

Economic Impact for Integrating Constructivism, Project-Based Learning and Practice into High Quality Professional Graduate Education for Engineers in Industry to Enhance Corporate Advantage and U.S. Competitiveness in the Global Economy

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Abstract

This is the fourth of four papers prepared for a special panel session of the National Collaborative Task Force on Engineering Graduate Education Reform focusing on new educational approaches and processes that better meet the development needs of the U.S. engineering workforce in industry to enhance global competitiveness. Further graduate development of the U.S. engineering workforce in industry is critical to the continuous improvement, invention, development, and innovation of new technology which is the engine for U.S. economic prosperity and competitiveness. This paper focuses on a unique model for workforce development that represents a significant advancement in professional graduate education extending through the professional masters, professional doctorate and fellow levels of engineering practice. This advancement in professional graduate education forms a new partnership for university-industry engagement for U.S. engineering workforce development that completes a missing piece of the process to better enable U.S. technological innovation which is long overdue. The impact of project-based learning on industrial innovation is evidenced. This model is designed specifically to support the on-site engineering process for continuous improvement and innovation in industry. It purposefully integrates postgraduate professional education for industry's employed engineers with on-site technology development projects that are chosen to be directly relevant to industry's continuous innovation needs and high-end engineering projects. The returns for enhanced corporate advantage generated through this unique model are measured as a matrix of increasing complexity of economic worth of on-site projects and of increasing human proficiency gained for leadership of technological innovation.

The Importance of Developing a World-Class Engineering Workforce: Educating Creative Professionals for Innovation and Leadership in Industry

The United States of America must remain preeminent in creating new innovative technologies through engineering to enhance its economic prosperity, quality of life, and national security.

Our technical capability is the engine that drives our national economy and provides for our national security. Professional development of the US engineering workforce is the critical to our very way of life. The vast majority of engineering innovations are needs-driven and market-focused (requiring

purposeful engineering creativity, engineering problem-solving, and responsible leadership). Due to this fact, engineering innovation originates primarily within industry.

“The United States is in a long-distance race to retain its essential global advantage in Science & Engineering human resources and sustain our world leadership in science and technology,” said NSB Chair Warren M. Washington. “For many years we have benefited from minimal competition in the global S & E labor market, but attractive and competitive alternatives are now expanding around the World. We must develop more fully our native talent.”

The United States must define a coherent policy for graduate development of its domestic graduate engineering workforce whose professional careers are centered on creation, development and leadership of new and improved technology in Industry.

“...it is a lack of adequate educational training rather than ‘outsourcing’ that poses the greatest threat to future American prosperity...the better approach is to intensify efforts to increase the skills and knowledge of the U.S. Workforce.”

Allen Greenspan, Feb. 20, 2004

If the U.S. is to remain preeminent in creating new innovative technologies through engineering to enhance its economic prosperity and national defense, the U.S. system of engineering graduate education must remain the world’s leader - and new models for professionally oriented graduate education must be created and implemented that better support the lifelong development needs of the graduate engineering workforce in industry.

Impact to Corporate Advantage: Developing the Professional Educational Process to Support the Process for Continuous Improvement and Innovation (Six Sigma and Beyond)

A unique and repeatable system to finish machine the rough casting provided by universities into the final leadership product of a Chief Engineer is needed by US industry.

“Partnerships are more important today than they ever have been. When educators and real world businesses ... work together, students have opportunities to learn which reach far into the future. Students can make better decisions about their life’s work and companies can better ensure a well-prepared, more able and dependable workforce.”

Dr. Suellen K. Reed, Indiana Superintendent of Public Instruction

Development of an innovation-based professionally oriented graduate education will:

- Complement research-based engineering graduate education
- Support further graduate development needs of America’s domestic engineering workforce
- Strengthen leadership of technology development and;
- Develop innovation for competitive advantage

Our country’s lasting wealth comes from industry

Raw materials converted into products and sold for a profit. This is NEW MONEY! A service oriented economy can not sustain itself resulting in massive trade deficits. This is RECYCLED MONEY!

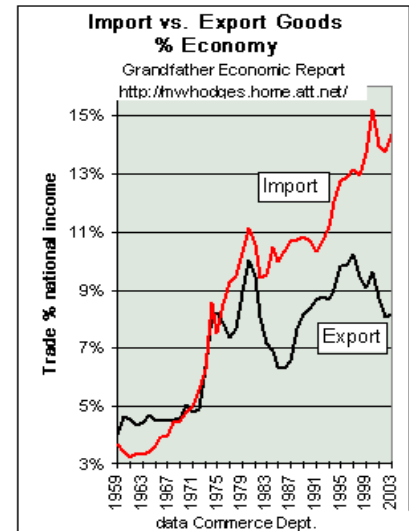
Our nation and local communities must maintain “a balance of payments” to maintain our standard of living Industrial plant closures have devastating impact.

The enhancement of the academic professorate is important for research ... The enhancement of a strong U S engineering workforce in industry is extremely important to our nation's competitiveness, national security, and continued technological development and innovative progress for our nation's welfare.

“Scientist discover what already exist ...

Engineers create what has never been here before.”

Theodore VonKarman



Next Steps:

Implementing the Innovation Agenda Across the U.S.

Major systemic reform in US engineering graduate education must begin by establishing new innovative graduate programs with special focus on professional engineering practice, leadership of innovation, and technology development.

This is a bold initiative and an exciting new advancement in partnering professionally oriented engineering graduate education with the practicing engineering industry professional that will stimulate technological innovation and regional economic growth to improve global competitiveness. Creation of Institutes or Centers for Advanced Professional Education for Engineering Innovation with Industry to Enhance U.S. Competitiveness is a strong next step. Such Centers or Institutes would have the unique capability to provide high-quality advanced professional education programs (practice-oriented) that foster the innovative capability and professional development of the regional U.S. engineering workforce in industry.

“The United States could lose its preeminence in technology unless a new national innovation agenda is developed.” (Council on Competitiveness)

Biography

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Appendix

Appendix A: Impact of Professional Education to Competitiveness of U.S. Industry

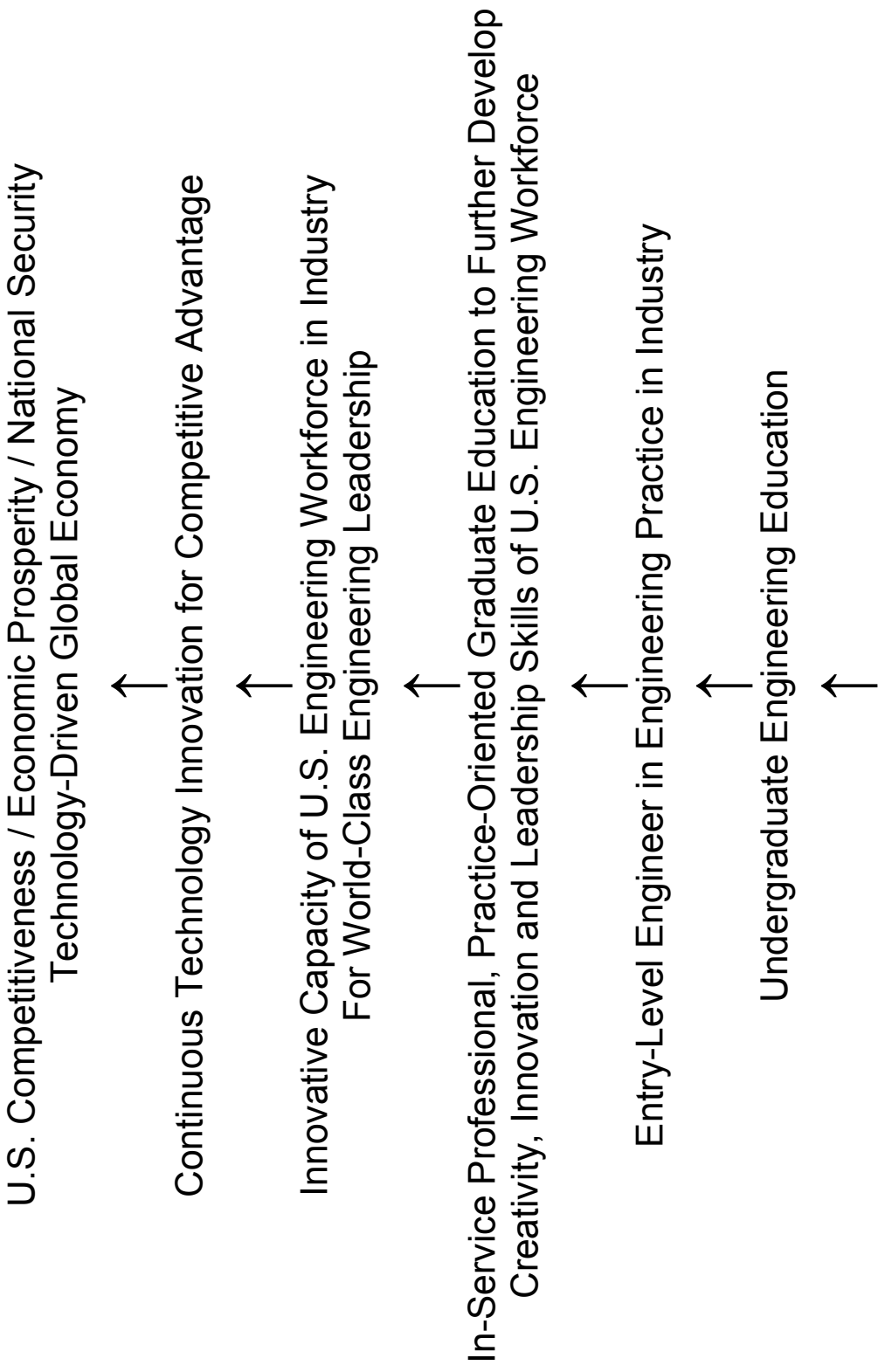
Appendix B: Role of Engineers in the Innovation-Driven Economy

Impact to Corporate Competitiveness Relevant to Project Worth and Integrative Professional Education for Continuous Technological Improvement and Innovation

Engineer-Leader Level of Responsibility	Scope of Projects/Programs/Systems Managed Importance and Value Added to Company
Engineer IX (Chief Engineer/Vice President) (Corporate Responsibility)	\$ multi-million level
Engineer VIII (Systems/Program/Project Leader) (System Integration)	\$ multi-million level
Engineer VII (Project/Sub-assembly Leader) (Professional Fellow Technology Leader)	\$ 1,500,000 level (+) (-)
Engineer VI (Professional D.Eng. Technology Leader)	\$ 1,000,000 level (+)
Engineer V (Senior Engineering Leadership)	\$ 500 K – 1 M level (+) (-)
Engineer IV (Professional M.Eng. Technology Leader)	\$ 500,000 level (+)
Engineer III (Project Engineer)	\$ 500,000 level (+)
Engineer II	\$ 500,000 level (+)
Engineer I (Entry Level)	\$ multi-thousand level

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The Role of U.S. Engineers in an Innovation-Driven Economy



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