

Growing the National Innovation System: Leading Change at Universities for Innovative Graduate Education

**D. R. Depew,¹ S. J. Tricamo,² D. H. Sebastian,² S. K. Fenster,² R. J. Bennett,³
D.D. Dunlap,⁴ G. S. Jakubowski,⁵ M. I. Mendelson,⁵ T. G. Stanford,⁶
D. A. Keating,⁶ J. M. Snellenberger⁷**

**Purdue University¹ / New Jersey Institute of Technology² / St Thomas University³
Western Carolina University⁴ / Loyola Marymount University⁵
University of South Carolina⁶ / Rolls-Royce Corporation⁷**

Abstract

This is the fourth paper in the panel session of the National Collaborative Task Force on reshaping professional graduate education in engineering and technology that is more relevant to the needs of industry to ensure a strong U.S. engineering workforce. As the final and integrating paper of the panel session, this paper ties together the three previous papers and focuses on leading change for purposeful action at comprehensive research universities to implement this needed innovation into the mainstream of university operations across the country. The National Collaborative Task Force believes that innovation in engineering education can be accomplished best at the graduate level through a national demonstration project effected by a critical mass of innovative leaders from a strong coalition of universities and industry who are committed to taking purposeful action for reform. The paper presents strategies to overcome systemic and institutional obstacles in implementing this significant transformation at comprehensive research universities across the country. Additionally, the paper builds upon recommendations of the National Academy of Engineering, ASEE, the Kellogg Commission, the Council on Competitiveness, the Council of Graduate Schools, and other calls for reform in engineering education. The National Task Force is playing a key role as change agent for this transformation with industry.

Introduction

The first paper in this series considered the need for professionally oriented graduate education as a catalyst for sustainable economic development in the United States. The second paper focused on identifying the skill-sets, learning outcomes, and experiences appropriate for professionally oriented graduate programs in engineering as defined by leaders in business and industry. The third paper identified some of the important characteristics of innovative professionally oriented graduate programs at the master's level and beyond.

The paper focuses on bringing the series to a beginning rather than a conclusion. The authors will attempt to ask questions important to fostering an ongoing dialogue designed to improve professional graduate education in engineering. Graduate education should be viewed as an ongoing process of change and improvement. This ongoing improvement process should follow Dana Cound's view on continuous improvement. Cound advocated that striving for excellence in quality improvement should be considered a journey rather than a destination.

If we are to be successful in evolving professional graduate education, that is appropriate for the needs in industry, then significant leadership and focus will be required. This leadership will have to come from technology leaders in industry, universities, and governmental agencies. Strong leadership from committed technology leaders will help create an environment which will promote the translation of a good vision into recommendations, and recommendations into actions that produce results.

Background

For the purpose of this paper the authors will refer to the research, teaching, and service activities in a slightly different vernacular. We will use the words discovery, learning, and engagement as synonymous to the traditional terms of research, teaching and service. Engagement will be defined as any mutually beneficial partnership between the university and any other entity (i.e. business, industry, governmental agencies, etc.).

Many university mission statements express their contributions to society in terms of research, teaching, and service. The relative importance of these three may vary by institution and in some cases within institution. For example, land grant and major research universities will rank research or “discovery” as their primary function and regional comprehensives may rank research as secondary to their teaching or learning mission. The area of service is also considered to be an important activity, especially for publicly supported colleges and universities.

However, most colleges and universities, regardless of mission class, consider research as an important part of their missions. The area of research often includes both basic research and applied research. One important output of most research activity is the dissemination of research through scholarship and teaching. As new knowledge is discovered, the dissemination of this new information in the classroom and to the external community is vitally important. Universities have proven to play a vital role as engines for research. But universities serve other vital missions as well: one of which is professional education. As the Kellogg Commission has pointed out, there is a need for universities to change and to be more responsive to the needs of their constituencies. Spitzer points out that creating a learning environment which promotes entrepreneurship and innovation is considered to be a cornerstone for engineering education.

Leadership for Engagement with Industry

The recent economic downturn has seriously impacted state support for higher education. Many states have experienced significant declines in revenue, which has resulted in reduced funding for higher education. As state financial resources have diminished over the past two years, state supported research universities are searching for ways to be viewed more favorably by state and federal government as catalyst for economic development.

Many major research universities are now making contributions to economic development in the areas of discovery or research, learning, and engagement. New ideas and technological innovations are continuously being created and developed at research universities. These same universities are working with entrepreneurs and corporations to transform these new innovative inventions into products and services for the market place.

Universities and state governments are investing resources into the development of discovery parks as one way of stimulating innovation and incubation of new enterprises. At the very core of this activity one can find graduate students and entrepreneurs working to transform new technology into marketable products and services. Another important long-term outcome of this activity is the creation of new jobs and

expansion of the tax base. As economic activity increases, the resource base, which supports higher educations, will also increase.

Because major research focused universities are blessed with a rich base of intellectual capital, corporations are motivated to develop closer partnerships with universities, which will provide access to intellectual capital in the form of discovery and technological invention. Strategic partnerships between corporations and universities are becoming more focused and aligned to compliment their respective missions. Another important outcome of these new partnerships will be the need for graduate education programs in engineering with an appropriate professional orientation.

Industry leaders have been vociferously advocating for professionally orientated graduate education experiences, which will provide engineers with the skills to be competitive in the global market place. Today and in the future business and industry will continue to turn to universities for a well educated entry level workforce and post graduate educational experiences, which foster professional development and growth.

These new jobs will require a well-educated technological workforce, which will result in universities responding with new educational programs and delivery systems. As new businesses and industries develop, universities will need to continue to focus on discovery and research, with an emphasis on the dissemination of these new discoveries and technologies in the classroom.

University, corporate, and governmental leaders are now recognizing the importance of working together to stimulate and grow economic development at the state, national and global levels. Engaging industry is now becoming a major goal for universities. Engagement at some major universities has become a major cornerstone of their strategic plan.

Today, more universities are becoming key leaders in developing new discovery parks and partnering with business and industry to make available intellectual capital to create new products, services, and markets. These new partnerships are creating new jobs and opportunities for educational advancement for these new employees. Some research universities refer to their university-industry partnerships as **engagement**. These new technology incubators are more collaborative and interdisciplinary than any other time in recent history.

They also want access to educational opportunities for employee professional development and life enrichment. Corporations would like to see educational opportunities which allow for professional development and growth, while complimenting the employee's ability to contribute to creativity and innovation. Research universities need to accelerate the development of new programs, educational experiences, and innovative delivery systems to respond this need.

Finally, another important reason for cultivating and promoting discovery and engagement opportunities between universities and industries is to keep talented faculty in the academy. In recent years many of our best professors have exited the university to pursue professional opportunities in business and industry. Apparently, the desire to leave the university has less to do with money than with stretching themselves professionally. The technological environment in industry provides an opportunity to translate discovery and invention into products and services that are important in today's global market. If universities and industry work together professional and economic goals can be achieved, while providing graduate professional education opportunities for engineers.

Creating an environment which brings together engagement in professional education and research

produces desirable results. New enterprises are created and economic opportunities for all involved in the engagement partnership benefit.

Some Questions for Transformation

During the planning process for this transformation many questions will develop that need to be addressed. The authors of this paper do not presume to know all of the possible questions or answers, which will arise during the journey. However, as a beginning point, some of the questions that university, business, and governmental leaders should consider are as follows.

1. How do the objectives of the proposed innovation-based, professionally oriented graduate programs enhance university-industry engagement and enable engineers/technologists to continue to grow?
2. What are the regional and national target markets for these programs?
3. How do the programs support the mission, role, and scope of a comprehensive research university?
4. How will the programs support the technology-driven economy and impact the economic growth of the region and nation?
5. How do these programs benefit comprehensive research universities in increasing tuition revenue and in fostering better engagement with industry?
6. Are these programs cost effective?
7. Do these programs fit nicely into existing research-oriented academic departments; and, if not, what is the organizational structure required for these innovative programs to survive, grow, and flourish?
8. What institutional resources will be required to initiate and sustain these programs?
9. What collaborative resources need to be supplied by regional industry to sustain these programs?
10. What financial resources need to be secured from industry, government, universities and foundations to initiate, to improve, and to sustain these programs?
11. How do these programs help to improve the corporate culture for innovation?
12. What steps must be taken to implement the program into existing universities?
13. What are the outcomes of the proposed graduate programs?

Conclusions: Leadership for a National Collaborative

Many of the ideas and concepts developed in this paper build on a conceptual basis for transformation in professional graduate education and on several successful experiments that have already occurred across the country. However, they have been piecemeal at best, and have not been integrated into a nation system for change. Clearly, when universities, industry, and governmental agencies work together toward common goals, great outcomes are possible. As a national steering committee from universities and industry, the authors recommend that the next steps for transformation are to develop a comprehensive strategic plan to translate ideas and recommendations into goals and actions, which have metric and benchmarks for measuring progress. The plan should also be aligned to adequate sources of funding to insure success and sustainability with strong industry, university, and government partnership.

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Biography - National Collaborative Task Force Members

RONALD J. BENNETT is director and chair engineering and technology management, University of St. Thomas.

DENNIS R. DEPEW is professor and dean of the school of technology, Purdue University.

DUANE D. DUNLAP is professor and department head of engineering technology, Western Carolina University.

DONALD A. KEATING is associate professor of mechanical engineering, University of South Carolina.

THOMAS G. STANFORD is assistant professor of chemical engineering, University of South Carolina.

STEPHEN J. TRICAMO is professor of industrial and manufacturing engineering, and formerly dean of engineering, New Jersey Institute of Technology.

DONALD H. SEBASTIAN is professor of industrial and manufacturing engineering, and vice president for research and development, New Jersey Institute of Technology.

SAUL K. FENSTER is president emeritus, New Jersey Institute of Technology.

GERALD S. JAKUBOWSKI is professor, and dean of the college of science and engineering, Loyola Marymount University, and immediate past president of the American Society of Engineering Education.

MEL I. MENDELSON is associate professor of mechanical engineering, and director of the engineering and production management graduate program, Loyola Marymount University.

JAY M. SNELLENBERGER is manager, employee development, strategic engineering and business improvement, Rolls-Royce Corporation, Indianapolis, Indiana, and member of the Engineering Workforce Commission.

