2019

NC DEFENSE SUPPLY CHAIN ANALYSIS

NCDIDI

NORTH CAROLINA DEFENSE INDUSTRY DIVERSIFICATION INITIATIVE

CONNECTING THE DOTS, EXPANDING OPPORTUNITIES

NC STATE

Industry Expansion Solutions

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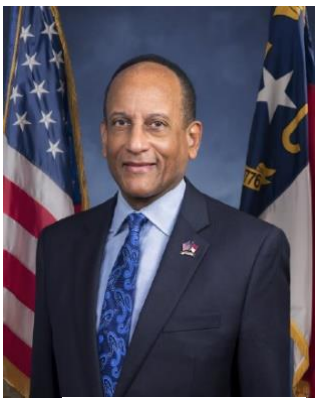
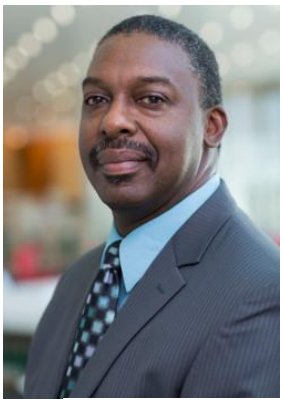
North Carolina Department of Military and Veterans Affairs



Secretary Larry D. Hall
North Carolina Department of Military and Veterans Affairs



Executive Director Phil Mintz
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North Carolina boasts significant defense assets. According to the United States Department of Defense Office of Economic Adjustment State by State Report, in fiscal year 2017, DoD spending in North Carolina totaled $3.3B, ranking the state 23rd nationally in total defense contracts spending. In addition, North Carolina is home to six active military installations, has over fifty percent of all Special Operations Forces and has the 3rd largest active duty presence in the nation.

With these active installations and a diverse industrial base, North Carolina has strong links to the military and the companies and people that support it. What North Carolina lacks, however, is a data-driven approach to quantifying the breadth of its defense sector – as well as its potential vulnerability and opportunities for enhancement and growth – amid a changing defense spending landscape.

In 2017, the North Carolina Defense Industry Diversification Initiative (NC DIDI) was established via a planning grant from the Department of Defense Office of Economic Adjustment (OEA). As Co-Chairs of the NCDIDI Advisory Board, it is our privilege to bring together partners and stakeholders from industry, government, and academia to improve the knowledge of the impact of the defense industry on North Carolina's economy.

As a preliminary step to helping local communities adapt to DoD program changes, expansions, and cutbacks, a DoD Supply Chain study was conducted in 2017-18. Today, data and information gathered for that study is being used to: 1) help identify suppliers and other sectors at risk in the event of a local company or plant closure; 2) identify potential new markets for these at risk firms; 3) identify local gaps in the supply chain where an OEM is using overseas suppliers and can help support reshoring efforts; 4) help point state, local and regional policy makers identify which existing assets can be aligned to respond to supply chain issues and opportunities.

We later traveled the state from Murphy to Manteo holding Supplier and Contractor Town Halls interviewing the states foremost authorities and stakeholders. Lastly, we sourced data from all the federal defense purchasing offices and federal spend records. All that has led us to having the state's most comprehensive defense cluster analysis, six regional defense industry profiles and a complete strategic plan. Our next task was to develop a commercialization project. We welcomed small-to-medium size manufacturers and service providers to apply to our commercialization program to receive services customized to suit their business. That successful work has expanded and continues.

This data-driven DoD supply chain initiative is critical to North Carolina. We know that defense program impacts come in all shapes and sizes and, when defense programs change or are cut, contractors and business and industry may be faced with budget cuts, staff layoffs, or closings. Via funding from OEA, NCDIDI is well positioned to implement a series of proven strategies at a statewide and regional level with a focus on regional job creation through business development, attraction and expansion, workforce development, and community economic diversification. We invite you to join us!

All the best,

Secretary Larry D. Hall
North Carolina Department of
Military and Veterans Affairs

Executive Director Phil Mintz
Industry Expansion Solutions
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EXECUTIVE SUMMARY

In 2016, Industry Expansion Solutions (IES) and the North Carolina Department of Military and Veterans Affairs (NC DMVA) received a grant from the U.S. Department of Defense (DOD) Office of Economic Adjustment (OEA) to produce data and new insights about the defense manufacturing supply chain in North Carolina. The partnership was later named the North Carolina Defense Industry Diversification Initiative (NC DIDI). Working with the Strategic Development Group (SDG), NC DIDI embarked on a process to compile and aggregate critical information about defense-related supply chains in North Carolina.

This report is meant to serve as a guide to economic developers, lawmakers, the DOD and others interested in the defense and manufacturing industry to underscore the various opportunities and risks to the companies and communities in North Carolina that help power the nation's broader defense supply chain. Manufacturing supply chains consist of organizations that exchange products, services, data and money to deliver a product to an end user. Understanding which organizations are involved in defense supply chains is very important for all involved.

This report will help economic developers better understand the supply chain perspective to identify opportunities and risk. One of the greatest opportunities is to leverage these insights to better position the state and its companies to win business. Commercial and government customers are increasingly looking for companies that not only meet requirements for price, quality and delivery, but also make good supply chain partners.

There were several major findings in the analysis of government procurement data that shed light on the composition of the region's industrial base participating in defense work.

1. The largest defense industry sector in North Carolina by number of companies is North American Industry Classification System (NAICS) 54 – Professional, Scientific and Technical Services, with 2,284 firms. Second largest is NAICS 31, 32 & 33 – Manufacturing, with 1,719 companies.
2. In fiscal year 2017 (FY17), the largest group of products purchases by the DOD from North Carolina companies was related to textiles, totaling more than $142 million. Next was firefighting, rescue and safety equipment, with purchases slightly over $140 million.
3. North Carolina companies support a variety of weapon systems, with $37 million in sales related to the F-16 fighter and another $19 million for other aircraft.
4. Small- to medium-sized enterprises (SMEs) in the state are not well-prepared to participate in sophisticated supply chains. The companies surveyed rely on inefficient data exchange tools and have limited awareness of their lower-tier suppliers.

The analysis of these and other findings identified several major strengths and weaknesses for the region.

1. Professional services is a core strength, with 2,284 companies covering the state.

2. Another strength is the 1,719 manufacturers in the defense industrial base that produce goods from raw materials to finished goods. This is particularly true for the textiles industry.
3. One potential weakness is the small number of machine shops participating in defense work. These companies are an important element to many different supply chains.
4. The lack of supply chain readiness by the region's SMEs also is considered a weakness as buyers become increasingly sophisticated in their requirements.

These strengths and weaknesses help shape opportunities that could deliver business growth and a greater competitive advantage for North Carolina. Some of the opportunities include the following.

1. Improving supply chain competitiveness would better position all regional manufacturers to compete in the global marketplace. By enhancing capabilities that include the seamless exchange of data, increased visibility to lower-tier suppliers and better management of supply chain risk, the region's suppliers become more desirable supply chain partners.
2. Cultivating the textile industry could have significant potential. These products accounted for the largest group of DOD purchases in FY17. Leveraging involvement in organizations like the Advanced Functional Fabrics of America Institute and the Manufacturing Solutions Center could help better position the state as a leader in advanced fabrics.
3. Helping the North Carolina DOD contracting offices source more of their services from companies in the state could have an impact. Recapturing just some of the $900 million that left the state in FY17 could yield substantial results.

There is a growing emphasis on the role of manufacturers and service providers in global supply chains. Companies and regions must look beyond the traditional single buyer-to-supplier relationship to prepare for and capitalize on this opportunity. The work in this report should help in that transition so that the state and its companies can grow and prosper.

INTRODUCTION

The North Carolina Defense Industry Diversification Initiative (NC DIDI) is focused on helping strengthen the state's industrial base. A contributing effort in this project is the identification and analysis of the region's defense supply chains. In support of that effort, the Strategic Development Group (SDG) team has been assembling data and conducting research for this analysis.

For this effort, we are defining a supply chain as a group of organizations that exchange products, services, data and money to deliver a product to an end user. The focus is on supply chains for the state's Defense Industrial Base (DIB), which consists of those companies that are providing goods or services for use by the DoD. In some cases, these companies have a direct prime contract with the DOD. In other cases, a company sub-contracts with a larger company that in turn supplies the DOD.

The DIB is a subset of the overall industrial base within the state of North Carolina. For instance, there are about 700 manufacturers identified in the NC DIB while there are just over 10,000 total manufacturers in the state. Although insights from the DIB can help shed light on the region's capabilities, the DIB should not serve as a proxy for the entire state industrial base due to the unique demands and nature of defense business.

The supply chain data used for this analysis is compiled from a variety of public and private sources, providing insights into different aspects of the region's defense supply chain. One element is the identification of attributes for those companies in the defense supply chain, ranging from the types of products and services sold to their revenue dependency on the Department of Defense (DOD). Another aspect of the analysis looks at the flow of monies for products and services into and out of the state.

A typical commercial supply chain analysis focuses on efficiencies and risks to guide the practices of supply chain professionals. This report is written for Industrial Expansion Solutions and its state and regional economic development professionals and partners, who can then the information and insights to help strengthen the region and its businesses. The objectives of the analysis are to:

- Define the characteristics of the NC DIB
- Understand the flow of products, services, monies and data into and out of the region
- Identify defense industrial base opportunities and risks
- Determine how to capitalize on the opportunities and mitigate the risks

Following are the methodologies used in assembling the materials for this analysis.

Data analysis	Government data were pulled primarily from USA Spending, which includes information on both prime- and sub-contracts. This analysis focuses on the government's fiscal year 2017, which ran from October 1, 2016 through September 30, 2017.

	Commercial data was collected from IHS Markit, which provides an offering branded "Haystack Gold." This product provides data on DOD procurement of weapon system parts and components.
Online survey	A quantitative survey was conducted to discover various factors related to manufacturing supply chains in North Carolina. The target list of subjects consisted primarily of DOD suppliers and commercial manufacturers, resulting in a total pool of 894 companies. (No service providers were included.)
Interviews	To understand some of the supply chain challenges in the state, the SDG team targeted a limited group of small- to medium-sized manufacturers (SME) for one-on-one interviews. The team conducted one-on-one onsite interviews with four manufacturers and another three ad hoc interviews at the North Carolina Defense Business Association (NCDBA) business-to-business showcase in March. Interviewees were either the business owner or a senior executive. None of the subject companies had a person who focused on supply chain.

There were several challenges that the SDG team encountered while conducting research and preparing this report. These challenges should be considered while reading this report.

1. There are many known quality issues with government data, resulting in gaps, duplications and conflicts
2. Data collection from DOD prime contractors regarding their subcontractors is relatively new, often resulting in missing or inaccurate information

FINDINGS

What is the composition of the North Carolina defense industrial base?

As of February 1, 2018, there are 12,637 for-profit companies in North Carolina that have a Commercial and Government Entity (CAGE) code, which means that they are registered in SAM to do business with the government. Of those companies, 1,470 did business with the DOD as a prime contractor in 2017. The remaining 11,167 were not DOD prime contractors in 2017 but may have been in other years or may have been subcontractors to a prime DOD contractor.

To understand the makeup of companies in this group of just under 13,000 (referred to as the NC DIB), we looked at the organization's primary NAICS codes. These codes were selected by each company when they registered in SAM[1]. For a variety of reasons, these codes may not represent the entire or even majority of the business. They simply indicate what the person completing the form chose at that time. Surprisingly, 1,785 companies did not select any primary NAICS code.

The largest industry sector represented in the set of companies with a CAGE code is NAICS 54 – Professional, Scientific and Technical Services, with 2,284 companies identified in this group. Services provided by this group include logistics, communications and engineering/technical.

The second largest industry sector represented is NAICS 31, 32 & 33 – Manufacturing. There were 1,719 companies in this category, producing everything from raw materials to finished goods in many different forms and materials. The breakout of those manufacturing industry segments was as follows.

NAICS 31 199 Companies
Food and beverage as well as textiles and apparel
NAICS 32 291 Companies
Wood, paper, chemicals, cement and pharmaceuticals
NAICS 33 1,229 Companies
Primary and fabricated metals, machinery, electronics and transportation

An important note is that there are only 54 companies with a primary NAICS code of 332710 – Machine Shop. This represents just 3% of all manufacturers, while states with strong manufacturing sectors have closer to 10% in their defense industrial base. Since machine shops are often an important element in many different supply chains, this may be an important factor in growing the state's manufacturing base.

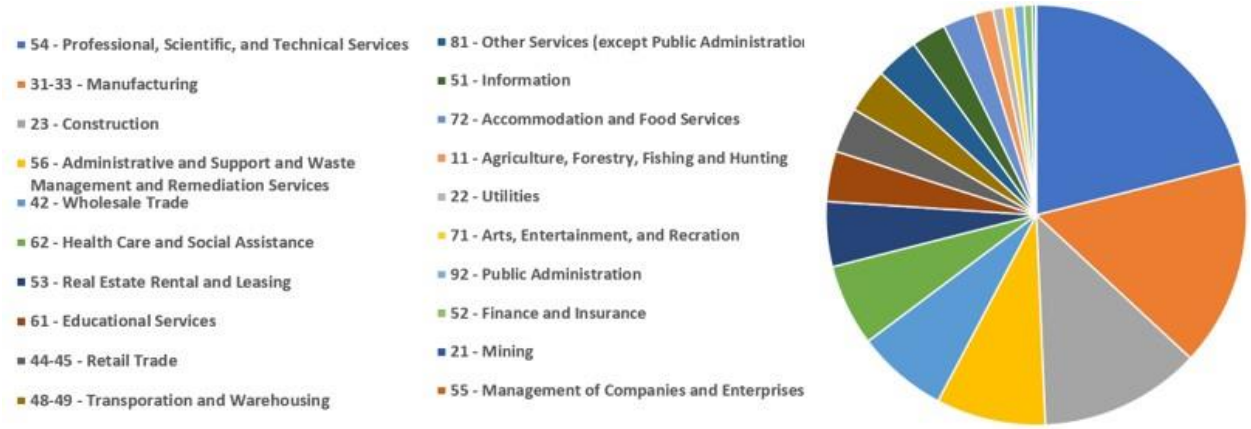
The third largest industry sector was NAICS 23 – Construction, with 1,345 companies identified. These firms construct new buildings and infrastructure as well as repair and renovate existing

[1] SAM.gov: System for Award Management

structures. Just behind construction is NAICS 56 – Administrative and Support and Waste Management and Remediation Services.

As seen in Figure 1 – Distribution of NC DIB Companies by Two-Digit NAICS Code, the remainder of the industries is distributed. NAICS 42 – Wholesale Trade had 760 companies and NAICS 53 – Real Estate Rental and Leasing had 542 companies, which would be expected in the presence of several large bases. (APPENDIX A – 2018 NC Company Count by NAICS has a table of numbers for each industry.)

Figure 1 – Distribution of NC DIB Companies by Two-Digit NAICS Code



What materials are DIB manufacturers buying and from where?

The focus of our research was on "direct materials," those materials that become part of the product being produced. While we captured some information on "indirect materials," which are used in the production process, they were not our focus. The SDG team used both interviews and a quantitative survey to determine what materials manufacturers purchase and from where.

Chemicals/plastics and electronics tied at 16% for the top materials purchased by survey respondents. The first group included items ranging from elastomers to foam and plastics. Electronics items were wiring, computers, solar panels and so on.

Metal stock was the third highest group of direct materials, coming in at 13%. These products can be in structural shapes, like tubes and angles, or in bulk shapes, like coil or plate.

Other direct materials ran the gamut from batteries to software and textiles. (Only 7% of the respondents indicated buying textiles, which may be more a result of the limited survey audience than a regional indicator.) While some of the materials are unique to the DOD, most of the materials bought are what we would expect to see in a traditional supply chain.

A positive finding is that respondents indicate they are buying about 53% of their materials from within North Carolina. Nearly 41% of the remaining purchases are largely from other states in the U.S. and just under 5% indicate they are purchasing from overseas sources.

What products are DIB manufacturers selling and to where?

The products being sold by the survey audience are wide-ranging. In most cases, it is difficult to identify a particular industry with which to associate the products as most can be applied to multiple industries.

From a supply chain perspective, it is helpful to determine whether these items sold are a raw material, part or component, finished goods or a service. Looking at the survey results in this way helps us understand where the respondents lie in the supply chain. The team evaluated the survey responses and made the best estimate to assign responses to one of those four categories.

About 10% of the respondents indicate that they sell a raw material, such as chemicals and minerals, placing them at the beginning of the supply chain. Another 25% said that they sell parts or components, ranging from engine components to plastic parts. These companies are typically somewhere in the middle of the supply chain, which requires them to buy from and sell to industry partners.

Just under 19% of those completing the survey said that they sell services, which included medical, environmental and management services. The percentage of service providers is slightly higher than we have seen in similar surveys. Missing from those indicating they sell services were any companies that provide contract manufacturing services, such as machine shops. (Two such manufacturers were listed under parts and components.) As explained in the section above on "composition of the defense industrial base section," contract manufacturers are an important element of many different supply chains and the lack of contract manufacturers may hold back growth of the state's manufacturing segment.

Approximately 46% of the responding manufacturers sell finished goods. Some of these reported finished goods, like "military troop seats," actually end up as a component of a larger item. Some of the items, such as cabinets and blast doors are likely used in DOD facilities. There were very few items that would likely end up in the hand of warfighters.

Nearly 37% of the respondents selling their goods within the state. More than 50% of the respondents indicated that they sell goods outside of North Carolina, but within the United States. Only 9% reported that they sell their products outside the country, which may represent export opportunities.

The sale of significant portions of both parts or components and finished goods within a region may typically may indicate that the region has strong supply chains in certain sectors. However, there were insufficient survey responses in this case to identify a strength

in particular industry segments. Additional research would be needed to flesh out more details.

What products and services is the D OD buying from North Carolina companies? To best understand what types of products and services the DOD is purchasing, a review was conducted of nearly 80,000 prime contracts awarded to North Carolina companies in Fiscal Year 2017. While there are many known problems with DOD data, using the Product Services Code (PSC) that is part of every contract provides a reasonable picture of just what North Carolina companies sell to the DOD. (See Appendix B – FY2017 Contracts by Product Service Code.)

The largest group of products purchases was related to textiles, totaling more than $142 million. These purchases spanned two PSC groups.

- Group 84: Clothing, individual equipment, insignia and jewelry
- Group 83: Textiles, leather, furs, apparel and shoe bindings, tents and flags

Next was sales under Group 42: Firefighting, rescue and safety equipment; and environmental protection equipment and materials with FY17 purchases of just over $140 million. Products in this group ran the gamut from scuba gear to safety glasses and tactical operations gear. There were only 34 unique companies in this group. The company H Squared, Inc. was by far the largest recipient, with $124 million in product sales in this category[2].

Group 89: Subsistence made up the third largest group of products purchased, totaling more than $62 million. As you would expect, these products consist of many different types of foods ranging from fresh fruits and vegetables to prepared foods. There were nearly 16,000 transactions in FY17, with the majority of them less than $100,000. This likely represents regular replenishment orders for the state's military bases.

The greatest DOD spending for services in FY17 was Category Z: Maintenance, repair, and alteration of structures/facilities at just over $316 million. The transactions are widely distributed, with the top ten vendors receiving more than $10 million each. The largest are Thalle Construction Co., Inc. at $50 million and URS Group, Inc. at $33 million.

Along the theme of supporting the bases, the next largest services spending was for Category S: Utilities and housekeeping at $253 million. Following that was Category R: Support (Professional/Administration/Management) at $218 million.

While the analysis by PSC provides more granular detail, it also is helpful to look at the contract awards by NAICS to understand what monies are flowing into and out of the state. Readers should keep in mind that these contract NAICS are assigned by a DOD contracting officer and are not always representative of every item in the contract.

[2] This company also operates under the name Quantico Tactical.

One of the most important groups to look at because of its impact on the economy is NAICS 31, 32 and 33 – Manufacturing. North Carolina had $524 million inbound awards from DOD contracting offices outside the state in FY17. Contracts from DOD contracting offices in the state to outside companies was nearly $80 million. This smaller number is likely due to the limited number of contracting offices in the state, but it does represent an opportunity for business retention.

The numbers for NAICS 54 – Professional, scientific and technical services tell a very different picture. Inbound contracts in this segment were just over $336 million, while the value of contracts going to companies outside North Carolina was $670 million. Many of the outbound contracts were awarded by the Durham office of the Army Contracting Command – Aberdeen Proving Ground (ACC-APG).

ACC-APG handles contracts for all of the services and the Defense Advanced Research Projects Agency (DARPA). The data does not include a lot of detail, but it does provide some insights through the description requirement field. Topics range from various electronics needs to research and technical services.

NAICS 23 – Construction had the second highest value for both inbound and outbound contracts. Monies being spent with North Carolina companies in FY17 was $354 million while the value of outbound contracts was almost $211 million. There were only 119 outbound contracts, with the top four vendors receiving eight-figure contracts. The location of these out-of-state awardees was widely varying, even extending to companies outside the U.S.

What weapon systems are North Carolina companies supporting?

There are two sources for data on products and services being sold in support of various weapon systems. The first is contracts awarded by the DOD to a prime contractor and the second is Federal Logistics Information System (FLIS). Prime contracts typically contain awards for significant amounts covering major new or existing weapon systems. FLIS contracts are usually for specific replacement parts for an existing weapon system. (See Appendix C – NC Weapon System Sales.)

The prime contracts data for FY17 lists only seven contracts that have a weapon system identified and the value for those contracts is less than $100,000. Such a low amount is likely due to the lack of specific weapon system program offices in the state.

Transactional data from FLIS is more detailed, with just under 5,000 rows of data covering the period from 2013 to 2018. These contracts totaling nearly $124 million are spread across 112 North Carolina companies.

The largest amount for a specific weapon system was for the F-16 Fighter, totaling $37 million. A quick scan of all aircraft supported yields another $19 million, with significant

amounts for the C135 Stratolifter ($6.8 million), the B52 Strato Fortress ($3.8 million) and the A10 Close Support Aircraft ($2.5 million).

P-24 Fire Trucks accounted for $12 million in sales, although there were only 19 contracts for the entire period. Most of the sales were by Curtiss-Wright Controls in Shelby, NC for large orders of "gearbox assembly parts." Another $4.5 million was spent on parts for ground vehicles in general, including Heavy Expanded Mobility Tactical Trucks ($1.9 million) and the M-1 Abrams Tank ($1.4 million).

What products and services are North Carolina prime contractors buying from outside the state?

The requirement for prime contractors to provide information on their subcontracts is relatively recent, and there are still many issues with the effort. First is that most prime contractors are not completing the information, so it is difficult to get the entire picture. Second, the information that is entered is often incomplete or inaccurate. Data completeness and accuracy appear to be improving with time and enforcement by DOD contracting authorities.

There are only 68 rows of data showing contracts awarded by NC prime contractors to subcontractors outside the state. This number is smaller than other states. There is insufficient data to determine whether the reason for this low number is due to underreporting or a small number of prime contractors in the state.

The total value for FY17 is just over $18 million. The largest group by NAICS is 236220 – Commercial and institutional building construction, with $14.3 million leaving North Carolina. Most of these subawards appear to managed through a North Carolina contracting office for work at DOD facilities that are located outside of North Carolina.

How prepared are NC manufacturers to be supply chain partners?

Many small- to medium-sized manufacturers have little awareness of supply chain issues beyond their immediate suppliers or buyers. There typically is little knowledge of which companies are their lower tier suppliers, much less what potential risks those lower tiers might pose. Buyers today are becoming increasingly sophisticated and, given several suppliers that are comparable in price, quality and delivery, the one that is a better supply chain partner has a great competitive advantage.

To help gauge the ability of NC manufacturers to participate and succeed in a modern supply chain, three different elements were included in the quantitative survey.

Automation	Do manufacturers have systems that allow them to exchange data with trading partners?
Data Exchange	What information do manufacturers already exchange with trading partners?
Supply Chain Visibility	How well do manufacturers know their supply chain, down to raw materials?

Automation

One of the survey questions asked respondents to indicate which business systems they use. Overall, about 52% report using an Enterprise Resource Planning (ERP) system. ERP systems are deployed by all of the companies with more than 500 employees and 50% of those companies with 25-99 employees. None of the companies with 24 or fewer employees reports having an ERP.

Survey participants also were asked if they use a Manufacturing Execution System (MES) or Manufacturing Operations Management (MOM) system. (There is much debate among the technical community about the differences and overlaps of these two applications. They were both included in the survey to cast a wider net for either system as they both leverage valuable data that could be shared with trading partners.) About one-third of the respondents use either MES and/or MOM, which included two of the companies under 24 employees and most of the companies with 50-99 employees.

In a review of some of the types of companies in the survey, an MES or MOM may not be needed. However, there were many others for which such software would likely yield financial benefits and could provide a competitive advantage.

Data Exchange

Another key element in the desirability of supply chain partners is the ability to exchange data with trading partners. The survey asked about three categories of information: design specifications and computer aided design (CAD) files, accounting, and order status or logistics.

About 91% use email to exchange design and specification documents, including CAD with their suppliers, while 96% use it with their buyers. One of the challenges with heavy use of email for this purpose is that email is unstructured data that cannot easily be captured, shared and re-used. This is particularly important when design and manufacturing teams must collaborate across multiple locations and enterprises.

Electronic Data Interchange (EDI) is a very structured means for exchanging data and has been around for decades. Just over 30% of survey respondents said they use EDI for accounting and 22% use it for logistics with their suppliers. The number for EDI exchange with buyers is nearly double that at 41%. These are ideal uses for EDI as that kind of data tends to be transactional and very structured. Roughly 20% report using EDI for design specifications with both suppliers and buyers, which is not as efficient as design typically requires dialog for collaboration, something that does not easily fit into a rigid structure.

The use of a portal to exchange design and specification documents was reported by about a third of the respondents. Their use for order entry or accounting and logistics was about 13% with suppliers and around 20% with buyers. This seems logical since many of the suppliers in this survey are mid-tier and they are often dealing with larger buyers that are more sophisticated. One downside is each connection to a portal requires a level of effort,

with some needing more than others. This results in overhead costs that increase with the number of portals to which a company must connect.

Fax communications use came in higher than would be expected for an old technology. About 22% reported using for design specifications with both suppliers and buyers. Just over one third of respondents report using fax to exchange order entry and accounting data in both directions. While fax is still common among smaller companies, it is one of the least efficient communications methods. Moving those faxed communications to EDI or a portal represents one of the greatest opportunities to increase the desirability of a company as a supply chain partner.

Supply Chain Visibility

One of the most important aspects of success in modern supply chains is visibility down to the lowest tiers. This is particularly true in supply chains where risk identification and mitigation are important.

One of the questions in the quantitative survey asked subjects about visibility into their supply chains. Nearly 38% indicated that "All suppliers are known," while 25% said that they know their immediate suppliers only. The remainder of the respondents said they know varying levels of their lower-tier suppliers. While the 38% may be considered high compared to broader surveys, it could easily be explained by the respondents being from smaller companies that have fewer layers of suppliers.

ANALYSIS

The analysis of these findings is for the defense industrial base only, which is not likely representative of the entire North Carolina industrial base. The tools and structure used for this data do lend themselves to inclusion of data on the commercial sector, which would provide a more complete picture of the region's supply chain challenges and opportunities.

While a typical supply chain analysis for a company would look primarily at ways to increase efficiencies while mitigating risk, the analysis in this report is done from more of an economic development perspective. In this context, the analysis focuses more on what are the region's strengths and weaknesses in participating in and contributing to defense supply chains.

Strengths

Professional Services

This is the largest segment of the DIB, with 2,284 companies listing NAICS 54 – Professional, Scientific and Technical Services for their primary offering. Services provided by this group include logistics, communications and engineering/technical.

The area of professional services, particularly engineering and technical, is very important to manufacturing supply chains. This is particularly true with the drive by both government and commercial organizations to more closely connect design and manufacturability.

There are 314 firms with a primary NAICS of "Engineering Services" in the state. Having these engineering services in the state increases the opportunity to collaborate onsite with regional manufacturers. Pairing these engineering and manufacturing capabilities can help provide each with a competitive advantage. Pitching this strength with large firms outside the region can help position North Carolina firms as more desirable supply chain partners.

Manufacturing

North Carolina has substantial strength in manufacturers, with 1,719 covering products from raw materials to finished goods. These manufacturers provide a variety of capabilities, which can help the region better participate in a wide range of national and global supply chains.

Nearly 71% of those manufacturers are focused in NAICS 33, which encompasses primary and fabricated metals, machinery, electronics and transportation. Machinery is produced by 263 of those companies and 234 produce computer and electronic products. These types of supply chain partners are very important for industries like aerospace and automotive, which are often valuable to economic development efforts.

Additive manufacturing is a rapidly growing element of strong manufacturing sectors. While the DOD data does not provide insights into its use within the DIB, our secondary

research found evidence that suggests additive manufacturing is gaining strength in North Carolina.

The Center for Additive Manufacturing and Logistics (CAMAL) has raised regional awareness of the technology and is being credited with helping grow the state's capabilities. Economic development authorities have stated "We have quite a few companies locating plants in the region from other areas." (Nash-Hoff, 2017) Some of those listed include ProtoLabs, UNYQ, Oerlikon and Fusion3. The presence of these new additive manufacturing-focused companies along with the adoption of this technology by existing companies becomes an important strength for North Carolina manufacturing.

Textiles

When evaluating products sold, textiles was the largest segment with more than $142 million in sales to the DOD in FY17. This segment was much larger than we've seen in other states.

The participation of NC State in the Advanced Functional Fabrics of America institute and the availability of resources like the Manufacturing Solution Center provide the state with additional strength in the textile industries. These resources can be used to help grow existing companies and to lure new businesses.

Construction

Contracts with a primary NAICS of 23-Construction was the second highest source of DOD revenue for the state in FY17. There are 1,345 construction companies in the NC DIB, with 283 of them listing their primary NAICS as "Industrial Building Construction" or "Commercial and Institutional Building Construction." This is logical, as growth at the state's large military bases requires contracted construction support.

The size and makeup of this group could help the NC region better handle industrial growth that requires new or updated structures. Requirements for infrastructure growth should also be readily addressed, with 73 contractors registered for "Highway, Street, and Bridge Construction."

Weaknesses

Machine Shops

As noted in the findings section, there are only 54 companies with a primary NAICS code of 332710 – Machine Shop. These companies can make products for sale, provide additional capacity for high demand and also repair parts to keep production equipment running. Another advantage is that these shops can typically produce products for most all industries. Since machine shops are often an important element in many different supply chains, this may be a key factor in growing the state's manufacturing base.

Since this analysis is focused on the "defense" industrial base and may not be representative of the state-wide industrial base, this issue of the machine shops warrants further research.

Supply Chain Partners

One of the greatest weaknesses that could hamper the region is that few SMEs have taken steps to make them a more desirable supply chain partner. When asked about top supply chain issues, most SMEs had little knowledge of what it takes to understand and manage an extended supply chain aside from their immediate suppliers and buyers.

While some companies report having automation tools, such as ERP, MES and MOM systems, they are still heavily reliant on tools like fax and email to exchange data. These tools are inefficient and create silos of information, limiting the ability for supply chains to capture and re-use that data.

Another area in which NC manufacturers will want to improve is visibility into the lower tiers. This is becoming increasingly important for the DOD and large corporations to better manage supply chain risk. Companies that can provide complete visibility into their supply chains will have a competitive advantage.

While a number of articles have cited geography as the primary reason for losing the Toyota-Mazda plant to Alabama (Shore, 2018) (Dukes, 2018), it would be interesting to dig deeper. Could NC companies trail those in Alabama when it comes to their ability to participate in supply chains? Does NC lack the right mixture and quantity of automotive supply chain partners, such as machine shops?

Opportunities

The research and data analysis has identified a number of areas in which the NCDIDI team could help their constituents diversify their client base, become more desirable supply chain partners and grow their businesses.

Cultivate Textile Manufacturing

The state has significant experience in and resources related to textile manufacturing. Particularly within the DOD, there is a growing opportunity for U.S. textile manufacturers to meet the demands for American products. While some of these are for traditional products, groups like the Special Operations Forces are always looking for advanced materials and capabilities. In fact, the Army had a recent solicitation for "Advanced Materials for Soldier Environmental Protection," which the SDG team passed along to the Manufacturing Solutions Center.

There may be an opportunity for NCDIDI to help better connect organizations looking for advanced materials and products with companies in the state. Questions to be answered in exploring this opportunity include the following.

1. Are there already resources that connect government and commercial textile needs with qualified organizations in the state?

2. Do textile manufacturers review government resources, like the Defense Innovation Marketplace (www.defenseinnovationmarketplace.mil) for opportunities?

Help DOD Source Locally

In FY17, there were approximately $900 million of services bought by DOD contractors inside North Carolina from companies outside the state. Just over $670 million was for NAICS 54 – Professional, scientific and technical services while about $211 million was for NAICS 23 – Construction. Many of the outbound professional services contracts were awarded by the Durham office of the Army Contracting Command – Aberdeen Proving Ground (ACC-APG). ACC-APG handles contracts for all of the services and the Defense Advanced Research Projects Agency (DARPA).

While there may be important reasons these services were bought elsewhere, it would be good for NCDIDI to understand those needs to see if they can be matched to regional capabilities. This is particularly true for those contracts awarded by the ACC-APG in Durham. Some of the questions to be answered include:

1. What services are needed by the DOD that they cannot find in the state?
2. How do the state's DOD contracting offices find sources to meet its needs?
3. Are the region's DOD contracting offices aware of NC firms that are providing goods and services to DOD contracting offices outside the region?

Leverage Government Research and Development Grants

There are a number of government resources that provide grants to help companies improve their technology or increase their capabilities. Very few of the companies interviewed for this work were aware of those resources but expressed interest once they were explained.

Small Business Innovation Research, Rapid Innovation Fund, ManufacturingUSA and other government programs can be a great source to help local companies grow, and thereby strengthen the region. Raising awareness of these programs and helping companies through the application process could reap great rewards and position NCDIDI in a very favorable light.

More importantly, grants like these help companies create or increase the value of their intellectual property. That can result in greater outside investments, higher company valuations and the launch of new companies.

Considerations include the following.

1. How aware are SMEs of these government grants?
2. Are there any barriers that keep regional companies from participating in these programs?
3. What regional resources are available to help companies through the application process?

Bolster Contract Manufacturing

Contract manufacturing is loosely defined as companies that quote on and manufacture to the specifications of others. Machine shops, fabricators and stampers are typical examples. Contract manufacturers are important to supply chains as they provide flexibility and elasticity.

Taking steps to help bolster contract manufacturing not only strengthens the region's supply chain capabilities, it could also help existing firms find new business and diversify their sales portfolios. Some of the most common ways to achieve this are to help firms increase their competitive advantages and improve their marketing effectiveness. Industry Expansion Solutions (IES) is part of the Manufacturing Extension Partnership and is ideally suited to help with those efforts. Following are some of the key questions to consider in gauging the need and value of this effort.

1. What are the state's contract manufacturing capabilities and where are they located?
2. Do the region's large manufacturers and DOD installations often source contract manufacturing from outside the area?
3. If the DOD has demand for these services that is not being met by NC defense manufacturers, could NCDIDI encourage others to consider DOD work?

Improve Supply Chain Competitiveness

Participating in modern supply chains is placing greater demands on today's manufacturers that go beyond the traditional requirements of price, quality and delivery. Manufacturers today need to be responsive and make it easier to connect both systems and processes – all while providing clients with greater visibility into their own supply chain.

The NCDIDI team could work with IES and APICS, one of the country's leading organizations for supply chain management, to develop and implement a program that would help regional manufacturers improve their desirability as supply chain partners. Some of the areas to be addressed for improved desirability include the exchange of data, increasing visibility to all tiers and better managing supply chain risk. Questions to be answered in support of this effort include the following.

1. What do large companies look for in supply chain partners, beyond just price, quality and delivery, and how much value do they place on those capabilities?
2. How much effort and cost are required to help the region's SMEs build these supply chain capabilities?
3. Can the region partner with supply chain hubs like Exostar or Covisint to expedite the process and create a regional infrastructure?

SUMMARY

The findings provide detailed information about the exchange of goods and services between NC organizations and the DOD. (Data regarding the exchange between prime and subcontractors was minimal.) While some of the information is likely already known to the NCDIDI team, the SDG team was surprised that the services sector in the DIB is nearly 75% larger than the manufacturing sector.

Further research is needed to help better understand the composition of those professional services being provided. Coupling that insight with the research initiatives throughout the state could help identify new opportunities for growth. For instance, could the work at CAMAL be matched with research monies available for additive manufacturing and small businesses to help NC strengthen and grow its manufacturing base?

In the analysis of these findings, the SDG team has identified a number of strengths, weaknesses and opportunities. Despite a small manufacturing footprint in the NC DIB, there are a number of interesting opportunities that can not only help the professional services sector, but also strengthen and grow the manufacturing base as well. The challenge will be to define any additional opportunities and then prioritize them on what will have the greatest impact in the shortest period at the lowest cost.

As next steps are planned, the NCDIDI team can benefit from the rapid growth of additive manufacturing and the resurgence of American textile manufacturing. Ensuring that the state's advanced research organizations and NC companies are aware of and aligned with these growth areas can help the state better strengthen and grow the region's capabilities.

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Appendices

APPENDIX A – 2018 NC Company Count by NAICS

These figures were taken from the government's System for Award management in February 2018.

NAICS Code	Percentage	Number
54 - Professional, Scientific, and Technical Services	21%	2284
31-33 - Manufacturing	16%	1719
23 - Construction	12%	1345
56 - Administrative and Support and Waste Management and Remediation Services	8%	913
42 - Wholesale Trade	7%	760
62 - Health Care and Social Assistance	6%	682
53 - Real Estate Rental and Leasing	5%	542
61 - Educational Services	4%	420
44-45 - Retail Trade	3%	375
48-49 - Transportation and Warehousing	3%	371
81 - Other Services (except Public Administration	3%	360
51 - Information	3%	289
72 - Accommodation and Food Services	2%	269
11 - Agriculture, Forestry, Fishing and Hunting	1%	154
22 - Utilities	1%	91
71 - Arts, Entertainment, and Recreation	1%	85
92 - Public Administration	1%	84
52 - Finance and Insurance	1%	68
21 - Mining	0%	26
55 - Management of Companies and Enterprises	0%	7

APPENDIX B – FY2017 Contracts by Product Service Code

These figures are from USASpending for fiscal year 2017.

Product Service Code Groups - PRODUCTS	Base and Exercised Options Value
Group 42: Firefighting, rescue and safety equip; and environmental protection equip and matls.	$ 140,158,291
Group 84: Clothing, individual equipment, insignia and jewelry	$ 96,594,984
Group 89: Subsistence	$ 62,360,022
Group 83: Textiles, leather, furs, apparel and shoe bindings, tents and flags	$ 45,444,363
Group 61: Electric wire, and power and distribution equip	$ 44,055,726
Group 16: Aerospace craft components and accessories	$ 35,360,079
Group 23: Ground effect vehicles, motor vehicles, trailers and cycles	$ 28,332,209
Group 65: Medical, dental, and veterinary equipment and supplies	$ 27,425,031
Group 58: Communications, detection and radiation equip	$ 26,939,653
Group 66: Instruments and laboratory equip	$ 20,400,505
Group 38: Construction, mining, excavating and highway maintenance equip	$ 19,481,577
Group 70: Information technology equipment (including firmware), software, supplies and support equipment	$ 15,961,910
Group 34: Metalworking machinery	$ 13,855,981
Group 62: Lighting fixtures and lamps	$ 11,058,596
Group 73: Food preparation and serving equip	$ 10,656,599
Group 60: Fiber optics materials, components, assemblies and accessories	$ 8,732,643
Group 59: Electrical and electronic equip components	$ 8,249,175
Group 71: Furniture	$ 6,584,986
Group 25: Vehicular equipment components	$ 6,233,536
Group 63: Alarm, signal and security detection	$ 5,946,072
Group 49: Maintenance and repair shop equipment	$ 5,193,154

Product Service Code - SERVICES	Base and Exercised Options Value
Cat Z: Maintenance, Repair, Alteration of Structures/Facilities	$ 316,619,145
Cat S: Utilities and Housekeeping	$ 253,593,496
Cat R: Support (Professional/Administrative/Management)	$ 218,768,494
Cat Y: Construction of Structures/Facilities	$ 87,161,760
Cat Q: Medical	$ 78,456,016
Cat AD: R&D - Defense Other	$ 51,623,833
Cat U: Education/Training	$ 49,524,415
Cat D: Information Technology and Telecommunications	$ 41,286,381
Cat J: Maintenance, Repair, and Rebuilding of Equipment	$ 27,003,664
Cat C: Architect and Engineering Services	$ 25,050,186
Cat AC: R&D - Defense Systems	$ 19,936,225
Cat AJ: R&D - General Science/Technology	$ 13,502,931
Cat F: Natural Resources Management	$ 12,860,776
Cat V: Transportation/Travel/Relocation	$ 7,450,962
Cat W: Lease/Rental of Equipment	$ 6,348,823
Cat AZ: R&D - Other Research and Development	$ 6,334,974
Cat AN: R&D - Medical	$ 5,398,629
Cat M: Operation of Structures/Facilities	$ 5,063,695
Cat N: Installation of Equipment	$ 2,917,419
Cat AE: R&D - Economic Growth	$ 2,626,005
Cat P: Salvage	$ 1,844,508
Cat H: Quality Control, Testing, and Inspection	$ 1,309,258

APPENDIX C – NC Weapon System Sales 2013 to Present

These figures are from "Haystack Gold," which is a commercial service providing transactional data from the Federal Logistics Information System. The numbers here are primarily for the purchase of parts and components to support a weapon system. They do not necessarily represent all contracts in support of a particular weapon system, particularly for entire systems or some large bulk purchases.

Weapon System	Total Sales	
F 16 AIR COMBAT FIGHTER Total	$	36,966,489
DLA/GSA MANAGED ITEMS THAT CANNOT BE IDENTIFIED TO A SPECIFIC ARMY WEAPONS SYSTEM/END ITEM Total	$	33,019,919
P-24 FIRE TRUCK Total	$	12,927,515
C 135 STRATOLIFTER Total	$	6,883,101
COMMON ARMAMENT AND FIRE CONTROL MATERIAL Total	$	5,905,205
B 52 STRATO FORTRESS Total	$	3,804,015
A 10 SPECIALIZED CLOSE SUPPORT AIRCRAFT Total	$	2,563,093
HEAVY EXPANDED MOBILITY TACTICAL TRUCKS (HEMTT), ABT, M977, M978, M983, M984 AND M985 (TACTICAL VEHICLES) Total	$	1,940,502
OV 1 (FIXED WING AIRCRAFT) Total	$	1,509,650
TANK, ABRAMS M-1 Total	$	1,437,182
HELICOPTER, APACHE AH-64 Total	$	1,350,159
PAVE PHASED ARRAY WARNING SYS (PAWS) Total	$	1,108,294
COUNTERMEASURE SET, AN/SLQ-32 Total	$	1,094,842

Notes

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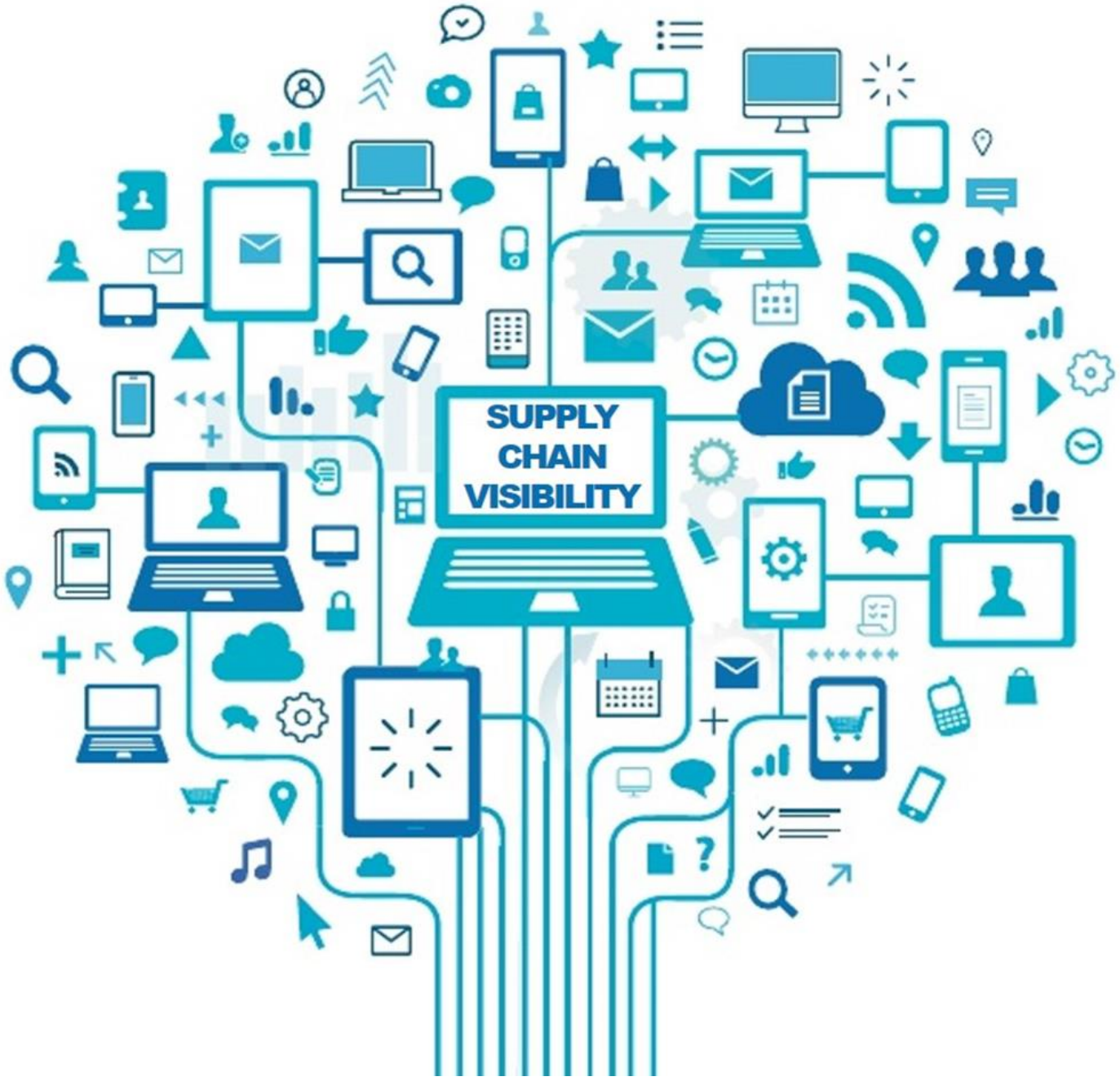

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