

OEA Support for Defense Supply Chains: Rationale and Lessons Learned

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Introduction

The Department of Defense's Office of Economic Adjustment (OEA) has long had a mission of building closer military-community partnerships. This mission drives all OEA's program components, but it is especially critical for the Industry Resilience (IR) program, which focuses on developing a more resilient and competitive defense industrial base. In the past, most IR program investments targeted large prime contractors and their surrounding communities, investing to build enhanced infrastructure or to support community planning when plants were closed or major military contract reductions were announced.

This work continues today, but the program has evolved to reflect the new realities of the defense industrial base. Today's defense industry is driven by supply chains that often span thousands of companies and engage numerous communities around the US. Understanding the new defense industrial reality is a complex undertaking, given advances in new technologies, imperatives to provide cybersecurity protections, and the diffused nature of threats from adversaries around the world. OEA's IR program has responded to this need by making major investments to 1) help state and community leaders and economic development organization (EDOs) understand the location, composition, and needs of defense industry suppliers, 2) analyze and leverage this information to inform private sector strategies to take advantage of opportunities and mitigate risks, and to inform public sector efforts to link contracting needs with industry capabilities, and 3) assist defense suppliers preparing for DoD and OEM contract opportunities and adapting to new challenges such as cybersecurity and the rapid pace of technological change. Armed with this analysis, community leaders can target support programs to local businesses, upskill and retrain local workers, and develop a rapid response system to help at-risk companies and communities.

Because of the importance of the defense industrial base and strong supply chains to our national security and state and local economies, OEA has developed this guide to inform state and local efforts for working with defense industry supply chains. It is divided into four sections: Background on Supply Chains, Gathering Market Intelligence on Supply Chains, Data Sharing and Application, Services to Strengthen the Defense Supply Chain, and Common Themes and Challenges. It offers real-life lessons learned from the experience of dozens of OEA grantees. It provides background on how and why supply chains matter, along with tips on what to do and what not to do. It is designed to help communities and states build a stronger, more resilient, and more ready local defense industrial base.

Background on Supply Chains

For the past 20-30 years, global manufacturing and production has been organized around a series of global supply chains that vary based on individual businesses, industries, and regions. Global supply chains can now be considered the "new normal" for many industries, but their emergence represented a true innovation in industrial organization. For most of the 20th century, firms operated via a hierarchical model of vertical integration. Ford's production of the Model T automobile is the paradigm of this model, where the entire vehicle, and all its components, are produced and assembled under one roof by one company.

This management model is a thing of the past. In today's world, where outsourcing and corporate specialization rule, most original equipment manufacturers (OEMs) rely on hundreds, and even thousands of outside suppliers. In some ways, they assemble more than they manufacture as they combine thousands of parts and components into a final product, such as a plane, train, or automobile. Boeing reportedly works with more than 13,600 domestic suppliers who employ 1.3 million people, far exceeding Boeing's total in-house US employment of 137,000 people.¹ Today, around 60% of the value of a final manufactured product is derived from the work of outside suppliers as opposed to the work of the OEM.² We now operate in what some researchers refer to as "the supply chain economy."³

Figure 1: The Complexity of Boeing's Supply Chain

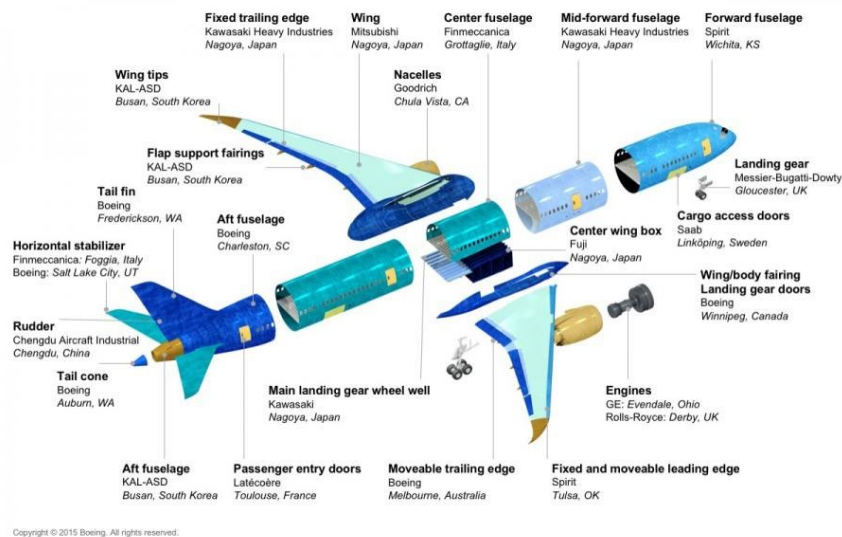


Photo credit: US Chamber of Commerce and Boeing⁴

The shift to a supply chain economy generates many benefits for businesses and consumers. Supplier specialization and economies of scale help reduce product costs and increase operating efficiencies. The new structures also open new business opportunities for many suppliers, especially small and medium-sized enterprises (SMEs). And the supply chain economy provides good jobs. According to one estimate, firms in the supply chain economy (those that primarily sell directly to other business or government) account for 37% of total US private sector employment. These jobs tend to be well-paying and utilize key skills and talents related to STEM and other disciplines.⁵

¹ "Tick Tock," *The Economist*, August 24, 2019, pp. 49-50.

² The Executive Office of the President and the Department of Commerce, *Supply Chain Innovation: Strengthening America's Small Manufacturers*, 2015, p. 5.

³ Mercedes Delgado and Karen G. Mills, "The Supply Chain Economy: A New Framework for Understanding Innovation and Services," MIT Innovation Initiative Policy Briefing, 2017.

⁴ <https://www.uschamber.com/series/above-the-fold/global-supply-chains-explained-one-graphic-0>

⁵ *Ibid.*, pp. 3-4.

While the benefits of supply chains are readily apparent, they introduce a great deal of complexity into the management process. Instead of operating “under one roof,” firms now manage far-flung supply chains with thousands of components and thousands of suppliers all contributing to a final finished product. OEMs may sometimes struggle to find qualified suppliers or to manage a complex set of logistics, distribution, and production challenges. Meanwhile, SMEs often struggle to identify business opportunities and to become integrated into supply chains. Policymakers struggle to understand supply chains and to identify pain points as they may relate to national security, workforce training, or other issues. A whole new field of supply chain management has emerged to help deal with these many risks and challenges.

Effective supply chain management matters for all industries, but it matters even more so in the defense sector where new products and technologies are highly advanced, where suppliers can be highly specialized, and where the risks of supply chain disruption are more pronounced. Like other manufacturing sectors, the defense industry has operated via this supply chain model for decades. Major systems production is highly concentrated in a few major OEMs, and these companies are supplied by thousands of subcontractors and SMEs. The current American defense industrial base is complex marketplace. As a 2018 US Department of Defense (DoD) report defined it:

“America’s manufacturing and defense industrial base consists of the end-to-end set of capabilities, both private and public, that design, produce, and maintain the platforms and systems (hardware and software) on which our Warfighter depends. With an extensive, multi-tiered global supply chain, the industrial base encompasses the extraction and refinement of primary materials, the manufacturing of components and parts, and the integration and sustainment of defense platforms and systems. It relies on a geographically and economically diverse network of private sector companies, R&D organizations, academic institutions, and government-owned facilities to develop and produce the technologies enabling U.S. military dominance and ensuring national security.”⁶

Faced with this diverse set of supply chain players, defense officials face a host of potential issues as they seek to address two primary objectives: 1) To provide the warfighter with state-of-the-art equipment, services, and technologies in a timely, efficient, and effective manner, and 2) To understand the supplier base and ensure that it is secure, efficient, and competitive. Current DoD leaders argue that the US defense industrial base faces an “unprecedented set of challenges,” and have created a host of new strategies and programs to help bolster local industry. The Office of Economic Adjustment’s (OEA) Industry Resilience (IR) programs are an important component of this response.

For the Department of Defense, supply chain policies and programs should support the mission of “Meet(ing) readiness goals with acceptable risk with minimum total supply chain cost.”⁷ As such, the

⁶ *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States*. Report to President Donald J. Trump from the Interagency Task Force in Fulfillment of Executive Order 13806, September 2018, p. 15.

⁷ Eric Peltz, Marc Robbins, with Geoffrey McGovern, *Integrating the Department of Defense Supply Chain*, RAND Corporation Technical Report, 2012, p. 27.

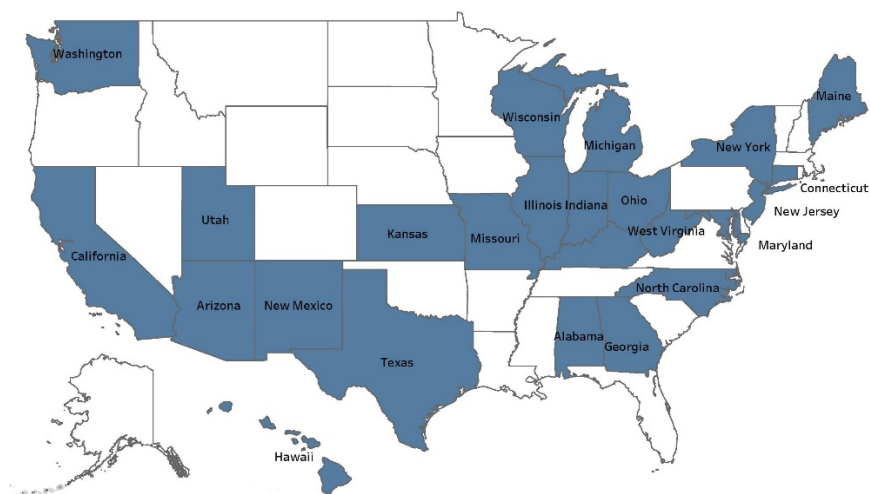
military services seek to work with industry partners that can provide advanced technologies and systems that support a ready, lethal, and resilient military force.

Community leaders can and should support these objectives as well. They can do so by developing a comprehensive understanding of their local defense industrial base, and by investing in programs and projects that help local firms to become more competitive and more resilient.

Meeting these community goals can be challenging due to the complexity of the defense supply chain marketplace. It can be very difficult to obtain good updated information on local defense firms. DoD buys everything from consumer goods to weapons systems, so DoD contractors operate in almost every industry. They cannot simply be identified as part of an industry cluster or a specific industry classification code. As noted above, these companies operate in complex global supply chains where a given weapons systems program may have thousands of suppliers and partners located around the US and around the globe. The defense industrial base contains many “tiers” of suppliers. Tracking prime contractors is fairly straightforward but identifying their suppliers and their suppliers’ suppliers (the 2nd, 3rd and 4th tiers of the defense industrial base) is complicated. These tiers are not always fixed in place; the same company may operate at different levels in the supply chains for different products and customers. For example, large prime contractors can sometimes operate as lower-tier suppliers, and small firms often operate as prime contractors as well. Finally, many defense contractors operate in both commercial and defense sectors, and it can be challenging to isolate and understand various business components.

Gathering Market Intelligence on Supply Chains

Figure 2: States Engaged in Supply Chain Mapping



Because of these challenges, the Office of Economic Adjustment’s Industry Resilience program has made a series of investments to help communities map their local defense supply chains. OEA’s Industry Resilience grants are designed to support the key objectives noted earlier: building a more resilient local industrial base and strengthening important DoD-community partnerships. More than 25 states and

regions have utilized OEA IR funds to support supply chain mapping projects. For the first time, this work has provided key insights into strengths and weaknesses in the local defense industrial base, and tens of thousands of local defense suppliers have been identified and mapped. These insights are helpful for research and analysis, but they lead to improved business services as well. Thanks to supply chain mapping research, IR grantees have provided assessments and assistance to more than 2,100 small defense suppliers around the US.

Via supply chain mapping, economic development organizations gather and analyze data on the local defense industry and its connections to key contracts and global supply chains. They then use this data to enhance program design and to understand the local economic impacts of defense activities. We dig deeper into supply chain mapping and related business support programs in the chapters that follow.

Supply Chain Mapping 101

The OEA IR program made its first supply chain mapping grants beginning in 2014. At that time, defense budgets were hard-hit by budget sequestration, and contractors (and their surrounding communities) were struggling to understand the potential impact of major contract reductions and cancellations. At this point, several defense-dependent states, such as Virginia, Maryland, and Connecticut, approached OEA to support development of data tools that would help them understand their defense sectors and to forecast the impacts of budget sequestration.

Budget sequestration served as an initial driver of local supply chain mapping efforts, but communities have embraced these efforts for many reasons. Defense supply chain mapping helps localities in many ways, including:

- Helps identify suppliers and sectors at risk in the event of a company or plant closure;
- Reveals potential new markets for existing firms;
- Provides insights about local gaps in the supply chain where an Original Equipment Manufacturer (OEM) can substitute local companies for overseas suppliers;
- Helps state, local and regional policy makers determine which existing assets can best respond to supply chain issues; and
- Supports Department of Defense (DOD) efforts to better understand the national defense industry supply chain infrastructure - to maintain readiness in the U.S. manufacturing and defense industrial base and supply chains that is also capable to surge in response to an emergency.

Via defense supply chain mapping, economic development organizations gain critical market intelligence and a deeper understanding of the local defense industrial base. Armed with this information, EDOs can create new support programs or refine existing efforts to support the specific needs of those within the industrial base. And, they can also identify new market opportunities for existing defense suppliers or introduce other local businesses to the world of defense contracting. This work is already generating significant bottom-line benefits for many OEA grantees. Grantees reported that supply chain mapping increased local awareness of the defense industrial base, improved understanding of the industry for

service providers, connected defense suppliers and improved defense supplier's ability to obtain contracts.

Thanks in part to services provided as a result of supply chain mapping, over 2100 small defense suppliers retained more than 14,000 jobs and experienced over \$188 million in new commercial sales and \$20 million in new government or DoD contracts. Services provided to these companies helped grow small defense suppliers. Defense suppliers that received supply chain services reported the creation of 1,000 new jobs and \$14 million in new private investment, leading to \$2 million in product development by defense suppliers.

Many EDOs have experience in gathering and using commercial business data, but very few have deep expertise in understanding the defense sector. Defense contractors operate in a unique environment. They develop and supply complex advanced technologies, and often perform classified or sensitive work. As a result, they often maintain a low profile in their communities. The business of defense contracting is also unique. It is heavily regulated and operates via its own unique business practices and procedures. And, as noted earlier, the industry is quite diverse. Defense contractors exist in numerous industry sectors, and, in many cases, their only common attribute is that they all count DoD as a customer.

These unique characteristics complicate the supply chain mapping process. In many commercial industries, an industry cluster or supply chain mapping effort can be built by identifying key industry codes for target sectors---utilizing the North American Industry Classification System (NAICS). Analysts identify target industries by NAICS code and can then use the code to easily gather data on industry trends. This process may work for some defense unique sectors, such as ammunition manufacturing (NAICS 332993) or operating a naval shipyard (NAICS 336611). Yet, most defense sectors include both commercial and defense operations. Examples include aerospace products and manufacturing (NAICS 33641) or radio television broadcast and wireless communication equipment (NAICS 334220). In these latter cases, a sizable share of the sector serves DoD, but the NAICS classification includes many commercial firms as well.

Because of complexities, defense supply chain mapping is more an art than a science. It typically requires data gathering from industry data sets (using NAICS codes and other tools), government spending data (such as [USASpending.gov](https://www.usaspending.gov)), and on the ground data-gathering to identify other firms, especially SMEs, who may do business with the government. We now turn to the implementation process: what are the best ways to do defense supply chain mapping?

How to Do Defense Supply Chain Mapping

The process of defense industry supply chain mapping entails several key steps:

- 1) Define the Goals: Why are we doing defense supply chain mapping? What data do we want?
- 2) Data Gathering: Where and how will we get the needed information?
- 3) Outreach and Communications: How will we share our data and findings?

We further discuss each of these areas below.

Define the Goals: Why are we doing defense supply chain mapping?

As discussed above, supply chain mapping can help support numerous local policy goals. Yet, it helps greatly to specify these objectives in advance. By specifying goals, we can streamline the data collection process and develop better performance metrics to track later progress. At this point, program managers should also identify potential customers for supply chain mapping data. This list can vary, and may include economic developers, elected officials, industry, small business owners, or academic researchers. To maximize effectiveness, the supply chain mapping effort should address the potential value proposition for all targeted customer or user groups. For example, if the mapping effort views small business as a core customer, the data sets should include information on new contract, business development, or partnership opportunities. If workforce developers are viewed as a core customer, data on workforce gaps and job qualifications should be highlighted.

Project metrics development should follow a similar pattern where metrics align with key customer needs and program goals. If a primary goal is increasing public awareness, data on website users and media coverage makes sense. If business matchmaking is a key goal, data on how businesses use and benefit from supply chain mapping will be required.

Data Gathering: Where and how will we get the needed information?

Effective supply chain mapping begins with good data, so the process of data gathering and development is a critical part of the process. This work can be quite complicated, and researchers with specialized expertise are typically needed. Some OEA grantees have been able to do the data and analysis in-house. In these cases, they have often tapped university partners or researchers employed at state agencies. Other grantees have opted to use outside consultants with deeper expertise in the defense industry and relevant data sources.

Ideally, OEMs and prime contractors could share data on companies within their respective supply chains. Unfortunately, few firms are willing to share such lists as supply chain data is proprietary information and a key source of competitive advantage. As a result, analysts opt to use other data tools. Most supply chain analyses are built on three primary information sources: Public data sets like USASpending.gov, industry and trade association data sources, and direct engagement with businesses via surveys, focus groups or other means.

Figure 3: Supply Chain Mapping Data Sources and General Data Collection Methods

Supply Chain Mapping Data Sources
<ul style="list-style-type: none">• Aerospace & Defense Technology Magazine• Census.gov• Chambers of Commerce• Defense & Aerospace Competitive Intelligence Services (DACIS)• Department of Commerce• Dun & Bradstreet• Economic Development Organizations• EMSI• Federal Procurement Data System• Government Contracts Won• Hoover's• Industry Associations – e.g., National Defense Industrial Association• Interviews with Primes & other Supply Chain Businesses• System for Award Management (SAM.gov)• Manufacturing Extension Partnership (MEP)• Military Installations & Support Organizations• Procurement Technical Assistance Centers (PTAC)• Purdue Regional Development Center• ReferenceUSA• Small Business Development Centers (SBDC)• Small Business Search Tool – Small Business Administration (SBA)• USAspending.gov
General Data Collection Methods
<ul style="list-style-type: none">• E-Survey & Phone Survey<ul style="list-style-type: none">○ Traditional Questions○ Supply Chain Information• Public Databases• User Group & Face-to-Face Meetings• Military Installations• Proprietary Databases

Federal Data Sources

Past and current IR grantees agree that data analysis should begin with the USASpending.gov site, a free and searchable Federal government website that includes the names of entities receiving government awards, award amounts, recipient locations, and other useful information. Typically, this dataset provides a decent accounting of a region's prime contractors, i.e., those firms that directly contract with federal government agencies. However, the USASpending.gov dataset performs less well in terms of tracking other lower tier suppliers, which operate via subcontracts with the OEM or the OEM's subcontractors.

In addition to USASpending.gov, several other federal government data sources are sometimes used for supply chain mapping purposes. Some past OEA grantees have used information from the U.S. Small Business Administration to track local government contractors. In particular, listings of Small Business Innovation Research grantees can be a useful tool to identify early-stage research-focused companies. The System for Award Management (SAM) database, which lists all firms with an interest in federal government contracting, can provide additional insights. OEA's annual *Defense Spending by State* report also contains useful data for state-level analyses.

Private/Industry Data Sources

Public datasets like USASpending.gov are necessary but not sufficient to develop an effective defense supply chain map. These sources do a good job of tracking prime contracts and larger projects, but they do not provide enough information to identify all subcontractors and lower tier suppliers, or to reflect the real complexity of the local industrial base. As a result, most program managers supplement federal data with other sources from trade associations, think tanks, and private data providers.

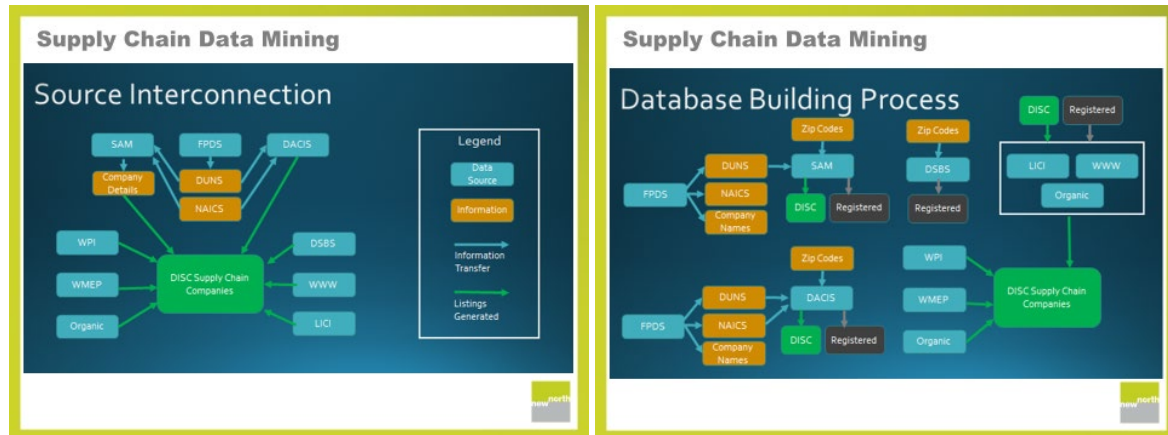
Industry associations can be a good source of insight. Groups like the National Defense Industrial Association, and military service-focused associations, like the Association of the U.S. Army or the Navy League, primarily focus on defense contractors. Other trade associations, like the National Association of Manufacturers or local Chambers of Commerce, include defense suppliers and commercial firms as well.

Industry associations can be a great resource as they have deep expertise and knowledge about local companies. However, many associations may be reluctant to freely share their membership lists and other sensitive information. Before reaching out to industry associations, program managers should be very clear about their value proposition. Why should the association collaborate with your supply chain mapping effort? What is the purpose of the exercise, and how can the mapping data provide added value to the association's membership? When association leaders and members see a win-win partnership, they will be more likely to cooperate and share information on industry trends and concerns.

Proprietary databases are a final source of information. Several websites, such as Government Contracts Won, provide information on government contractors. In addition, proprietary business information sites, such as Dun & Bradstreet, D&B Hoovers, and InfoUSA, can provide helpful business lists focused on key geographies, industries, or company types. These sites can all provide useful

information, but they also require payment, sometimes substantial amounts, for lists and datasets. They offer the benefit of timely information, and they also avoid issues related to data suppression (due to privacy concerns) that can sometimes affect federal data sources. Finally, it is important to remember that private sources may not be completely accurate and will likely require additional work to scrub company lists and related information.

Figure 4: Flow charts documenting the process and sources of information organized in Wisconsin's efforts.



Source: Wisconsin New North⁸

Direct Business Engagement

Previous OEA grantees have found that public and private data sources provide a decent amount of useful information and background material. If a community is seeking a general snapshot of the local defense sector, these sources may be enough for identifying major contractors and their primary areas of work. However, few communities are only interested in a “general snapshot.” They want to map the defense industry to identify areas of risk and opportunity. Are certain companies at risk due to potential contract reductions? Are firms poised to capture new contracts or new markets? Would local firms benefit from new or existing business support programs such as those available from the MEP program or workforce development partners? When done right, this work can support several local policy objectives, as shown in Figure 5 below.

⁸ Acronyms describing the sources include: Federal Procurement Data System (FPDS), System for Award Management (SAM), Small Business Administration Dynamic Small Business Search (DSBS), Wisconsin Manufacturing Extension Partnership (WMEP), Wisconsin Procurement Institute (WPI), Defense & Aerospace Competitive Intelligence Service (DACIS), NAICS Exports – ESRI by East Central Wisconsin Regional Planning Commission (ECWRPC).

Effective Uses of Defense Supply Chain Mapping⁹

- **Raising Awareness of the Defense Sector**
- **Promoting Economic Development Opportunities**
- **Finding Gaps in the Supply Chain**
- **Matchmaking between Companies**
- **Business Diversification**
- **Workforce Development**
- **Supporting New Policy Initiatives or Legislation**

Obtaining information to answer these questions requires more active engagement with industry. Ideally, this business engagement work starts with development of contact lists derived from public data, industry partners, and other sources.

Business engagement has proved to be a major challenge in past defense industry supply chain mapping efforts. Business owners have limited time to meet and discuss supply chain issues and may not fully understand the potential benefits of the supply chain mapping efforts. They may also be reluctant to share sensitive or proprietary information on company trends and performance. OEMs are typically unwilling to share much information on their supply chain partners and practices, as this is viewed as proprietary information. For smaller firms and subcontractors, local plant managers may not have access to this type of information.

These factors complicate the business engagement process. As a result, program managers will need to budget extra resources and time for the business engagement process. Project staff should consider numerous steps to more effectively engage local businesses and to convince them that they will benefit from a local supply chain mapping effort.

OEA grantees have offered many tips for this work. First, the project's value proposition to business must be very clear. How will a local business benefit from meeting with and sharing information with the supply chain mapping team? Benefits may vary based on location and company, but examples might include information on new business opportunities, new market intelligence, or access to business support services. Where possible, project staff should seek endorsements or introductions from trusted intermediaries, who might be managers at major OEMs, trade associations, elected officials, or staff from business support programs, like the SBDC or local MEP partners.

⁹ Based on input provided by OEA IR grantees.

Information gathering is typically done via in-person interviews, focus groups, or on-line surveys. For interviews, business managers are also more likely to meet if the supply chain mapping team has a referral or endorsement from influential local leaders, such as major prime contractors, trade associations, or other community leaders. Finally, the project team should personally visit a reasonable and representative sample of key companies, and keep meetings short, efficient, and on schedule.

Short on-line surveys, with a small group of questions, seem to be more effective. As with all survey work, active monitoring and follow-up will be needed to ensure a good response rate.

What information should be collected?

All these data gathering tools place limitations on the types and amount of data and information that can be collected in the supply chain mapping process. As such, project managers should develop a clear listing of key topics and data that should be sought in every interview or survey. This list will vary across locations, but a few common information needs do exist.

Past grantees have highlighted several categories of important information¹⁰ that should be captured in the survey and interview processes:

- Basic Company Information (Locations, NAICS Code, etc.)
- Recent Employment Trends
- Recent Revenue Trends
- Current/Past Experience with Government Contracting
- Primary Products and Outputs
- Key Suppliers/Customers
- Key Business Challenges, Pain Points, and Opportunities

This set of issues will provide the project team with a rich set of data. Some of the core information, such as company location and primary products, can be used to populate a supply chain map or other database. Meanwhile, information on key business challenges and opportunities can be used to help design new business support services or to target existing services to areas of greatest need or potential.

Effective mapping efforts are not one-time research exercises. They provide data on regular updated basis, perhaps with updates done every year. Because data gathering is time consuming and expensive, project managers should establish procedures for regular database updating. Some grantees ask companies to update their own information, while others reach out via surveys and interviews to get updates. In all cases, a plan and budget for future data updates should be developed early in your project's lifecycle.

¹⁰ Some grantees reported that firms can be reluctant to provide such information unless access to it is limited and/or it is properly secured. Of course, there is a trade-off between meeting these conditions and making the data available for market intelligence, competitive advantage, etc.

Updating supply chain data can be time consuming and expensive. Company staff may lack the time or interest in updating business data, and the costs of new surveys and outreach efforts may be prohibitive. For this reason, many OEA grantees are opting to use automated tools such as web scraping technology to capture updated information on local companies, though if source data are changed or require updating, this can still involve significant costs.

These various research methods should generate a significant—and perhaps overwhelming—amount of information. For large regions and defense industry hubs, supply chain mapping will likely identify hundreds of local contractors and suppliers. A long laundry list of companies can be a useful resource, but this list will be even more helpful when refined to focus on key targets or priority areas. These targets will vary based on one's location or the nature of the local defense industrial base. However, examples of targeting might include a focus on small suppliers, certain industry segments (e.g., machine shops), workforce issues, or identifying new markets. Supply chain mapping can provide useful data, but it is only effective and sustainable when this data is used to design and improve local development programs, and to assist local firms in becoming more competitive and profitable. Relevant examples of effective targeting are presented below.

Data Sharing and Application

Communications and Outreach: How to share Supply Chain Mapping Results

When embarking on a supply chain mapping effort, it is essential to note that this work will not sell itself. Supply chain data and resources must be presented in a compelling fashion and in formats that potential customers and partners can use. The style and format of the presentation matters greatly, but, even the most compelling information will not sell itself. A good supply chain mapping project must also be accompanied by a major outreach effort to promote the project and its results, and to engage businesses and other partners in regularly using project data, research, and website tools.

In its raw form, most supply chain information is overwhelming to companies, community leaders, and economic developers. Large lists of companies, government contracts, and other information must be scrubbed and refined for use by the public and by key customer groups. This effort should reflect the needs of core user and customer groups identified at the start of the supply chain mapping process. If small subcontractors are a core audience, the data should include detailed information on business development opportunities and connecting with prime contractors. Economic developers will be most interested in the location of defense firms and their potential plans for growth and expansion. Workforce development officials will seek information on the skill sets/job requirements of incumbent works and potential new hires. A good user interface with filtering/search and geospatial mapping capabilities are key.

Most OEA-supported supply chain mapping projects have developed a public supply chain web portal to share information on the local defense industrial base. The typical supply chain portal will include a directory of companies, often organized by industry sector, size, location, and other key factors. Sites may also list contract opportunities, provide access to government support services, and include a calendar of industry-related events. Most sites require some type of registration, which provides

additional information for the database and allows for better targeting of data and support services. Registration also enhances site moderation, so that marketing agencies and others do not misuse the database. In some cases, firms may pay small fees to list on or access the site, and these funds can be used to support data updates and maintenance.

Figure 6: The Wisconsin Supplier Network¹¹ provides access to 2,255 defense suppliers in Wisconsin



Grantees agree on key building blocks for success: Simplicity, Completeness, and Accuracy. An effective website is simple to use and to navigate. It has clear directions on how to use the site and how to find needed information.

Completeness refers to the level and depth of information provided on the website. Ideally, the supply chain project should include the same types of information on every company in the database (e.g., Name, Address, NAICS Code, Product Services Codes, etc.). Accuracy requires that data be vetted, cleaned, and updated on a regular basis. Effective supply chain projects provide information on a regular basis, as opposed to a one-time listing of local defense suppliers.

Beyond these core features, OEA IR grantees have used a variety of tools and methods as part of their on-line supply chain work. Some grantees use the database and website to provide matchmaking services, which are in high demand among smaller subcontractors. The [Georgia Defense Exchange](#) is actively used for this purpose. Other regions had hoped to use the website as a forecasting tool to better understand the potential impacts of various defense budget actions. While there is strong interest in this service, forecasting has proved to be more difficult than expected. Time lags and data

¹¹ <https://wisconsinsuppliernetwork.com/>

limitations have complicated the ability of project leaders to predict quickly how budget cuts might affect local suppliers.

In addition to a web-based supply chain platform, other forums and venues for outreach have proved helpful to past OEA grantees. As noted earlier, the rollout of a supply chain mapping project should include extensive outreach, entailing in-person presentations at industry and community meetings and publicity via partner networks, media outreach, newsletters, social media, and other venues. Successful projects regularly present or purchase a booth at industry association events. These venues allow sharing of the website and an opportunity to demonstrate the site to a live audience. Several grantees, such as the University of Alabama-Huntsville, have enjoyed success via specialized data reports for companies, who can receive data focused on their specific industry or target customer.

Reaping the Benefits of Supply Chain Mapping

Many OEA IR grantees have incorporated supply chain mapping as a core part of their industry resilience projects. In fact, roughly half of all OEA IR projects include a supply chain mapping component. Supply chain mapping has been viewed typically as an important first step that helps project managers better understand the local defense industrial base, its key challenges and opportunities, and where and how local economic development, business support, and workforce programs can help companies be more competitive and be better suppliers to the US military.

Within this grouping of supply chain projects, several specific benefits have proved to be most important. Supply chain projects help local economic developers and other leaders in several key areas: market Intelligence, enhanced and improved business support services, and building a more resilient defense industry base. Examples of these benefits are discussed below.

Market Intelligence

For companies, market intelligence is the most important potential benefit of a local industry supply chain mapping project. Supply chain assessments have the potential to identify gaps in the market and prospective customers, suppliers, and partners for local companies. OEA IR projects have provided many kinds of market intelligence to local companies and community stakeholders. Basic data on defense budget trends can be helpful to local companies. Effective supply chain mapping programs provide forecasts and scenarios for the impact of potential defense budget increases or cutbacks. They do not simply share information on budget trends, which can be accessed in other media. They use this baseline information to forecast how potential defense budget changes may affect firms across a local supply chain. These forecasts can aid future planning for SMEs that can target potential growth markets or gain early warning of potential spending reductions.

Community leaders benefit from deeper insights into the types of businesses located in their regions. Via supply chain mapping, they better understand the nature of the local industrial base and can improve local support efforts.

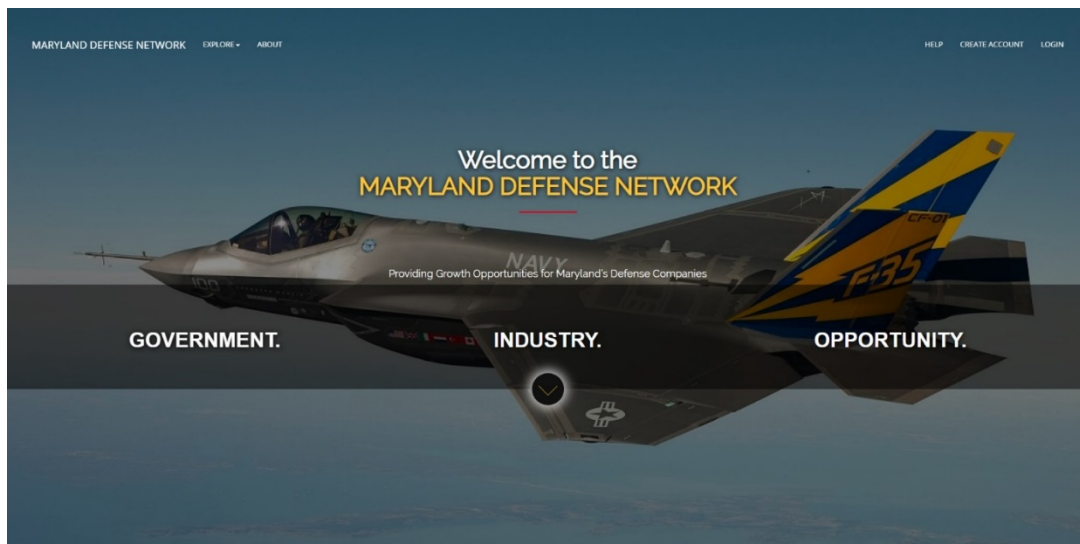
Finally, businesses can identify potential new customers. If your program can provide real business leads to local companies, it will likely be actively embraced by local company managers. Yet, providing “real” business leads is easier said than done. A list of business leads rarely leads directly to new

business. Business development staff must act on leads to build connections, which may take years to create an actual new contract. Meanwhile, most OEMs require strict standards and certifications for any firms within their supply chains. Because of these complications, program managers should offer realistic appraisals of their capacity to serve as a “matchmaker” for companies. They can identify potential leads, but substantial investments of company time and resources may be required to convert a lead into a new contract.

Many OEA grantees have enjoyed great success in providing market intelligence services to local companies. Maryland has enjoyed great success with its supply chain mapping efforts, centered on its [Maryland Defense Network](https://marylanddefensenetwork.org/) website. The Maryland Defense Network site allows users to map the location of defense suppliers, but it also does much more. Data sets include:

- Background on Maryland’s Top Contractors
- Vendors Located Near Major Military Installations
- Contact information for Government Contract Offices
- Information on new or expiring contracts
- On-line discussion boards
- Listing of patents available for commercialization from local labs and defense facilities

Figure 7: The Maryland Defense Network¹² provides access to 3,102¹³ defense suppliers in Maryland



The Maryland Defense Network (MDN) is the state’s public-facing website providing information on the defense supply chain. It supports outreach to defense contractors to promote business development events (like supplier/OEM matchmaking), the state’s cybersecurity program, and company diversification programming, since it includes data on the most defense dependent contractors in the

¹² <https://marylanddefensenetwork.org/>

¹³ This number reflects 2018 data from the Explore Data portal which filters vendors by fiscal year. In totality, there are vendor profiles for 8,267 Maryland vendors and 8,456 out of state vendors with contractual relationships with Maryland firms.

State. It also supports market intelligence for defense contractors and regional defense industry cluster programs near Aberdeen Proving Ground and Patuxent River Naval Air Station.

The Maryland tool set is customized to reflect the unique nature of defense contracting activities. Maryland is home to one of the largest concentrations of defense research activities, so its patent database (linked to MDN but accessible at www.Defpatmd.com) is especially useful in promoting technology transfer and licensing activities.

In addition, Maryland's defense installations contain significant levels of research and industrial activities, and thus provide good opportunities to nearby vendors that can supply the base with defense-related materials and consumer products as well. The Maryland Manufacturing Directory (<https://marylanddefensenetwork.org/manu>), which is also part of the Maryland Defense Network, was built to diversify the DoD supply chain with new suppliers.

Alabama and its key partners at the University of Alabama-Huntsville (UAH) are using a different approach. The Alabama Defense Industry Diversification Analysis Project (ADIDAP) shares a public [defense industry mapping tool](#) that provides basic information on the state's defense sector. The UAH team, which provides the bulk of the project's business support services, further customizes this basic data to provide specialized market intelligence reports to local contractors. UAH team members use the tool as a door opener with firms and with local economic development officials, who not only get access to unique data but also receive coaching in how to best work with local defense suppliers. They now serve as trusted intermediaries for UAH and for other state and local programs to assist SMEs. The database now contains information on more than 300 defense firms across Alabama. UAH's first phase of work also engaged 78 companies and provided in-depth technical assistance to fourteen firms who were eligible for support services and positioned to successfully retool or diversify their markets to be more successful, profitable, and sustainable.

Expand Awareness of the Defense Industrial Base

By helping to improve programs and to close business service gaps, supply chain mapping efforts make important contributions to a more resilient defense industrial base. Yet, they also support this objective in other ways, such as via their role in highlighting the statewide or local economic importance of the defense industrial base. Elected officials and the general public understand the importance of the defense industry in states that are home to large prime contractors, such as California, Texas, or Virginia. In contrast, most states have a relatively small or poorly understood defense base. In these states, supply chain mapping has been very important in highlighting economic impacts and in building closer public-private partnerships.

Figure 8/9: The Mississippi Defense Initiative highlights the location of key suppliers and support assets in the MS supply chain and MS military installations

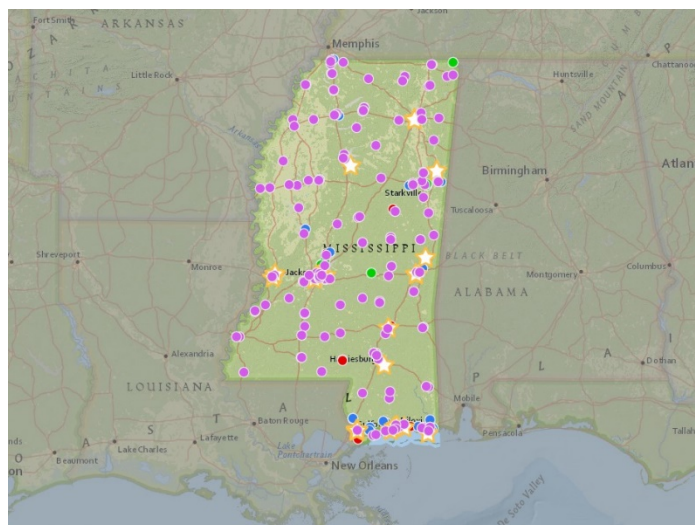
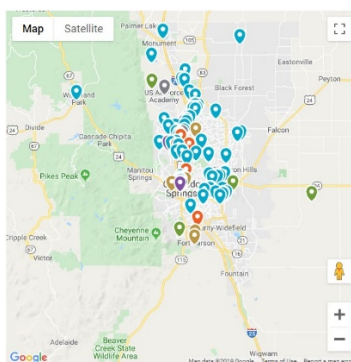


Figure 8/9: Colorado Springs Supply Chain Map highlights location of key suppliers in the region's defense supply chain



The Mississippi Defense Diversification Initiative (MDDI) is a prime example of this process at work. MDDI has used its web platform, www.msdefense.net, to share new research on the Mississippi defense economy. MDDI's awareness campaign helped prompt then-Governor Bryant to issue Executive Order 1419 to protect, grow, and diversify defense and national security assets as an economic driver for Mississippi by synergizing relationships among military, government and private sector partnerships and exploiting their respective intellectual and physical assets collectively.

West Virginia's defense sector has also received greater public attention and support thanks in part to OEA-supported supply chain mapping work. This work spurred creation of the West Virginia Defense Industry Alliance (WVDIA), the state's first organization focused on supported the defense industrial base. This effort is being enthusiastically supported by State and Federal officials in both the Executive and Legislative branches. This includes support from the Secretary of Commerce, the Vice President for Research at West Virginia University, the Executive Director of the West Virginia Development Office, and the Adjutant General of the West Virginia National Guard. These agencies and offices

are represented on the WVDIA Advisory Board, along with the state's largest defense contractor Northrop Grumman (formerly Orbital ATK), and several other private defense contractors.

Through the Illinois Defense Network (IDN), the Illinois project team has engaged with defense suppliers and key partners in five regions across the state to mobilize support for the defense industry (<http://illinoisdefense.org/>). This work has involved increasing awareness of and developing strategies to support defense supply chains, targeting key strategic industries, and increasing cybersecurity compliance. The companies that the IDN has engaged are important components of the region's supply chain, responsible for over \$5 billion in defense sales and nearly 50,000 jobs in the Chicago region, plus another \$1 billion in DOD contracts and over 7000 jobs in the Rockford, Peoria, and Quad Cities regions.

In addition to building closer community partnerships, supply chain mapping builds a more resilient industrial base in other ways as well. In Colorado Springs, supply chain mapping data has been used to develop and advance new industry-wide workforce programs. Local supply chain mapping efforts supported by OEA identified numerous local issues related to cybersecurity. Local SMEs were not well prepared for cyber threats, the local cybersecurity talent base was too small and lacked needed skills, and local education programs were not filling the gap. Using the insights, the project team created a comprehensive set of cyber-related initiatives, including strong business-education partnerships and several new training programs at the high school and college levels.

Defense industry supply chain mapping provides useful market intelligence to companies, and it also provides critical market insights to economic developers and program managers. Thanks to the data and analysis provided by supply chain mapping, program managers have an "early warning system" that can identify at-risk companies, gaps in existing business support programs, and new challenge areas that require new types of business solutions. Supply chain mapping helps to align support programs with the capabilities and assets/gaps within the local defense industrial base.

OEA IR grantees have tapped supply chain insights for all these purposes. Many of them address the most significant supply chain challenges faced by businesses today. A recent APICS [report](#) identifies those challenges as: Capacity/resource availability, Talent, Complexity, Threats/challenges, Compliance, and Cost/purchasing issues. The next section details myriad ways that IR grantees have leveraged information from supply chain mapping and related research to address these business challenges and provide effective business services to current and potential defense suppliers.

Services to Strengthen the Defense Supply Chain

In general, OEA IR grantees provided business services to current or potential defense suppliers in the categories listed below. In each case, the services provided were designed to enhance the capabilities of current or potential defense suppliers and strengthen the defense industrial base. In most cases, the OEA mapping and research on the nature, extent, location, and challenges of defense supply chains influenced the strategies for which services to deliver and how. This section provides examples of each and lists some insights gleaned from that work about effective business services for defense suppliers.

Categories of services include:

- Integration of new technologies like additive manufacturing and robotics
- Assistance with required certifications (ISO)
- Cybersecurity awareness and mediation for compliance
- Diversification Support (e.g., Business strategy analysis and planning, Assistance with identifying new markets and new product development for company diversification)
- Talent (e.g., talent development/Workforce education and training, working to expand the pipeline of potential workers for the industries important to the defense industrial base)
- Targeted Strategies/Clusters

Integration of new technologies

Battle Sight Technologies—This veteran-owned company in NY has developed a visible light and infrared surface marking system using technology spun out from the Air Force Research Lab. The MARC DIA is a pressure-activated chemiluminescence writing instrument that enhances communication in low-light and no-light conditions with the capability to be invisible to the enemy. NYSTAR partners are working to align them with NYS research assets that can assist with their product’s materials and chemistry needs and in providing manufacturing scale up research and support through FuzeHub. This has great potential for DOD to provide technological superiority at reduced cost and less waste compared to current solutions. Viable commercial opportunities with law enforcement agencies would diversify company customers and strengthen its competitive position.

In Utah, only one metal additive manufacturing (AM) services firm existed before the University of Utah awareness program, with low state-wide awareness and maturity around AM technologies. A training module developed with Qualified Rapid Products (in West Jordan, Utah) and EmergenTek showed how to incorporate AM processes into their suite of manufacturing solutions. It helped machinists in Utah understand how AM shortens product development, expands their product mix to help them enter non-defense markets, diversify, and strengthens the supply chain.

Soldiers in Iraq reinforced the doors of the International MaxxPro MRAP vehicle with 400 pounds of additional metal to protect against the impact of IEDs. Unfortunately, the extra weight caused door hinges to sag and break, forcing soldiers to drive without doors and wait 6-18 months for replacement hinges. In response, the U.S. Army’s Tank Automotive Research, Development and Engineering Center (TARDEC) commissioned engineers from Elementum 3D and the Colorado School of Mines ADAPT center to develop an additively manufactured door hinge. ADAPT researchers tested the effect of different build parameters, such as laser density, on the material’s roughness and fatigue life. AM processes enabled researchers to now produce the hinge as one part, increasing the design’s strength ten-fold. Design changes such as reducing the hinge to one part reduce the complexity of DoD logistics by reducing the number of moving parts to track. The AM design can maintain integrity even when driving full-speed and the doors wide-open.

Assistance with required certifications (ISO)

Survival Innovations in Mills River, NC provides design and development services and critical safety item production for military customers in the aviation life support industry including ejection seat components, head and neck restraints, flotation collars, and parachute system components. In the Phase I project, the company underwent a TDMI project conducted by RTI International and an ISO gap

analysis and a Lean training project led by IES. Currently they are undergoing an AS9100 project, delivered by IES, to strengthen credentials necessary to work in the aerospace sector of the DoD and prime contractors. Survival Innovations will have increased opportunities with Lockheed, Boeing and other prime defense contractors once the company is certified in February - March 2020. Recently, Survival Innovations was selected to be profiled in a DoD success story.

Export compliance training played a central role in helping Airex (Somersworth, NH) connect to several new overseas contract opportunities. A Merrimack company used training programs implemented under OEA IR funds to increase their compliance with export regulations and now has an export compliance program in place. Further, due to the initiatives that the NHADE Executive Director has helped the company pursue, it has increased sales by nearly \$500,000.

In Oklahoma, a company that specializes in all types of hardware and software life-cycle support for military fixed wing, rotary wing, and ground-based operational and maintenance training devices received CMMI (Capability Maturation Model Integration) training. We provide new device design and build as well as device modifications and upgrades. We specialize in providing COTS solutions for existing simulation systems.

Cybersecurity

Many current OEA IR grantees are now focused on cybersecurity awareness and preparedness. Many defense SMEs are struggling to keep up with the rapid pace of change and ever evolving nature of the cybersecurity threat landscape. A recent Department of Commerce review estimated that roughly half of surveyed small defense suppliers had no cybersecurity protections in place. These small businesses often lack the Information Technology (IT) expertise and financial resources needed to invest in and maintain the highest levels of cybersecurity protections. This puts them at a competitive disadvantage in trying to conduct business with the military and among the nation's largest defense contractors. Moreover, since 2018, it is now federal law that defense suppliers have basic cybersecurity protections and systems in place if they want to remain as government contractors.

Tackling this cybersecurity challenge is now a major priority for the OEA IR program, and for its various partners at NIST MEP, within DoD, and elsewhere. Thanks to previous supply chain mapping efforts, most IR grantees have a solid listing of potential customers with additional detail on their areas of specialization, contracting activity, and the like. This information is invaluable in helping support providers to identify at-risk companies and delivering services and training programs where needed.

With support from OEA, MassMEP has created a cyber security program, focused on becoming a trusted advisor to companies by providing educational information, multiple solutions, access to funding for implementation, and an integrated approach to mitigating risk against Cyber hackers and attackers. MassMEP's efforts began with the development of a supply chain cybersecurity roadmap. The organization acquired expert talent to help companies with NIST 800-171 compliance and used OEA funding to prototype the assistance with three defense manufacturers. The projects involved cyber-risk assessments and NIST 800-171 compliance plans. The companies assisted included Akita Innovations, an SBIR company that makes protective lens products, Silverside, which makes nuclear materials detectors,

and San-tron Inc., which makes connectors, adapters, and cables for the military. The struggle for many companies in conducting cyber-risk assessments is that they outsource their information technology support activities, so they have little direct control over implementation.

From these efforts, MassMEP has developed several direct service products at the “bronze,” “silver,” and “gold” levels. Bronze services (CSET MassMEP Advisor) involves a self-guided assessment tool, a checklist driven process that provides ratings, status updates, and basic reports. The assessment examines policies, plans, and procedures, providing a base line for comparison purposes. The assessment process meets NIST Controlled Unclassified Information (CUI) requirements. Silver services (Cyber Saint and the Cyber Strong Platform™) provides a comprehensive assessment and supports any framework. The assessment follows NIST Rules Engine and provides the company with a specific plan of action, including recommendations and costs. It provides intelligence with proposed actions and an assessment of the most credible risks as well as an executive reporting process. Gold services (ExoLytic) provides a third-party security management system completed with internationally recognized certification and compliance procedures. The process maps over not only NIST 800-171 but also ISO9001. The process is standardized and auditable and has been certified under ISO-27001.

Technical Micronics Control (TMC), a veteran-owned company that opened its doors in 1965, works in Precision Chemical Cleaning, Environmental Pollution Control and Testing Techniques for both government and commercial contractors in the aerospace and governmental defense industries. At the TMC facility at Cummings Research Park in Huntsville, Alabama, they perform in-house Precision Chemical Cleaning, Tube Bending and Panel Fabrication.

Through services that provide education and support via one-on-one coaching, the Alabama Cybersecurity, Coaching, Education and Support Services (ACCESS) Program at the University of Alabama in Huntsville (UAH) was able to help TMC understand the NIST 800-171 requirements and evaluate TMC’s system against that standard. Services provided by the Office for Operational Excellence (OOE) team helped TMC increase their DoD business and number of employees because they became DFARS compliant.

Diversification Support

Inertia Switch Inc. in NY specializes in acceleration switches of all kinds, but also manufactures limit switches, prostheses, incandescent digital displays, and many other standardized and unique products. The company relies on DOD spending for 60% of their current revenue. They are replacing the current Quality Management System with a new Enterprise Resource Planning System to increase process capabilities and reach higher volume customers in the commercial aerospace industry. Commercial success will ensure a reliable supply chain during downturns and reduce unit costs by increasing production efficiency including shortening the manufacturing life cycle. Along with cost and time saving benefits, Inertia Switch’s success will allow more time for innovation and improvement of their products.

North Charleston, South Carolina’s CodeLynx LLC, a software developer and security integration firm, was one of the IR program’s first customers. Founded in 2003, CodeLynx enjoyed great early success and

was named to the Inc. 5000 list on several occasions. However, CodeLynx was highly dependent on DoD work as contracts with SPAWAR and related entities accounted for about 80% of the company's revenue. After it lost a major contract in 2013, the firm's managers began a focused diversification effort, investing in new product research and searching for new markets for its technologies. CodeLynx managers quickly embraced the IR diversification initiative and began partnering with the SCMEP program. They used these funds to identify and target new commercial markets, including utilities, oil & gas, and critical infrastructure protection. These customers have a need for strong security systems akin to those used by CodeLynx's traditional clients in the DoD. In addition, CodeLynx leveraged the diversification assistance to obtain state incumbent worker training funds used to upgrade the skills of its workforce and assist key personnel in obtaining critical industry certifications in cybersecurity.

In Wisconsin, through the networking abilities of AeroInnovate and EAA AirVenture, a F16 mechanic from the Air National Guard has made valuable connections to consumers, manufacturers and distributors for his product, the Grypmat. The Grypmat is a multi-purpose tool tray made from silicon polymer, that can withstand heat up to 500 or 600 degrees. The high friction surfaces allow tools to be placed where the work is being done and helps reduce foreign object debris and overall maintenance time while increasing aircraft longevity. This material holds tools up to a seventy-degree angle with no magnets while protecting surfaces and tools alike. The flexible material allows for it to contour on curved surfaces and can be used for a variety of vehicles. With the investment opportunity from ABC's tv show "Shark Tank," Grypmat can build up the inventory and continue creating new and innovative products and accessories.

Amidon Inc. in Cary, NC is a provider of several products and services including training facilities and ranges, construction, historic preservation, professional services, and ballistic concrete. The company has been forced to restructure because of sharp downturns in defense spending in recent years. During Phase I, NCDIDI enabled Amidon to evaluate the company objectively, looking at the firm's competitiveness and deficiencies and conducted a comprehensive review of competing firms in their market. Amidon has reinvested in research and development, and the company now holds three patents for Amidon Ballistic Concrete (ABC). The product uses a unique forming technology for concrete curing that provides superior ballistic performance to valuable hard targets (e.g., seismic applications, protective solar transformers, etc.) compared to established ballistic concrete products. The ABC catches bullets (no ricochet), cures in a fraction of the time of standard concrete and is 50% lighter than the competition. Amidon is exploring options to continuously update their patents, for example by integrating carbon fiber into their ballistic concrete. Because of the technical superiority of ABC, survival of Amidon has implications for DoD's ability to protect critical infrastructure. ABC has proven to be the only ballistic concrete capable of replicating successful installations by being tested and used in the field with zero failures, with over 50,000 ABC units produced. It also has been used in lane divider walls as well as for building retrofits to provide ballistic protection without the need for complete reconstruction.

In Georgia, GDX and the SOAR networking sessions are also opening new markets for Georgia's smaller DoD suppliers. Over the past five years, hundreds of companies have participated in SOAR events. In addition to networking and business development opportunities, participating firms also attend

development sessions and hear from other companies and support organizations (e.g., SBDC, MEP, SBA, GTPAC). SOAR events are well received and clearly provide good business leads. A follow-up survey of SOAR business attendees found that 78% made a solid connection to a potential customer.

Several companies made great strides thanks to SOAR connections. For example, Spenergy LLC, a Cumming, GA marketer of oils and lubricants has used SOAR and GDX to win more than ten new contracts valued at over \$400,000. In addition to provide market leads, program support has helped Spenergy create new processes for identifying and winning new contracting opportunities. Precision Parts International, a women-owned machine shop located near Dalton, has enjoyed similar results thanks to SOAR participation. PPI is now supplying parts and other services to Boeing, Lockheed-Martin and other major OEMs.

In Texas, Sempulse, a member of the inaugural MCTX class, has a patented lightweight wireless, non-invasive vital signs sensor that adheres to back of the ear and acquires patients' 5 major vital signs – cuffless blood pressure, pulse oximetry, heart rate, respiratory rate, and core body temperature, plus GPS for use anywhere. The product helps save valuable minutes for soldier triage which holds the possibility of saving thousands of lives. Over 50 percent of the U.S. fatalities in Iraq and Afghanistan were deemed “potentially survivable.” Sempulse is working with U.S. Special Operations Command (SOCOM) on user testing. Company leadership credits MCTX with providing effective mentorship (e.g., advice on securing FDA approval), exposure to funders (e.g., including a \$100k cash prize from MCTX), and new relationships leading to new opportunities (e.g., introductions leading to meetings with NATO and the French military).

Workforce Training and Talent Development

AMP SoCal: In April 2016, CED selected a proposal submitted by several Los Angeles County organizations, including the South Bay Workforce Investment Board (SBWIB), to receive funding as part of its Managed Career Pipeline program to build a workforce training initiative. SBWIB created the Aero-Flex Pre-Apprenticeship (Aero-Flex) and worked closely with Northrop Grumman to complete its pilot and graduate the first cohort. Their use of the seed funding and initial pilot was so successful that they have secured \$240,000 by the California Workforce Development Board to continue developing and growing Aero-Flex for more employers, students and regions. The SBWIB is expecting to enroll up to 100 Aero-flex Pre-Apprentices with this funding and it is now working with more manufacturers and schools within the region. The Aero-Flex advisory group of companies worked with the SBWIB to create the first registered Aerospace Engineering Apprenticeship in the nation, and the first degreed registered apprenticeship in the engineering discipline.

In Colorado Springs, working with 18 defense contractors and four other private companies, the grantee is designing a bootcamp to develop secure coding practices among programmers. While still in development, the initial plan is to provide a two weeklong program during which students will secure their own code, after identifying its weaknesses and vulnerabilities using a DoD tool. Marketing for the program will be funded by local defense contractors, and the Air Force Academy is looking to spin this boot camp off as a capstone course. With programmers writing secure code that reflects DoD security

levels, the DoD will have to spend less money re-securing code and will become less vulnerable to cyber-attack.

Activities by The Alliance for the Development of Additive Processing Technologies (ADAPT) network spurred the development of additive manufacturing programs offered by the Colorado School of Mines. The recently developed Masters in Additive Manufacturing graduated between 12-15 students last year, and the University plans to provide an online graduate certificate in AM for industry. The programs focus on the intersection between materials science, design, and data, teaching students how to identify advanced manufacturing solutions and their use cases, while considering business factors such as operational and capital expenditures. And CSM recently unveiled a Graduate Certificate and Master of Engineering programs in Additive Manufacturing and is working with Red Rocks Community College to revise their AM technician program.

To meet the requirements of the National Security Agency Center of Academic Excellence (NSA CAE2Y) program, Pikes Peak Community College (PPCC) developed Associate of Applied Sciences (AAS) programs in Cybersecurity and a dual degree AAS in Computer Networking and Cybersecurity that address 11 components of cybersecurity identified by the NSA and DHS. In the fall of 2018, 125 students enrolled in the Cybersecurity AAS, a number that increased by 200% for Fall 2019. The benefits of the CAE2Y designation not only recognizes PPCC as a leader in cyber security education, but also facilitates articulation to 4 Year CAE universities, and creates opportunities for cybersecurity related funding and collaboration in research. Students from local high school cybersecurity CTE programs receive college credit applicable to the PPCC AAS in cybersecurity. As a result of the grantee's outreach to market this program, the number of high schools with a cybersecurity CTE program grew from one to seven of the 16 regional Pikes Peak high schools. High school students in this program receive a CompTia Sec+ certification and up to a year's credit towards their AAS. Additionally, the PPCC degree program developed seven articulation agreements with four-year colleges, including cybersecurity programs at UCCS and Regis University. Legacy DoD technologies designed without cybersecurity in mind already lack the talent to secure these systems as their lifespan is extended. The growth of a strong cybersecurity talent pool in Colorado Springs provides the necessary workers to support these DoD operations.

Targeted Strategies/Clusters

Virginia offers an example of how supply chain mapping results have helped it to proactively identify company clusters and regions that could benefit from more active engagement with its business support programs, including state export assistance programs and the GENEDGE Rural Supply Chain Growth Program.

Virginia is one of the nation's most defense-dependent states. After all, it is home to the Pentagon and the world's largest naval shipyard in Norfolk. These regions of Northern Virginia and Hampton Roads are heavily focused on supporting the local defense industry, but they are not the only locations where significant government contracting work occurs. Thanks to its initial defense supply chain mapping efforts, local leaders identified a wide array of rural Virginia locations with significant local contracting activity. However, companies in these rural regions were not well integrated into various business support ecosystems, such as those managed by GENEDGE, Virginia's MEP affiliate. Under the new Rural

Supply Chain Growth Program, the GENEDGE team is now focusing new services to rural defense contractors seeking assistance in areas such as new technology development, capacity expansion, risk management, and new supplier development.

Vermont used supply chain mapping insights in a similar manner. Vermont has a very small defense sector, especially in comparison to nearby defense industry clusters in Connecticut and Massachusetts. But Vermont's small defense base accounts for a large share of statewide manufacturing capacity. It is also a provider of high-quality jobs and career opportunities. Thanks to insights developed via a New England-wide supply chain mapping effort (the Regional Aerospace and Defense Exchange), Vermont created a new business support program targeted to these small manufacturers. New services include cybersecurity training, diversification support, and targeted aid to help precision metals manufacturers use new additive manufacturing tools and technologies.

In the Chicago region, CMMC used data from the supply chain mapping tool to create a comprehensive profile for each county. This provided a more granular understanding of the diversity of defense contracting within the region and deepened partnerships with the EDOs representing these counties. CMMC developed materials showing each county's DoD composition, industry trends, and key DoD contributors and presented to Choose DuPage, Lake County Partners, Kane County Development, Economic Development of Kendall County, McHenry County Economic Development Corporation and Will County Center for Economic Development. This led to more coordinated efforts among partners including outreach and services to defense contractors, events on risk management & cyber security awareness, and engagement with local Procurement Technical Assistance Centers (PTACs). Specific impacts resulting from this effort include \$220 million in new sales from exports across 360 companies in Chicago and Peoria alone. Manor Tool & Manufacturing Company, a family-owned metal stamping business and partner in the Chicago Metro Metal Consortium, reported a 30% increase in export sales because of programs designed to help manufacturers diversity into global markets.

These examples of effective services provided to current and potential defense suppliers demonstrate impressive diversity across the nature of services delivered, the industry sectors served, the partners engaged, and the breadth and depth of the impacts benefiting DOD and the warfighter. As noted above, most grantees could describe how the supply chain research and mapping described above influenced their approach to delivering these services.

The examples provide a few insights about delivering effective business services to defense suppliers:

- Determine services based on findings from research and mapping of defense suppliers;
- Engage trusted intermediaries to design and deliver services to defense suppliers;
- Focus on results and deliver value to companies and impact for DOD; employer engagement and strategy and planning meetings are important but not ends in themselves; and
- Employers should co-invest in the services they receive so the assistance is valued.

Common Themes and Challenges

Our earlier section on "How to Do Supply Chain Mapping" identified a few challenges tied to various phases of project design and development. When the OEA IR program began making supply chain

mapping grants in 2014, OEA grantees had limited knowledge and experience about “what works.” MEP partners and some local EDOs had supported supply chain-related research, but a deep knowledge base on best practices did not exist. Over the past five years, IR grantees have learned a great deal, thanks to an OEA-backed peer learning network, and much hard work in the field. This concluding section dives deeper into these issues and offers some tips and ideas for addressing common program implementation and management challenges.

Figure 9: Top Defense Supply Chain Mapping Challenges*
1. Acquiring Data
2. Sustaining the Effort after the Grant Period
3. Industry Engagement
4. Defining the Purpose for the Mapping Effort
5. Data Validation
6. Having a Strategic Communications Plan
7. Stakeholder Buy-In
8. Effective Data Visualizations
9. Measuring Data Utilization/Outcomes

* As ranked by OEA Learning Community members

Figure 9, developed by OEA IR grantees, lists common challenges facing supply chain-related projects. Below, we dig deeper into some of the more pressing challenges, offering tips on how to improve program operations and sustain momentum along the way.

Data Gathering and Updating

Gathering supply chain data is a time-consuming and complicated process. Supply chain maps require integration of multiple data sources, requiring solid expertise in research methods, data sources, and data visualization. Because of the need for deep expertise, many grantees opted to use outside consultants in this role. Consultants ensured that the work was done right, and that complete sets of data were compiled. However, this outside support was often quite expensive. At the same time, reliance on outside consultants limited the development of in-house expertise and capacity to manage the supply chain data after initial data collection was completed. Some projects with limited budgets lacked resources and in-house staff to update the data and were not able add newer information to their initial supply chain maps.

OEA IR grantees offer numerous suggestions to avoid these types of problems. First, the project team must budget for multi-year data collection at the outset. Data gathering is not a one-time effort; it must occur on an annual basis. At project kickoff, the team should identify resources and staff to do data updates after the first year. In-house staff should be trained for this role, or, if consultants, additional follow-on funds should be reserved for future data updates.

This process will be easier if the supply chain mapping effort is not viewed as an isolated one-time project. If possible, the project should integrate in-house information technology staff and researchers, where available. Most state-level agencies will have staff with this expertise. Local projects may be required to rely on consultants or might consider tapping into expertise at a local college or university. In addition, the project website and other resources should be designed at the outset for easy updating and upkeep.

Engaging Partners

Engaging business and economic development leaders also has served as a common challenge for some OEA IR grantees. Because supply chain mapping is a complex, data-driven process, its benefits are not always immediately understood by these partners. As noted earlier in this report, a clear value proposition is needed for all potential partners and customer groups. The project team must be able to answer a key question: why should this group care about supply chain mapping and what benefits will they receive from this project?

Each group's value proposition will differ, but most partners will benefit from a deeper understanding of the local defense industry. They will become even more engaged if the project leads to new business leads, such as new customers or suppliers for business or new members for trade associations, or new business engagements for support programs offered by EDOs and other partners.

The supply chain map will not sell itself. Partner engagement must be top priority for the project team. This entails development of attractive and compelling supporting materials, such as "how to" guides, FAQ summaries, specialized reports, and the like. In addition, it will require that the project team get out in the community and promote the supply chain work at industry meetings, town hall events, and other places where potential partners and customers gather.

Sustaining Programs

A final, and perhaps the most pressing, program challenge relates to sustainability: how to keep the project funded after the OEA funding has been deployed. Discussions regarding sustainability must occur at the start of the process, not as an afterthought. A good understanding of value propositions matters greatly here. If program managers make a good case about how and why the supply chain data helps customers and partners, the likelihood of raising additional funds will improve.

Wisconsin's supply chain projects offer a useful example of how grantees should think about project sustainability. Wisconsin's first supply chain mapping projects were focused on the region around Oshkosh, where Oshkosh Defense operates a major manufacturing facility. The initial defense supply chain mapping work was combined with other supply chain guides targeted to industries such as manufacturing and wind power. The [mapping tools and website](#) were developed in a modular fashion. This allowed the project team to target certain industry sectors, or to link the supply chain marketplace to other activities across the state.

For example, a section of the website is devoted to supply chain opportunities related to Foxconn's major new facility in Mt. Pleasant. In addition, the site contains specialized business portals for numerous industry sectors, including wind power, energy systems, forest products and marine

manufacturing. Each of these industry portals receives support from industry partners and offers specialized industry-specific tools and resources. The tool has also been customized for statewide use and for use by various regions of the state, such as the Northeast Wisconsin Lakeshore region. By engaging other regions and industries, Wisconsin has been able to create a more stable and resilient funding base for the entire supply chain mapping project.