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How to Prepare Tomorrow's Technologists for Global Networks of Innovation

University curricula must prepare them to be able to recognize and embrace technologies, components, markets, and customers wherever in the world they happen to be.

Two of the most important changes the global innovation engine has undergone in the last decade are the emergence of global networks of innovation and the increasing distance between technology innovators and their customers and markets. They represent a critical challenge for future technologists and imply a looming crisis in engineering and technology education worldwide. How effective are today's curricula in preparing them? If you conclude (as I do) that the answer is not effective enough, then we must begin to reconfigure the curricula now.

The emerging global innovation environment requires the next generation of engineers and technologists be able to go beyond narrow sets of technical skills to gain a much broader perspective for how innovative technologies and solutions are developed. This requirement implies that engineering and other technology-oriented university programs must incorporate and promote this broad perspective, or world view, of technology and innovation evidently missing in today's curricula. Unfortunately, few schools in the U.S. seem to have acknowledged the challenge or begun to adapt their programs. If technology educators, as well as future technology employers, don't address the issue, we are likely to see a steady decline in our ability to produce engineers and technologists capable of adapting to and thriving in tomorrow's global environment.

The first challenge for them is the emergence of global networks of innovation. In the last several years, a revolution has taken place in the nature and process of innovation in most industries, particularly those involving technology (such as telecommunications and consumer electronics). More and more new products and services are being developed collaboratively by an array of firms located around the world. In such distributed projects, each individual firm contributes only part of the solution, and the components are ultimately brought together to create new products or services.

Probably the most illustrative case in point is Apple Computer's iPod portable music player [4]. Despite being Apple-owned and -branded, the original idea came from an independent contractor, Tony Fadell, who was hired by Apple in 2001 specifically to develop the product. The platform design came from PortalPlayer and the operating system to run the user interface from Pixo, both Silicon Valley startups. The hard disk was developed in collaboration with Toshiba. The flash memory chip was obtained from Sharp Electronics. And the planar lithium battery came from Sony. The iPod also incorporates a stereo digital-to-analog converter from Wolfson Microelectronics and a 1394 firewire interface controller from Texas Instruments. All these components were assembled and packaged by

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Inventec, a Taiwanese firm. In short, the development of the iPod involved a worldwide network of firms. Apple's primary role in the project was to configure the network of partners that would contribute the components and coordinate the innovation processes within the network.

Examples of such distributed innovation projects are seen in other industries, too, including biotechnology and software. The specific nature of a global innovation network may depend on the industry in which it operates and involve structures ranging from tightly woven co-development models to more open technology consortiums. Given today's highly dynamic and competitive markets, diverse and complex technologies, and demand for innovation, global networks of innovation represent the most promising approach to enhancing the speed, efficiency, and effectiveness of innovation without increasing the technological and financial risk exposure of individual firms.

The second challenge to educating technologists to participate in these networks is the increasing distance between technology innovators and their markets. Innovation often involves solving a problem, and thus requires listening to and understanding customer and market needs. In many technology sectors (such as consumer electronics and wireless networks), because a significant portion of the customer base has shifted to Europe and Asia, U.S.-based technologists and innovators must understand the needs and technological idiosyncrasies of these far-away markets and customers.

In the case of the camera phone, Sharp and Nokia, both of which played a critical role initiating this revolutionary product in 2000–2002, leveraged not only their technological expertise, but their awareness and understanding of the Asian and European markets and technological standards. A narrow focus on the cell phone market and technologies in the U.S. can produce a misleading picture of the future of the camera phone, while a broader focus on the global market indicates its enormous potential to radically redefine the landscape of several related technology sectors, including digital cameras, printers, and imaging [1, 3]. As noted in [2], much of the growth in the market for these technologies and their applications is taking place in South Korea, Japan, Finland, and other Asian and European countries; hence, the adoption of a global perspective needed to understand and interpret their changing technological and market trends is critical for U.S. technologists to develop mind-sets capable of producing future innovation.

A critical success factor will be the ability to develop and maintain a broad perspective of the innovation system while working in one's own area of expertise. Increasingly, most firms will scour the world for new technologies and components, establishing links across multiple firms in order to design and develop new products and services. Technologists must be able to collaborate and leverage these links to help their companies produce successful products. In many cases, they will also need to be technology brokers to find innovative solutions and applications at the intersection of highly diverse technologies (such as biotechnology and IT).

All these expectations for the emerging global innovation economy and the people who will work in it imply the need for new engineering and technology university programs that emphasize a way of thinking and communicating that has not been part of the traditional focus. Future technologists need a broader understanding of complementary disciplines and fields; superior collaboration and communication skills; awareness of the diverse global social and cultural contexts in which technologies are applied; and how to identify new technology application opportunities. Needed are new curricula initiatives incorporating broader sets of core or foundational courses, including those in the humanities, social sciences, and life sciences. Also needed are more interdisciplinary specialization opportunities (such as bioinformatics, electronic media, and the arts), multi-university collaborative student projects, and internships and practicum bridging theory to practice in multicultural contexts.

The evaluation process has yet to determine which initiatives or approaches will be best. However, one thing that is clear is technology- and engineering-oriented programs must be rethought and revamped to reflect the new realities of global innovation—if we hope to prepare future technologists to participate in the emerging global networks of innovation. C

References

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