



Changing an Electrical and Computer Engineering Department Culture from the Bottom Up: Action Plans Generated from Faculty Interviews

Elise A. Frickey, Iowa State University

Elise is a graduate student at Iowa State University. As a doctoral student in Counseling Psychology, she has been involved with research on the application of self-determination theory to different domains to allow for better understanding of the relationships between contextual factors, basic psychological needs, and indices of well-being. Prior to attending Iowa State University, she obtained a Bachelor of Arts in Psychology and Spanish from Hillsdale College.

Dr. Diane T. Rover, Iowa State University

Diane Rover is a University Professor of Electrical and Computer Engineering at Iowa State University. She has held various faculty and administrative appointments at ISU and Michigan State University since 1991. She received the B.S. in computer science in 1984, and the M.S. and Ph.D. in computer engineering in 1986 and 1989 (ISU). Her teaching and research has focused on embedded computer systems, reconfigurable hardware, parallel and distributed systems, visualization, performance monitoring and evaluation, and engineering education. She has held officer positions in the ASEE ECE Division, served as an associate editor for the ASEE Journal of Engineering Education, and served on the IEEE Committee on Engineering Accreditation Activities, the IEEE Education Society Board of Governors, the ABET EAC (2009-2014), and EAC Executive Committee (2015-2018). Dr. Rover is a Fellow of the IEEE and of ASEE.

Prof. Joseph Zambreno, Iowa State University

Joseph Zambreno has been with the Department of Electrical and Computer Engineering at Iowa State University since 2006, where he is currently a Professor. Prior to joining ISU, he was at Northwestern University in Evanston, Ill., where he graduated with his Ph.D. degree in electrical and computer engineering in 2006, his M.S. degree in electrical and computer engineering in 2002, and his B.S. degree summa cum laude in computer engineering in 2001. While at Northwestern University, Zambreno was a recipient of a National Science Foundation Graduate Research Fellowship, a Northwestern University Graduate School Fellowship, a Walter P. Murphy Fellowship, and the EECS department Best Dissertation Award for his Ph.D. dissertation titled "Compiler and Architectural Approaches to Software Protection and Security."

Prof. Ashfaq Khokhar, Iowa State University

Ashfaq A. Khokhar received his B.S. degree in electrical engineering from the University of Engineering and Technology, Lahore, Pakistan, in 1985, MS in computer engineering from Syracuse University in 1988, and his Ph.D. in computer engineering from University of Southern California, in 1993. After his PhD, he spent two years as a Visiting Assistant Professor in the Department of Computer Sciences and School of Electrical and Computer Engineering at Purdue University. In 1995, he joined the Department of Electrical and Computer Engineering at the University of Delaware and served at assistant and associate professor levels. Dr. Khokhar joined UIC in Fall 2000 and served there till Summer 2013. He is currently serving as Professor and Palmer Department Chair of ECE at Iowa State University. Dr. Khokhar has published over 280 technical papers in refereed conferences and journals in the areas of wireless networks, parallel computing, image processing, computer vision, and multimedia systems. Dr. Khokhar is a recipient of the NSF CAREER award in 1998. He is a recipient of numerous outstanding paper awards. He is also an IEEE Fellow for his contributions to multimedia computing and databases. His research interests include: search and retrieval for Internet data, multimedia systems and communication, multidimensional spatial databases, data mining, health informatics, computational biology, and high-performance computing.

Dr. Douglas W. Jacobson, Iowa State University



Doug Jacobson is a University Professor in the Department of Electrical and Computer Engineering at Iowa State University. He is currently the director the Iowa State University Information Assurance Center, which has been recognized by the National Security Agency as a charter Center of Academic Excellence for Information Assurance Education. He teaches network security and information warfare and has written a textbook on network security. For a non-technical audience he co-authored a book on security literacy and has given numerous talks on security. His current funded research is targeted at developing robust countermeasures for network-based security exploits and large scale attack simulation environments and is the director of the Internet-Scale Event and Attack Generation Environment (ISEAGE) test bed project. He has given over 75 presentations in the area of computer security and has testified in front of the U.S. Senate committee of the Judiciary on security issues associated with peer-to-peer networking. He has served as an ABET program evaluator representing IEEE for 10 years. He is a Fellow of IEEE and received the IEEE Educational Activities Board Major Educational Innovation Award in 2012 for his work in teaching information assurance to students of all ages.

Dr. Lisa M. Larson Ph.D., Iowa State University

Dr. Larson is a professor in the department of psychology. She has examined Self Determination Theory as a framework to explain how the environment impacts well-being for faculty, students in general, and student veterans. Her other work includes the intersection of personality and vocational interest as well as how counselors learn to become effective in their work with clients.

Prof. Mack Shelley, Iowa State University of Science and Technology

Mack Shelley holds the titled position of University Professor of Political Science, Statistics, and School of Education. He currently serves as Chair of the Department of Political Science. His research and teaching focuses on public policy. He has extensive experience with grants- and contracts-funded research and evaluation for federal and state agencies, and for nonprofit organizations.

Changing an Electrical and Computer Engineering Department Culture from the Bottom Up: Action Plans Generated from Faculty Interviews

Previous research [1] has documented the pressures encountered by STEM faculty at R1 institutions: weighty teaching loads, pressure to “publish or perish,” urgency to obtain funding, mentorship of graduate students, and the stress of promotion/tenure all can have deleterious effects on the well-being and job satisfaction of faculty. Moreover, these pressures interact with the disproportionate barriers faced by underrepresented faculty [2]. Given the predicted growth of faculty positions in coming years (11% from 2018-2028) [3], and that many of these positions will be held by traditionally underrepresented groups of women and persons of color, it is imperative that institutions consider the climate and culture of their departments to best meet the needs of current and future academics. Prior research points to the benefit of collaboration between faculty developers and engineering educators [4], as representation, retention, and satisfaction of diverse faculty have important implications for the education of undergraduate students in STEM as well. The purpose of the present article is to outline a collaborative implementation of a National Science Foundation (NSF) grant-funded program targeting areas of concern in a large Electrical and Computer Engineering (ECE) Department.

One National Science Foundation (NSF) program that has been widely and successfully implemented in more than 160 academic institutions and non-profit organizations is called ADVANCE Institutional Transformation. The program is designed to assist in the recruitment, retention, and advancement of women in STEM fields by systemically altering culture, structure, norms, practices, and policies of institutions that historically have perpetuated inequity among faculty. These initiatives approach change from both top-down (e.g., establishing policy change at college- and university-levels) and bottom-up (e.g., altering structures and policies at a department-level) perspectives to enhance productivity, satisfaction, and diversity of faculty. This university was awarded an ADVANCE institutional NSF grant in 2006; the work of transforming department cultures that began as part of the grant has now been institutionalized. The present document outlines how one component of the ADVANCE initiative was leveraged in collaboration with a Revolutionizing Engineering and Computer Science Departments (RED) NSF grant awarded to a large ECE department at this University. The RED program supports revolutionizing ECE departments through the cultivation of an inclusive, collaborative, and innovative department culture by facilitating structural, policy, and procedural changes. Currently, 21 departments nationally are funded by RED grants [5]. This paper will describe that ADVANCE initiative before detailing its impact on the ECE department.

The Department Enhancement Program (DEP), originally called Collaborative Transformation, was a key part of the NSF ADVANCE grant and has now been implemented in 30 departments at the University. Fitting with ADVANCE’s bottom-up approach to transformation, the DEP allows departments to identify specific areas of concern to their faculty to develop strategies that address these issues, thereby improving satisfaction and retention of faculty. The goal is to “mirror back” to faculty aspects of their workplace that support or impede satisfaction, productivity, and retention of faculty, particularly faculty from diverse backgrounds. The process begins with a 90-minute interview with the department chair, followed by similar interviews with focus groups of volunteering faculty by rank. These interviews are audio-recorded, transcribed, and subsequently analyzed by a social scientist for consistent themes that

are included in a report to be presented to the faculty. Using this report, the faculty themselves develop a plan consisting of action items to address the barriers identified.

The original ADVANCE institutional grant included nine STEM departments participating in DEP. Collectively, 278 faculty participated in the focus groups, with a participation rate of 74% [6]. Salient themes found to be consistent across these nine departments included collegiality and work environment; faculty recruitment and hiring; promotion, tenure, and faculty evaluation processes; mentoring faculty; work-life balance and family friendly policies; teaching loads, course distribution practices, and rewarding teaching; and facilities, administrative support, and technical support [6]. A more recent study focused exclusively on four engineering departments; 63% to 91% of faculty participated. Themes that emerged echoed earlier topics, with additional themes emerging surrounding diversity, stress for untenured faculty, and leadership transparency, support, and feedback [7]. A follow-up study was conducted to determine if the action plans generated by faculty were executed in those respective departments. On average, 13.7 actions were taken by the departments, with 76.9% of these items being acted upon [8]. The actions included new/revised structures (e.g., space allocation), policies (e.g., teaching loads), and practices (e.g., chair communication, transparency). The data are encouraging and point to the efficacy of the DEP process as faculty engage with and act on identified areas of concern.

This successful ADVANCE initiative was leveraged as part of the RED NSF grant awarded to this ECE department. Forty-four ECE faculty members participated in these DEP interviews in the Fall of 2017. The interviews were specifically focused on departmental support and challenges, distribution of resources, faculty workload, career/family balance, mentoring, faculty professional development, productivity, recruitment, and diversity. Faculty were interviewed in groups according to rank, and issues important to particular subcategories of faculty (e.g., rank, gender, etc.) were noted. Data were analyzed by a social scientist using the full transcript of each interview or focus group and the NVivo 12 Qualitative Research Software Program. The social scientist presented the written report to the entire faculty. Based on the results of the focus groups, in the Fall of 2018 the ECE department developed an action plan with six main thrusts for improving departmental culture and encouraging departmental change and transformation. This activity of developing the action plan coincided with the department's five-year strategic planning process, and members of the department's administrative committee participated in the development of both plans. The action plan subsequently was shared with the faculty and with upper administration. A summary of the main themes identified and corresponding recommendations is below:

- 1. Department Interactions** – Faculty reported varying levels of collegiality in the department, and stressed the importance of an open dialogue with the chair regarding the state of the department. The action plan recommended that the department chair encourage more open dialog among the faculty, and consider the structure and frequency of department meetings. Separately, the action plan recommended that chairs of academic areas in the department be held accountable for the working environment, and that academic areas be encouraged to discuss department-related issues.

2. **Mentoring, Promotion, and Evaluation** – While faculty reported that expectations and processes were clear for promotion to associate professor, it was perceived as considerably less so (from the perspective of both the department and upper administration) for promotion to professor. Other critical feedback related to the primary emphasis on research productivity in annual evaluations, and the relative weights given to teaching versus research activities, both on paper and in practice. The action plan recommended that the department continue mentoring junior faculty, supplement existing mentoring for mid-career faculty, improve the clarity of operational documents related to promotion and tenure, and seek faculty input on the annual evaluation system.
3. **Teaching Loads** – Faculty expressed concerns regarding the quality and quantity of teaching assistant (TA) support provided to the department, as well as the perceived unfairness of the equal weighting of classes for faculty workload consideration. Recommendations included a request to develop TA allocation models as well as more equitable teaching workload policies and corresponding expectations. Additionally, the plan recommended the department chair balance research and teaching needs with regards to future strategic faculty hiring decisions.
4. **Diversity, Equity, and Inclusion** – While faculty expressed their belief that hiring and retaining diverse faculty is important, the department has had challenges in doing so in recent years. The lack of representation amongst the faculty was perceived as a potential reason for the consistently low numbers of female and underrepresented students in the undergraduate population within the department. Corresponding recommendations in the action plan were to go beyond the required focus on diversity in future faculty searches institutionalized by ADVANCE, at the expense of narrowly defined strategic research areas, and to review department policies and syllabus statements on inclusive teaching and learning environments.
5. **Building** – Faculty reported significant discontent with the state of the department's primary building. Interviews indicated a clear and unambiguous negative impact on faculty recruitment, retention, and overall department reputation. The action plan recommended that the department chair communicate with upper administration about the need for a new building, and explore the potential for collaborating with complementary departments on housing programs in a jointly shared building.
6. **Support Staff** – While faculty expressed appreciation for the hardworking staff in ECE, there was concern regarding the level of staffing, which has decreased relative to student population. The action plan recommended that the department chair increase communication with the department regarding new service delivery models, request additional support for human resources, communications, and finance, and recognize staff excellence at the annual department banquet and through college/university awards.

In total, the action plan made twenty separate recommendations. At the time of this writing, ten of the recommendations have been implemented at least in part. The department is using an emergent change framework to characterize and evaluate the impacts of grant activities including the DEP process [9], [10]. Evaluation and follow-up studies will guide the department

in continued implementation of the action plan. In coming years, technological and social changes will mandate the adaptation of engineering programs [11], a transformation which must also include department climate and cultural change. STEM faculty report placing a high value on supportive work environments conducive to meeting their needs for flexibility, balance, personal development, and diversity [12]. Given that ADVANCE transformative efforts have shown promise in generating real, self-determined, and lasting improvement in such department practices [13] - [16], the present findings point to the attainability of positive change for ECE departments which can and should be replicated for the benefit of future faculty.

Acknowledgments

This material is based upon work supported by the National Science Foundation (NSF) under award EEC-1623125. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the NSF.

References

- [1] M. F. Fox, "Women and men faculty in academic science and engineering: Social-organizational indicators and implications," *American Behavioral Scientist*, vol. 53, no. 7, pp. 997–101, 2010.
- [2] M. Sabharwal and E. A. Corley, "Faculty job satisfaction across gender and discipline," *The Social Science Journal* vol. 46, no. 3, pp. 539-556, September, 2009.
- [3] Bureau of Labor Statistics, U. S. Department of Labor, *Occupational Outlook Handbook*, Postsecondary Teachers, on the Internet at <https://www.bls.gov/ooh/education-training-and-library/postsecondary-teachers.htm>, visited January 25th, 2020.
- [4] A. C. Strong, M. Chua, S. Cutler, "Talking 'faculty development' with engineering educators, then talking 'engineering education' with faculty developers: A collaborative reflection on working across communities" in *ASEE Annual Conference and Exposition, Conference Proceedings*, New Orleans, LA, June 26th-29th, 2016.
- [5] "Making academic change happen – Welcome to the MACH community. "Available: <https://academicchange.org>. [Accessed January 29th, 2020.]
- [6] S. R. Bird, C. Fehr, L. M. Larson, and M. Sween, "ISU ADVANCE Collaborative Transformation Project: Final focal department synthesis report" Iowa State University ADVANCE Program." NSF SBE 0600399; April, 2011.
- [7] E. Frickey, E., and L. M. Larson. "A closer examination of engineering department culture: Identifying supports and barriers." Poster presented at the *American Psychological Association National Convention*, Chicago, Ill., August, 2019.
- [8] L. M. Larson, M. Schenkenfelder, and S. R. Bird, "Transforming the institution one department at a time." Poster presented to the *AWIS/ADVANCE National Conference*, Baltimore, MD, May, 2016.
- [9] C. Henderson, A. Beach, A., and N. Finkelstein, "Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature." *Journal of Research in Science Teaching*, vol. 48, no. 8, 2011, pp. 952-984.
- [10] D. T. Rover, J. Zambreno, M. Mina, P. H. Jones, D. W. Jacobson, S. McKilligan, and A. Khokhar, "Riding the Wave of Change in Electrical and Computer Engineering," *Proc. 2017 ASEE Annual Conference & Exposition*, Columbus, OH, June 2017.
- [11] J. E. Froyd, S. M. Lord, M. W. Ohland, K. Prahallad, E. D. Lindsay, B. Dicht, "Scenario planning to envision potential futures for engineering education," *IEEE Frontiers in Education Conference (FIE) Proceedings*, pp. 1-6, October, 2014.
- [12] E. Alpay and R. Verschoor, "The teaching researcher: Faculty attitudes towards the teaching and research roles," *European Journal of Engineering Education*, vol. 39, (4), pp. 365-376, 2014.
- [13] A. J. Stewart, D. LaVaque-Manty, and J. E. Malley, "Recruiting female faculty members in science and engineering: Preliminary evaluation of one intervention model," *Journal of Women and Minorities in Science and Engineering*, vol. 10, pp. 361–375, January, 2004
- [14] D. Bilimoria, S. Joy, and X. Liang, "Breaking barriers and creating inclusiveness: Lessons of organizational transformation to advance women faculty in academic science and engineering." *Human Resource Management*, vol. 47, pp. 423–441, August, 2008.
- [15] S. V. Rosser and J. L. Chameau, "Institutionalization, sustainability, and repeatability of ADVANCE for institutional transformation," *Journal of Technology Transfer*, vol. 31, pp. 335-344, May, 2006

[16] Constant, K. P. (2011, June), *ISU ADVANCE: Sustaining and Institutionalizing Efforts to Enhance Recruitment, Retention, and Advancement of Women Faculty in Engineering* Paper presented at 2011 ASEE Annual Conference & Exposition, Vancouver, BC.
<https://peer.asee.org/18213>