March 7, 2018

Mr. Ted Wackler
Deputy Chief of Staff and Assistant Director
Office of Science and Technology Policy
The White House
Washington, DC

Dear Mr. Wackler:

I am writing in response to the request for information (RFI) published in the February 5, 2018 Federal Register relating to the National Strategic Plan for Advanced Manufacturing.

Public Law 113–235 directs the National Science and Technology Council (NSTC) to develop and update, in coordination with the National Economic Council, a strategic plan to improve government coordination and provide long-term guidance for federal programs and activities in support of US manufacturing competitiveness, including advanced manufacturing research and development (R&D). According to the RFI and pursuant to this statutory requirement, NSTC seeks to develop a National Strategic Plan for Advanced Manufacturing (i.e., the Plan) that will "create jobs, grow the economy across multiple industrial sectors, strengthen national security, and improve healthcare."

The following response represents my own views and not that of Indiana University nor the School of Public and Environmental Affairs.

The Importance of Domestic Manufacturing to the Nation

Before answering the questions posed in the RFI, it is first necessary to characterize the US manufacturing sector, which I undertake in this section.

The United States is a leading manufacturing country. According to a recently published report from the Congressional Research Service,¹ the US ranks second in manufacturing value added (behind China), fourth in value added per capita (Germany is #1, China is #10), tied for first (with Japan) in domestic value of exports of manufactured goods, and second in R&D spending (behind China).

According to the Bureau of Labor Statistics, the US manufacturing sector employs more than 12.5 million people (or 8.5% of the workforce). Average compensation per worker is relatively high (due to historically high labor productivity), which is why the sector

has been and remains a gateway to the middle class for millions of Americans who lack a traditional, four-year college degree.

Domestic manufacturing generates 12% of nominal GDP, a figure that has declined over time from its high of 28% in 1953. As a share of real GDP, however, manufacturing has remained relatively steady for decades because productivity in manufacturing is greater than that of the overall economy, although it has declined slightly since the Great Recession.3

Manufacturing has a significant impact on national productivity trends. In particular, manufacturing is the engine for US productivity growth, which is the main determinant of rising living standards.4

Manufacturing also has a positive impact on national security because a strong industrial defense base is critical in times of war, a fact understood by every US president5.

Not all “spillovers” from manufacturing are positive, however. For example, despite significant reductions in its pollution intensity over decades (due primarily to regulation),6 the domestic manufacturing sector remains a major source of pollution, contributing, for example, 21% to national GHG emissions in 2015.7

Questions To Inform Development of the Plan

The remainder of this document addresses a subset of the questions posed in the RFI. I have skipped question 3 as it is best directed to engineers or others with extensive knowledge of a wide variety of advanced manufacturing technologies and techniques.

Q1. In priority order, what should be the near-term and long-term objectives for advanced manufacturing, including R&D objectives, and the anticipated time frame for achieving the objectives, and the metrics for use in assessing progress toward the objectives?

A: The overall goal ought to be to increase productivity growth, as it will be the major determinant of economic growth (and rising living standards) in the coming years.

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5 As Secretary of Treasury for George Washington, Alexander Hamilton underscored the importance of manufacturing to national security in a 1791 report to Congress. In recent years, the Department of Defense issues an annual assessment of the defense industrial base. In 2017, President Trump issued an executive order requiring a top to bottom review of the defense industrial base; a report is due to be released by April 2018.
7 Source: US Environmental Protection Agency.
Manufacturing has been and remains the leading driver of national productivity trends (positive and negative), and currently productivity growth is at a historically low level, reflecting the sluggish performance of manufacturing (with the possible exception of the computers and electronics subsector, where quality-adjusted productivity has been steadily increasing in accordance with Moore’s law).8

Policy makers could leverage manufacturing to achieve national economic objectives. For example, the current Administration aims for 3% annual growth in GDP. Because GDP is a product of labor productivity and the size of the labor force, and the labor force is not expected to grow in the foreseeable future, GDP growth must come from gains in labor productivity. Manufacturing, as the leading driver of labor productivity growth, is therefore key to meeting a 3% economic growth objective. This involves dual strategies – increasing productivity in manufacturing and maintaining or even increasing the share of the economy accounted for by manufacturing.

Short- and long-term objectives could be geared toward elevating the USA into a leadership position with respect to value-add (i.e., as a percentage of global value add in manufactured goods). Specifically, the USA could focus on relatively knowledge-intensive products, building on the country’s comparative advantage.

It is important to note that while R&D is an important driver of innovation, there are other ways to advance productivity, such as providing greater incentives for capital investment by manufacturers in known productivity-enhancing technologies. For example, the recently enacted tax reform law lowered the cost of capital investment for domestic manufacturers and can be expected to boost productivity over time.

Q2. How can Federal agencies and federally funded R&D centers supporting advanced manufacturing R&D foster the transfer of R&D results into new manufacturing technologies and United States-based manufacturing of new products and processes for the benefit of society to ensure national, energy, and economic security? What role can public-private partnerships play, and how should they be structured for maximum impact?

A: The government can and should play a role in bridging the so-called “valley of death” between basic R&D and innovative activity. There is strong evidence that the private sector alone will not invest sufficiently to bridge this divide, especially in areas of advanced technology where innovation has become extremely resource-intensive, such as in the development of semiconductors.9

One relatively new federal program, Manufacturing USA, aims to boost R&D in manufacturing through partnerships among federal agencies, the private sector, and academia. Fourteen such institutes are up and running; more are in the queue. The statutory authority for this $1 billion program lasts just five years.

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The one program evaluation conducted to date on Manufacturing USA shows that the program is exceeding its goal for attracting private sector investment, and that many (but not all) of the institutes have garnered a large number of partners and collaborators. To date, no evaluation has been published as to its impact on innovation and productivity. This is not surprising given the program’s young age and the fact that there is often a significant lag between the development of new technologies and its widespread adoption.

There is a body of academic literature on entrepreneurial ecosystems, which suggests that public-private partnerships, including collaboration with institutions of higher education, have and can boost innovation in the manufacturing sector. Lessons learned from such academic research can and should be applied to Manufacturing USA and other efforts to increase innovation and productivity.

Q4. How can such Federal agencies and centers develop and strengthen all levels of manufacturing education and training programs to ensure an adequate, well-trained US workforce for the new advanced manufacturing jobs of the future?

A: The top issue for domestic manufacturers nationwide is the so-called “skills gap”. Manufacturers cannot find the skilled production workers they need. This issue has been growing in importance since the Great Recession. There are several factors that together have led to this problem: the historically low labor force participation rate; the low unemployment rate which limits the availability of workers; a cultural emphasis away from vocational education; and the ongoing retirement of highly skilled baby boomers.

There is also uncertainty over the skills gap. Is this a structural or cyclical problem? If it is cyclical, government intervention may not be needed. If applicants lack needed skills, what exactly are the skills that are needed? Are these educational skills (i.e., obtained through the public education system), occupational skills (i.e., obtained through trade schools or by employers), or employability skills (e.g., having a strong work ethic, being a team player)? Any policy prescription ought to be informed by answers to such questions.

One popular solution is to promote and expand apprenticeship programs. An apprenticeship is a unique form of workforce training, combining on-the-job training under the supervision of seasoned professionals with classroom instruction over a defined period, usually leading to some sort of certification and a full-time job opportunity. Importantly, apprenticeships address each of the three skill sets that are thought to be deficient (educational skills, occupational skills, and soft skills).

It is important to note that employers—not the government—must take the lead in addressing the skills gap. Manufacturers are in the best position to know which workforce skills they need and to assess the adequacy of their current and future

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training. And they are doing this by working in partnership with local educational institutions (public schools, community colleges, trade schools), with other manufacturers, and with community economic development officials.

Government (federal, state, and local) can help by (1) shifting resources for higher education from traditional, four-year colleges and universities to vocational education and apprenticeships; (2) undertaking a retrospective review of federal and state regulations for registered apprenticeship programs to determine if they should be modernized or updated; and (3) encouraging high-quality non-registered apprenticeship (or work-and-learn) programs for those who prefer to avoid government registration.

It is also critical that the federal government consider carefully any changes to immigration policy. Changes should be made only after careful consideration of the impact on the manufacturing sector.

Q5. How can such federal agencies and centers assist small- and medium-sized manufacturers in developing and implementing new products and processes?

A: Social research into the sluggish productivity growth seen in the US and in other developed countries has discovered some important trends. Namely, (1) that productivity growth varies widely across firms within a narrowly defined manufacturing subsector, (2) while the frontier firms are increasing productivity significantly, the laggards (firms at the bottom end of the distribution) are failing to catch up to frontier firms as quickly as they used to, and (3) market share is not shifting as quickly as it used to shift from low-productivity firms to high-productivity firms.

These findings (applicable to manufacturers but also to the service sector) suggest that productivity can best be enhanced by boosting the productivity of laggard firms (as opposed to policies that boost the productivity of frontier firms). Therefore, it is appropriate and necessary for the Plan to focus on the least productive firms—either by increasing their productivity or by creating an environment where more productive firms can replace them or take their market share.

More research is needed to plot the best path forward. However, it seems wholly appropriate for the Plan to bolster the one federal program that exists to improve the productivity of small- and medium-sized manufacturers: the Manufacturing Extension Program (MEP).

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Registered apprenticeship programs are known to have positive employment and earnings outcomes for participants, according to a federal agency review of job training programs. A 2007 survey of registered programs found that most sponsored programs have been around for a decade or longer, most sponsors would recommend federal registration to others, and poaching by other firms is not perceived to be a serious problem. See Lerman, R., Hyster, L. and Chambers, K. 2009. “The Benefits and Challenges of Registered Apprenticeship: The Sponsors’ Perspective.” Washington, DC: The Urban Institute.
There is some evidence that the MEP program works. A recent program evaluation of
the MEP found that it increases productivity of the smallest manufacturers in the
durable goods sector. This research can and should be extended to MEP programs at
the state level as each state has crafted a program to best serve its needs.

Q6. How would you assess the state of the following factors and how they impact
innovation and competitiveness for the United States advanced manufacturing?

(a) technology transfer and commercialization activities,
(b) the adequacy of the national security industrial base,
(c) the capabilities of the domestic manufacturing workforce,
(d) export opportunities and trade policies,
(e) financing, investment, and taxation policies and practices;
(f) federal regulations;
(g) emerging technologies and markets,
(h) advanced manufacturing research and development undertaken by competing
countries, and
(i) the capability of the manufacturing workforce of competing nations.

A: Looking down this list, I would suggest that the most critical items to address in the
Plan include (a) technology transfer and commercialization (to boost productivity by
"frontier" firms), especially for knowledge-intensive products; (e) incentives for
productivity-enhancing investment (to boost productivity by all firms, including the
"laggards"); (c) the quality of the domestic workforce (to address the skills gap); and (h)
intelligence on industrial policy in other countries (to inform revisions to the Plan).

The other items listed are also important, but are not as critical as these four elements if
the goal is to boost productivity of the US manufacturing sector.

Q7. Is there any additional information related to advanced manufacturing in the United
States, not requested above, that you believe OSTP should consider?

A: Given the way the questions in this RFI are formulated, the focus of the Plan appears
to be on the positive economic spillovers from manufacturing. It is, however, just as
important to consider negative spillovers and the human dimension to an ever-evolving
manufacturing sector. For example, if the manufacturing sector rapidly increases its
productivity through investment in new technologies (such as AI and the Industrial
Internet of Things), there could be significant negative impacts in terms of displaced
workers and local economic development. The Plan should include steps that the nation

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12 Clifford A. Lipscomb, Jan Youtie, Philip Shapira, Sanjay Arora, and Andy Krause, 2018. Evaluating the
Impact of Manufacturing Extension Services on Establishment Performance, *Economic Development
can and should take today to minimize the negative impacts and maximize the positive impacts of modern manufacturing—on workers, on the environment, and on communities. At a minimum, the Plan should allocate (1) a small portion of federal resources toward social research and policy analysis designed to make the country (including workers and communities) more resilient in the wake of rapid change in the manufacturing sector and (2) a larger portion of federal resources toward activities that enhance resiliency (e.g., by modernizing the social safety net for displaced workers) as a result of this research. Such an allocation of resources is best viewed as an insurance policy; something that may not be needed (e.g., if the rate of change in manufacturing is slow) but is prudent to have, just in case.

Conclusion

A National Plan for Advanced Manufacturing is justified given the importance of this sector to the nation, the positive and negative spillovers from domestic manufacturing, and the ever-evolving nature of 21st century manufacturing. Central to the Plan should be a focus on boosting productivity growth through (1) pre-commercial R&D and (2) appropriate incentives to boost productivity-enhancing investments by manufacturers. Two federal programs—Manufacturing USA and the Manufacturing Extension Partnership (MEP)—should be a part of the Plan, as should policies to expand apprenticeship programs to ensure a pipeline of skilled production workers. As part of the Plan, the federal government should allocate a small portion of available funding for social research on resiliency with respect to displaced workers and communities potentially harmed by rapid technological change in manufacturing.

Thank you for the opportunity to respond to this request.

Sincerely,

Keith B. Belton
Director, Manufacturing Policy Initiative