WIN: Women in Networks, Building Community and Gaining Voice

The proposed work is designed to increase the work satisfaction, retention, and advancement of women faculty in science and engineering at Boston University through enhancing women's networks, and to analyze the ways in which network-building can contribute to women's satisfaction and success in academic science and engineering. Programs adapted from ADVANCE schools and some developed at BU will be implemented to build strong and functional networks for women faculty. Programs will include pre-tenure mentoring, lunches with leaders, inter-university and industry interactions, re-start-up grants to reinvigorate the networks of female faculty in STEM disciplines, and catalyst grants to support new collaborative research ventures.

To evaluate the effectiveness of these programs in fostering strong networks for women, male and female faculty will be surveyed at the beginning of the grant period and at its end about the individuals in their networks who provide them with important resources such as professional advice. Respondents also will be asked how they met individuals in their networks. Comparing responses from the first and the final survey we will learn about the ways in which academic networks grow and change over time. Finally, we will examine whether participation in ADVANCE programs is associated with changes in women's networks over time and whether characteristics of networks are associated with work satisfaction and productivity and with benchmarks such as promotion.

Intellectual merit of proposed activity

The innovative aspect of the proposed work is the systematic approach to building and analyzing social networks to improve the career success and satisfaction of women faculty. Many of the networking and mentoring programs developed through ADVANCE are explicitly designed to enhance women's networks, and thus their access to critical information, influence, recognition, and collaborative opportunities, but few programs track changes in women's networks over time to assess the role of such programs in enhancing women' networks or monitor the association between changes in characteristics of women's networks and the career success and satisfaction of women faculty. The data from our prospective, longitudinal study will identify links between our ADVANCE programs and changes over time in women's networks, satisfaction, and career success.

Broader impacts resulting from proposed activity

Greater understanding about ways to overcome network limitations and enhance networks should help to increase the retention of women faculty in STEM disciplines and may well generalize to other groups such as women graduate students. Research findings about the implications of network characteristics may generalize to non-academic work places and to other academic disciplines. The network analysis tools developed as part of the WIN project will be made available for use by other institutions. This proposal will also fund 20+ new collaborative research projects in a broad range of STEM fields, launching new research in science and engineering spearheaded by women.

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WIN: Women in Networks, Building Community and Gaining Voice

This proposal describes how coupling the study of personal networks with network-building programs developed at other ADVANCE schools and at Boston University (BU) will help to identify best practices for the retention and promotion of female faculty in science and engineering. Research has shown that faculty women in the sciences and engineering often have networks ill-suited to professional development, collaboration, productivity, or high morale (Etzkowitz, Kemelgor, & Uzzi, 2000). Beyond their own departments, women faculty tend to have fewer ties than do men of comparable rank, resulting in fewer channels through which they might receive information about new scientific discoveries, funding opportunities, or methods of research or through which they might become known and valued in their fields (Etzkowitz et al., 2000). Within their own departments and universities women often find themselves cut off from the timely flow of information through informal channels, thus missing out on the tacit knowledge that is essential to effective performance in the university setting (Rankin, Nielsen, & Stanley, 2007). Relatively isolated, women also find themselves diminished in political power and "voice" (Settles, Cortina, Stewart, & Malley, 2007).

Many of the programs developed through ADVANCE are explicitly designed to enhance women's networks through mentoring or network-building efforts and thus to augment women's access to critical information, collaboration, influence, recognition, and connection (Stewart, Malley, & LaVaque-Manty, 2007). To our knowledge, however, there have been no studies that explicitly assess the impact of such programs over time on the networks of women faculty members and the impact of network changes over time on common metrics used to measure academic success, job satisfaction, and key benchmarks including retention, promotion and movement into positions of leaderships. We propose to conduct such a prospective assessment by measuring networks at two points in time, once before and once after network-building interventions have been introduced at BU. Our network-building efforts will include those that have already been implemented successfully at other ADVANCE schools as well as additional network-building programs developed specifically for BU faculty women. Programs will include pre-tenure mentoring, lunches with leaders, inter-university and industry interactions, re-start-up grants to reinvigorate the networks of female faculty in STEM disciplines, and catalyst grants to support new collaborative research ventures. Our research will result in detailed information about the ways in which specific network-building programs affect key elements in women's networks, and about the ways in which academic success, job satisfaction, retention, promotion, and movement into leadership positions are related to specific characteristics of women's networks. Our work will also contribute innovative network-tracking methods that could be adopted by other ADVANCE schools seeking to measure the role of social networks in mediating the impact of ADVANCE programs on women's advancement.

This proposal first describes the urgent need for ADVANCE activities at Boston University as well as the efforts already underway at BU to increase the participation and advancement of women faculty in science and engineering, largely through the improvement of recruitment practices and enhanced leadership from department chairs. The proposal then offers a conceptual framework for understanding the problems with women's networks in the sciences and engineering and specific network-building programs designed to remedy these problems. We next turn to our methods of assessing the impact of our network-building efforts and

assessing the extent to which networks mediate the impact of advancement programs on women's professional success and satisfaction. (Mentoring is considered here as a special case of network-building.) Finally, the research and management team, institutional support, and the dissemination and sustainability plans are addressed.

1. Need and support for institutional transformation

Since the arrival of President Robert Brown two years ago, Boston University has been on a course to recapture the University's founding principles of inclusion. Boston University was begun in 1839 by three Methodist abolitionists who believed that higher education should be accessible to all, and Boston University has always admitted students of both sexes and every race and religion.

- BU was the first university in the country to admit women to graduate education.
- BU was the first university to award a doctorate to a woman: classical scholar Helen Magill, in 1877.
- BU's medical school began as one of the first medical schools for women in the United States.
- BU's medical school was the first co-educational medical school in the world.
- Dr. Solomon Carter Fuller, an 1897 graduate of the School of Medicine, became the first black psychiatrist in the United States.
- BU medical school graduated the first African American woman physician: Rebecca Lee Cutler.
- BU medical school was a leader in the resurgence of women medical students in the 1970s.
- Dr. Leah Lowenstein, the first woman dean of an American co-educational medical school, was a long time faculty member at BU School of Medicine before assuming her historic post in 1982.
- BU Law School graduated the first woman admitted to the Massachusetts bar.
- BU School of Theology awarded the first degree in theology to a woman.
- BU was the first to grant a doctorate in medicine to a Native American.
- Dr. Martin Luther King, Jr. received his doctorate from BU in 1955.

This legacy of inclusiveness was lost however in recent decades. At the turn of the millennium, Boston University had become conspicuous instead for the paucity of women and minority group members in positions of leadership and decision-making power and, in fact, for the near-absence of minority group faculty on campus. In academic years 2005-2006 and 2006-2007 no woman chaired any of the 24 departments in the College of Arts and Sciences or any of the 4 departments in the College of Engineering. More than half of these departments have not had a female chair in the previous quarter century. At Boston University the representation of African American faculty is only half as high as it is at virtually all of the top-ranked universities and liberal arts colleges in the nation.

In symbolic ways as well, the University resisted the national movement for equality in higher education. The administration barred the use of gender-neutral language. Nor could the word "feminism" be used in course titles. The University also refused to include "sexual orientation" in its affirmative action statement and refused to join the Boston area Graduate Consortium on Women's Studies, to which all other major research universities in the area subscribed. For

decades Boston University also refused to provide data on faculty salaries to the American Association of University Professors, as was otherwise the norm across the nation.

In 2004 BU entered a new era with a change of leadership. The University's affirmative action statement now includes sexual orientation, the number of appointments of women to high-level leadership positions has increased dramatically, and the administration supported the formation of the BU Women in Science and Engineering Committee (BU WISE: www.bu.edu/wise).

Robert Brown, who had played a prominent role in transforming the environment for women faculty in science and engineering during his years at MIT, became president of BU in 2005. Since his arrival the administration has initiated institutional transformation. Examples include:

- Implementation of an inclusive and transparent leadership style
- Disclosure of salary data revealing large gender disparities
- Creation of a salary equity fund
- Adoption of gender-neutral language
- Increase in budget for BU WISE
- Bestowing of an honorary degree on Judy Norsigian, co-author of *Our Bodies, Ourselves*, and an icon of the feminist health movement
- Creation of a university-wide Council on Faculty Diversity and Inclusion (CFDI)

Several recent achievements and programs that stem from the efforts of BU WISE, CFDI, and the new Dean of CAS include:

- A University wide "day with Virginia Valian"
- A public lecture by Abigail Stewart, with an introduction by President Brown
- A half day symposium on women in academic science and engineering, including talks by national leaders Lotte Bailyn, Eve Riskin, and Debra Rolison, and responses by Provosts David Campbell and Karen Antman
- A day long conference on Work/ Life Balance for scientists and engineers with talks by national experts as well as campus leaders including President Brown
- A WISE Lunches with Leaders series
- Access to experts via the BU WISE external advisory board: Nancy Hopkins, Meenakshi Narain, Abigail Stewart, Eve Riskin, Lotte Bailyn, Debra Rolison, Susan Metz, Howard Georgi
- A University wide diversity assessment
- The adoption of a Faculty Search Manual
- Workshops for university and college leaders on good practices for recruitment for excellence and diversity
- The first faculty search committee chair training session
- An interview study of current and former BU science and engineering faculty women
- An exit interview process and questionnaire
- A University wide climate survey conducted for BU by the MIT Web Survey Group
- Participation in the COACHE survey of pre-tenure faculty
- A new policy of regular rotation for department chairs in the College of Arts and Sciences

Seizing the moment at Boston University

Boston University is in a position now to effect a tectonic transformation for women faculty and to contribute significantly to the national movement for women in science and engineering that has shown us the way. A rapidly increasing proportion of Boston University leaders and administrators are women and outspoken supporters of women, including the Provost of BU's Medical Campus and the deans of the College of Arts and Sciences, the Law School, Sargent College of Health and Rehabilitation Sciences, and the College of General Studies. Many faculty are impressed and encouraged by the pace of change and have become more active and engaged. Furthermore, the University's recently released strategic planning document calls for 100 new tenure track faculty hires in the College of Arts and Sciences over the next 10 years, with an announced emphasis on increasing diversity. Provost Campbell has vowed to double the representation of women faculty in the STEM disciplines. The Women in Networks (WIN) programs described in this proposal will provide needed support for new women faculty in the STEM disciplines and will improve retention of those women STEM faculty already at the University. WIN will also support research on social and professional networks that will enable novel assessment of the proposed programs and the correlation of network characteristics to the success and advancement of women of all ethnicities in the academy.

Analysis of our faculty benchmark data shows us how far we have to go. Boston University is a large, private, urban, research university with over 30,000 students on 2 campuses: the Charles River Campus (CRC), which includes the College of Arts and Sciences (CAS), the College of Engineering (ENG), and Sargent College of Health and Rehabilitation Sciences (SAR), and the Medical School Campus. CAS contains 9 departments categorized by the University as Natural Science departments (Astronomy, Biology, Boston University Marine Program (BUMP), Cognitive and Neural Systems (CNS), Chemistry, Computer Science, Earth Sciences, Mathematics and Statistics, and Physics. ENG contains departments of Biomedical Engineering, Electrical and Computer Engineering, Aerospace and Mechanical Engineering, and Manufacturing Engineering. Together, these 13 departments in CAS and ENG have 37 faculty women who are tenured or on the tenure-track. There are additional women elsewhere at the University who do natural science research that is funded by NSF, particularly in the Psychology Department, in SAR, and on the Medical Campus.

On the Charles River Campus (CRC) of BU, the modal male faculty member is a full professor, and the modal female faculty member is not on the tenure track at all. Men on the CRC are also much more likely than women to have been hired at senior rank. Of all male full professors now in the College of Arts and Sciences (CAS), 40% were hired as full professors or promoted to that rank within three years of hire, whereas only 18% of female full professors were hired at that level. However, this gender difference has declined dramatically. Over the past three academic years, 11.5% of men and 10.2% of women hired into tenure slots were hired with tenure. There has also been improvement in the hiring of females into tenured or tenure-track positions at Boston University. The percentage of women hired has increased steadily since AY 2004, reaching 50% in AY 2008.

Despite this progress at the University level, there are problems with respect to hiring and retention of STEM women in particular. The overall percentages of women in natural science and engineering departments have remained flat over the past decade (see Table 1) and future prospects are troubling unless changes are made. The percentage of females among tenure-track

assistant professors in the CAS natural science departments (16.2%) is below the average for comparable disciplines in the NSF "top 50" departments (20.5%). Although junior faculty women in the natural sciences at BU are as likely to achieve tenure, and do so as quickly, as their male counterparts, the rate of attrition from BU's CAS natural science departments between AY 1997 and 2007 was 70% higher for females than males. Although junior faculty women in Engineering are also as likely to achieve tenure as their male peers, they spend two years longer, on average, before promotion to tenured status. Rates of attrition in Engineering are also higher (by about 50%) for females than for males of professorial rank with nonmodified titles.

Dept	**1997**		**Hired 97-06**		**Lost 97-06**		**2007**		**2005 NSF**
CAS									
Astronomy	2	13.3%	1	25%	1	33.3%	2	12.5%	12.1%
Biology/BUMP	6	17.6%	7	33.3%	3	37.5%	10	21.3%	18.3%
Cog. Neur. Sys.	2	22.2%	0	0.0%	0	0.0%	2	22.2%	
Chemistry	2	9.5%	1	11.1%	1	14.3%	2	8.7%	11.2%
Comp. Sci.	1	9.1%	1	11.1%	1	33.3%	1	5.9%	11.4%
Earth Sci.	1	12.5%	2	28.6%	2	33.3%	1	11.1%	13.2%
Math and Stats.	4	14.3%	0	0.0%	1	12.5%	3	10.0%	10.5%
Physics	4	11.8	2	13.3%	2	18.2%	4	10.5%	7.3%
Total for Nat. Sci.	*22*	*13.8%*	*14*	*18.4%*	*11*	*23.4%*	*25*	*13.2%*	*13%*
ENG									
Biomedical	3	15.8%	3	27.3%	2	66.7%	4	14.8%	
Elect.& Comp.	3	8.3%	4	18.2%	2	14.3%	5	11.4%	7.9%
Aero. & Mech.	4	15.4%	2	14.3%	3	21.4%	3	11.5%	7.7%
Manufact.	1	5.9%	2	28.6%	0	0.0%	3	14.3%	
Total for Eng.	*11*	*11.2%*	*11*	*20.4%*	*7*	*20.6%*	*15*	*12.7%*	

Table 1. Boston University faculty with unmodified professorial ranks AY 1997 to AY 2007. Each column has total number of females and percent female in category. Columns are total number in department 1997, number hired AY 1997-2006, number lost AY 1997-2006, total number in department 2007, total percent in top 50 NSF funded schools from (Nelson, 2005). ENG numbers include research and teaching faculty who are not tenure-tracked as they have unmodified titles. In AY 2006-2007, there were 12 female *tenure-track* faculty in ENG.

Results from the just completed BU faculty climate survey revealed several areas in which women from STEM disciplines were much less satisfied than their male peers. Only 11% of female faculty (compared to 54% of male faculty) from Natural Science departments in the College of Arts and Sciences and from the College of Engineering agreed that the climate and opportunities for female faculty at BU were at least as good as those for male faculty. Over a third (37%) of female faculty in these STEM departments, but only 16% of their male peers, believed that they have to work harder than some of their colleagues to be perceived as legitimate scholars. More male than female STEM faculty members (72% versus 48%) agreed

that the academic leadership within their departments was supportive of improving the climate and opportunities for women faculty, and more female than male faculty (41% versus 16%) disagreed with the statement, "I feel diversity of opinion is valued and respected at BU." A higher percentage of male STEM faculty than of female STEM faculty (62% versus 47%) said that they had a voice in the decision-making that affects the direction of their departments, and a smaller percentage of female STEM faculty than male STEM faculty (41% versus 56%) reported that they had sufficient opportunities to collaborate with departmental colleagues.

Women STEM faculty were more likely than their male colleagues to report having had a mentor formally assigned to them within their own departments (44% versus 17%), and were also more likely to report having had an informal mentor (63% versus 51%). Despite this apparent female advantage in mentoring, only 19% of female faculty reported receiving adequate mentoring at the University, while 45% of male faculty did so. Women were less likely than men to agree that there had been clear communication about the criteria for tenure (42% versus 70%) and promotion (15% versus 49%). Women were also more likely than men to report that the formal mentoring they received was actually unhelpful (23% versus 9%).

2. Ongoing programs at BU and programs on the horizon

The strategy adopted for the WIN project of providing programming at the faculty level that will enhance networks and provide new research opportunities for women relies on the Central Administration and College's support of programs aimed at breaking down barriers and raising awareness. Three such programs are listed here.

Recruitment

With the leadership of the University-wide Council on Faculty Diversity and Inclusion (CFDI), BU has just created and disseminated a Faculty Search Manual. The manual was based primarily on the WISELI search manual from the University of Wisconsin-Madison and it includes many of the best practices noted in the manuals at several ADVANCE schools. Early experience with the manual suggests that it has been well received, but that its impact would be strengthened if there were also on-going discussions with search committees or training of recruitment committee chairs as occurs in some other institutions. Provost Campbell has decided, therefore, to create a faculty committee based on the University of Michigan's STRIDE model to facilitate this effort.

Leadership Workshops

Research has shown that departmental climate is often the critical factor in women's satisfaction or dissatisfaction with their jobs, and that department chairs have tremendous power to create departments that serve women well, or departments that do not (Etzkowitz et al., 2000). The Leadership Workshops developed and run by other ADVANCE schools focus both on supporting current chairpersons and stimulating others, particularly women of all ethnicities and men from underrepresented minority groups, to consider the possibility of serving as department chairs. The workshops also provide opportunities for women and men in different departments to get to know each other and to become sounding boards for each other as they carry out the duties of chairing departments or further explore the possibility of becoming department chairs. WIN Leadership Workshops will invite STEM department chairs and emerging leaders from CAS, ENG, and SAR to come together to focus on issues that are

particularly important in the STEM disciplines. The first of these leadership workshops will take place in the spring of 2008.

Mentoring
The dean of the College of Arts and Science has made a commitment to imstitute a formal mentoring program for all junior faculty in CAS within two years.

3. Building and analyzing faculty networks

3.1 Background on social networks
Social scientists have long understood that network connections have profound implications for an individual's access to critical information, instrumental assistance, emotional support, and political power (Fischer, 1982; Granovetter, 1973). Dense networks of individuals well known to each other are critical to successful day-to-day engagement in shared activities. Yet in many circumstances it is more useful to have "bridging" ties that lead outside and beyond the densest part of one's social network. Ties that connect us to individuals with new, non-redundant sources of information are often "weak" ties, in the sense that we do not know such individuals well, do not see them often, and do not share a large group of network members in common. [See Rankin, Nielsen, & Stanley (2007) for a discussion of such "hot networks" and "weak links."]

Network connections are also critical sources of political power. Those who are isolated often are unable to appreciate the extent to which their own problems are shared, and may even blame themselves for difficulties that are external or systemic in origin. Even if individuals appreciate the ways in which their own problematic experiences are externally caused and shared by others, without effective networks of like-minded others they may be unable to mobilize effectively to change the situation (Granovetter, 1973; Hanson, 2000).

Although networks can be sources of valuable social capital, they can also be sources of stress, taxing an individual's coping strategies and depleting her resources. Stressful social ties include those in which expectations for support are unmet, interactions are actually aversive, or in which empathy for a distressed network member or demands for assistance make such a network tie a source of distress, rather than (or in addition to) a source of support (Belle, 1982a; 1982b; Riley & Eckenrode, 1986; Rook, 1984). Few network ties are perfectly reciprocal, with each network member receiving resources equivalent to those she provides, and these asymmetries can also be stressful (Belle, 1982b).

Networks often function differently for men and women (Higgins & Kram, 2001; Kram & Ragins, 2007). Using personal contacts in job searches, for instance, results in jobs that are of lower status when women are doing the searching, but jobs of higher status and better pay when male job seekers are studied (Hanson, 2000). Women appear to be more vulnerable than men to "stress contagion," when they empathize so strongly with others in distressing situations that they reflect this vicarious stress in their own poor health or poor morale (Belle, 1982b). Aral et al. (2007) found that in a business environment, where receiving diverse information and receiving it quickly is associated with productivity, men received news from their networks faster than women. Furthermore, differences between individuals in age, education, experience or gender reduced news sharing between these individuals. In STEM

disciplines, where most faculty are men, such a reduction in the sharing of information would disproportionately harm women.

3.2 Networks in science and engineering

In attempting to understand and remedy the remaining barriers to women's advancement in academic science and engineering, attention has focused on women's isolation and lack of supportive network ties (Dyer & Montelone, 2007; Etzkowitz, Kemelgor, & Uzzi, 2000; Posey, Reimers, & Andronicos, 2007; Rankin, Nielssen, & Stanley, 2007; Realff, Colatrella, & Fox, 2007). Science today is often conducted in large collaborative research groups, and women who are isolated from such networks find their opportunities for funding and research success weakened. Women's experiences in university science and engineering are often marked by social and intellectual isolation, rather than by support, mentoring, and community (Etzkowitz, Kemelgor, & Uzzi, 2000; Rosser, 1995). This isolation has been directly implicated in women faculty's dissatisfaction with academic careers, lowered productivity, and attrition from the field (Etzkowitz et al., 2000). In a recent university climate survey, women faculty reported significantly lower levels of satisfaction than did male faculty, but this gender difference entirely disappeared when a control was introduced assessing the extent to which a faculty member reported a sense of belonging (Cornell University, 2006).

Both within and beyond their own departments, faculty women in the sciences and engineering often have networks ill-suited to professional development, productivity, or high morale (Etzkowitz et al., 2000). Within departments, faculty women often have networks that are too small to provide them with adequate information and emotional support. Yet overly large networks can deplete women's resources with their many demands, providing too few supportive resources in return (Etzkowitz et al., 2000). Beyond their own departments, women faculty tend to have fewer ties than do men of comparable rank, resulting in fewer channels through which they might receive information about new scientific discoveries, funding opportunities, or methods of research, through which they might develop collaborations, or through which they might become known and valued in their fields (Etzkowitz et al., 2000).

Network limitations can deny women a "voice" in decisions that are made, resulting in ineffectiveness and demoralization. Even when women scientists experience a sexist or hostile departmental climate, those who perceive that they have a say in departmental matters show higher levels of job satisfaction than those who experience themselves as powerless to affect what goes on (Settles, Cortina, Stewart, & Malley, 2007). Smith-Doerr (2004) has shown that women life scientists are eight times more likely to achieve leadership positions and are more satisfied with their work when their work settings are characterized by greater transparency and a more lateral, egalitarian authority structure.

Many of the networking and mentoring programs developed through ADVANCE are explicitly designed to enhance women's networks, and thus their access to critical information, influence, recognition, and connection. A particularly exciting current ADVANCE project at the New Jersey Institute of Technology is testing the hypothesis that complexity in research networks created by support of select interdisciplinary research areas and encouragement of networking activities contributes to increased research productivity and career satisfaction.

3.3 Network-building programs to be undertaken as part of the WIN program

The programs that will be supported as part of the WIN program seek to improve faculty women's networks including their professional networks at BU, in the Boston area, nationally and internationally as well as their personal/social networks. Each program will have an oversight committee who will help to ensure that the program runs effectively. Oversight responsibilities, with one exception, will not be labor intensive, as the program manager will handle all day-to-day tasks required to implement the programs. All faculty members who will take on oversight responsibilities will already have gone through their tenure reviews. We acknowledge that membership on the panel which will review applications for the WIN "re-start-up packages," invited faculty program, and catalyst awards will require considerable time. All faculty members who will serve on the oversight committee for this program are senior faculty who understand the time requirements of this responsibility. Membership in this oversight committee in particular may well change from year to year to avoid overburdening specific faculty members.

- **Pre-tenure mentoring panel**

WIN will sponsor twice-yearly panel discussions and workshops for all pre-tenure male and female faculty in CAS, ENG, and SAR to complement college-wide mentoring programs already in place and under development. The WIN program will bring together junior faculty members with senior faculty members who have just finished serving on either college-wide or university-wide tenure and promotion committees. These senior faculty will be maximally knowledgeable about the nature of tenure decisions at Boston University and will be able to offer tenure-track faculty accurate information and advice. After the formal portion of each program there will be informal opportunities for junior faculty to make personal connections with each other and with panel members who could then become their tenure mentors. An important element of this program is the availability of multiple mentors on each panel, and the ability of a junior faculty member to seek out and choose her or his own mentor(s) for future consultation. The panelists will be compensated for their time. The oversight committee for this program will include Assoc. Prof. Greg McDaniel (AME), Prof. Suchirita Gopal (GEO), and Prof. Deborah Belle (PSY), who are all past members of the University Promotion and Tenure Committee.

- **Network-building for newly hired tenure track women in the STEM disciplines on CRC**

WIN will work with departments to implement welcoming receptions for all newly hired tenure track women in STEM disciplines in CAS, ENG, and SAR. We will invite all faculty members of the department the newly hired woman is entering and all other women in STEM disciplines in CAS, ENG, and SAR. In addition, we will invite any other individuals from the Boston area with whom the woman has or would like to have a professional relationship. We will encourage the faculty woman to ask members of her current professional network to recommend others engaged in related work who could be valuable additions to her network, especially those based in or close to Boston. These will explicitly include junior people just starting out as well as senior people who already have visibility in her field. In this way the newly hired faculty member might enhance connections with new or familiar members of her professional networks, and these individuals might make connections as well with other members of the BU STEM faculty. The oversight committee for this program will include Assoc. Prof. Sheryl Grace (AME) and Assist. Prof. Karen Warkentin (BIO).

- **Lunches with Leaders**

Both the Universities of Washington and Michigan made the idea of Lunches with Leaders popular. BU WISE sees the goal of the lunches as multifold. First, as stated by ADVANCE at UW, 'The lunches are informal events in which women faculty are encouraged to consider and pursue positions of academic leadership. Each month, a different woman leader discusses her career trajectory and the benefits and challenges of holding an administrative job. Emphasized are techniques for time management, obtaining consensus among faculty, and implementing a vision of excellence.' Second, they are networking opportunities for the women faculty. Third, leadership tips that are given at the lunches can be applied to managing one's research group or carrying out service obligations. We will continue our adaptation of this program by sponsoring 8 events per academic year to which we will invite notable women scientists and engineers (from both the academy and industry) and encourage them to discuss their own careers, highlighting the strategies they have found most useful in overcoming barriers, combining work with family life, or achieving career success. The presentations will be followed by questions and general discussion, affording the women in attendance a chance to learn from each other as well as the invited speaker. The oversight committee for this program will include Assoc. Professors Maja Bystrom (ECE) and Joyce Wong (BME), and Prof. Ulla Hansen (BIO).

- **Inter-University Events**

To forge and strengthen network connections for women in the Boston metropolitan area, WIN will sponsor at least one invitational event or jointly-sponsored event annually with faculty in the sciences and engineering at other local universities. Some of these events may be partnered with organizations like American Women in Science (AWIS.) BU WISE already has strong connections with MIT, Harvard, and Brown through its external advisory board. These connections, along with other one-to-one connections between BU faculty and colleagues at Northeastern, Boston College, Brandeis, etc. will be the catalysts of these events. All events will include a formal program element (lectures, panel discussions, etc.) and ample opportunity to meet others afterwards during an informal reception. These events will be open to all members of the scientific/engineering community in the Boston area, men and women. The oversight committee for this program will include Assoc. Prof. Barbara Shinn-Cunningham (CNS), Prof. Bennett Goldberg (PHY), Assoc. Prof. Margrit Betke (CS), and Prof. Roscoe Giles (ECE).

- **Industry Interaction**

The Open Partnership Initiative recently started at New Jersey Institute of Technology (NJIT) matches individual women faculty from NJIT with senior women in business and industry in their research fields in order to increase access to information about industry research agendas and open summer research opportunities for faculty in industry (Steffen-Fluhr, 2006). NJIT also provides the industry mentors with opportunities to work in academia as "professors of practice." WIN will adapt NJIT's program that increases interaction between faculty and research colleagues in industry. We will invite industry leaders to take part in our Lunches with Leaders events. We will also sponsor jointly with departments 4 colloquiua annually with women in research positions in industry. Ideas for potential speakers will be solicited from departments and the events will be run jointly with the winning departments. An honorarium for the speaker will be provided by the WIN project. The selection committee will include Professors Deborah Belle (PSY), Tom Bifano (MN), and Cassandra Smith (BME), and Assoc. Prof. Margrit Betke (CS).

- **Improved research networks:**

Female faculty sometimes find themselves isolated, side-tracked, or stalled in their research. Many ADVANCE programs have sought to overcome this difficulty through various support programs. The WIN adaptation is a three-fold program that combines several of the ideas previously used by other ADVANCE Universities. The WIN focus will be to work with women who wish to get their research careers going again through re-invigorating their networks. First, 7-8 small and quickly available "re-start-up packages" (on the order of $3000) will be available annually to cover travel costs to attend conferences, meet with potential research collaborators or funding agencies, to give lectures at other institutes or to bring potential collaborators to campus. To obtain these funds, STEM faculty women in CAS, ENG, and SAR will submit a brief application to be considered for selection.

Second, WIN will sponsor visits to BU by female faculty members in STEM disciplines from other ADVANCE schools. Each visit will include a research seminar within the hosting BU department as well as an ADVANCE related seminar or discussion during which WIN participants can learn more about the initiatives and outcomes of ADVANCE at the visitor's institute. Any BU STEM department in CAS, ENG, or SAR will be eligible to apply for such a sponsored visit, including departments which do not have women in them. Travel expenses will be provided as well as an honorarium. Two such visits will be sponsored annually, and departments will submit brief applications to be considered for selection.

Third, 3 catalyst awards will be available each year to women STEM faculty in CAS, ENG, and SAR. These awards are intended to seed new collaborative projects in which the collaboration involves at least one female BU faculty member from a STEM discipline. Proposals for these awards will describe both the new area a faculty member would like to pursue and the new collaboration that is being developed to undertake the project. The funds can be used for equipment, graduate student support, partial teaching release time, summer salary, travel to research sites, expenses for specialized child care to permit research activities, etc. We will follow the University of Michigan model where these grants were on the order of $20k. The selection committee for these awards in the first year will consist of Professor Lucia Vaina (BME), and Assoc. Professors Margrit Betke (CS), and Barbara Shinn-Cunningham (CNS).

- **Geographical connectedness**

BU faculty are geographically dispersed in many neighborhoods around the Boston metropolitan area. Faculty can feel isolated and find it hard to maintain their personal networks while striving for tenure, particularly if they also have child care responsibilities. BU faculty neighbors who were aware of each other might share information on local schools and child care options, potentially building local connections that would be supportive. Thus as part of the WIN program, following a program in existence at Harvard, a geographical connectedness map for faculty will be constructed. Faculty will be encouraged to participate in an address share program that will enable them to meet colleagues who live in close proximity. This program could be expanded to include STEM faculty at other local schools. The oversight committee for this program will include Prof. Suchirita Gopal and Assoc. Prof. Mark Friedl (GEO).

- **Networks for family matters**

Boston University operates only one child care center, which offers only 31 slots for children 2-5. To respond to this dearth of University-provided child-care, an on-line bulletin board will be

developed which will enable faculty to share information on alternative child care resources, including student au pairs who can care for infants on campus while faculty mothers work, and family day care homes or day care centers close to campus or in the different neighborhoods where BU faculty live. In addition, a list-serv will be developed so that faculty can send specific inquiries both about child-care and other items such as contractor recommendations. The development and maintenance of the on-line bulletin board and list-serve will be the responsibility of WIN's program manager. Suggestions for bulletin board content will be provided by the STEM community at BU.

4. Assessment of programs and outcomes

4.1 Formative evaluation

We will engage in continuous formative evaluation of our programs using questionnaires distributed and collected at specific events and periodic informal focus groups to reflect on the strengths and weaknesses of our programming. In addition to asking attendees to rate the quality of each event and to describe what they have learned from attendance, we will ask attendees to note whether they have met new people (or deepened existing relationships) at the event and if they anticipate an ongoing relationship of any kind as a result of attendance. (We will also track network changes over time as described below.) We will also attempt to contact and learn from those faculty members who do not attend WIN program events. These may well be faculty members whose networks are already so satisfactory that they have no need or wish for further contacts or expanded networks. If, however, their lack of attendance results instead from the inconvenient timing of events, poor publicity, or the failure of our programs to meet their needs, we would like to learn about these problems and improve our program offerings. In conducting this formative evaluation we will also be attuned to the possibility that our WIN events may actually have some negative consequences for STEM faculty women, particularly the possibility that attendance at or preparation for WIN events will require too much time from faculty members, drawing them away from their research priorities. If such effects occur, programs will be modified accordingly.

4.2 External evaluation

The MIT Web Survey Group will serve as our external evaluators, re-administering in the grant's final year the web climate survey they conducted with all BU faculty as a baseline assessment during fall, 2007. Response rates on this first assessment were acceptable (61% for the University as a whole, and 71% for the Charles River Campus). This climate survey will be funded by BU and will include new questions to assess faculty members' networks and their participation in WIN programs and other programs at the University that may contribute to network-building. By the end of the grant period we would expect to see improvements over baseline in faculty women's assessments of departmental and campus climate, particularly in their reports of collaborative opportunities, voice, satisfaction with mentoring, and communication about the requirements for tenure and promotion. Since several of the programs we will institute will engage and benefit male faculty as well as female faculty, we also expect to see improvements over baseline in men's reports of campus climate variables. (The WIN program would thus show itself to be a WIN-WIN program.)

4.3 Studying networks as mediators of outcomes

Kalev, Dobbin, and Kelly (2006) have argued that we still know very little about successful strategies for improving diversity in the workplace, and that what we really have are "best guesses," not "best practices." Rigorous evaluation of efforts to advance women in the sciences and engineering is difficult to accomplish. Researchers generally measure changes over time in the numbers and proportions of women hired, tenured, promoted, and moved to leadership positions, often in comparison to peer schools or paired departments which did not receive the intervention program. The numbers of women concerned are generally small, however, and it is often difficult to apply statistical tests of significance to such data or to be sure that the specific programs under study, rather than other forces, produced the observed results.

Our intervention programs are designed to affect women largely through their impacts on women's network relationships. The WIN evaluation therefore will assess the extent to which each specific program fielded as part of the WIN program results in changes over time in faculty networks.

At the beginning of the grant period, a questionnaire survey focusing on networks will be administered to all faculty women and men in CAS, ENG, and SAR. As part of this survey we will also assess self-reported work satisfaction, perceived campus climate, voice, and productivity, using questions adapted from various sources including Etzkowitz et al. (2000) and Settles, et al. (2007). Using questions adapted from Etzkowitz et al. (2000), participants will be asked about the individuals who provide them with professional advice, those who serve as models for professional success, those they collaborate with, those they socialize with, and those who have helped them to balance work and personal issues. Participants will be asked about individuals within their own departments, individuals outside their departments but within the University, and individuals from other universities or settings. Following Etzkowitz et al., questions will ask each participant to name the network members to whom the participant provides important social support resources as well as the network members from whom the participant receives such resources, which will inform us about reciprocated and unreciprocated social support. Respondents will also be asked about individuals in their professional worlds who are the source of negative interactions. Once the list of network members is produced, the respondent will be asked which of the named individuals know each other. Demographic information about each named individual will be requested, including the person's gender, academic rank, parental status, field or department, the length of time the respondent has known the individual, the geographic location of the individual (if not at Boston University), and the frequency with which the respondent gets together with or communicates with the individual.

Answers to these questions will be used to calculate several measures of each respondent's network, including total network size, numbers of network members who provide each specific resource (such as professional advice), density (the extent to which network members know each other), demographic diversity, frequency of contact, supportiveness, the extent of stressful network ties and of "conflicted" network ties which produce both supportive and stressful experiences, and the extent to which the respondent is involved in reciprocated or unreciprocated exchanges with network members. We anticipate on the basis of previous research that networks will generally tend toward demographic homogeneity, with women's networks containing a higher proportion of women, men's networks a higher proportion of

men, networks of full professors containing a higher proportion of full professors, etc. On the basis of previous research we also anticipate that men's networks of professional support and advice will be larger than those of women and will contain more individuals of high academic rank and more "bridging" ties to other departments and other universities. We anticipate that women will engage in more unreciprocated support to others and will receive less unreciprocated support from network members than men do. With data from this first year survey we will be able to test whether certain characteristics of an individual's network are associated with her or his work satisfaction, productivity, voice, and perceptions of campus climate.

Faculty participants will be re-surveyed in the final year of the grant period. The second survey will repeat the network questions asked in the original survey questionnaire and will then compare the network members named in the later survey to those named in the earlier survey. Whenever a respondent names an individual who was not mentioned before as a network member, the questionnaire will ask how the respondent met or came to know this individual. We will thus learn about the ways in which academic networks change and grow over time. We will be particularly interested to learn if new network connections have been formed through WIN program activities or other University programs designed to promote faculty diversity and inclusion. We anticipate that some of our events will result largely in building new connections among faculty women at Boston University, while other events and programs will more often connect BU faculty women with male faculty or with individuals at other universities. Some events are likely to lead to new relationships that provide information and expert advice and lead to new research collaborations, while others are more likely to contribute to building sociable and personal relationships.

We will then test the hypothesis that specific WIN programs affect women's work satisfaction, "voice," and productivity largely through their impacts on women's network relationships. We will therefore study the links between women's attendance at specific programs we implement and changes over time in women's networks, as well as the links between changes in women's networks and later outcomes. We will also examine whether women's retention, promotion, and movement to leadership positions are related to characteristics of their networks and, in particular, to changes in their networks over time. Are women with stronger networks within their own departments, for instance, more likely to remain at Boston University?

5. Research and management team

PI Deborah Belle will oversee the project and will focus on its research component -- creating various networks for women faculty in science and engineering at BU, and evaluating these networks before and after interventions. She will also be responsible for analyzing the formative evaluation data collected through questionnaires after each event and through focus groups. She will supervise one doctoral student. Co-PI Sheryl Grace will work with the Program Manager and senior investigators to organize the various programs. Senior investigator Carol Neidle, who has analyzed benchmark data through the BU Council on Faculty Diversity and Inclusion and earlier through the BU Faculty Council, will analyze benchmark data for this project. The Program Manager will be responsible for implementing the WIN programs and collecting formative evaluation data about each program.

Professors Margrit Betke , Maja Bystrom, Mark Freidl, Sheryl Grace, Greg McDaniel , Barbara Shinn-Cunningham, Karen Warkentin, Joyce Wong, Deborah Belle, Tom Bifano, Roscoe Giles, Bennett Goldberg, Sucharita Gopal, Ulla Hansen, Carol Neidle, Cassandra Smith, and Lucia Vaina have strong track records supporting women and underrepresented minorities in STEM disciplines. They have donated their time for various outreach and mentoring efforts at BU and elsewhere, e.g., Pathways (women high school students) and various GWISE (women graduate students) groups. Our team is in an excellent position to develop the professional and social networks that would benefit women in science and engineering to advance their careers.

WIN will benefit from yearly interaction with an external advisory board to be created by extending the current BU WISE board that includes: Lotte Bailyn, Howard Georgi, Susan Metz, Meenakshi Narain, Eve Riskin, Debra Rolison, and Abigail Stewart.

Support and supervision of the proposed work will be provided by a steering committee, including Provost David Campbell of the Charles River Campus, Provost Karen Antman of the Medical Campus, Dean Sapiro of the College of Arts and Sciences, Dean Lutchen of the College of Engineering, and Dean Waters of the Sargent College of Health and Rehabilitation Sciences.

6. Institutional Support

Boston University will increase its financial support for programs that advance women faculty in the STEM disciplines as well as programs that benefit broader groups of faculty members on campus by increasing WISE's budget for the duration of the WIN award. The University will also fund one round of the University-wide climate survey directed by the MIT Web Survey Group with additional questions designed specifically for the WIN evaluation, and will provide annual data updates to facilitate the analysis of time trends in faculty hiring, retention, tenure, promotion, salary, etc.

7. Dissemination, and Sustainability

Following the lead of other ADVANCE schools, we will create a website to provide extensive information on the implementation of programs, evaluation methods, and results of our evaluations. In every way that is possible, the network evaluation and our method of assessing the impact of programs on networks will be automated and made available on-line. We will present what we learn at appropriate conferences such as those of Women in Engineering Programs Advocacy Network (WEPAN). We will publish findings in journals devoted to women in science, network analysis, and the psychology of women.

Many of the programs described here are viewed by BU deans as pilot programs that could be expanded in their own colleges if the programs prove their worth. The deans of CAS, ENG, and SAR will be quite familiar with the implementation and evaluation of these programs through their participation in our steering committee. Programs that do prove useful are thus likely to be adopted at these colleges. Although the WIN program will focus on the Charles River Campus of BU, Provost Antman of the Medical Campus will, as a member of our steering committee, become aware of successes which she may decide to adopt on the Medical Campus as well. One of the responsibilities of the PIs and of the program manager will be to investigate potential funding sources that will sustain the catalyst program and support the program manager position after the conclusion of the grant period.

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