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Letting Rocket Scientists Be Rocket Scientists: A New Model to Help Hardware Startups Scale

For hardware startup companies, growth can be dangerous. Scaling up production, coupled with expanding physical space to meet quickly rising production targets, is a challenge unique to companies that make complex physical objects, such as solid rocket motors or lithium-ion batteries. For hardware companies supplying products to the defense and space industries, the squeeze is often more severe, exacerbated by the difficulty of obtaining the appropriate infrastructure for testing, prototyping, and manufacturing. This has real consequences for national security.

Consider the recent experience of a dual-use military and commercial robotics company in Texas. Rapid growth in demand from customers caused the company to expand so quickly that it needed to relocate three times in just three years. With each move, the company had to break lease agreements, pay substantial moving costs, and relocate heavy and difficult-to-calibrate pieces of machinery—all while navigating multiple disruptions to its production process.

Hardware startups face different challenges from those for software or other industries; typically, they require long lead times to ensure robust development and significant capital investment to demonstrate market potential, making emerging companies less attractive to both potential investors and commercial landlords. In 2017, CB Insights looked at nearly 400 consumer hardware startups and found that they were half as likely to raise second-round funding as tech companies in general; by their fifth

year, 97% had failed. New strategies are needed if we want to see more promising hardware companies succeed and reach their market potential.

The American Center for Manufacturing & Innovation (ACMI), where I am founder and CEO, is advancing a new industry campus-based model to minimize risk in the process of hardware scaling and help small businesses in critical industries establish secure supply chains within the United States. Our model aims to reduce hardware companies' growing pains by building campuses where they and other members of their supply chain can grow together. Since 2022, we've been working with the Department of Defense (DOD) to overcome systemic barriers facing hardware startups with an eye toward maintaining a resilient and secure defense manufacturing ecosystem.

The goal of ACMI's campus model, in essence, is to free up rocket scientists to be rocket scientists, rather than burdening them with other business tasks. Recently, we met with a solid rocket motor manufacturer that had struggled to acquire real estate for production facilities. That company finally resorted to selling equity in the business—an unwise move because unlevered returns for real estate development (the return a property investment produces for its owner if funded solely with equity) are roughly 70% less than the returns typically demanded by startup company investors. Subsequently, the chief technology officer (CTO), a rocket engineer, was assigned to manage the development project, an area in which he had little experience. This situation exemplifies a typical predicament for companies at this

stage, struggling with how to make the best use of scarce resources. With ACMI's campus model, we could have helped the company find the right space while freeing its CTO to focus on rocket design and engineering.

Startups play a crucial role in security and defense supply chains

The DOD has long recognized the vital role of small business as a driver of innovation. In the wake of pandemic-driven supply chain disruptions, and in the face of escalating cybersecurity threats and active warfare in many parts of the world, helping small businesses in the defense sector bridge supply chain gaps and accelerate the deployment of new and innovative technology has become a major national security concern.

Since February 2022, Heidi Shyu, the under secretary of defense for research and engineering, has been focusing resources on creating a resilient defense industrial ecosystem. This strategy can help startups cross the divide from development to deployment in critical technologies, including advanced engineering materials, clean energy

across this network. In addition to the well-established and competitive Rapid Innovation Fund, DOD created the Rapid Defense Experimentation Reserve, a collaborative effort among military branches, industry, combatant commands, and joint partners to promote experimentation in new technologies to fill joint warfighting capability gaps. Another pilot program, called Accelerate the Procurement and Fielding of Innovative Technologies (APFIT), seeks to help companies that are developing innovative defense hardware and technology—especially small businesses and nontraditional defense contractors—fast-track development, production, and delivery.

These recently established resources, along with existing Small Business Innovation Research and Small Business Technology Transfer grants, provide a welcome amplification of government support for defense-related hardware startups. Standard technology incubator and accelerator programs are generally designed for software companies, but hardware startups face different challenges in finding the support and resources they need to scale up once they outgrow these programs. Government-funded programs can contain

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generation and storage, biotechnologies, semiconductors and microelectronics, directed energy, hypersonics, and space technologies and systems. The ecosystem approach is rooted in the recognition that early-stage technology development must be accompanied by investing in manufacturing and deploying new technology at scale.

In March 2023, William LaPlante, under secretary of defense for acquisition and sustainment, emphasized the need to help companies achieve production scale in a statement to the House Armed Services Subcommittee on Cyber, Innovative Technologies, and Information Systems: “A paradigm shift is required: we have traditionally thought about ‘innovation in technology’ whereas now we must think about innovation not only in prototyping but also in development and production as well. This means rethinking the intersection of traditional design and manufacturing phases; the more we can collapse the two together, the more successful we’ll be in accelerating capability delivery at scale.”

In December 2022, the DOD established the Office of Strategic Capital to facilitate connections between the DOD and companies developing critical technologies with national security applications and to align funding sources

bureaucratic hurdles that limit innovation and extend timelines. For example, the Department of Energy’s Seeding Critical Advances for Leading Energy Technologies with Untapped Potential (SCALEUP) program has a requirement for companies to surrender some of their intellectual property rights, which can be a significant barrier for innovators who are also seeking commercial applications for their technology.

Amid renewed national focus on the innovation ecosystem, ACMI grew out of my 20-year career in financial services, where I recognized the enormous need for infrastructure and capital investment in the hardware sector. Later, I started a high-precision hardware company to address an unmet need in the specialty vehicle and motorsports industry, an enterprise that provided me with firsthand experience of the challenges of bringing a new hardware product to market.

ACMI, through three affiliated companies, is working to create a holistic solution where hardware companies can grow. ACMI Federal, which is focused on managing government programs, supports the domestic supply chain and innovative commercial companies that seek to work with the federal government. ACMI Capital, which invests in early-stage companies, provides private investment and guidance

to hardware technology companies during the critical period when they are scaling up. The third affiliate, ACMI Properties, develops shared industry campuses, providing a manufacturing-suitable scaling-up space—a foundational service for start-ups requiring shared infrastructure to foster innovation.

The industry campus model

At ACMI, we developed our industry campus model to bring together startup company tenants within a specific sector to share specialty infrastructure, be near their large corporate counterparts, and have access to facilities that are scalable and adaptable to their needs. Niche industry startups often require specialized spaces, which demand capital investment. Scale-up and production then require even more capital and expertise. Co-locating startups within a dynamic ecosystem that includes established manufacturers, technical experts, service providers, and other companies creates natural connection points for collaboration, joint ventures, rapid growth, and acquisitions. The campus model provides the benefits of vertical integration and efficient use of resources without losing specialization.

ACMI's first DOD contract, in 2022, was for the Critical Chemical Pilot Program, which sought to generate a domestic manufacturing base for chemicals needed for munitions manufacturing. The two-year program, funded through the Defense Production Act Title III Program, aimed to use DOD funding to leverage private capital at a 10-to-1 ratio to support the effort. In October 2023, ACMI was awarded an extension of the program. The extension noted that the project had a private-to-public funding ratio of 16 to 1 and that we anticipate eventually reaching a ratio of 25 to 1. In the pilot extension, ACMI will expand the number of chemicals and add new academic and commercial partners to the team.

During the extension, we intend to build upon our successes with domestic production of critical chemicals in the initial pilot program. For example, we worked with a commercial chemical company to produce a key chemical that has not been available domestically in nearly two decades. In another example, we worked to support the certification of a lower-cost, commercially available material for use in place of one that met military specifications but was not available domestically. And finally, we worked with a company on process innovation to enable future domestic production of several critical chemicals with fewer waste products.

Building on our experience with critical chemicals, ACMI is branching out with two new campuses to help hardware companies bridge the gap between traditional incubator or accelerator programs and full production scale. In September 2023, ACMI was awarded, in a

competitive process, a \$75 million contract by the Office of the Deputy Assistant Secretary of Defense for Industrial Base Resilience through its Manufacturing Capability Expansion and Investment Prioritization office to establish a state-of-the-art munitions campus to foster innovation clusters in support of companies specializing in production at different points in the domestic supply chain. We are also working to develop a space systems campus to support commercial businesses in the space economy in NASA's Exploration Park in Houston. In addition to the support of startups, we intend to make these campuses attractive places for workforce development of specialized talent and powerful engines for regional economic growth.

Establishing a vibrant manufacturing ecosystem

ACMI's industry campus model aims to provide emerging companies with the structure and support they need to achieve production scale. Instead of focusing on individual companies and innovators one at a time, our regional hubs have the potential to move an entire industry forward. The intention of ACMI industry campuses is to act as a force multiplier, accelerating growth for individual companies and maximizing the impact of both private and government investment while also spurring job creation and economic development.

The US innovation ecosystem is a vibrant cauldron. Harnessing its energy—and mitigating its risks—requires strategic, operational, and financial expertise as well as a high degree of collaboration. Although some nations rely on substantial government funding for technological innovation, as seen in the East Asian chip industry, the campus model leverages modest federal funds to gain a more sizable investment from aligned private capital sources. By taking advantage of these uniquely American, market-driven resources, ACMI is establishing new ways to efficiently transition critical technologies from laboratories to end users. This approach aims to rebuild the US industrial base organically by cultivating a dynamic, domestic defense manufacturing ecosystem.

Although ACMI's initial award successes have primarily revolved around DOD priorities, the versatility and benefits of the industry campus model may prove to be fruitfully applied to more commercially oriented hardware industries. Numerous hardware innovations have applications in both the defense and commercial realms. Facilitating the introduction of these innovations not only enables the DOD to maintain its technological superiority in critical sectors, but also lays the foundation for a broader commercial manufacturing renaissance—and subsequent economic growth—in the United States.

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