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Innovation in the Heartland

Universities throughout the country—not just on the coasts—are critical drivers of regional economic growth and competitiveness.

News reports about the death of the United States' heartland are wrong and potentially a danger to the nation's health. The US economic engine is not powered solely by efforts on the coasts. Innovations in industries as diverse as aviation, energy, and fast food have come from Wichita, Kansas, and can continue to do so. At Wichita State University (WSU), we are trying hard to help spur competitiveness, and we have charted a path that is focused on delivering higher education deeply grounded in applied learning and research.

The passage by Congress in 1980 of the Patent and Trademark Law Amendments Act, commonly called the Bayh-Dole Act, represented a watershed event for higher education and the impact that research universities could have on discovery and job growth. Bayh-Dole provided formal recognition of the importance of universities in technology transfer that would increasingly propel the national and global economy. Thirty-eight years later, the foresight of Bayh-Dole cannot be overstated. It marked a formal beginning of the movement of higher education from the sidelines, as that place where you prepared to "enter the real world," to being a major pillar of US future prosperity, security, and quality of life.

It has become clear since Bayh-Dole that higher education is a crucial component of US economic success now and into the future. University education and research play a pivotal role in the nation's global competitiveness. We at WSU take this responsibility seriously, and we are fully focused on our role in securing the future. Our strategic plan is straightforward in its vision and direction:

- Our core vision is for Wichita State University is to be internationally recognized as the model for applied learning and research.
- The mission of Wichita State University is to be an essential educational, cultural, and economic driver for Kansas and the greater public good.

This vision and mission are inspiring WSU to focus on becoming a model US university driven by the emerging educational needs of a much broader range of students than traditional universities, as well as by the need to better compete in today's globalized marketplace for the benefit of the people, the region, and the state we serve. In short, we are driven to provide employment opportunities, prosperity, and economic inclusion for those living in southcentral Kansas.

One size will never fit all

In the abstract, applied education that incorporates internships, mentorships, and apprenticeships focused on science, technology, engineering, and mathematics (STEM) improves outcomes for students in these areas. However, when moving beyond the abstract, what to implement and how to implement it becomes much more difficult and nuanced. What might be appropriate in Huntsville, Alabama, may not fit well at all in Wichita.

We have learned that programs to improve STEM education must be designed and implemented with an integrated approach that involves economic analytics, economic structural analysis, and rigorous feedback and assessment.

From a student's perspective, STEM courses are challenging. Each student needs to be able to see the value, or the work won't be seen as worth the effort. Increasing the number of students in STEM education, as well as the quality of that education, has to be linked to the student's goals and life interests. In many cases, those interests have more to do with family, community, and nonacademic pursuits than in long-term, challenging, academic programs. We must be prepared to answer the student's questions about why education in a STEM field is worth the effort.

There were four major components to WSU's contextual analysis that provided the basis for modifying the university's approach to education, research and development (R&D), and its relationship with its broader community.

Regional economic structural analysis. A number of studies of the restructuring of the national and global economies have documented the shift of economic outputs to major metropolitan areas, with these major metros acting as hubs for broader regions of production, distribution, and economic networking.

Globally, there are approximately 40 such hubs, with 10 of them in the United States. Third-party analyses of Wichita show that it is part of what is called the I-35 corridor, which is one of these 10 hubs. The region known as the Texas Triangle, formed around four main cities, Houston, Dallas-Fort Worth, San Antonio, and Austin, is the focal point of this hub, with cities in Kansas, Oklahoma, and western Missouri feeding into this economic engine.

Trade good destination analysis. The key driver of new income for both businesses and individuals is the volume and value of goods traded that have their origins within the region. Analyses of Wichita's trade good destinations showed that they largely followed the I-35 corridor, with substantial trade moving to the coasts for export.

Specific metropolitan economic analysis. The Wichita area possesses several significant distinctions:

- Among the nation's 100 largest metropolitan areas, Wichita ranks number one in manufacturing jobs as a percent of all jobs and has the highest concentration of aerospace manufacturing, according to the Brookings Institution.
- Wichita ranks third in the percentage of engineers in the workforce, exceeded only by San Jose and Houston, according to the National Science Foundation.
- Southcentral Kansas is the nation's most manufacturing-specialized region, with nearly 18% of all jobs in manufacturing, according to Brookings.
- Wichita is ranked number three as an "advanced manufacturing hot spot," according to Brookings.

Blueprint for regional economic growth. As these statistics demonstrate, Wichita has in many ways a higher stake in effective STEM education than nearly any area in the country. These general characteristics provided a backdrop for our next steps. We found that designing effective models to undergird the region's future prosperity and quality of life required a much finer detailed analysis than was available to the community and university when we began this work about five years ago. This led to the development, funding, and sponsorship by WSU of the Blueprint for Regional Economic Growth (BREG).

This final step in our learning process involved bringing in a national firm that specializes in detailed analyses of potential clusters of innovation that might drive the future economy. The university, with the assistance of this firm, looked in detail at potential economic growth sectors. We identified eight. Business leaders and job creators from these sectors were brought together for multiple meetings where they identified needs, stumbling blocks, trends in their areas of business, and potential for further development. The eight clusters identified were advanced manufacturing, advanced materials, aerospace, agriculture, data service and information technology, health care, oil and gas and transportation, and logistics.

Although many of these clusters could fit a large number of metropolitan areas, what BREG accomplished was to localize the clusters so that university programs and approaches could increasingly fit specific situations within this metropolitan region. Based on the needs defined by enterprises in these clusters, coupled with the more general analyses described above, the university began responding by focusing on critical educational and R&D approaches that could improve the competitiveness in several of these clusters.

This is a continuing process, and WSU is committed to extending its capacities to support these crucial clusters. Finally, it should be noted that the process was considered of enough importance that it is now being sponsored and managed by the metropolitan area's primary economic development group, the Greater Wichita Partnership.

STEM education as part of an ecosystem

One of the major issues facing the greater Wichita area has been the continuing outmigration of educated workers and jobs that are being replaced by lower-wage positions filled by less-skilled workers. According to the economic analyst James Chung's work for the Wichita Community Foundation, from 2011 to 2013 the typical household leaving the metropolitan area had earned nearly $71,000 per year, whereas those moving in averaged approximately $58,000 and were filling jobs with lower educational requirements.

It's not enough to produce more highly capable STEM graduates; the university also needs to take a role in strengthening local companies so that our graduates can be employed here. The university has therefore worked systematically to expand the opportunities for those students,

especially in engineering, to remain in the region. WSU's Innovation Campus, our broader partnerships with business, our focus on applied R&D relevant to the region, and our increasing support for entrepreneurship and innovation are all part of the university's overarching approach to increasing the competitiveness of the region.

WSU has a long history of supporting the local economic drivers and, in turn, being supported by them. Wichita bills itself as the "air capital of the world," and the aviation industry has been, and will remain, the core advanced manufacturing industry in the region. Partnerships between the university and this industry can be traced back to at least 1948, with the Beech Aircraft Corporation's donation to the university of the Walter H. Beech Wind Tunnel. These partnerships are, from our experience, crucial to development and maintenance of the highest-quality STEM education. Because of our continuing interaction with business, we have been able to respond to many pressing needs and to design programs that support the student's education as well as the industry's ability to compete.

Over the years, one of the most pressing problems that we heard across industries regarding workforce availability and industrial competitiveness was that, on average, newly graduated engineers took two additional years of training on the job before they could contribute to their companies' profitability. In response, we created and tested a modified apprenticeship model with one of the advanced manufacturers in the community. Using undergraduate students, we were able to digitize the plans for their most important product with an accuracy, speed, and cost not matched by their Asian-outsourced engineers. Although the program was not designed to provide permanent employment for the students, 35% of the participants were offered jobs, and 83% of the group found employment within the region. The remainder found immediate employment outside the regional area or entered graduate school. Most important, the company estimated that the apprenticeship model reduced a newly graduated WSU engineer's time to contribute to profitability from two years to less than six months.

This model has demonstrated that a well-designed apprenticeship program greatly benefits student learning and increases the student's value to employers while providing a major benefit for industry. Instead of leaving the region, the vast majority of students in this test of the model remained in the region and will continue to contribute to regional economic competitiveness and quality of life.

Applied learning for all

Apprenticeships and longer-term internships can be important components of an overall strategy for STEM, but thinking differently about how to educate the students on campus also plays a critical role. That is why WSU's strategic plan calls for all students to have applied learning experiences regardless of major. It is also why we are experimenting with new programs and program design. One possibly unique example of a program that is designed to increase competitiveness is WSU's Master of Innovation Design. Based on the concept of "design thinking," the program expects each graduate to develop:

- Portfolio, patent application, process, or prototype
- Willingness and ability to experiment with their ideas
- Network of individuals and businesses with whom they can continue to collaborate
- Desire to continue to design solutions to problems they identity

Demand for this program already exceeds available resources, but this type of innovative approach to education linked to technology, as well as other STEM fields, can be a crucial part of the infrastructure and ecosystem that produces new businesses that are globally competitive and can drive demand for STEM-educated workers within the metropolitan region. This, then, can be an important element in convincing students to take advantage of STEM education so they can have good careers within their communities.

Private-sector engagement

Starting a process by involving the private sector, nongovernmental organizations, and other entities outside the university provides a base from which to begin developing educational programming. Maintaining those relationships is critical. The competitive situation in the broader market requires interactions with business and the job creators so that the models of STEM education can be modified in ways that continue to promote competitiveness and success that supports the community, region, and state.

Whereas universities typically maintain "business advisory councils" or hold other regularly scheduled meetings with industry leaders, WSU's approach has been more in-depth and broader. Of specific note is the strong relationship between industry-sponsored applied R&D and the development of the university's Innovation Campus.

As highlighted above, WSU is a national leader in R&D sponsored by industry. This meaningful interaction has allowed the university to not just hear about potential changes in the market but to have strong, continuous relationships with industry that allow for robust support and development of nuanced educational programs that address the rapidly changing business environment. Our modified apprenticeship model derived from the applied R&D conducted at WSU's National Institute for Aviation Research. That was an important step, but it also was the origin of a major restructuring of higher education in the greater Wichita region that will, over time, create new programs and new approaches to STEM education.

In addition to our efforts at WSU, the area has been served for decades by Wichita Area Technical College. This

college provides GED to associate degree education for the people of Sedgwick County, and it has a long track record of success. But what became clear several years ago was that the changing nature of STEM education and emerging needs of industry were increasingly difficult to meet either by the technical college or the university. This recognition resulted in the two entities affiliating. The technical college is now known as WSU Tech, though its formal name is the Wichita State University Campus of Applied Sciences and Technology. Since the affiliation, WSU and WSU Tech have begun jointly occupying learning centers in downtown and south Wichita. They were already partners in the National Center for Aviation Training, in northeast Wichita.

Within WSU, there is a substantial reorganization under consideration to create joint bachelor of applied science degree programs with WSU Tech. This would allow much better integration of hands-on technology with traditional STEM education and strengthen both institutions' capacities to respond to emerging business conditions.

Reaching the young

Many of the major technology-based employers in our region (and throughout the world) use CATIA software as the platform for their engineering applications, from design to manufacturing. To prepare students to enter engineering fields, the university worked with the European software company Dassault Systemes to make the software available free of charge to the region's high schools. Demand from schools across the area has been high, and students who take the class come to university with much stronger background in engineering design. And with WSU Tech, the CATIA program can be more readily linked with pre-collegiate technical programs, early-entry technical and STEM programs for high school students, and joint planning and programming in the high schools to encourage students to enter STEM fields at a level that fits their interests and abilities.

This approach of linking high schools and STEM fields is increasingly being integrated into the university, especially in the College of Engineering. The college is increasing the number of graduates equipped with the skills, entrepreneurial mindset, and experience to advance economic and technological prosperity, health, and well-being.

We aggressively promote engineering and computer science through strategies that include direct outreach to students in elementary schools, middle schools, high schools, and community colleges, along with indirect outreach by training K-12 teachers in a pre-engineering curriculum and by fostering relationships with high schools and community colleges to ensure smooth transition into our undergraduate programs. Throughout, we bring industry professionals into schools and into the camps we hold to provide vivid accounts of career opportunities. The result has been four consecutive years of record numbers of engineering and computer science students graduated.

Supporting innovation

The type of innovation that we are pursuing at WSU can be facilitated by a number of changes in the higher education ecosystem. For example, the existing accreditation system tends to be a conservative approach that reinforces the status quo definition of quality. Outcomes-based accreditation, rather than more input-based processes that are currently still the norm, can promote experimentation, innovation, or entrepreneurial actions by universities and professions.

Federal financial aid currently is focused on traditional degrees taken by full-time undergraduate students, yet all indications are that nondegree short courses, certificates, stacked credentials, and mixed traditional and apprenticeship programs offer great opportunity to expand the number and capacities of STEM-qualified students. There should be much better alignment between the federal financial aid system and the rapidly changing environment in which we all are working.

Although federal research should continue to emphasize basic research, directing some support to STEM doctoral programs that focus on applied R&D could be of great, immediate assistance. It might eventually increase the supply of faculty who value, and are trained in, how to effectively conduct applied R&D within a university context.

The Integrated Postsecondary Education Data System (IPEDS), which is administered by the National Center for Education Statistics within the US Department of Education, has for years collected information for the government, but the data collected no longer represent the reality of today's higher education and tend to lead both university leadership and policy-makers to focus on very limited outcomes measures. Rethinking IPEDS and other federal data-reporting systems so that they accurately reflect the new approaches to education will be a strong signal to institutions that the nation understands how universities are fulfilling their mission.

There is very little recognition within the academy or in federal policy that traditional organizational structures that supported the industrial economy are counterproductive in today's postindustrial, technology-driven economy. Refocusing the missions of research universities to allow unique differentiation of the type of teaching, research, and service they provide would be beneficial. Movement in this direction has already begun in other countries, such as the United Kingdom's development of "business facing universities." The United States is very late to the table. Policies that boost external linkages can be of great benefit in encouraging institutional transitions to new models of education that promote quality within the highly technological, globally competitive world within which we now all operate. In sum, it is time for Congress to consider Bayh-Dole 2.0.

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