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The Role of Mentoring in the Careers of Women Engineering Deans

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Abstract

Despite tremendous gains over the past 30 years, women are still severely underrepresented in engineering and engineering education. In 2009, only 17.8% of the more than 74,000 engineering bachelor's degrees awarded in the United States went to women, down from 21.2% in 1999. Women are currently 12.7% of all engineering faculty, and only 7.7% of full professors in U.S. engineering schools (Gibbons 2010). According to the American Society for Engineering Education (ASEE), 69 women had served as dean of engineering at one of the almost four hundred engineering or technology colleges in the United States and Canada that are institutional members of ASEE, and 38 women held that title in spring of 2010. Seven of the 50 largest engineering schools (in terms of bachelor's degrees awarded) are or have been led by women, and one of these institutions (Purdue) currently has its second female dean. The majority of female deans have assumed that role since the turn of the century, with several women appointed dean each year since 2005, and nine appointed in 2009. Of the 31 former deans, half have gone on to other academic leadership roles including provost, vice-president for research, chancellor, and president. Interviews with 21 women deans between 2002 and 2010 for profiles in the *SWE Magazine* explored their career paths, accomplishments, work/family issues, and leadership styles. This paper focuses on the role of mentors, professional society activities, and other leadership experiences in the career development of female engineering deans. Future leaders may benefit from the experience of these pioneering women.

Introduction

Women have entered formerly male-dominated careers in increasing numbers over the past 40 years, but remain significantly underrepresented in engineering and in academic leadership positions. It may be helpful for future female engineers and especially female engineering faculty members to understand how the small number of women who have served as deans of engineering have successfully navigated the opportunities and challenges they have faced in their careers. This study focuses on the role of mentors, professional society activities, and other leadership experiences in the career development of female engineering deans.

The number of women earning bachelor's degrees in engineering in the United States increased dramatically from the early 1970s to the late 1980s, and then remained relatively static until the early 21st century, when numbers began a slight climb. The number of women earning doctoral degrees in engineering increased by an order of magnitude from 1980 to 2000, but both the number of women earning engineering degrees and women's percentage of degrees awarded remains relatively small: in 2009 women earned 17.8% of engineering bachelor's degrees and

21.2% of engineering doctorates in the U.S. (Di Fabio et al. 2008; Gibbons 2010) To put these numbers in context, from 1997-98 to 2007-08 women earned between 56% and 58% of all bachelor's degrees in the U.S. (NCES 2010), including half of all bachelor's degrees in science and engineering fields (including physical, biological, social, and psychological sciences and engineering) (Di Fabio et al. 2008).

Women are now a majority of students at U.S. universities, but remain underrepresented on the faculty, especially at the more senior ranks and at more prestigious institutions. Among full-time faculty across all disciplines, women currently make up 52% of lecturers and 51% of instructors, 45% of assistant professors, 33% of associate professors, and 24% of "full" professors (Dean 2009). The proportion of women among *engineering* faculty reached 10% in 2006 (Burrelli 2008), and women currently comprise 21.6% of assistant professors, 14.5% of associate professors, and 7.7% of "full" professors at U.S. engineering schools (Gibbons 2010). Several high profile universities are currently led by women presidents, including Harvard, Massachusetts Institute of Technology (MIT), Rensselaer Polytechnic Institute (RPI), and Purdue, so progress is being made. In 2007, 23% of college presidents and 38% of provosts or chief academic officers were women, but senior women leaders are still more likely to be found at community colleges and baccalaureate institutions than at research universities (Madsen 2010).

Almost 400 institutions in the U.S. and Canada have accredited engineering programs, and 38 of those had women in the role of dean of engineering or director of the engineering program in the spring of 2010, according to the American Society for Engineering Education (ASEE). At least thirty-one additional women are known to have served as dean at some point in the past 20 years, bringing the total to 69. Some of these women served as acting or interim deans, and others led small programs consisting of a single department. Six deans have served at bachelor's degree granting institutions, 28 at master's level schools, and 34 at institutions that grant doctoral degrees (ASEE personal communication, 2010). Seven of the 50 largest engineering schools (in terms of bachelor's degrees awarded) are or have been led by women, and one of these (Purdue) currently has its second female dean. The majority of female deans have assumed that role since the turn of the century, with several women appointed dean each year since 2005, and nine appointed in 2009.

Academic deans at research universities are responsible for a collection of departments, usually grouped by discipline into a school or college. They oversee faculty recruitment, hiring, and development, as well as financial planning, budgeting, and management, and are increasingly responsible for fund raising and maintaining relationships with alumni, donors, and legislators. Deans work with department heads and faculty to set priorities and develop and implement a vision for the college. Within the general constraints set by the upper administration, deans often have a lot of discretion in leading their unit, and have a great deal of influence on the work environment and overall climate for faculty and students. Deans gain a broad perspective on how their institutions work, and experience as dean often leads to more senior administrative positions such as provost or president (Gmelch and Wolverton 2002; Montez et al. 2002; Wolverton and Gmelch 2002). Of the 31 female former engineering deans, half have gone on to other academic leadership roles, including provost, vice-president, chancellor, and president.

Theoretical Framework

This study draws on the literature on mentoring and career development, especially in higher education and for underrepresented groups such as women and minorities, to analyze the careers of female engineering deans. A mentor is a trusted adviser or counselor. The term has its roots in Homer's *Odyssey*, in which Mentor was a trusted friend of Odysseus who watched over his son, Telemachus, while Odysseus was away fighting the Trojans. The goddess Athena also appeared to Telemachus in the form of Mentor to provide advice.

In current usage, a mentor is usually a more senior individual who gives advice to someone more junior. Definitions of mentoring vary, from providing assistance in professional skill development and insight into organizational culture to nominating the junior colleague for positions (sponsorship), providing visibility within the organization, and protecting from criticism. Good mentors also provide candid feedback and constructive criticism to their protégés or mentees. Studies of mentoring describe two primary functions: technical or career-enhancing and psychosocial. In addition to the career-enhancing function of mentoring, mentors provide encouragement and social support, helping the junior colleague to develop confidence and self-esteem (Chandler 1996; Chesler and Chesler 2000; Nies and Wolverton 2000; Dean 2009). The psychosocial aspects of mentoring have been shown to be especially important for women faculty (Bilimoria et al. 2006).

Majority group members often have access to informal mentoring not available to minorities, including women in male-dominated careers. Majority individuals may not even recognize that mentoring is occurring when they have seemingly casual conversations with senior colleagues in the hallway, over lunch, at the gym, or on the golf course. Since people tend to provide informal mentoring to individuals who are like themselves and there are many fewer women than men in high level positions in engineering and academe, women often have less access to this form of informal mentoring. Men can certainly be valuable mentors for women (and vice-versa), but senior men may hesitate to mentor junior women for fear that their relationship may be misinterpreted, and men may not be able to provide advice to women on issues such as how to balance demands of work and family. Different communication styles may also complicate mentoring relationships between men and women (Chandler 1996; Nies and Wolverton 2000; Brown 2005; Dean 2009).

Traditional one-to-one mentoring may not always be the most appropriate model for women. Chesler and Chesler (2000) describe the traditional mentoring model as based on the heroic journey, in which the hero must pass many tests and overcome challenges in order to prove his worthiness and ultimately must succeed on his own. Several alternative models of mentoring have been proposed as more collaborative and thus more appropriate for women, including nonhierarchical support networks (Chandler 1996), collective mentoring (Chesler and Chesler 2000), peer mentoring (Dyer et al. 2007), multiple mentors (de Janasz and Sullivan 2004), and virtual or electronic mentors (Muller and Chou-Green 2005).

Studies of academic leaders show that mentoring can be important in their career development, and not only in the early years of an academic career. A national study of academic deans found that 55% of them had mentors, with the women more likely than the men to have mentors.

However, no engineers were included in this study and the majority of women deans surveyed were in schools of nursing (Nies and Wolverton 2000). Dean (2009) found that 82% of the female chief academic officers she surveyed had mentors at some point in their careers, and 47% had current mentors. The mentors were described as “incredible professional assets...who supported their professional development and advancement opportunities” (Dean 2009). The majority of women presidents of independent colleges surveyed reported having mentors, with 63.1% having one to three mentors and 15.5% reporting four or more. Of those with mentors, 71.4% said that their mentors had sought them out. A majority of these women also served as mentors themselves (Brown 2005). Madsen’s interviews of female university presidents found that mentors were especially important to these women when they reached the vice-presidential level (Madsen 2010).

Methodology

The author interviewed 21 of the known women engineering deans for profiles published in the Society of Women Engineers magazine annually since 2002. Two or three deans were selected each year to represent different types of academic institutions, different geographic regions of the U.S., and different engineering disciplines. One dean was at a bachelor’s degree granting institution, 6 were at master’s level universities, and 14 at research universities with Carnegie classifications of high or very high research. Disciplinary backgrounds include electrical engineering (9), biomedical engineering (3), chemical engineering (3), civil engineering (2), mechanical engineering (2), industrial engineering (1), and statistics (1).

When they were interviewed, the women had been in their role as dean for varying lengths of time, ranging from one to 18 years. Ten had been in their position for 3 to 5 years, 7 for less than 3 years, and 4 for more than 5 years. Nine of the deans have since moved on, one to retirement, one to a non-academic position, 4 to become provosts or vice-president for academic affairs and 3 to positions as president or chancellor of a university.

The deans were asked to respond to the following open-ended questions:

- What do deans really do, and how do you see your role as dean?
- What are the best and worst things about being a dean?
- What have you accomplished/do you hope to accomplish as dean?
- How is your institution different as a result of your leadership?
- What influence does the fact that you are a woman have on your leadership style?
- What decisions did you make early in your career that led you to your current position?
- What people or events influenced your career path?
- Have you been involved in professional societies, and if so, how has your involvement influenced your career?
- How has your role as a leader in engineering education influenced your personal life, and vice versa?
- Can you recommend a particular book or article on leadership that is meaningful to you, and why?
- Do you have any other “words of wisdom” or advice for SWE members reading this article?

Respondents were given the option of replying by email or in a telephone interview, and in some cases the author supplemented the email responses with telephone conversations. The telephone interviews were not recorded but careful notes of the discussions were kept. The deans were also asked to provide biographical information such as a curriculum vitae. After the profiles were published, the author compiled all of the interview responses and reviewed them to identify commonalities and differences that emerged across the interviews. The deans' career paths, perceptions of their role as dean, and views on gender and leadership are discussed elsewhere (Layne 2010; Layne 2011). This paper focuses on the deans' responses to the questions about people or events that influenced their career path, their involvement in professional society activities, and other leadership experiences.

Since the interviews were originally intended for magazine profiles, there was no promise of confidentiality, and potentially sensitive issues were not explored in depth. The deans may also have censored some of their responses, knowing that the interviews were intended for publication. No comparable data set for male engineering deans is available for comparison. Even considering these potential shortcomings, the women deans' descriptions of their careers can provide useful insights into how they perceive their own development as leaders and how they have negotiated the male cultures of engineering and academe.

Findings

The women deans interviewed followed many different paths to their positions as dean. Only 9 of the 21 served as a department head before becoming dean, while others gained leadership experience in professional societies, managing research grants, and in federal agencies in addition to their faculty responsibilities. While not every dean interviewed mentioned mentors when asked to describe people or events that influenced their career, 13 out of the 21 explicitly named mentors or described mentoring relationships.

In describing people or events that influenced their career path, the deans mentioned their parents, pre-college teachers, university professors, colleagues, professional society activities, and career events that caused them to think about taking on leadership responsibilities. Two deans decided to move from faculty to administrative roles to address a perceived need in the department, such as an upcoming accreditation visit. Few set out to become deans; one interviewee even exclaimed "I honestly never aspired to be a professor let alone a dean!" Only one confessed an early interest in academic leadership:

"I may have been the only assistant professor who actually wanted to be a dean. I was fascinated by people who had a big, broad vision of where the university fit in the larger society, what changes were going on in the legislature, the economy, with students. Many researchers focus on narrow problems, but I like to think broadly."

More than half of the deans interviewed brought up the importance of mentors in their development and recommended mentoring for others. One dean observed: "In every position I have met people who mentored me and supported me and helped me to get where I am." Another dean made a point of saying that she actively sought out mentors in her career. In the words of a third dean:

“I can’t overstate the importance of mentors in my life. Every important professional decision I’ve made, and most of the personal ones as well, have involved the advice of mentors. They helped me think about graduate school instead of a job, an academic career, committing deanery, running for office in my professional society, and so much more.”

Mentors were described as playing various roles, including encouraging the protégé to pursue a graduate degree, offering a fellowship, helping to develop specific skills, providing advice, nominating the protégé for a position, sharing knowledge about institutional policies and processes, and serving as role models. One dean described the function of her mentors as both cheerleaders and sponsors, providing psychosocial benefits as well as career-enhancement by helping to build her confidence as well as opening doors for her and validating her abilities to others. In her words:

“These are people who have seen some talent in me, frequently talent I didn’t see myself. They have encouraged me along the way and they shared with others their faith in my abilities to positively change whatever organization I have joined.”

In most cases, the mentoring described was informal, not part of any organized framework or program. Only one dean described a formal leadership development experience that involved a more structured mentoring relationship:

“When I was still an assistant professor [...], I applied for a position called Faculty Associate to the Provost. [...] This was a rotating one-year position created to help increase the number of women in higher education administration. The individual in that role reported directly to the provost, was mentored by him, attended meetings of the President’s Cabinet and Deans’ Council, and was responsible for several special projects. [...] I spent the next year working with [the provost]. He was an extraordinary mentor and a great provost and this position was the turning point for me.”

One individual was inspired to pursue a leadership role after attending a workshop designed to expose female engineering faculty to the rewards and challenges of academic leadership. The event provided an opportunity for mentoring and building professional networks by bringing together current women deans and department heads, professional society leaders, and senior women faculty to discuss ways to increase the participation of women in leadership roles in engineering. In addition to leadership skill building, the participants spent time brainstorming, identifying obstacles, and developing action plans. A faculty member at the time, the future dean “... looked at and listened to these women [deans and department heads] and thought, ‘I can do this!’”

Involvement in professional society activities provides an opportunity to develop leadership skills and to build a network of colleagues outside of one’s own institution. All of the deans interviewed have been involved in professional society activities at some level, and at least five

of them served as national president of a professional association. One dean described the career benefits of serving as a leader in a professional society this way:

“As President of the [...] Society, a professional organization of over 9,000 worldwide, I learned about cultures, communication, goal setting, and leading large organizations. This involvement in my profession provided me opportunities to excel and to learn beyond the traditional academic pathways.”

Another dean specifically mentioned her professional society as a source of mentors, and observed that being an officer in a professional society “gives you an opportunity to explore leadership...the skills are transferable wherever you go.” Comments from other deans address the importance of professional society involvement in their careers:

“...professional societies have been a key resource for networking and professional development.”

“These board activities contributed to my development of communication and interpersonal skills during a career that has exposed me to industry, business, academic, community, and government operations.”

“The opportunity to network at conferences and meet people is personally satisfying and good for my career.”

Three of the deans interviewed served as program officers at the National Science Foundation for a time before becoming dean. Such roles provide the opportunity to manage budgets, build leadership skills, gain a broad perspective on one’s discipline, and develop relationships with leading scholars across the country. One dean who served as an NSF division director observed that the experience:

“gives ... tremendous opportunities to connect with other disciplines, [there are] lots of creative people to connect with at the agency as well as researchers across the country – really broadening horizons, increasing [my] personal network in a different way from taking a sabbatical or temporary job in industry.”

Three other deans gained leadership experience as directors of major university research centers, and one led a department at a national laboratory. Experience in these roles often requires managing more people in more different roles than a typical faculty member’s research group, and sometimes involves working across departments or institutions, exposing the faculty member to cross-disciplinary or national perspectives. A dean who received an NSF Engineering Research Center grant commented that “becoming director of that grant led to connections across universities and got me started thinking broader.”

While seven of the deans interviewed subsequently moved on to provost, vice-president, president, or chancellor positions, few deans mentioned future career plans during their interviews. Only one described actively preparing for other leadership roles:

“I am also extremely fortunate and perhaps unique as a dean to have an executive coach [...] who keeps me on task regarding my life, my career and my future direction. We

work together full-time so I receive incredible on-the-job training every day as I lead the engineering school and prepare for my future as either a president of a university or a director of a major research institute.”

Discussion

Some of the 21 women engineering deans interviewed developed leadership skills through the traditional academic route by serving as department heads, while others held leadership roles in professional societies and federal agencies. They received career-enhancing advice as well as encouragement and social support from mostly informal mentors, many of whom were male. Despite being severely underrepresented in engineering, these women were able to access informal mentors and benefit from traditional one-to-one mentoring relationships.

Mentors clearly played an important role in the careers of many of these distinguished women leaders, preparing them both to be successful as deans and for more senior leadership roles. Most of them have relied on advice from multiple mentors as well as networks of colleagues within and outside their own institutions. Few benefited from assigned mentors or formal mentoring programs; rather they developed informal mentoring relationships with graduate advisors, senior colleagues, and peers. The deans sought and received guidance from different individuals at different points in their careers, in some cases moving from a traditional mentor/protégé relationship to multiple mentors or a peer or group mentoring model as they moved into leadership roles.

Given the small number of women in senior leadership positions in engineering, it is not surprising that the deans interviewed describe both male and female mentors, and that the female mentors tend not to be engineers but women in other academic disciplines who hold senior leadership roles. The deans describe many traditional one-to-one mentoring relationships in which a senior colleague gave them advice and counsel when they were in the early years of their careers. In some cases those relationships continued as their careers developed: one dean described her PhD advisor as her “advisor for life”. In most cases, the deans referred to multiple mentors, including their PhD advisor, senior colleagues, and individuals they met through professional societies and elsewhere.

Because of their small numbers and high visibility within the engineering education community, the women deans often know each other and in some cases have developed networks among themselves. The NSF-funded Women in Engineering Leadership Institute brought several of the earlier women deans together for a series of workshops between 2003 and 2006 to build a network, provide mentoring to junior colleagues, develop leadership skills, and encourage more women engineers in academe to pursue leadership roles. At least one later dean was inspired to seek a deanship by her participation in one of these events.

Future research could gain a deeper understanding of the specific functions of mentors and their influence on the careers of women academic leaders in engineering through confidential interviews or focus groups to explore strategies for developing and maintaining successful mentoring relationships, different models for more formal structured mentoring programs,

potential negative impacts of mentoring, and other mechanisms to support women in male-dominated fields such as engineering.

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