AC 2010-2048: ENGINEER DEVELOPMENT AND MENTOR PROGRAM

Tammy Baldwin, Schweitzer Engineering Laboratories, Inc.

Tammy Baldwin graduated with a B.S. in Psychology and an M.S. in Clinical Psychology from the University of Idaho. She is currently pursuing her PhD in Educational Administration. Tammy has been with Schweitzer Engineering Laboratories, Inc. for four years and is the University Relations Coordinator responsible for encouraging and supporting engineering curriculum at universities across the United States and internationally.

Marisa Hemingway, Schweitzer Engineering Laboratories, Inc

Engineer Development and Mentor Program

Overview

The electric power industry in the United States is at a critical juncture for skilled workers in all facets of the industry. During the last decade, researchers, small and large interest groups, government agencies, and universities have been reporting on the necessity of a highly skilled and adequately trained workforce. In 2007, IEEE published a task force report[1] indicating a declining national trend in power engineering graduates. Additionally, power engineering curriculum requirements have declined since 2001. Now, less than 59 percent of universities require a power engineering course to fulfill the electrical engineering curriculum. The assistant professor power faculty also declined to only 12 percent in 2006.

Developing the power engineering and energy workforce for the next millennium has become a national and global challenge. Not only is the industry workforce approaching retirement, so is the educational backbone of electric power engineering[2]. It is estimated that approximately 30 to 40 percent of the national electric power workforce will reach retirement or move into other industries by 2013[3]. Universities need to revamp and invigorate their electrical engineering programs to entice new faculty as well as new students. The projection for the 2013 workforce looks somewhat bleak.

In order for the United States to provide an adequately skilled labor force for the electric utility industry, curriculum reform, training programs, and K–12 initiatives need to be improved, expanded, and evaluated. The 2007 National Science Foundation Workshop report indicates that the United States must begin to devote a significant amount of effort, support, and dedication to university power programs to sustain technological advances, workforce demands, and essential infrastructure. More universities are beginning to revise curriculum and commit to additional industry partnerships[2]. However, energy research is lacking because of faculty retirement, which can exacerbate the lack of technological experiences for new graduates. Government agencies, industry, and educational institutions have developed various working groups, such as the Center for Energy Workforce Development (CEWD), Task Force on America's Future Energy Jobs, and the National Science Foundation Workshop on the Future Power Engineering Workforce. This indicates that the United States is taking considerable measures to ensure that the nation has a leading edge on future workforce demands, research, and technological innovations.

The challenges at universities are intensified by K–12 gaps in science, technology, engineering, and math (STEM) programs. These gaps are created from declining graduation rates in high school, a decrease in technical skill attainment, and limited training for educators to completely understand and develop programs for workforce demands[3]. Without a strong feeder pool into the university systems, it remains difficult to expand power engineering programs and produce enough graduates to sustain future workforce needs.

Schweitzer Engineering Laboratories has devoted significant amounts of resources, equipment, and programming to support this need. One such example is the Engineer Development Program (EDP) created and implemented by the company's university and university relations programs in partnership with engineering divisions in Sales and Customer Service. This program is intended to decrease gaps that exist between the education received in the classroom and the experience needed to be a successful engineer.

Background

In 2008, Schweitzer Engineering Laboratories (SEL) decided to embark on a mission to further develop the new engineers they were hiring to fill gaps in their own workforce demands. Within the previous three years, SEL had hired a significant number of new graduates with limited or no industry experience. Overall, these new graduates lacked expertise, knowledge, and even some fundamental electrical engineering information about how the power system operates, the research development process, and the protection of power systems. As a significant stakeholder in the electric power industry, it is essential for SEL to provide a balanced and well-developed performance support mechanism for engineers. In addition, it is essential to the mission of SEL to devote time on training to enhance the industry-education partnerships that already exist.

The program was created in line with traditional and contemporary training delivery methods for adult learners. Even more essential was the need to not only develop technical training for all participants but also allow for nontechnical training or soft-skill development. The program success hinges on university partnerships as well. Gaps in knowledge and understanding are identified in associate-level engineers. Using that knowledge, Schweitzer Engineering Laboratories representatives work intimately with targeted universities to enhance curriculum and industry research partnerships and also develop essential programming to continue to feed the pipeline for future engineers. The EDP is hinged on the industry-university partnerships SEL has in order to continue. Recommendations from faculty regarding new hires, is essential to continue enrolling new and qualified engineers into the program. SEL has donated working equipment, expert engineers, and senior design projects to over 70 universities in the United States. Even with all of the support universities receive from the industry and corporate sponsors, there is still a lack of graduates and training. The entire purpose of Schweitzer Engineering Laboratories' University Relations program is to partner with universities and colleges across the United States and internationally to partner in curriculum reform, STEM programming, and provide faculty and student support.

The Task Force on America's Future Energy Jobs[3] developed a series of recommendations to address shortages in the upcoming workforce. The EDP at Schweitzer Engineering Laboratories addresses many of those issues. Specifically, in the developmental stage, coordinators spent time evaluating specific training needs, best practices, and performance gaps associated with new engineers. SEL also developed a competency-based training program related to varying tracks of power engineering and curriculum at universities. The program addresses the need for retention efforts and further university partnerships.

Schweitzer Engineering Laboratories has an internal university that meets the needs of many industry professionals, technicians, and engineers. This curriculum is developed from an adult learner's perspective and encompasses many theories and applications associated with traditional university lecture material. In addition, SEL donated much of the curriculum to universities across the United States to aid in essential development, particularly for rising power engineering programs. All of the coursework is available through the SEL website and can be integrated into various industry internal or university-level curriculum modules. Additionally, this internal university offers a scholarship program to university level seniors and master's students to allow them access to a corporate technical training program specific to power engineering. Many students across the U.S. do not have access to advanced power courses and this opportunity allows students to network and learn from some of the brightest engineers in our industry.

Mentor Program

Mentoring can become a critical component of any training program. Essential fundamentals associated with successful mentoring can assist learners with professional development and personal growth far beyond technical training. As many are aware, the idea of mentoring originates in Homer's *Odyssey*. The original Mentor was a trusted teacher and caretaker for Odysseus's son. Mentors can be individuals who help others reach their ultimate potential by coaching, advising, counseling, and, most importantly, listening.

Schweitzer Engineering Laboratories developed and integrated a formalized mentor program into the EDP. The program coordinators reviewed the needs of associate engineers, evaluated best practices, and created benchmarks for success. It became evident that a mechanism beyond supervision and teaching was a necessary component of the new training program. Mentoring serves many purposes at varying levels. The EDP includes numerous individuals across the United States and therefore had to be multifaceted and deliverable through contemporary training and communications methods.

The needs of the associate engineers included a formal mentoring component that would aid their ultimate success as well as assist with swift facilitated growth. Formal mentoring can be a challenge, because it requires time, attention, commitment, and effort. The power industry still possesses numerous individuals with years of accumulated knowledge and an inherent desire to train and develop the next generation of power engineers. After interviewing numerous associate-level engineers and senior engineers, SEL was able to identify those engineers who would make great mentors and those associate engineers who would benefit significantly from a formal technical training and mentoring program.

Coordinators evaluated the senior-level engineers who had prior training and teaching experience and who had at least ten years within the industry. This allowed the coordinators to bring in a variety of mid- to upper-level engineers and support their mentor training by networking with seasoned employees, while still maintaining a strong mentoring and supervisory base. It was also essential that mentors have a professional understanding of university curriculum and how that relates to industry needs and a desire to work with university faculty to enhance a student's educational experience.

The EDP was set up to allow associates to begin their technical training tracks immediately and in parallel with mentor training. The formalized mentor program was grounded in the fundamental skills[4] associated with effective mentors, while emphasizing the importance of establishing an open culture of mentor behavior throughout the company.

The mentor program is composed of several primary components. These components allow mentors and mentees to operate on a level of trust, compatibility, and expertise beyond a standard supervisory role. At the inception of the program, associate-level engineers (mentees and associate engineer labels are interchangeable terms for this paper) participated in introductory mentee training via Acrobat® Connect™. Instructors also delivered technical training virtually, as discussed below.

It was not feasible to have an on-site training and orientation program because of travel and additional training schedules. The coordinators developed the program to be facilitated via the Internet whenever necessary. The associates participated in an overview to cover their roles and responsibilities as a mentee, the mentor roles, and expectations for future activities. Roles and responsibilities for mentees include: communicating future goals and expectations clearly, actively participating in their career development plan, participating in networking activities, identifying potential pitfalls to success, and developing an increased sense of self-assurance and self-directed behavior. The coordinators asked mentees to commit time to regular meetings with their mentor that would include discussions beyond technical training. Topics to consider included general professional development questions, struggles and accomplishments, and opportunities for further education or experience. Again, these nontechnical training topics allow mentees and mentors to expand their relationships and professional accomplishments.

After identifying qualified and skilled mentors within the company, EDP coordinators required mentors to participate in an on-site training activity. Coordinators provided a detailed overview of the EDP and initialized the first formal mentor training. The training consisted of reviewing general expectations for the mentees (as covered earlier), expectations for mentors, mentoring as phases, challenges to mentoring, and specific communication and learning style training associated with the Myers-Briggs Type Indicator® (MBTI®).

The primary goal of bringing all the mentors together for an on-site training orientation was to allow them to interact and foster each other's individual strengths. Creating a sustainable mentoring program as part of the EDP requires establishing a supportive mentoring culture within an organization. All mentors agreed that mentoring along with technical training was essential to developing strong and committed engineers. Particularly, all mentors agreed that new graduates are lacking many fundamental skills associated with becoming a successful engineer and that coordinating with universities would be beneficial. Coordinators of the EDP utilized primary principles associated with establishing a mentoring culture and training program[5].

Mentor expectations include communicating clearly and concisely, providing networking tools, encouraging multifaceted career development, sharing plans and ideas for first year success, providing guidance to the mentee in setting short- and long-term career goals, developing self-direction and self-confidence, and acting as an unbiased resource to mentees. Mentors were able to discuss amongst themselves the pitfalls and opportunities associated with each expectation. During their first meeting, mentors and mentees reviewed and signed a contract that outlined all expectations, goals, and responsibilities of both parties during the course of the mentorship, a variation of a learning contract[6]. This exercise makes the experience more personal and creates motivation through making a commitment to another person.

The mentor component of the EDP requires that participating mentors be able to teach, council, advise, and listen to their mentees in an efficient and effective manner. To aid this process, all mentors were administered the MBTI to assess personality preferences that would later be linked to work habits, learning styles, and communications inclinations. Each mentor received feedback regarding their preferences at the end of the orientation. In addition, they received materials as references to their own type and the other MBTI types. Each mentor was also provided with a mentor pocket guide[7]. A subject matter expert on the MBTI provided each mentor the type preferences of their mentees and guidance on how to interpret each preference rating. Training and interaction strengthens the networking process for mentors and allows them to interact in the most effective manner with their mentee.

Training Program

A well-designed training program assists individuals in meeting performance standards more efficiently. The impending exodus of the Baby Boomer Generation from the workforce means universities and corporations are under increasing pressure to develop competency among students and employees more effectively and efficiently. Schweitzer Engineering Laboratories designed and implemented a training program as the other main component of the EDP. The training program includes formal training combined with field training to maximize results. The program coordinators began the design process by defining the desired outcome and working backwards, asking the question, “What qualities make an exceptional engineer?” Through focus interviews with senior-level engineers, mentors, trainers, and managers, four core competencies were identified: technical expertise, superb communications skills, excellent problem-solving skills, and modeling SEL values and ideals.

Beyond these core competencies, the performance development program aimed to develop two types of intelligence: crystallized and fluid. Crystallized intelligence is learning skill sets and applying them appropriately. Fluid intelligence requires learners to revise existing problem-solving strategies, assemble new ones, and search for new analogies or perspectives[8]. The core competencies were broken into specific performance objectives. The program coordinators then selected adult learning methods that would facilitate development of the performance objectives and types of intelligence. Those two methods were formal training and field work. Field work includes all activities related to associates’ job descriptions where skills learned through formal training are applied and practiced. Examples of this include designing and implementing power system protection solutions, visiting customer sites, and providing ongoing product support to customers.

The EDP formal training is an objectivist approach. Objectivism considers knowledge to be separate from the learner’s mind. Learning occurs most efficiently when instructions are programmed into simple skills, while leading to more complex skills in a scaffold approach. This methodology facilitates the s development of crystallized intelligence (i.e., skill sets appropriately applied given certain conditions)[8].

A training path was created that outlines all formal training courses that associates must complete during their two years in the program. Formal courses are offered in multiple formats to support learning objectives and to minimize travel. Theoretical and topic courses are offered in a virtual training environment. Product application courses, which include hands-on lab work with equipment, are offered in a traditional, instructor-led classroom.

Acrobat Connect is the SEL's virtual training platform. It was selected as the virtual training and meeting platform because it was intuitive and easy for instructors to use. Additionally, it facilitates learning through interactive tools (chat, quizzes, question and answer, file share) and supports Flash® and Captivate® movies and simulations. In addition, synchronous sessions can be recorded and archived for future review and reference by students.

All technical classes are offered through the Schweitzer Engineering Laboratories University. The university is open to the public, offering 135 courses annually that cover a range of topics related to the power system protection industry. Consequently, the EDP training plan can be adopted by outside universities and corporations.

Utilizing existing educational tools and SEL University was cost-effective. This was an important selling point to executive management to implement the program, particularly given the current economic climate and the company's emphasis on streamlining processes and reducing costs, while still maintaining the highest level of quality in products, services, and programs.

In addition to formal training, field work was implemented as part of the training program because it provided an opportunity for associates to apply skills within a real-world context. Supportive research reports that "…initial lessons should provide background knowledge in a direct instruction format (crystallized abilities) followed by discovery or inquiry based formats enhanced with cooperative learning projects that emphasize the abstraction, transfer, and application of important concepts (fluid ability)."[9] As an example, associates learn the fundamentals of designing protection for power systems in the classroom. Back on the job, they will then work on project teams to design and implement power system protection solutions for Schweitzer Engineering Laboratories' customers. This example illustrates how introductory concepts are learned through direct instruction (classroom) and then are applied, practiced, and evolved within the complexity of real-world applications and in collaboration with a team. The nature of the field work is outlined in associates' job descriptions and assigned by their manager.

Learning within this environment is informal, unscripted, and, most importantly, constructive in nature. In constructivism, "…emphasis is on the active processes learners use to build knowledge."[8] Experiences should be authentic and meaningful and help the learner to "…construct understandings and develop skills relevant to solving problems."[10] One of the core competencies is the ability to problem solve. Technical trainers and mentors assist associates with developing problem-solving strategies during formal training. However, their field work in conjunction with coaching from their mentors is the primary method for developing this competency.

True to constructive learning environments, the field work component of the EDP is undefined and cannot be prepackaged[10]. The program coordinators consider these qualities to be part of this method's strength. Associates learn to apply skills within the context of the workplace with a degree of autonomy not present in a formal classroom. It is through this opportunity that associates incorporate skills primarily taught in the classroom into their existing and evolving mental models. Though this part of the training program cannot be prepackaged for outside organizations, it can be replicated, as long as the field work provides an opportunity for associates to apply skills learned in the classroom.

While the mentoring program and the training program were designed separately and facilitate different performance qualities, they were integrated into the EDP because the combination of both creates a higher level of performance than either program would alone. Thus, the EDP design strategy is to teach skill sets to associates in the classroom (crystallized intelligence, objectivist methodology) and then, through collaboration with their mentors, to apply those skill sets within the complex context of field work (fluid intelligence, constructivist). This blended approach facilitates necessary skill acquisition and performance standards in the most effective and efficient manner.

Results

At the time of this writing, the EDP is six months into a one-year pilot. Associates have completed five to seven classes (depending on their track) of the required 18 to 20 training courses. This first phase of the coursework is largely centered around power systems protection theory, as well as cultural training. Associates will soon begin the second phase of their training plan, which includes intermediate-level theory courses, product-specific application courses, and leadership training. All associates are expected to meet their six-month performance objectives. Currently mentors are completing performance reviews and will report on associates' progression through the program. Anecdotal evidence from mentors and associates has also been positive. Additionally, it is expected that the senior level engineers will provide feedback to university faculty that will make the next cohort of mentees even more successful.

Program coordinators will continue to monitor associates' growth through the following data points: timely completion rate of performance objectives and formal training courses, performance reviews, and the rate of promotion from "Associate Engineer" to "Engineer" after two years. A minority of mentors report that having enough time to complete their engineering duties and mentoring responsibilities can be difficult at peak times. This response is not unusual however, for the majority of new pilot mentoring and development programs in industry. Data on this topic will continue to be monitored and analyzed through surveys and anecdotal reports and communicated to upper management.

Conclusions

The coordinators continue to evaluate the EDP at regular intervals to assess strengths, opportunities for improvement, and lessons learned. Some of these lessons are anecdotal, while others are regular reviews of participation, acceptance, and connection completed by the mentors.

Overall, the program is moving ahead successfully. Associates are completing the technical and soft skill training courses, and mentors are providing associates with structured training plans and assessments. The formal training plans have been an asset to associates by enabling them to be proactive in their own professional development and to evaluate their own progression. The training plans have also been useful to new managers who are familiarizing themselves with existing learning resources within the company. Coordinators have received requests to create training plans for other job functions based on their success in the EDP. Associates are gaining valuable skills from the formal training and are provided with regular opportunities to apply and practice those skills. Skills are related to designing, implementing, and supporting power system protection systems and products. Mentors will submit additional formal assessments, utilize each other as networking and project resources, and develop stronger relationships with their mentees as the program progresses.

The mentors and their associates have expressed positive feedback regarding the MBTI®. The associate were able to clearly identify their own unique learning and interaction styles. Mentors were able to utilize the information to enhance their communications and expectations of associates. The MBTI® was a welcome addition to strengthening the mentor program. The mentors themselves have participated in one formal training together. There are plans to continue to bringing mentors together to share experiences, learn enhanced techniques, and meet with other mentees.

Expectations for future development include creating more classroom-based training, networking, and evaluation opportunities and requirements. The coordinators are working to maintain high expectations for associate performance within the program, while balancing the need for flexibility given the day-to-day responsibilities of the workplace now and as the program evolves.

At the time the pilot program was implemented, all associate engineers, regardless of hire date, were eligible for enrollment. Though all participants in the EDP are associate engineers, their dates of hire differ by as much as a year. Consequently their experience levels also vary. In the future associates will be enrolled within two months after they are hired. Changing the entry times will allow associates to all participate in a one-month on-site culture, technical, and soft skill training mechanism as a connected group, prior to being spread throughout the United States for their individual work duties.

Several divisions at Schweitzer Engineering Laboratories have associates that are participating in the EDP. These divisions do not have equal workloads at parallel times in the year. This dispersion created a difference in what training and at what time associates could participate. Associates could not always enroll in courses as a full cohort and have had limited time to complete all soft skill or technical training courses offered. A potential solution to this issue is to create a formal test-out policy. This would allow additional flexibility to associate to move through their training path at their pace.

The virtual training environment has enabled associates from across the United States to complete training with a high degree of flexibility in relation to their schedule and other job responsibilities. While this is an asset to the program, the coordinators also need to ensure that training is not de-prioritized regularly due to this flexibility. As a solution, SEL could offer lower-level courses and overview courses virtually but require advanced-level courses to be completed on-site. Associates will be completing their first classroom-based training in the next six months.

This program is currently and will continue to allow lead engineers to develop stronger relationships with entry-level engineers and reducing the knowledge gap being created by retirements, job shifting, and workforce needs. The EDP is also providing associate engineers the tools and resources to be proactive in their own professional development. Companies that implement formalized, successful EDPs can provide critical knowledge and feedback to universities, including suggestions for curriculum reform and necessary skill sets.

Growing engineers into the next generation of innovators and leaders is critical to the industry and SEL. The success of the EDP, and programs like it, will result in future successes for generations to come. Continuing to identify opportunities for improvement in curriculum, in training and the EDP and enhancing the strengths the EDP provides, we will empower each generation to solidify their own successes and growth opportunities. We will continue to improve and monitor our progress while adapting to fit industry, collegiate and individual needs.

Bibliography

[1] Electric Power Engineering Education Resources 2005-2006 IEEE Power Engineering Society Committee Report. The Power Engineering Education Committee (PEEC) Task Force on Educational Resources. *IEEE Transactions on Power Systems*, Vol 23, No.1, February 2008, pp. 1–24.

[2] National Science Foundation. "Report of the National Science Foundation Workshop on the Future Power Engineering Workforce (Held November 29-30, 2007)." September 2008. Available: http://ecpe.ece.iastate.edu/nsfws/Report%200f%20NSF%20Workshop.pdf.

[3] Task Force on America's Future Energy Jobs. National Commission on Energy Policy. 2009, pp. 2–98.

[4] Shea, Gordon F. *Mentoring: A Practical Guide.* Crisp Publications, Inc., 1992.

[5] Zachary, Lois J. *Creating a Mentoring Culture: The Organizations Guide.* John Wiley & Sons, Inc., 2005.

[6] Clark, Ruth Colvin. *Building Expertise: Cognitive Methods for Training and Performance Improvement*. John Wiley & Sons, Inc., 2008.

[7] Cohen, Norman. *The Manager's Pocket Guide to Effective Mentoring.* HRD Press. 1999.

[8] Wilson, Brent G. *Constructivist Learning Environments: Case Studies in Instructional Design*. Educational Technology Publications, Inc., 1996.

[9] Nietfeld, J.L., Finney, S.J., Schraw, G., McCrudden, M.T. (2007) *A Test of Theoretical Models That Account for Information Processing Demands.* Contemporary Educational Psychology, pp. 32, 499–515.

[10] Galbraith, Michael W. *Adult Learning Methods.* Krieger Publishing Company. 1998.