
AC 2011-699: FROM DEFENSE TO DEGREE: ACCELERATING ENGINEERING DEGREE OPPORTUNITIES FOR MILITARY VETERANS

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David L. Soldan is Professor of Electrical and Computer Engineering at Kansas State University. He recently spent a sabbatical at the United States Naval Academy serving as the ONR Distinguished Chair for Science and Technology. He served as Head of the KSU ECE Department from 1989 to 2004. As a member of the IEEE Committee on Engineering Accreditation Activities from 1999 to 2007 he was active in new program evaluator training and new evaluator mentoring. He was a member of the ABET Engineering Accreditation Committee from 2003 to 2010 and served as an Executive Committee member from 2007 to 2010. He has served on the IEEE Education Society Adcom and has been the IEEE Computer Society representative to the Frontiers in Education Conference Steering Committee. He served as FIE Co-Program Chair in 1995 and 1998. Soldan served as President of the Electrical and Computer Engineering Department Heads Association in 2002-03. He chaired the Computer Engineering Curriculum Committee of the Joint IEEE Computer Society/ACM Computing Curriculum Taskforce that published the first model curriculum for computer engineering in 2005. The Computer Society recognized this with an Outstanding Contribution Award. Dr. Soldan is a Fellow of IEEE and a member of Eta Kappa Nu, Sigma Tau, Phi Kappa Phi, and the American Society for Engineering Education. He is the faculty advisor to Eta Kappa Nu and the trustee of the Kansas State University Amateur Radio Club. He served on the Eta Kappa Nu Board of Governors from 2006-09. He received the 2006 Robert M. Janowiak Outstanding Leadership and Service Award from the Electrical and Computer Engineering Department Heads Association. In 2008 he received the IEEE Education Society Distinguished Member Award. In 2009 he received the ASEE Electrical and Computer Engineering Division Meritorious Service Award.

Noel N. Schulz, Kansas State University

Noel N. Schulz received her B.S.E.E. and M.S.E.E. degrees from Virginia Polytechnic Institute and State University (Virginia Tech) in 1988 and 1990, respectively. She received her Ph.D. in EE from the University of Minnesota in 1995. She is currently working as Paslay Professor of Electrical and Computer Engineering at Kansas State University. She has served as a faculty member at Mississippi State University and Michigan Tech in the past. Her research interests are in computer applications in power system operation including artificial intelligence techniques. She has been active in the IEEE Power and Energy Society, currently serving as President-Elect. She has served as IEEE/PES Secretary and Treasurer as well. She is recipient of the IEEE/PES Walter Fee Outstanding Young Power Engineer Award and NSF CAREER award. Dr. Schulz is a member of IEEE, ASEE, SWE, Eta Kappa Nu and Tau Beta Pi.

Blythe A Vogt, Kansas State University

Mrs. Vogt joined the faculty in Architectural Engineering & Construction Science and Management at Kansas State University in January 2008. She received her BSAE from K-State in 2001 and completed her MSAE from K-State in 2010 related to Curriculum Development in Architectural Engineering and Construction Science with regards to Building Information Modeling. Mrs. Vogt is currently pursuing her PhD in Electrical and Computer Engineering with an emphasis in Engineering Education/Outreach under the supervision of Dr. Noel Schulz. During 2001-2008, Mrs. Vogt was employed full time with a large scale national engineering consulting firm in Madison, WI where she held several roles including: project manager, project engineer, commissioning agent, conference speaker, and business development/marketing liaison. She also collaborated with the University of Wisconsin Construction Engineering & Management as an adjunct faculty, teaching one course each fall semester related to building systems (2002-2007). Mrs. Vogt was awarded the 2008 National Electrical Contractors Association Faculty Award for her instruction and mentoring of construction science students.

Don Gruenbacher, Kansas State University

Don Gruenbacher is an Associate Professor and Head of Electrical and Computer Engineering at Kansas State University. In addition to administrative responsibilities and research, he continues to teach courses in networking and digital design. His research interests include computer networks, wireless communications, and digital design. Prior to joining K-State he was a member of the senior staff at the Applied Physics Laboratory from 1994 to 1997. Dr. Gruenbacher received his Ph.D. in 1994 from Kansas State University

Rekha Natarajan, Kansas State University

Rekha Natarajan earned her B.S. and M.A, both in mathematics, at Arizona State University in 2001 and 2002, respectively. She also earned her B.S. in secondary education from Kansas State University in 2004. She is currently the college algebra coordinator in the Department of Mathematics at Kansas State University, where she coordinates and teaches both traditional and studio versions of college algebra.

From Defense to Degree: Accelerating Engineering Degree Opportunities for Military Veterans

Motivation

This paper addresses curricular issues involved in integrating post-9/11 veterans into the engineering workforce. A 2009 NSF Workshop on Enhancing the Post-9/11 Veterans Educational Benefit¹ indicates that new, more generous veterans' educational benefits create an opportunity to expand the technical workforce while benefitting those who have served our country. The workshop further indicates that the veterans include a diverse and qualified pool of future talent for the nation's engineering and science employers.

There are two main aspects to this Kansas State University project: (1) an accelerated track for veterans into bachelor's degrees in engineering for those with no bachelor's degree or with a non-technical degree and (2) bridging to engineering master's degrees for those with bachelor's degrees in technical non-engineering areas. The initial focus will be in the renewable energy and energy distribution systems area.

Technical focus

Energy has been identified as a critical area where there is a large projected shortage of trained technical personnel. A 2008 NSF Workshop on the Future Power Engineering Workforce² indicated "a serious need is emerging for more power and energy engineers to: a) replace retiring engineers so that critical expertise is maintained; b) meet rising infrastructure construction needs; c) modernize the grid as communications, computing, and electric energy technologies converge; d) help stem the tide of electric equipment manufacturing moving off-shore, and; e) solve arising engineering challenges, such as the development of advanced power electronics and energy conversion systems, new generation and storage technologies, and the integration of those technologies into the grid." The IEEE Power and Energy Society³ has also indicated that "Immediate action must be taken to avoid letting a growing shortage of well-qualified electric power engineers slow progress in meeting critical national objectives."

Electrical utilities in the geographic region and engineering firms in the electrical power arena also recognize this upcoming critical workforce shortage. This resulted in the formation of an industry consortium called the Kansas State University Electrical Power Affiliates Program (EPAP) in 2008. EPAP is a consortium of industry leaders committed to the continued excellence of engineering education in the area of electrical power and energy systems. The program can be leveraged to help with various aspects of this proposed work, including the recruitment seminar, internships, and research projects. At the recruitment seminar, EPAP members will be able to discuss career opportunities for graduates in the power and energy field. They can also provide realistic technical problems or scenarios that can be presented to workshop participants so that they can better understand the current challenges in this field. Students already in our program will have the opportunity to participate in research projects, internships, or co-ops sponsored by EPAP members.

While EPAP has many objectives, the top goals that are relevant to this proposal are:

- To provide direction and support of technology development and research and instructional activities in the area of Power Engineering;
- To increase the number of students interested in and actively involved in the area of Power Engineering;
- To provide undergraduate and graduate support for outstanding students interested in Power Engineering; disciplines throughout engineering are included, especially electrical, mechanical, nuclear, chemical, and civil engineering;
- To provide central focus for a strong undergraduate and graduate program in Electric Power Engineering;
- To establish a strong sense of association between the engineering students and the EPAP member companies;
- To facilitate summer, internship, co-op, and career employment opportunities with the Affiliates;

This program has funded multiple student projects, in addition to field trips to member facilities and national conferences and a mini Career Fair for the electrical power industry.

The energy systems emphasis builds on the existing expertise of the faculty at Kansas State University. Energy systems is one of the five areas of specialization in the electrical engineering program and attracts more than 25 percent of the undergraduate students. In addition, the department offers a master's degree with an energy systems emphasis. This master's program has been offered via distance education since 1992, and has approximately 25 off-campus students per semester. Currently the energy systems program produces approximately 15 to 20 bachelor's degrees and five on-campus master's degrees, and 7 to 10 off-campus master's degrees per year.

Accelerated Bachelor's Degree

This paper will focus on the accelerated track for military veterans into bachelor's degrees in engineering. It is important to have contact with the military veteran prior to their arriving on campus to begin their schooling.

An initial thorough evaluation of the veterans' training, experiences, and expertise will be conducted with the option of granting academic credit where appropriate. Current policies give little credit for military experience or training. One issue with the use of military credit is that most of the academic credit is ungraded. Current policies at many universities do not recognize courses that are evaluated as credit/no credit. A possible avenue to overcome these rules is the use of advanced placement exams (where they exist) and university generated quiz-out exams. Other resources such as American Council on Education⁴ directory and regional university

credits for community college work also provide a resource to determine class equivalency. The next step will be to use the initial evaluation to identify areas where the veteran has the technical background but may be lacking the necessary mathematics or has not used the mathematics for a long time. An existing mathematics placement exam will be used to evaluate a veteran's mathematical abilities. Pre-tests will assess veteran's weaknesses, on-line review modules will be developed for review and extra practices in an individual's identified weakness and post-tests will be administered to show knowledge capture. Together this process will better prepare veterans to enter the mathematics sequence at the calculus level.

The creation of accelerated courses specifically for veterans enrolled in the program will be another aspect used to accelerate degree completion. Veterans may have a base of technical knowledge acquired through the technical nature of their military service. Assigning them to introductory level courses with traditional freshman and sophomore students does not respect their technical expertise nor challenge their capabilities and accustomed pace. Additional on-line courses will be developed in the area of computer based tools including such programs as MatLab, P-Spice, and Verilog (used in introductory course taken by all electrical engineering students.)

Another aspect of this project is the inclusion of summer internships for participants. These will be provided by members of EPAP as discussed earlier and by funded research projects at the university.

Master's Degrees for Non-engineering Bachelor's Degree Holders

The second aspect of this program proposes accelerating veterans with technical bachelor's degrees into an engineering master's program. Participants in this program would have completed physical science and calculus courses as part of their bachelor's degree. Currently typical bridge programs for students with bachelor's degrees in fields other than electrical engineering require students to complete several undergraduate engineering courses which may require up to three semesters. A focus of this project is to develop accelerated undergraduate classes to reduce time required for the prerequisite courses. This accelerated program would allow entry into the master's program in a shorter time period than with current programs. This aspect of the project would leverage the veterans' technical expertise as an asset in the engineering program.

The Electrical and Computer Engineering department at Kansas State University has a long history of facilitating the entry into the master's program by students with bachelor's degrees in other engineering disciplines and areas such as physics, mathematics, computer science, and other technical areas. These students are required to take a set of undergraduate electrical engineering courses to prepare them for graduate study in electrical engineering. While these requirements are customized for each student the usual requirements range from 24 to 30 hours of undergraduate courses. These courses often include introductory courses that are offered to freshman and sophomore students. A major focus of this project will be to develop accelerated courses that allow the military veteran to complete these prerequisite courses in fewer hours than currently required. Some of the accelerated introductory level classes should be useable for both the accelerated bachelor's and as prerequisites for the master's degree.

This part of the project is still in the initial planning stages and will use some of the results of the accelerated bachelor's program.

Kansas State University and the Military Environment

Kansas State University is near a major U.S. military installation, Fort Riley, and has more than 60 years of experience providing educational opportunities to military personnel and their families. The university provides academics, activities, services and support for military families. Kansas State University has been ranked among the most military-friendly universities in the country by *Military Advanced Education* magazine and by *G.I. Jobs* magazine. Fort Riley is a 15 minute drive from campus. In addition courses are offered on post and via the Internet. Military personnel stationed on active duty, their dependents, and members of the National Guard are eligible for in-state tuition.

A model partnership between Kansas State and Fort Riley was recently renewed. The agreement was designed to serve as a model military-to-university-community partnership. The agreement sets the following objectives: enhancing each institution's ability to accomplish its mission through collaboration; enhancing the professional and personal quality of life for each institution's constituent communities; creating new and innovative opportunities and programs that add great value to each institution through partnership; and increasing capacity at each institution to steward, manage and sustain major resources through collaboration, innovation and partnership.

Also, another military installation, Fort Leavenworth, is located within a two hour drive from Kansas State University. The university has had many programs of research and education, including a master's degree delivered by distance education, with this military installation.

The university has numerous programs aimed at understanding and supporting the needs of military personnel as identified in the recent American Council on Education report⁴. These include:

* The Institute for the Health and Security of Military Families was recently formed at Kansas State to address the health and well-being of military personnel, veterans and their families "after the battle." The institute coordinates a multidisciplinary group of researchers tackling issues such as the effects of trauma on deployed personnel and family, and the effects of deployment on marriage, children, employment and family income. The institute also provides university students with specialized training on working with military families, conducts comprehensive research on military family issues and provides services to the state and the nation that address the current and future needs of military families.

* Kansas State University has worked with one of the local military installations for nearly 20 years to administer master's and doctoral degree programs in operations research, adult and continuing education, security studies and history. As of spring 2009, these partnership programs

have resulted in nearly 600 master's and doctoral degrees, with recently added graduate certificate programs reaching more than 130 additional students.

* The university's office of student financial assistance has a dedicated counselor who specializes in scholarship and financial aid opportunities for members of the military and their dependents. In addition, the university has created a special merit-based scholarship program for college-bound children and spouses of military personnel, and assists with access to other military-specific financial aid opportunities.

* The university offers a Military and Veterans Campus Visit Day for prospective students with military ties to learn firsthand about the resources available to military personnel and their families.

* The university has long had an office at Fort Riley to provide initial information and enrollment advice for the University classes. In addition, the university Research and Extension office recently opened an office at Fort Riley and is set to offer services and programs to military families later this year. A similar arrangement is being considered at Fort Leavenworth.

* The university's School of Family Studies and Human Services and the College of Human Ecology also have worked together on several military-related research projects, including one examining the factors families consider when deciding to relocate when their soldiers are transferred to the military installation. This project resulted in several substantive changes at the post to encourage relocation. Another project will study aspects of traumatic brain injuries. Several programs also have been developed for military youth and families.

* The Saunders Barracks at the university's Housing Complex provides housing for ROTC and other military students. These feature one and two bedroom apartments. The building opened in fall 2008.

Today courses and degree programs are offered to military students and their families through distance education, evening college, on-campus and at the military installations. Military students bring a unique depth of experience to the classroom that is appreciated by fellow students and faculty. The university has a Veterans Administration office on campus.

There are many additional support structures that may or may not be available on any given campus. Key supporting components include the development of strategies to inform veterans of engineering workforce opportunities and the recruitment activities, and coordination with campus military veteran support staff and personnel at nearby military installations. Understanding what is available is an important part of the overall success of a program.

Project Success

Student success in the accelerated courses and follow-on courses will be the primary evaluation metric. This evaluation will take place once there are a significant number of students in the program. There are several intermediate outcomes that can be measured as the development process progresses.

The first step will be to evaluate the experiences of interested veterans to determine their preparation for academic study. This will involve evaluating military education and experience for academic credit and/or advanced placement. The comprehensive evaluation of this phase of the program cannot take place until the accelerated programs are in place. However, initial feedback will be gathered from veterans concerning their perceived abilities for success in an accelerated program.

The next step will be the development of recruiting strategies and materials. These materials will include program overviews, workshops, focus groups, and surveys. The effectiveness of these will be evaluated based on feedback from military active-duty and veterans. Evaluation instruments will be developed in concert with the development of the recruiting materials.

The ultimate final evaluation of these programs will be the student retention and degree completion statistics. These statistics can be compared to those of other cohorts using data that has been compiled with NSF support for the last ten years by the Women in Science and Engineering (WESP) program. The WESP Director will be involved in generating the necessary data that will be comparable to the existing retention and graduation statistics. This database was constructed to provide the ability to analyze retention and graduation rates by freshman cohorts at the university, college, and academic program levels.

Summary

This project is leveraging the training and skill sets of the returning veterans toward fulfilling a workforce need in the area of power engineering. The goals are to provide the academic and non-academic support structures to allow the veterans to be successful in completing their degree requirements. After initial activities within the power area, researchers plan to expand the program into other areas of engineering.

References

1. *Veterans' Education for Engineering and Science*, Report of the NSF Workshop on Enhancing the Post-9/11 Veterans Educational Benefit, McLean, Virginia, April 13, 2009.
2. *National Science Foundation Workshop on the Future Power Engineering Workforce*, September 5, 2008.
3. *Preparing the U.S. Foundation for Future Electric Energy Systems: A Strong Power and Energy Engineering Workforce*, IEEE Power and Energy Society, April 2009.
4. *From Soldier to Student: Easing the Transition of Service Members on Campus*, American Council on Education, July 2009.