as most salient, and how many women were to be served.

Multiple interventions can leverage one another.

For example, at the University of Rhode Island, funding to support new hires of STEM women faculty was coupled with education for department chairs about strategies to enhance diversity in recruiting and hiring, and chairs were held accountable for implementing these practices. Because concern for the success of the new hires sparked greater interest in faculty retention, the ADVANCE initiative was able to develop a campus-wide mentoring program for all pre-tenure faculty and to formalize expectations for department-based mentoring.

Institutional context influences the choice and design of interventions.

As they select and design interventions, institutions must consider their context: the culture, climate, traditions, and history that influence how things are done and thus shape what interventions are possible or not. Some things to consider: How do faculty and administrators interact, and to what extent does a sense of trust and collegiality pervade a campus? Who is involved in what kinds of decisions; who holds political power or has influence on the development of opinions?

Assumptions, values, and norms may be influenced by an institution's location, history and mission. For instance, the role and status of STEM disciplines may differ on a campus that began as a military and engineering college as compared to one that began as a teachers' college or has a religious mission.

Location is one contextual feature that shapes both the depth of a particular problem and the strategy chosen to address it, as in the example of dual-career hiring. As a major local employer in a small community, Utah State University helps place faculty partners in university non-academic jobs, while in a context of more abundant local job opportunities, the University of Alabama-Birmingham outsources this work through referrals to an outside employment agency. At other institutions in more urban locations, dual-career hiring is not a focus of effort.

Institutional organization and culture also shape change strategies. For example, with its more centralized organization, the University of Michigan used a campus-wide approach to strengthen attention to diversity in faculty search and hiring processes. They recruited senior faculty opinion leaders, who first educated themselves on the social science literature, then conducted trainings for search committees campus-wide to help them diversify applicant pools and recognize and counter implicit bias in evaluating applicants. At the University of California, Irvine, a highly decentralized organization, this type of intervention was better implemented through equity advisors based in each college rather than through a campus-wide approach.

The StratEGIC Toolkit: A Resource for Institutions

These principles are illustrated in a web-based resource that we developed to assist institutional leaders in designing their own change efforts. The StratEGIC Toolkit—Strategies for Effecting Gender Equity and Institutional Change (www.strategicToolkit.org)—distills lessons learned about 13 main types of interventions, each presented in the form of a Strategic Intervention Brief. The intent and structure of the briefs are elucidated in the *StratEGIC Users' Guide*, which provides an overview of the research and the perspectives we have taken in constructing the Toolkit.

As a set, the briefs should enable users to assess whether and how any particular intervention may be useful to their own institution as part of an overall change portfolio. Rather than calling these interventions "best practices," we present these as possible options: Their value depends on their fit to a specific institutional context and the problems that the institution chooses to address. Each intervention has benefits but also limitations; each can be conceptualized, designed, and implemented in a variety of ways.

Each brief follows the same format:

- *Introductory comments* succinctly identify the focus and scope of the brief.

- The *Rationale* explains why the intervention is relevant to organizational-change initiatives focused on gender and STEM, with key references from social science research.
- Sections on the *Purpose* and *Audience* identify the specific goals of the intervention and its target groups.
- At the core of each Brief is a discussion of *Models*, describing the variations on the intervention that we discovered among our study institutions.
- Abundant *Examples* show how the strategy has been used in various ways in different institutional contexts.
- The *Evaluation* section describes how institutions have assessed the value and impact of the strategy and highlights available evaluation findings.
- Discussion of *Affordances and Limitations* offers our analysis of benefits that can accrue from using the strategy and its limitations or drawbacks.

Change Portfolios in Practice: Institutional Examples

A second component of the Toolkit provides institutional examples of how these interventions were combined into comprehensive change initiatives carried out under ADVANCE IT awards. Institutional Portfolios describe the scope and nature of particular ADVANCE IT projects and document aspects of the institutional context that influenced the choice and implementation of interventions.

They also highlight project outcomes at specific institutions, such as increases in the numbers and retention of women faculty, women's advancement to leadership roles, changes to policies and practice, and institutionalization of ADVANCE programs. The Portfolios show how interventions become strategic when they relate to specific goals for organizational change and the particularities of an institutional context, as well as when leaders consider how the interventions can be combined into an overall package that is relevant to their specific situation.

For example, at Case Western Reserve University (CWRU), the Academic Careers in Engineering and Sciences Project (ACES) focused on transforming the institution through increased transparency and accountability; more equitable practices, policies, procedures, and structures; and increased participation of women science and engineering faculty at all levels and in leadership (http://www.case.edu/admin/aces/). While ACES offered some programs that directly supported women, it focused on departments as the key workplace units that shape faculty work lives and the best places to

reach faculty. Leaders of departments and schools were seen as essential in setting a tone, controlling and distributing resources, developing and executing plans, and maintaining accountability.

CWRU was the first private university to receive an ADVANCE IT award, and its private status was important in how ACES focused its institutional transformation efforts. Without the state-defined expectations of public institutions, public accountability, or access to much data, ACES had an imperative to focus on transparency and accountability.

The autonomy of different schools at CWRU also meant that institutional processes tended to be informal, variable, and unevenly communicated with faculty. Thus the project made a concerted effort to standardize and formalize polices and processes in areas such as tenure-clock stoppage, family leave, and dual-career hiring.

One of ACES' signature programs was executive coaching, provided to deans and chairs to help them make positive changes in their units and to individual women faculty to support them to achieve professional and organizational goals. "Hotline" coaching allowed women to seek advice on emergent issues or opportunities.

To strengthen recruiting and hiring, ACES helped search committees and department chairs diversify the pool of applicants for faculty positions and reduce bias in evaluating applicants. This intervention dovetailed with improved data-gathering efforts on the composition of applicant pools; ACES then fed information to leaders who could act on it.

Chairs and deans were asked to set diversity goals and were held accountable for annual progress, but they were also supported in reaching these goals through coaching and other leadership training. Likewise, the integrity of recruiting processes was increased by giving deans the authority to sign off on searches and to return short lists to search committees if they felt insufficient effort had been made to recruit and fairly evaluate a diverse pool.

This example highlights how multiple interventions can reinforce one another in fostering positive and sustainable changes in practices that benefit women and other groups that are underrepresented on STEM faculties.

Collectively, these efforts contributed to increases in the proportions of women both in the hiring pools and among those hired, and in turn the numbers of STEM women faculty rose in the College of Arts and Sciences and in the School of Engineering at CWRU. The number of women chairs also increased in these two schools, and the institution had some success in advancing women to higher rank and into endowed chairs.

Many elements of the ACES initiative were institutionalized after the ADVANCE grant period. Work-life policies and hiring procedures were formalized, with support from permanent positions in the provost's office and in two schools. Leaders' accountability and institutional data collection became stronger. Faculty-level workshops, networking events, and celebrations at the women's center were made permanent. While cultural change was not a focus of the project, many long-time faculty and leaders noticed positive changes in everyday ways of working and interacting—aspects of the institutional climate for women that they felt would be lasting.

Using the StratEGIC Toolkit

Our hope is that institutions will use the Toolkit, including the briefs and portfolios, in practical ways. How might these scenarios work at your institution?

- A team charged with developing a proposal for organizational change to promote women faculty begins its work by reviewing the StratEGIC Toolkit for ideas. The briefs stimulate conversation about the problems and issues to address at that university and suggest data they need to gather, while a portfolio from an institution familiar to them provides a relevant example. The team begins to recognize elements of their context that will influence their choice of possible change strategies.
- A university committee develops a mentoring program. As committee members discuss the program with different campus constituencies, they use the mentoring and networking brief to build a checklist and assessment rubric as they work through possibilities, variations, and potential benefits and limitations.
- Midway through an ADVANCE project, an experienced project leader reviews the briefs for fresh ideas that could invigorate or extend the work already underway on campus. In one institutional portfolio, she notices a synergy between multiple programs that her team could develop on their campus.

With its emphasis on variations, options, affordances, and limitations, the StratEGIC Toolkit emphasizes that organizational-change processes must be dynamic and flexible. One intervention alone will usually not result in the desired change. The best choices and designs of interventions will depend on the institutional context and the issues to be addressed there.

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