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CUT TO INVEST

Support the Designation of 20 'U.S. Manufacturing Universities'

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Summary

Congress should establish an initiative to designate 20 institutions of higher education as "U.S. Manufacturing Universities" as part of a needed push to strengthen the position of the United States in the increasingly innovation-driven global economy. In 1862, Congress passed the Morrill Act, which established land-grant colleges to promote learning in "agriculture and the mechanic arts." These colleges played a key role in enabling the United States to later take the lead in the mechanization of agriculture and the industrialization of the economy. Today, the challenge is even greater as America competes against a wide array of nations seeking to win the race for global innovation advantage, especially in advanced manufacturing. A new cadre of federally-designated "Manufacturing Universities" that revamp their engineering programs with particular emphasis on work that is relevant to manufacturing firms while providing engineering students with real-world work experience should be part of the solution.

Background

In the aftermath of the Great Recession, states and metropolitan areas throughout the United States have come to recognize the importance of cultivating regional economies that are strong in production, innovation, and global trade. In contrast to the debt-driven, consumption-oriented economy of years past, this new economic growth model places great emphasis on innovation activity and advanced manufacturing capacity, which together improve the nation's competitiveness in the global marketplace.

As the largest internationally traded sector, manufacturing is critical to the health of the U.S. economy. It is simply impossible to have a vibrant national economy without a globally competitive traded sector. And for U.S. metro areas, where over 80 percent of manufacturing jobs and 95 percent of high-tech manufacturing jobs are located, such an advanced manufacturing revival is particularly critical.

As a relatively high-cost nation, the only way the United States can regain manufacturing competitiveness is through innovation and productivity, both of which are driven by engineering capabilities that are cultivated, in part, by the nation's institutions of higher education. University-based engineering programs can play a critical role in supporting advanced research, particularly in areas of relevance for manufacturers, and can help train the highly skilled workforce that advanced manufacturers need.

The Problem

The first decade of the 21st century witnessed a substantial decline in manufacturing, as the United States lost nearly one-third of its manufacturing workforce, saw on net over 66,000 manufacturing establishments close, and accrued a trade deficit in manufactured products of over $4 trillion. Approximately two-thirds of those jobs were lost because U.S. manufacturing experienced an unprecedented 11 percent decline in output even as U.S. GDP increased by 11 percent (when measured properly). Moreover, every lost manufacturing job meant the loss of an additional two to three jobs throughout the rest of the economy. The 32 percent loss of manufacturing jobs was a central cause of the country's anemic overall job performance during the previous decade, when the U.S. economy produced, on net, no new jobs. And while some have seized on the recent modest rebound in manufacturing jobs off Great Recession lows, the reality is that, at the rate of growth in manufacturing jobs that occurred in 2011, it would take until at least 2020 for employment to return to where the economy was in terms of manufacturing jobs at the end of 2007.

At the same time, a number of trends seem to point to some modest "reshoring" of manufacturing facilities that had been sent abroad, driven by a combination of global market dynamics and stable or declining cost factors in U.S. regions—particularly with regard to energy costs. Visions of a post-industrial economy have given way to a new economic vision that recognizes the critical importance of innovation capacity and manufacturing capability.

But manufacturing renewal will depend on more than luck, hope, and patience; it will require enacting and implementing a range of policies, of which one key step will be for the U.S. needs to embrace and reintegrate an engineering culture. While America has thrived on science-based innovation and has a strong science culture, it needs to become much more of an engineering economy. The notion that the U.S. can win through science alone is fallacious, because science is a public good that diffuses fairly rapidly around the world and, by itself, has no intrinsic economic value. By contrast, gains from engineering-based innovation are capturable and appropriable within nations and, more importantly, directly generate profits and high-paying jobs.

The United States must also be able to make things here, not just invent them. That requires engineering-based innovation, an appropriable activity through which U.S. establishments (and workers) can add and capture value. Only through engineering strength can firms in the United States take the insights acquired through basic and applied research and translate them into innovative products for the global marketplace. In a global, knowledge-driven economy, engineering capabilities are instrumental in facilitating the technological innovation necessary to sustain economic competitiveness and ensure long-term growth. By bridging scientific discovery and practical applications, and translating knowledge into competitive products and services, engineering helps ensure that companies are able to capitalize on innovations as they emerge.

It is in the cultivation of an innovation-driven, production-oriented engineering culture that the U.S. has fallen behind. When compared to key manufacturing competitor nations such as Germany, Japan, and South Korea, the U.S. produces far fewer bachelor's degrees in engineering. What is more, the U.S. produces fewer engineering bachelor's degrees than it did in 1986. Meanwhile, engineering departments at most major U.S. universities have shifted to a "science-based" model of engineering, which focuses more on publishing abstract scholarly papers than on working with private-sector firms to solve real-world problems. And compared with institutions of higher education in nations such as Germany, U.S. engineering departments work much less closely with industry, including in the training of engineers through work-based learning opportunities.

If the United States wants to win in the advanced manufacturing economy of tomorrow, it must transform its university engineering system away from its "research for the sake of research and knowledge accumulation" approach and align it much more with the knowledge needs of manufacturers in America.

Proposal

Given these challenges, the Information Technology and Innovation Foundation and the Metropolitan Policy Program at Brookings propose that the federal government support the **designation of a core of approximately 20 leading "Manufacturing Universities."** As part of this designation, academic institutions would receive an annual award from the National Science Foundation, ideally at least $25 million per year, plus prioritization of their other applications in the awarding of National Science Foundation (NSF) grants.

Designated universities would have several responsibilities. First, they would be required to revamp their engineering programs much more around manufacturing engineering, with particular emphasis on work that is relevant to industry. This would include more joint industry-university research projects; more training of students that incorporates manufacturing experiences through cooperative education or other programs; and a Ph.D. program focused on turning out more engineering Ph.D.s who would work in industry. These universities would view doctoral training as akin to high-level apprenticeships (as is often the case in Germany) and would not allow the conferral of a Ph.D. unless one has done some work in industry. Likewise, criteria for faculty tenure would consider professors' work with and/or in industry equally as much as their number of scholarly journal publications. In addition, their business schools would focus on manufacturing issues, including management of production, and integrate closely with the engineering program. One can imagine a number of leading engineering universities—Caltech, Carnegie Mellon, Georgia Tech, Lehigh, the Massachusetts Institute of Technology (MIT), Michigan, Purdue, Stanford, and others—readily transforming themselves to embrace this designation.

One possible model (albeit on a small scale) is the Olin College of Engineering in Massachusetts, which reimagined its engineering education and curriculum to prepare students "to become exemplary engineering innovators who recognize needs, design solutions, and engage in creative enterprises for the good of the world." Olin's results have been impressive. Its new method of teaching engineering has been widely praised among engineering firms, and, on a per-student-graduated basis, Olin graduates start more new businesses than MIT graduates. Olin is a one good model for how the United States can transform its universities into entrepreneurial factories while encouraging the development of completely new schools based on the needs of the current workforce.

These Manufacturing Universities would complement, not duplicate, any national manufacturing institutes established under proposed legislation to create a National Network of Manufacturing Innovation (NNMI). The NNMI institutes would be private-sector led and, while affiliated with universities, would not attempt to change how university engineering programs function. In contrast, the Manufacturing Universities proposal would work to ensure that universities themselves function in ways that are more supportive of the U.S. manufacturing economy.

Budget Implications

At a budget of $25 million per institution, with 20 designated universities, the annual budget for this proposal would be $500 million per year. Funding could come from any increases in overall federal R&D funding. Such funding is needed given the fact that if federal R&D funding had grown at the same rate since the late 1980s as it had in prior years, it would be $110 billion per year more than current levels. If Congress desired this to be done in a budget-neutral way, it could require the National Science

Foundation to fund this program out of existing funding, with the requirement that state and metropolitan area governments match the funding dollar for dollar (requiring a net of $250 million in federal funding).

State of Play

This is a brand new proposal, so it has yet to enter the political discourse. However, unless the proposal comes with new monies attached, the higher education community would likely oppose the initiative, seeing it as taking funds away from what they see as the university's true mission of basic, curiosity- and principal investigator-directed research and Ph.D. training of future faculty members.

Implementation Requirements

Legislative action would be required to establish the Manufacturing University initiative.

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Remaking Federalism | Renewing the Economy

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