

Engineering and Applied Science Programs for Professionals

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The Engineering and Applied Science Programs for Professionals (EPP), a part of the Whiting School of Engineering, has the mission to provide lifelong graduate education to working engineers and applied scientists. In this article, the history of the program is reviewed, including a description of the close partnership between APL and the Whiting School in the program. Recent developments and trends in the programs such as on-site partnerships and online delivery of classes are also described. Future goals that are part of the EPP strategic plan are discussed as well.

INTRODUCTION

The mission of the Whiting School of Engineering's Engineering and Applied Science Programs for Professionals (EPP) is to provide lifelong education for engineers and applied scientists. On the one hand this mission seems simple: find out what engineers need to learn to continue to be productive in their careers and then offer courses and degree programs in those areas. On the other hand this can be a very challenging task since it is not always clear what those emerging areas of technology will be, nor, with limited resources, can we respond to all the requests we receive. The directions we have taken have depended on our understanding of the educational needs of working engineers and applied scientists, on the amount of available resources, and on the vision of our program chairs and faculty members.

Technological change is so rapid that engineers and applied scientists must refresh their knowledge every 5 years or so or they will be left behind. Most employers of technology workers understand this and provide

generous education benefits to their employees. The challenge for employers is to keep their technical staff at the same level of currency not only with their U.S. competitors but also with competitors around the world as globalization of the economy increases.

HISTORY

JHU first offered courses to working engineers in Baltimore in 1916. The part-time undergraduate engineering program achieved its largest enrollments for a time after World War II when returning servicemen and women received GI Bill benefits for a college education. Until the late 1950s courses were primarily at the undergraduate level and were offered on the Homewood campus. In 1958 APL began to offer advanced technical courses at the graduate level with credit toward JHU academic degrees under the auspices of the Evening College. By 1963 a formal center for the Evening College was

established at APL to meet growing demand. With time, the number and variety of engineering and applied science courses and master's degree programs expanded, so that by 1983 five master's degrees were offered at the APL Education Center: Applied Physics, Computer Science, Electrical Engineering, Numerical Science, and Technical Management. Specific details on the history of the programs based at APL can be found in the article by Teesdale, this issue.

In 1983, when the APL-based programs came under the oversight of the new Whiting School of Engineering, eight additional degree programs were added: three part-time undergraduate degree programs in Civil, Electrical, and Mechanical Engineering and five master's degree programs in Chemical Engineering, Civil Engineering, Environmental Engineering and Science, Materials Science and Engineering, and Mechanical Engineering. With these additions, the total number of degrees that were offered rose to 13. This merger began a strong, flourishing partnership between APL and the Whiting School that continues to this day.

Many changes have been made in the program now known as EPP. Its name was the Part-Time Engineering Program from 1983 until 1987, Continuing Professional Programs from 1987 to 1992, Part-Time Programs in Engineering and Applied Science from 1992 to 2004, and finally Engineering and Applied Science Programs for Professionals after 2004. Several new master's degree programs and a few graduate certificates have been added throughout this period. EPP is now one of the largest programs in the country that provides graduate education for working engineers and applied scientists.

Another change was a phaseout of the part-time undergraduate programs in 2004. After noting a general decline in part-time undergraduate enrollment, in the late 1990s we developed a new undergraduate Bachelor of Science in Engineering Science, which was offered at the Southern Maryland Higher Education Center. However, after further declines in enrollments, we decided to discontinue the undergraduate programs and stopped accepting applications for admission in the summer of 2004. We are continuing to offer courses so that students who were admitted before that time will be able to complete their degrees with us.

ENROLLMENTS

Figure 1a shows enrollments in the EPP since the 1989–1990 academic year. During the 1980s the program experienced a steady growth, which gradually leveled off and then declined in the early 1990s as a consequence of reduced engineering activity when the Berlin Wall fell and the government began spending less on its military systems. Enrollments recovered after an upturn in engineering activity as the dot-com era began and the telecommunications industry was flourishing, but after the dot-com bubble burst, many schools saw dramatic downturns in enrollments. Our overall enrollments have remained steady despite a significant reduction in Computer Science Program enrollees. This robustness in the face of adverse conditions is largely due to the diversity in our degree offerings and our recent emphasis on corporate partnerships, particularly in the Systems Engineering Program. The Mechanical Engineering, Applied and Computational Mathematics, and Technical Management programs have also seen increased enrollments in recent years.

NEW PROGRAMS

Since the last special *Technical Digest* issue devoted to education appeared in 1989,¹ we have added three new

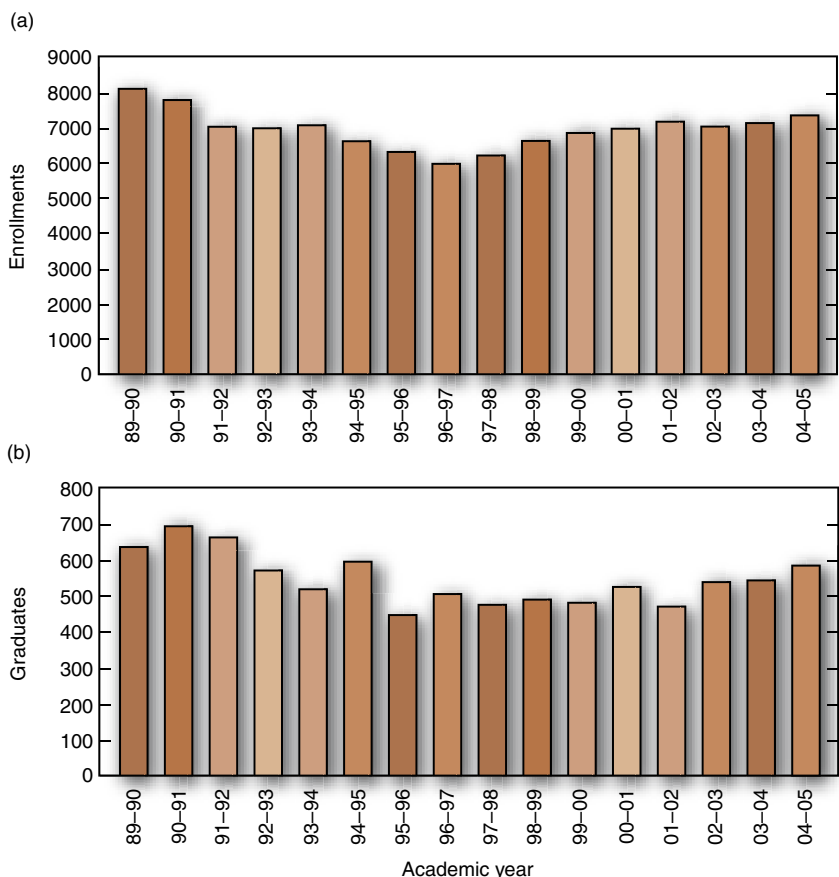


Figure 1. Enrollments (a) are closely related to the number of graduates (b), with the graduation trends delayed by 3 or 4 years as shown here.

APL-based master's degree programs, one new Homewood-based degree program, a joint degree program with the Krieger School of Arts and Sciences, three new graduate certificate programs, and several degree options. The new APL-based degree programs are Systems Engineering, Information Systems and Technology, and Applied Biomedical Engineering.

Systems Engineering was added in 1997, after being offered as a degree option in Technical Management since 1990. Technical Management faculty at APL and partners at Westinghouse collaborated to develop a curriculum that addressed emerging needs for greater expertise in systems engineering in the DoD. Since then, students in that program have also represented commercial companies involved in non-DoD work as well as many small high-tech companies in the area.

The Information Systems and Technology master's degree program was developed in 1997 to address the need for graduate-level education for those in information technology leadership positions with responsibilities for managing the network and software system infrastructure in their companies.

The Applied Biomedical Engineering Program, introduced in 1993 as the Engineering and Applied Physics of Biomedicine Program, grew out of a new program area at APL that focuses on biomedical engineering applications involving collaborative work with the Johns Hopkins Medical Institutions and other groups at the University.

The new Homewood-based program is the Environmental Planning and Management degree, which emerged in the Environmental Engineering, Science and Management Program to address the need for planning and management education in the ranks of middle management in both government and industry.

We also developed a new master's degree program in Bioinformatics jointly with the Advanced Academic Programs (AAP) in the Krieger School of Arts and Sciences. This program includes courses from the EPP Computer Science Program and the AAP Biotechnology Program. Plans are under way to also offer this degree program entirely online beginning in the fall of 2006.

For students seeking a program shorter than the master's programs, we offer a six-course graduate certificate in each graduate program. For those who already have a master's degree and desire further education, an Advanced Certificate in Post-Master's Study is available. In addition, for students wishing to develop new product lines within their companies or to commercialize new technology in a start-up company, a five-course Certificate in Technical Innovation and New Ventures has been added, with courses in managing innovation, finance, marketing, and the development of business plans. Other new offerings represent focus areas that span disciplines. These include the Telecommunications and Networking degree option

in both Electrical and Computer Engineering and Computer Science, the Photonics degree option in Applied Physics as well as Electrical and Computer Engineering, the Bioinformatics degree option in Computer Science, and the Materials and Condensed Matter degree option in Applied Physics. In addition to the above graduate degrees and degree options, about a dozen new courses are added each year.

Our overarching goals in these additions have been to broaden the students' knowledge, to focus academic attention on areas that represent the rapidly evolving technology landscape, and to reflect the new academic needs of our students. In all these areas we strive to maintain a strong academic thrust that will enable the students to continue to benefit from their degrees long after the specific technologies they use now have been replaced with new ones.

RESPONDING TO STUDENT AND EMPLOYER NEEDS

To make these degree programs as convenient as possible for the busy, working student we offer courses at six different public locations in Maryland near concentrations of employers: APL and the Dorsey Center, both in Howard County, the Montgomery County campus, the Southern Maryland Higher Education Center near Lexington Park, the Homewood campus in Baltimore, and the Higher Education and Advanced Technology Center in Harford County (Fig. 2). Classes are also offered in Crystal City, Virginia, and at the Washington DC Center on DuPont Circle. Classes are scheduled to meet the needs of working students at 4:30 and 7:15 p.m., as well as on Saturday mornings. In responses to our surveys, students have commented on the value of these convenient locations and times.

In 2002 we consolidated all our student service functions for admissions and registration at the Dorsey Center, which has been used for many years to accommodate increased enrollments as the APL Education Center was outgrown. The gathering of student services and other central administrative functions at the Dorsey Center has greatly improved our ability to provide high-quality services that are responsive to student needs.

The most important change in our programs over the last 15 years has been the emergence of partnerships with corporations so that degrees can be offered at corporate locations. We began to offer a graduate certificate in Systems Engineering at a company location in New Hampshire in 2001 and then a master's degree in Systems Engineering in 2001 when students requested it. Subsequently, a master's degree program in Systems Engineering was offered at companies in Massachusetts and Virginia. Our Information Systems and Technology master's degree program is also offered at a company in Virginia.



Figure 2. For the convenience of working students, classes are held in seven locations across the Baltimore–Washington area. (left) Graduation at the Homewood campus in 2005. Dr. Bjerkaas leads the procession accompanied by Alison Wampler (special assistant to the Dean) and Nicholas Jones, Dean of the Whiting School of Engineering (behind Dr. Bjerkaas). (center) The Montgomery County Campus central building. (right) Faculty member Cheryll Resch teaches a class on the APL campus.

Our faculty members teach at these locations weekly. At the Systems Engineering locations we also use co-instructors drawn from the ranks of the systems engineering staff at the local sites. These partnerships have been the source of significant growth in enrollments and have also benefited the programs by bringing our faculty into contact with engineers in other technical settings.

EPP ONLINE

After observing that many engineering schools were developing online programs and hearing from students that increased business travel or temporary work beyond the local region prevented them from enrolling in our programs, we began to explore offering courses online. For the last 5 years we have been developing such courses using faculty members who have been early adopters of technology in the educational domain. We now have 29 online courses in four programs: Environmental Engineering, Science, and Management; Computer Science; Electrical and Computer Engineering; and Information Systems and Technology. These courses have allowed students on travel to participate in our programs.

Beginning in the fall of 2006 we will offer our first fully online master's degree program in Bioinformatics, developed jointly by the Whiting School of Engineering and the Krieger School of Arts and Sciences. Students from around the country are expected to enroll in this program. In the fall of 2007 we anticipate offering an online degree in Environmental Planning and Management with an emphasis in water resources planning. This program is being developed in partnership with the U.S. Army Corps of Engineers. Two more fully online degree programs are expected to be offered over the next 5 years. These particular programs

remain to be identified and will depend on market needs and our ability to deliver high-quality education to address those needs.

PROGRAM GOVERNANCE

To provide academic oversight, each program has a Program Chair and a Program Committee. The committees comprise faculty members and, in some cases, representatives of the related professional community. Committee members help the Chair to review the programs, recommend changes, and approve new faculty members. One full-time Homewood faculty member is part of each APL-based Program Committee to reinforce the connection with the Homewood departments.

Every 4 years the Homewood Academic Council conducts an academic and management review of EPP and every 10 years the Middle States Association of Colleges and Schools conducts an accreditation review, which includes an examination of the activities of EPP.

LONG-RANGE PLANNING

As we have sought to accomplish our mission we have been adapting to the needs of our students. In 2002 we decided to adopt a long-range strategic planning process that would recognize our mission, our vision, and strategic goals for the future, with a focus on the next academic year. In 2005 a five-year strategic plan was adopted. The original strategic plan articulated a vision to be the best provider in the country of graduate education for working engineers and applied scientists. This very ambitious vision depends critically on three factors for success, which have all been touched upon above.

1. The academic excellence of our programs. Our faculty members must continue to work at the leading edges of the application of engineering know-how and scientific knowledge to ensure that students learn the very latest and very best in their fields.
2. Instructional excellence. Although students give the program high marks, we are ever striving to improve the quality of instruction to maximize the learning experience.
3. Responsiveness to student and employer needs. Down through the years our students have identified the most valuable aspects of our programs to be the breadth of the degree offerings, the convenience of the times and locations of our classes, and the positive impact our programs have had on their professional development.

Our mission and vision have remained constant over the years while the specific strategic goals have changed as some goals have been achieved and others revised. The three strategic goals for the next 5 years in the 2005 version of the plan are as follows.

1. Develop and deliver four fully online master's degree programs. Over the last 4 years, there has been strong student acceptance of the online courses developed so far. Standards have been generated that reinforce the educational quality of these courses so that students have excellent educational experiences. As noted earlier, we also recognize the need to offer completely online degree programs. These will be developed and built on the unique strengths of both our APL- and Homewood-based programs to meet the needs of the marketplace, nationally and internationally.
2. Improve the teaching skills of our faculty. We will continue to seek the most qualified faculty from the pool of practicing engineers and applied scientists employed in our regional industry, government, and academe. We expect our faculty to continuously improve their teaching skills and to optimize the design of their courses to maximize the effectiveness of the students' learning experience. We will find more ways to help them achieve these goals, for example, by providing resources, instructional workshops, and mentoring for new faculty.
3. Expand our capability to assess and respond to student and employer needs. Student surveys and class questionnaires have been used for many years to assess the programs, courses, and educational needs of the students so that the appropriate adjustments can be made. In addition, the EPP Advisory Council,

established in 2003, provides important insights from the technical and business communities. Employers beyond the present region have shown significant interest in our programs, which has resulted in more strong partnerships. We intend to more aggressively pursue regular meetings with the employers in our region to explore opportunities for new courses and degree programs that address either new technology areas or new applications areas.

If we achieve the specific goals and milestones outlined above, we will continue to be a strong and vital graduate engineering program that will truly fulfill our mission to bring lifelong learning to engineers and applied scientists, not only locally but throughout the United States and perhaps around the world.

CONCLUSION

Education for working engineers has come a long way over the last 90 years that Johns Hopkins has been engaged in this enterprise. Since APL has assumed a major role in its partnership with the Whiting School, significant strides have been made in graduate educational opportunities for our students. The future looks bright as we move forward to meet the opportunities afforded by more on-site partnerships and online delivery of courses and degree programs. The challenge to provide graduate education that will keep working engineers and applied scientists current in their knowledge and competitive in their fields is one we are prepared to take on as we move into the future.

REFERENCE

- ¹APL's Role in Education, special issue, *Johns Hopkins APL Tech. Dig.* 10(2) (1989).

THE AUTHOR

Allan W. Bjerkaas holds a bachelor's degree with a double major in physics and mathematics from the University of North Dakota and a master's degree and a Ph.D. in physics from the University of Illinois at Urbana-Champaign. He joined APL in 1973 after completing a 2-year postdoctoral appointment at the University of Pittsburgh. While at the Laboratory, Dr. Bjerkaas was a Project Manager in the Submarine Technology Department and a Group Supervisor in both the Submarine Technology Department and the Research and Technology Development Center. Since the mid-1970s he has taught in the part-time graduate programs that Johns Hopkins has offered for working engineers. He received the Excellence in Teaching Award in 1992. Dr. Bjerkaas has been the Chair for the Applied Physics and the Information Systems and Technology programs. Since 2001 he has been the Associate Dean for the EPP in the Whiting School of Engineering, a position he now holds full time since retiring from APL in February 2005. He can be reached at bjerkaas@jhu.edu.



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