

# Missouri Defense Supply Chain Analysis

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St. Louis Economic Development  
Partnership  
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Submitted by:



THOMAS P. MILLER & ASSOCIATES



**STLPARTNERSHIP**

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### 1. Strategic Recommendations

Thomas P. Miller & Associates' (TPMA's) consulting team has formed a series of 11 strategic recommendations for the St. Louis Economic Development Partnership (the Partnership), based on extensive primary and secondary data analysis. Following several months of defense data collection and analysis – including numerous secondary data sources,<sup>1</sup> in-depth interviews, and research into best practices – TPMA's consulting team met with representatives from the Partnership in early May 2017 for an in-person strategy session to discuss current analyses and approaches for translating the analyses into actionable recommendations for the Supply Chain Mapping project. Following this meeting and through ongoing collaboration with the Partnership, TPMA's consulting team further developed recommendations by enhancing prior research and adding case studies. The recommendations developed by TPMA's consulting team break into four categories, outlined in the section to follow:

**Connecting.** *Joining public and private stakeholders from across the state*

- Recommendation 1. Create an Association for Defense Contractors
- Recommendation 2. Connect with Existing Military Assets on Tech-Based Solutions
- Recommendation 3. Connect Private Sector and Higher Education Researchers Around Enabling Technologies

**Enabling.** *Encouraging greater industry diversification*

- Recommendation 4. Find Non-Defense Markets for Tier II Defense Suppliers
- Recommendation 5. Educate State Economic Development Organizations on Best Practices

**Coaching.** *Building capacity for future success by coaching and educating*

- Recommendation 6. Develop a Training Program to Assist Companies with DoD Contracting
- Recommendation 7. Provide Contractors and Potential Contractors More Clarity on DoD Budgeting

**Programming.** *Creating events and programs that can develop more sustainable and diverse defense contracting opportunities*

- Recommendation 8. Use and Maintain the Supply Chain Map
- Recommendation 9. Provide International Export Assistance
- Recommendation 10. Create Programs Aimed at Helping Veterans Get Jobs
- Recommendation 11. Develop a University-Housed Innovation Center

#### Connecting

*Recommendation 1. Create an Association for Defense Contractors*

One challenge affecting Missouri's defense industry is the need for a shared vision between key industry leaders and smaller businesses. While healthy competition is good for business, it becomes problematic when businesses do not collaborate to address major industry issues. TPMA's consulting team recommends creating an association for defense contractors headed by influential industry leaders, large and small, to give Missouri's defense industry a sense of direction and a common vision for moving forward. Industry leaders would serve on the association's board of directors and would appoint staff members to run its daily operations. This group would advocate on behalf of defense contractors across

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<sup>1</sup> See [Appendix A](#) for a listing of key secondary data sources.

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the State of Missouri on issues the defense community faces. Due to the diversity of defense contractors across an array of industries, it would be necessary to create sub-committees within the defense association. These sub-committees would be specific to the distinct clusters that comprise Missouri's defense contractors, such as construction contractors, manufacturers, research and development (R&D), and professional services contractors. Subcommittees could meet monthly, while the entire defense contractors' association could meet quarterly. All members would have access to the same benefits, which could include:

- Acting as an advocacy group for Missouri's defense industry
- Serving as a liaison with local, state, and federal agencies and elected officials
- Developing or improving the Missouri defense community's ability to develop, attract, retain, and execute business opportunities
- Improving interactions between defense contractors and defense customers

The association for defense contractors could be partially funded through memberships and structured similarly to other local and state defense associations; such as the Charleston Defense Contractors Association ([CDCA](#)), Dayton Area Defense Contractors Association ([DADCA](#)), Florida Defense Contractors Association ([FDCA](#)), North Carolina Military Business Center ([NCMBC](#)) or the Northeast Indiana Defense Industry Association ([NIDIA](#)). These examples illustrate different sizes of defense associations, ranging from metropolitan level, to regional level, to state-wide level; however, each model could be scaled up to suite the Partnership and Missouri's needs. These defense contractor organizations also represent many different types of contractors. For example, the NCMBC works to connect the following industries with defense contracts:

- Advanced Manufacturing and Materials
- Aerospace Systems
- Biotechnologies and Biodefense
- Clothing and Textiles
- Construction
- Cyber, Software and Advanced IT Systems
- Energy and Environment
- Food
- Furniture
- Human Factors
- Medical Technologies
- Transportation

The NCMBA is structured slightly different from the other defense industry associations mentioned, because it is more of a business development entity, rather than a true industry association. However, it is a great example of how many different contracting industries can be represented by an organization. Leveraging aspects of this organization in addition to the traditional activities of a membership driven industry association would be beneficial. The Partnership could also expand upon its Regional Advanced Manufacturing Partnership (RAMP) by scaling it into an industry association that focuses on more than advanced manufacturing. If the Partnership chooses this option, the asset map developed by TPMA's consulting team may be used to identify additional companies outside of advanced manufacturing, which could be brought into an expanded RAMP program. In this scenario, the RAMP program could expand from a regional program into a statewide program.

If the Partnership chooses the more traditional defense association model, memberships may be divided into multiple tiers and different rates could be charged for each. Companies could have more access to services depending on the level of membership purchased. Memberships could be based on the size of

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the company, with larger companies paying more in fees as they would likely be using more services that the association offers. A Missouri association for defense contractors could also offer networking opportunities and conferences, such as monthly “lunch and learn” events specific to each sub-committee. For example, the defense manufacturer subcommittee could have an expert present on international exporting, or product commercialization. Quarterly meetings that combine all subcommittees could focus on broader topics concerning the defense industry. Furthermore, a yearly summit could be hosted for association members that would include relevant exhibits and speakers. This summit could change locations each year throughout the state so that it does not appear that the defense association overly favors a particular geographic location.

### *Recommendation 2. Connect with Existing Military Assets on Technology-Based Solutions*

Missouri has valuable military assets including Whiteman Air Force Base, Fort Leonard Wood, and the Marine Corps Mobilization Command. Since World War II, military branches and defense contractors have been developing technologies that spin-off to a multitude of commercial applications. Examples include GPS, Radar/Microwaves, Nylon, Drones, and the Internet.<sup>2</sup> Building upon the rich tradition of commercialization of military technologies, the Partnership and appropriate economic development agencies throughout the state could meet with military installations to discuss assets and needs, while focusing on new and advancing technologies. Meetings could be set up between high-ranking EDO representatives and high-ranking military representatives. The content of these conversations could be focused on what technologies are available on base what may benefit nearby private sector companies, how would such partnerships be developed, and what specific characteristics military installations require of partnering companies.

Some military “smart bases” have already begun incorporating a variety of new, cutting-edge technologies. These bases are employing technologies such as artificial intelligence, Internet of Things (IOT), machine automation, robotics, and data analysis. New technology has been effective at improving the quality and speed of on-base functions. Smart technologies employed at US military installations are allowing base staff to process more data faster, which enables better decision making and cost savings.<sup>3</sup>

Fort Stewart in Georgia is currently using over 130,000 solar panels to help power the installation, but most importantly, the solar grid would allow the base to stay operational even if a disaster shut down the power-grid.<sup>4</sup> Fort Bragg is currently working to develop driverless vehicles to transport wounded soldiers to the base’s medical center. While these types of vehicles may be on al battlefield someday, they are currently saving the base money by providing soldiers with reliable transportation for base

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<sup>2</sup> Shu, L. (2014, May 23). GPS, drones, microwaves and other everyday technologies born on the battlefield. Retrieved June 15, 2017, from <https://www.digitaltrends.com/cool-tech/modern-civilian-tech-made-possible-wartime-research-development/>

<sup>3</sup> Johnson, T. (2017, June 03). Smart City Tech Would Make Military Bases Safer. Retrieved June 14, 2017, from <https://www.wired.com/2017/02/smart-city-tech-make-military-bases-safer/>

<sup>4</sup> Coleman, D. (2016, December 10). Army, Georgia Power build 250-acre solar energy farm on Fort Stewart. Retrieved June 14, 2017, from <http://savannahnow.com/news/2016-12-09/army-georgia-power-build-250-acre-solar-energy-farm-fort-stewart>

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hospital appointments. If a soldier misses one of these appointments it costs the base approximately \$5,000.<sup>5</sup>

The navy is also turning to advanced technologies by pioneering the use of 3-D printers to create replacement parts more conveniently on site.<sup>6</sup> The Partnership could work with local technology-companies and leaders of the state's military installations to see if new technology-based solutions could solve new and relevant issues. Through these efforts, the Partnership may be able to increase the portion of contracts from Missouri's military installations that are awarded to businesses within the state. For example, while 56% of FY13-16 prime contract dollars from Fort Leonard Wood were awarded to in-state firms, the percentage was significantly lower in technology-related industry groups. Among contracts for Durable Goods Manufacturing, only 9% went to Missouri businesses, while only 4% of Information, Professional, or Scientific contracts from the fort went to Missouri businesses.

In order to increase collaboration, the Partnership could facilitate an event, or series of events, that brings together local military leaders from the state's installations and members of the local defense and technology industries. During this event, military leaders could explain some of the issues that affect their bases on a re-occurring basis. The technology and defense companies could help talk through some of the problems and explain potential solutions available or brainstorm the creation of new solutions.

To accomplish this, the Partnership would need to consider key barriers associated with collaboration across the defense industry, such as confidentiality. The problem-solving session should be developed in a way that engineers and scientists could develop possible solutions without worrying about confidentiality issues. This could be accomplished by holding the event in the public sphere, such as at a statewide summit for defense contractors. This summit would be created to raise statewide awareness of Defense Technology, and to illustrate some of the fascinating technologies that Missouri companies are developing to keep the United States safe. Through these connections and deepened understanding of defense-related needs, local companies could develop and commercialize solutions to real and emerging problems that could then be sold back to Missouri's military installations, as well as other military installations throughout the United States and globally.

A collaboration event may also promote networking between defense companies and technology companies that otherwise might not occur. This could lead to more defense innovations beyond the immediate needs of military installations. Lastly, though the primary purpose of such technologies is to serve the purpose of defending Americans, there are likely occasions where such technologies have downtime or additional capacity that could be used by other local organizations.

*Recommendation 3. Connect Private Sector and Higher Education Researchers Around Enabling Technologies*  
Enabling technologies are any material or equipment that significantly advance user capabilities of a product. Encouraging and educating companies on enabling technologies could help reduce dependence

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<sup>5</sup> Truett, R. (2016, August 22). Army develops autonomous vehicles for use on bases first, battlefields next. Retrieved June 14, 2017, from <http://www.autonews.com/article/20160822/OEM06/308229999/army-develops-autonomous-vehicles-for-use-on-bases-first-battlefields>

<sup>6</sup> NAVSEA. (n.d.). Print the Fleet. Retrieved June 14, 2017, from <http://www.navsea.navy.mil/Home/Warfare-Centers/NSWC-Dahlgren/What-We-Do/Print-The-Fleet/>

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on defense spending. There are four main categories of enabling technologies that include advanced materials; biosciences; electronics, sensors and photonics; and information and communication technology (ICT).<sup>7</sup> Missouri and the St. Louis MSA are in a strong position to drive innovation in some of these categories due to the presence of highly regarded Universities and Colleges committed to Research and Development such as:

- [East Central College](#)
- [Fontbonne University](#)
- [Harris Stowe State University](#)
- [Lindenwood University](#)
- [Maryville University](#)
- [Missouri University of Science and Technology](#)
- [Ranken Technical College](#)
- [St. Charles Community College](#)
- [St. Louis Community College](#)
- [St. Louis University- Parks College of Engineering, Aviation, and Technology](#)
- [University of Missouri College of Engineering](#)
- [University of Missouri-St. Louis](#)
- [Washington University in Saint Louis](#)
- [Webster University](#)

For additional details around degree programs offered at each college see [Appendix F](#).

The Partnership could work with these institutions and defense manufacturers to identify gaps related to workforce needs. If companies are hiring a significant number of employees from other states to fill certain jobs, Missouri's universities should better align specific programs to address what companies are looking for. The Partnership could play a role in bringing these groups together to create program alignment solutions.

Furthermore, all categories of enabling technologies have applications in defense and commercial industries. The Partnership could focus on solutions that enhance the prominence of enabling technologies throughout the state. A creative program that the Partnership could facilitate is a yearly "reverse-pitch" conference where established companies pitch specific R&D issues to local universities (specifically engineering programs/students) or entrepreneurs that are skilled in coding, design, and technology. The goal would be for students or local entrepreneurs to design solutions to specific business issues that the companies have encountered but cannot yet address. The partnership could leverage the advanced manufacturing innovation center once it is completed by allowing the participants of this program free access to the facility, its resources, and technologies. Experts from the St. Louis community such as scientists, engineers, or skilled manufacturers could be approached to volunteer their time for advising the participants on their projects. The [Harvard Innovation Lab](#) offers a similar program and could be considered a best practice if the Partnership wanted to include this service in the reverse-pitch program. If the students' or entrepreneurs' reverse-pitch projects are successful, they could receive funding to continue their work, or jobs facilitating innovation with local companies. The Partnership could host this event at the Advanced Manufacturing Innovation Center that it is in the process of developing. The reverse-pitch program could also serve as a method for the Partnership to identify potential companies for its innovation center. Groups that were successful at receiving funding could also receive a space in the forthcoming innovation center to continue their ideas. The companies

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<sup>7</sup> Nanotechnology and Integrated Bioengineering Centre. (2012). Enabling technologies Strategy (Rep.). Retrieved June 14, 2017, from Nanotechnology and Integrated Bioengineering Centre website: [http://www.nibec.ulster.ac.uk/uploads/documents/enablingtechnologies\\_strategywebfinal\\_nov\\_2012.pdf](http://www.nibec.ulster.ac.uk/uploads/documents/enablingtechnologies_strategywebfinal_nov_2012.pdf)



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taking part in the reverse-pitch program could fund this through sponsorship fees tied to the event, or the cost could be built into the funding that winning teams receive.

Another option the Partnership could pursue is to create a consortium aimed at connecting local businesses already producing enabling technologies with appropriate defense companies. The consortium's goal would be to encourage collaboration between defense industries and other industries producing enabling technologies. Members of the consortium could be invited to attend quarterly networking events that highlighted major innovation or accomplishments made by Missouri industries in relation to enabling technologies, as well as networking sessions that would encourage technology leaders to consider ways in which their technologies could benefit one another. The goal would be to form business connections that could lead to the development of new technologies with applications in defense or commercial sectors.

To further support this recommendation, all events and activities that connect researchers from private industry and higher education could be hosted at the Advanced Manufacturing Innovation Center currently being developed by the Partnership.

### Enabling

#### *Recommendation 4. Find Non-Defense Markets for Tier II Defense Suppliers*

As shown in the regional economic impact analyses delivered in tandem with this report, areas such as Missouri Economic Development Council (MEDC) Region 5 have such a deep and integrated local supply chain supporting defense companies that the actual impact of defense contracts extends far beyond the walls of companies like Boeing. The jobs multiplier for Region 5 defense contracts is 3.1, indicating that for every 1 job at a direct defense contractor, another 2.1 jobs are supported throughout the region. Of course, when defense spending is strong, these multipliers highlight positive community impacts, but if defense contracts decrease the effect would run in the opposite direction, which could lead to large scale job losses.

One way to mitigate the potential negative impact of defense cutbacks is to assist Tier II suppliers in finding new applications for their products.<sup>8</sup> TPMA's consulting team's analysis revealed that there are numerous industries that serve as suppliers to large-scale defense contractors, yet produce products generic and flexible enough to be adapted to other industry applications.

The Partnership and other state economic development agencies could use TPMA's consulting team's list of defense contractors to identify Tier II defense contracts companies to meet with and discuss market diversification opportunities. The following 106-digit NAICS sectors are the strongest candidates for targeting within the State of Missouri based on evidence of purchases from Tier II defense suppliers and strong to moderate job growth in the past five years:

1. Light Truck and Utility Vehicle Manufacturing

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<sup>8</sup> Generally, private sector supply chain analyses focus on suppliers according to Tier level (Tier I, Tier II, etc.). When performing a supply-chain analysis for an entire industry group it is difficult to identify companies or industries beyond Tier III suppliers without performing a very invasive and time-consuming analysis. In some places, the Tier terminology is used within this report but TPMA's consulting team also uses terms such as; Prime contractors and Subcontractors, in accordance with DoD terminology.

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2. Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing
3. All Other Basic Organic Chemical Manufacturing
4. Dog and Cat Food Manufacturing
5. Breweries
6. All Other Plastics Product Manufacturing
7. Data Processing, Hosting, and Related Services
8. Plumbing, Heating, and Air-Conditioning Contractors
9. Motor Vehicle Seating and Interior Trim Manufacturing
10. Soap and Other Detergent Manufacturing

### *Recommendation 5. Educate State Economic Development Organizations on Best Practices*

US Department of Defense (DoD) contracting can be volatile and unpredictable. It is necessary for economic development organizations (EDOs) and manufacturers to adapt to rapid changes in the defense industry. Best practices exist for assisting defense contractors but it is likely that not all EDO representatives are familiar with these methods.

It is important for EDOs to stay current on DoD regulations and requirements such as certifications and sustainability requirements. Establishing stronger relationships with the Office of Economic Adjustment and National Defense Industrial Association should be prioritized. Relating back to [\*Recommendation 1: Create an Association for Defense Contractors\*](#) engaging with representatives from each of these organizations could be one of the functions of the association of defense contractors. The Partnership could create and maintain a dialogue with these institutions about topics affecting the defense industry nationally, globally, and at the state and community levels. Additionally, members of the Partnership, members of other EDOs, and business leaders, could attend a professional development opportunity that addresses government contracting such as the annual [\*Government Procurement Conference\*](#). EDOs across the state need to be kept aware of best practices to use the state's rich heritage of R&D, advanced manufacturing, engineering, and applied sciences to attract, retain, and grow companies in the defense pipeline.

The Partnership could work with other EDOs throughout Missouri to make the state a more attractive place for defense companies, and companies that support the defense industry. The Partnership could begin this process with an assessment of current knowledge base and demand to identify gaps that currently exist. To address gaps, the Partnership could collaborate with EDOs state-wide to share and disseminate this key information. The Partnership could assess Missouri's workforce skills and the pipeline of workers expected to enter the defense industry. This assessment will identify any gaps that exist. To address gaps, the Partnership could work with educational institutions statewide to develop programs to plug these gaps. Other gaps may exist within the defense industry itself.

The Partnership and other Missouri EDO's could have in-house DoD or government contracting consultants to further improve the skills of current or aspiring contractors. This could provide a valuable service to small defense businesses because they often need the assistance a government contracting consultant offers, but lack the funding to pay for these services. The Partnership's in-house contracting consultant's main responsibility could be to educate companies on how to pursue government contracts successfully, with the goal of increasing the amount of DoD contracts won by small businesses in Missouri.

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Some of the most significant barriers small businesses face during the contracting process are:<sup>9</sup>

- Contract solicitation documents and the metrics for evaluating the proposal are difficult to understand
- Delays in contract awards cause financial difficulties for small businesses
- Unique requirements and regulations related to DoD bidding that differ from commercial sales
- Lack of responsiveness from government leads after the contract has been awarded to a small business

A DoD contracting consultant working at the Partnership could be able to help small businesses cope with these barriers during the contracting process. A consultant could also be able to provide tailored business development strategies focused on winning more DoD contracts, and assistance following all contract clauses and minimizing liability for violating these. Helping design tailored business plans for small businesses that focus on winning more DoD contracts could be another valuable service that an in-house DoD contracting consultant could provide. The ideal candidate for this role would be someone who has sufficient experience in government contracting (preferably DoD contracting) to understand the nuances of Federal Acquisition Regulations (FAR).

With a successful staff member in place, the Partnership could model the position and collaborate with other EDOs around the state to facilitate the development of multiple contracting coaches, possibly in coordination with higher-educational assets.

### Coaching

#### *Recommendation 6. Develop a Training Program to Assist Companies with DoD Contracting*

There are more contractors capable of applying for defense contracts than actually apply. Better educating contractors on finding and applying for defense-contracting opportunities could increase the number of DoD contracts won by Missouri businesses.

In order to obtain a Commercial and Government Entity (CAGE) code a company must have a fully accurate and compliant System for Award Management (SAM) registration. Any business that plans to receive payments from the government must have a one of these codes. A SAM code registers a company to do business with the US government. To register for a SAM code a company needs to go to the SAM website and enter the appropriate contact information.<sup>10</sup> Once a business has a SAM registration, it can complete registration for a CAGE code. To accomplish this a business representative needs to visit the website for Federal Awards Management Registration (FAMR), and again enter the appropriate contact information.<sup>11</sup> Procurement Technical Assistance Centers (PTACs) are another valuable resource for businesses that want to receive contracts from the federal government. They are capable of assisting businesses with applying for a SAM registration and provide business strategies for selling to federal, state, and local government agencies. PTACs can further help businesses as they offer workshops and seminars, one-on-one counselling services for businesses, and matchmaking events that

<sup>9</sup> Schilling, R., Mazzuchi, T. A., & Sarkani, S. (2016, May 13). Survey of Small Business Barriers to Department of Defense Contracts. Retrieved June 14, 2017, from <http://dau.dodlive.mil/2017/01/06/survey-of-small-business-barriers-to-department-of-defense-contracts/>

<sup>10</sup> System for Awards Management. (n.d.). Retrieved June 14, 2017, from <https://www.sam.gov/portal/SAM/##11>

<sup>11</sup> Federal Award Management Registration. (2014). Get A Cage Code Registration. Retrieved June 14, 2017, from <https://federal.famr.us/cage-code/>

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connect businesses with agency buyers. There are eight PTACs located throughout the State of Missouri. They are located in the following cities:

- Columbia
- Joplin
- Kansas City
- Macon
- Springfield
- St. Joseph
- St. Louis
- West Plains

All services provided by PTACs are free of charge, and any business considering contracting with federal, state, and local governments, should take advantage of these services. PTACs can also help defense contractors diversify into other federal markets and reduce dependency. The Partnership could assist small to medium sized businesses without a CAGE code, or those not registered in SAM, by connecting them to the nearest PTAC and continually promoting PTAC services.

For small and medium sized defense companies, there are a multitude of opportunities to receive contracts from DoD. From FY13-16, approximately 85% of Missouri-based companies that were awarded DoD contracts are classified as small business.<sup>12</sup> Since 2006, the percentage of R&D contracts won by the “Big 5” defense companies have been decreasing.<sup>13</sup> In 2015, the percentage of R&D contracts won by the Big 5 was 33%, compared to 57% in 2009. Conversely, the value of R&D contracts won by all other defense companies has been increasing. In 2015, small and medium sized defense companies received 46% of R&D contracts (the remaining 21% of 2015 DoD R&D contracts were won by large defense companies).<sup>14</sup> The Partnership could use this information to encourage more small and medium sized defense companies to register with SAM, receive a CAGE code, and begin bidding on contracting opportunities with the DoD.

### *Recommendation 7. Provide Contractors and Potential Contractors More Clarity on DoD Budgeting*

The DoD is expected to receive a budget increase under the new US President. However, for most contractors this is not necessarily a benefit or guarantee that they will see increased success procuring DoD contracts. In fact, the President himself has demonstrated the unpredictability of DoD contracting at a very high level. The case of the F-35 Joint Strike Fighter versus the F/A-18E/F Super Hornet is a prime example. The President has suggested that the federal government could cancel part of the order for a specific version of the F-35 in favor of Boeings F/A-18 Super Hornet even though the F-35 program has been underway for over 10 years.<sup>15</sup> While this is an extreme case and no decision has been officially made, it does exemplify that a contract with the DoD can change at any minute resulting in losses for one company and potential gains for another.

<sup>12</sup> Small businesses are defined as businesses in any industry with less than 100 employees.

<sup>13</sup> The Big 5 defense contractors include; Lockheed Martin, Boeing, General Dynamics, Northrop Grumman, and Raytheon.

<sup>14</sup> Hunter, A., Ellman, J., Cohen, S., Johnson, K., McCormick, R., & Sanders, G. (2017). Defense Acquisition Trends, 2016 (Rep.). Washington, D.C.: Center for Strategic & International Studies, 65.

<sup>15</sup> Aboulafia, R., Wirtz, B., Keatley, R., & Kelly, R. E. (2017, February 21). Trump's F-35C Vs. F/A-18E/F Super Hornet Idea: An Interesting Debate...Four Years Ago. Retrieved June 14, 2017, from <http://nationalinterest.org/blog/the-buzz/trumps-f-35c-vs-f-18e-f-super-hornet-idea-interesting-debate-19522>

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In 2015, the Big 5's share of R&D DoD contracts was at its lowest percent in the 2000-2015 period, even though the defense budget has reached record highs. This can mostly be attributed to the fact that the R&D contracting market has been cut nearly in half since 2009.<sup>16</sup> This is attributed to a significant decrease in the amount development programs for major weapons systems throughout the military. Even though the DoD budget remains high and is predicted to rise, it is unclear if this money will be used to develop new programs that allow defense contractors associated with weapons systems R&D to enter the market. Essentially, there is little clarity on when contracts will be released or what the contracts will be for. This means that companies heavily reliant on DoD funding should still be looking for ways to diversify, especially into commercial markets, even though the DoD budget is expected to continue its growth.

It is important the Partnership makes contractors or potential contractors aware of the realities of DoD budgeting. Though it can be difficult for companies to see past the immediate present and consider that defense contracts may not always flow in their direction, the Partnership could embrace the role of being a truthful and data-driven voice. Statistics such as those revealed in this supply chain map can help remove the "scales from the eyes" of some businesses. After gaining their attention, the Partnership could be ready to offer diversification opportunities such as those described elsewhere in this set of recommendations, especially [Recommendation 4. Find Non-Defense Markets for Tier II Defense Suppliers](#) and [Recommendation 9. Provide International Export Assistance](#).

### Programming

#### *Recommendation 8. Use and Maintain the Supply Chain Map*

The Supply Chain Map outlined in [Missouri's Defense Supply Chain](#), along with the associated spreadsheets delivered with this analysis enables the Partnership to identify gaps in Missouri's defense supply chain and gaps related to manufacturing. To address these gaps, the Partnership could work with manufacturers to improve their position in the defense industry by generating more work in the defense industry. A best practice for the Partnership related to this recommendation is to help manufacturers determine needs for current and future certification requirements necessary to work within the defense industry, and take advantage of programs for manufacturers to gain certification. The Partnership can further assist manufacturers to address supply chain issues by helping businesses develop supply chain metrics that can be benchmarked effectively by the businesses themselves. Besides identifying gaps, the Supply Chain Mapping project can help strengthen the defense industry in other ways. The Partnership could plan to use the Supply Chain Map in the following ways:

- Identify businesses that are at-risk in the event another company or manufacturer were to close or move out of state
- Identify new market opportunities for at-risk businesses
- Identify instances of supply chain gaps where an Original Equipment Manufacturer (OEM) may be using an overseas supplier instead of a local company, or the Partnership or the state could focus on recruiting a US company to fill this need
- Identify which current assets can be utilized to respond to future supply chain issues

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<sup>16</sup> Hunter, A., Ellman, J., Cohen, S., Johnson, K., McCormick, R., & Sanders, G. (2017). Defense Acquisition Trends, 2016 (Rep.). Washington, D.C.: Center for Strategic & International Studies, 65.

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The Partnership will need to maintain and update the Supply Chain Map for it to remain a relevant tool, and there are three options to do this. One scenario would be to hire a consultant on retainer to update the supply chain map as needed. This would save the Partnership time but could become costly overtime. Another possibility would be to buy an existing software to update the map automatically. This also could be rather costly. Another option would having the Partnership hire or train someone in house to maintain the Supply Chain Map. This would likely be the most cost effective option over the long term, and it would require a moderate amount of training. If the Partnership chooses this option, they should also consider partnering with a state level organization that conducts an annual business survey, and integrate a “Are you a defense contractor?” question to the survey. If such a survey currently exists it is likely managed by the state Department of Labor or Commerce. If no such system exists, the Partnership could partner with such organizations to develop a survey tool.

### *Recommendation 9. Provide International Export Assistance*

International defense markets present key opportunities for defense contractors, manufacturers, and suppliers. In 2015, global defense spending increased for the first time since 2010, to roughly \$1.68 trillion.<sup>17</sup> Increased conflict in the Middle East and aggression from Russia and North Korea is motivating this global increase in spending. These factors uniquely position domestic defense manufacturers to aid United States allies looking to strengthen national defense. Small to medium sized defense companies that may not currently be exporting their products could look to take advantage of this trend.

Statewide export programs that aim to help local small and medium sized businesses sell their products overseas are trending nationally. Such a program could be designed at the state level to assist Missouri defense companies, because many smaller and medium sized businesses are not aware of international opportunities that they could capitalize on. A statewide export program could aim to make companies throughout Missouri aware of international export trends and provide the guidance to pursue these opportunities successfully. The Partnership could begin by considering the export assistance opportunities offered to businesses at the federal level.

The Partnership could work with other national export assistance programs such as the US Commercial Service ([USCS](#)). The USCS is the main trade promotion agency of the US Government, with offices in major cities throughout the United States and seventy-five foreign countries. The USCS has two Missouri locations in Kansas City and St. Louis. These locations have trade specialists for specific industry sectors including aerospace and defense, which can offer market assessments and insights, assistance finding trade partners in foreign markets, due diligence service, and promotion to targeted audiences. This agency could play a major role in linking Missouri’s defense companies to international buyers. The Partnership is in a position to work with the USCS by connecting companies that have expressed interest in exporting. This could be an opportunity to leverage the USCS as it already has the processes in place and specialization assisting US Defense companies with exporting.

The US Small Business Administration ([SBA](#)) provides a similar export assistance program. The SBA oversees the State Trade Expansion Program ([STEP](#)), which awards funding to individual states to support export growth of America’s small business. Forty-four states earned a STEP award in 2016 to

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<sup>17</sup> 2016 Defense Markets Report: Defense Products (Rep.). (2016, June). Retrieved June 14, 2017, from International Trade Administration website: [http://trade.gov/topmarkets/pdf/Defense\\_Top\\_Markets\\_Report.pdf](http://trade.gov/topmarkets/pdf/Defense_Top_Markets_Report.pdf)

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fund small business export sales. This program has been successful, and the SBA reports that 2011 awardees received \$11 for every one dollar of federal investment through the program.<sup>18</sup> Awardees from 2012 and 2014 reported an even better return on investment of \$28 and \$37 respectively, for every federal dollar invested. Missouri has received \$634,134 of STEP funding from the federal government. The Missouri Department of Economic Development (MDED) manages the state's STEP fund and is scheduled to expand exports to the Middle East, with a specific focus on the United Arab Emirates. STEP funding will allow small businesses to participate in a governor led trade mission to the Middle East. This mission afforded small businesses the opportunity to exhibit at the International Defense Exhibition and Conference (IDEX) 2017, which occurred in Abu Dhabi. The Partnership could work with the MDED to connect more defense focused small businesses to the STEP program.

In addition to leveraging existing resources, the Partnership and state level economic development organizations could consider developing successful export assistance programs that exist elsewhere in the United States. Virginia has a leading export assistance program known as Virginia Leaders in Export Trade or "VALET". The VALET program is selective and works with only 25 companies in Virginia every year. These 25 qualifying companies receive capital resources provided by the state as well as professional services from VALET's private sector partners. Businesses that participate in the program receive \$30,000 toward export related expenses, international sales plan development, and entry into new international markets. In collaboration with other economic development organizations and the MEDC, the Partnership could develop a similar program specially designed to assist companies within the defense industry. This program would assist a specific number of the most defense dependent small to medium sized companies in Missouri to begin exporting, or to scale-up the amount of products they are exporting, so that these businesses are not as heavily dependent on DoD sources of funding.

### *Recommendation 10. Create Programs Aimed at Helping Veterans Get Jobs*

Missouri has a significant population of veterans.<sup>19</sup> This pool of skilled, motivated, and highly disciplined workforce is one of the greatest assets available to the state's employers. When responding to or preparing for defense industry adjustment, retaining these men and women in the state should be a major priority.

While defense communities are acutely aware of the unique skillsets of military personnel, veterans of working age are not commonly targeted or leveraged through intentional programming. Missouri currently has the [Show-Me Heroes](#) program that helps connect members of the National Guard and other military personnel with businesses. This program is a good start and the state could increase its efforts in assisting veterans with skill development, job placement, and especially entrepreneurship.

Entire economic development strategies can be created around leveraging veteran talent across industries as they diversify. Developing veteran communities into thriving contributors to the local economy includes better understanding the veteran population and what they have to offer, as well as encouraging entrepreneurial growth among veterans in support of small businesses. Each of these

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<sup>18</sup> US Small Business Administration. (n.d.). STEP Builds Upon Prior Success. Retrieved June 14, 2017, from <https://www.sba.gov/offices/headquarters/oit/spotlight>

<sup>19</sup> According to US Census American Community Survey (ACS) 5-Year Estimates from 2015 (Table S2101), Veterans make up 9.8% of Missouri's Adult Population; this compares to a national average of 8.3%.

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strategies focus on growing and maintaining a veteran workforce through alignment with industry needs.

One tangible step the Partnership could take to promote veteran in the workforce would be to hire a Veteran Employment Representative (VER). This individual could be responsible for promoting the advantages of hiring veterans to a variety of organizations such as businesses and business/employer associations. This could include leading seminars for employers about the benefits of hiring veterans. A VER could provide direct services to veterans such as conducting job search workshops and establishing job search groups. A VER could also coordinate with unions, apprenticeship programs, and businesses to assist veterans with job placement or placement into training programs. Much of the job would also require coordinating with other Veteran oriented agencies to understand other services that are available and communicate those to employers and veterans, such as; Disabled Veterans Outreach Program (DVOP), Local Veterans' Employment Representatives (LVER), the Department of Veterans' Affairs (DVA), and County Veterans Service Officers (CVSO).

Two additional programming options to target Veterans in the workforce are listed below:

### **Potential Program 1. Veteran's Assistance Program**

*The Partnership could create a program on its own, or in partnership with Missouri's Workforce Development Boards to assist veterans with job placement and skill enhancement. Services that a veteran assistance programs can provide include:*

- *Assessment of current skills*
- *Development of individual employment plans*
- *Development of job interview and resume writing skills*
- *Help place veterans in federally funded training programs*
- *Information and referral services*
- *Job training and placement*
- *Job retention services*
- *On-the-job training*
- *Personalized career consulting and planning*
- *Monitoring job listings from federal agencies and federal contractors to assist veterans with referrals to these jobs*

*The Partnership or workforce boards could leverage relationships with local colleges, universities, or community colleges to help connect veterans to educational opportunities. At the state level, these services could be offered at all of Missouri's fourteen Local Workforce Development Area Regions.*

*The Partnership could also create this program without assistance from the Missouri Workforce System; however, it likely would not be as impactful at a statewide level without leveraging the American Job Centers.*

### **Potential Program 2. Veteran's Apprenticeship Program**

*The Partnership should also play a role in advocating for, and helping develop, new military focused training or apprenticeship programs. Working with the appropriate officials such as leadership from the Missouri Workforce Development Board, the Partnership could consider developing a military*



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*focused apprenticeship program. This program could focus on individual skill sets and optimally matching those skills to private sector workforce needs. A specialization of this program could be transitioning veterans to the private sector. Veterans and military personnel develop a syntax and concepts that are unfamiliar to the average civilian. An apprenticeship program specialized for veterans could more efficiently bridge communication gaps and skill matrices to better transition veterans into the private sector. Linking veteran workforce programs with the DoD's [SkillBridge](#) could also be beneficial as it focuses on transitioning service members into civilian jobs utilizing skills and abilities that translate well from soldiers' military occupational specialty code (MOS code). Apprenticeship and occupational recruitment can be streamlined by identifying talent and matching these skills with the appropriate civilian career.*

### *Recommendation 11. Develop a University-Housed Innovation Center*

St. Louis has a strong presence of R&D universities, private businesses, and public partnerships. There are opportunities for linking these assets, which include: utilizing the Innovation Center that is already under development, working to strengthen and grow these relationships, and to act as an incubator for creative technologies and manufactured goods. Also, the Partnership could develop an innovation center presence in two ways. One way is to expand current incubator or innovations programs and the other is to leverage its partnership with the [Cortex Innovation Community](#).

The Partnership oversees or is affiliates with, a number of innovation centers and entrepreneurship programs, these include:

- STLVentureWorks-Grand Center
- Helix Center
- STLVentureWorks-South County
- STLVentureWorks-Wellston
- STLVentureWorks-West County

The Partnership could work to have one of these locations focus specifically on R&D projects related to defense, aviation, manufactured goods, and enabling technologies. Businesses at this center may be focused on federal contracting or commercialization, but the innovation center program could push them to explore opportunities in the market to promote diversification. This again would rely on relationships with PTACS and in-house consulting opportunities offered by the Partnership. The Partnership could also leverage relationships with St. Louis's R&D universities. A university presence such as Washington University would greatly benefit the R&D capabilities of an innovation center.

The Cortex Innovation District is a 200-acre premier innovation hub located in St. Louis, Missouri, and provides an opportunity for innovation partnerships. Boeing has recently located Ventures, its start-up unit for defense, space, and security in Cortex's Innovation District. Ventures is looking to innovate outside its specialty of aircrafts and defense. Cortex presents a strong opportunity to advance R&D related industries in St. Louis. The Partnership could collaborate with the Cortex by identifying promising companies related to defense or R&D in general. The Partnership could work with the appropriate leaders at Cortex to engage businesses in the Cortex Community. This could benefit the businesses as Cortex has a variety of resources related to the cutting edge of R&D and has partnerships with leading research institutions.

# 1. Strategic Recommendations

## Missouri Defense Supply Chain Mapping Project

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Developing new technologies through small to medium sized defense companies is necessary to strengthen the defense industry and create less defense dependence overall. Cortex possesses the resources necessary to enable new technology development in small and medium sized businesses. The Partnership could emphasize the importance of diversifying the defense industry to the appropriate leadership at Cortex and attempt to align them with statewide diversification efforts. Cortex could be encouraged to focus on integrating more small and medium sized defense industries into its community with the goal of encouraging the development of new technologies not necessarily related to defense. The defense companies Cortex and the Partnership identify should have the potential to branch out into different markets, which could be determined based on the technologies these companies are producing. Companies with DoD contracts for products that could be considered enabling technologies are prime examples of which businesses to focus on attracting to the Cortex Innovation District first.

## 2. Executive Summary

### Missouri Defense Supply Chain Mapping Project

## 2. Executive Summary

With an average of \$10.5 billion in prime and subcontracts awarded each year to companies located or performing work within the state, the DoD has a large impact on Missouri's economy. Though Boeing receives the majority of Missouri's DoD dollars, defense contracting directly affects over 600 industries and over 25,000 businesses. Each of these businesses, in turn, purchases supplies and services from other businesses, many of which are located in Missouri, thereby leading to a vast and varied impact on the state's economy. Based on thorough analysis of defense contracting data and subsequent economic transactions within and outside Missouri, this study presents detailed findings on the scope and diversity of Missouri's defense economy. Based on interviews with defense industry leaders and insights from other regional and state-level defense reports, it then situates quantitative findings in the context of regional economic development activities. Key findings from both of these activities are presented in the [Executive Summary](#) and the [Strategic Recommendations](#) section of this report.

Government contracting can be segmented in a variety of ways, and this report strives to analyze each of these segmentations. By geographic location, the report includes both contracts given to companies with physical addresses in Missouri and contracts given to companies who perform their contract work within the state. Of course, companies can meet both criteria:

**81.2% of all Missouri contract dollars are given to companies that are both located within and performing work within the state.**

However, strong contracting linkages can be found between Missouri and states like Texas, California, Kansas, Illinois, and Virginia. On top of geographic considerations, the report also considers two tiers of contracting: first-tier "Prime" contract recipients and second-tier "Sub" contract recipients. Prime contracts make up 86.9% of Missouri's four-year contracting activity, but some companies receive the majority of their DoD revenue from subcontracts.

Of the \$10.5 billion in annual DoD contracting that impacts Missouri, most of it is concentrated in just a few companies and industries. At the industry level, Aircraft manufacturing represents 33.5% of all Missouri DoD contracting, while Commercial and Institutional Building Construction is the second largest industry at 9.2%. By broad industry sector, 65.0% of all Missouri DoD contracts are for Durable Goods Manufacturing. Contracting activity is also highly concentrated geographically, as the majority of Defense contracting companies are located and performing work in the St. Louis region (MEDC Region 5). Much of this concentration is due to the influence of just a few companies:

**Boeing receives an average of 56% of all Missouri DoD dollars, while DRS Sustainment Systems and Express Scripts come in second and third at about 7% each.**

As the country's second-largest defense contractor, Boeing has a large presence within the St. Louis area and across the state. Its primary activity is Aircraft Manufacturing, but it also participates in Aircraft Parts Manufacturing; Ammunition Manufacturing; and Engineering Services, among others. Because of Boeing's outsized influence on Missouri's economy, it is important to monitor how the relocation of its defense headquarters and other defense trends influence its in-state contracting activity.

## 2. Executive Summary

### Missouri Defense Supply Chain Mapping Project

Missouri's defense economy, however, should be understood as not just prime and subcontractors but those companies and industries that supply them. By analyzing total contracting revenue and calculating each industry's reliance on defense revenue for its total Missouri sales,

TPMA identified 73 *Key Contracting Industries* that represent 95.7% of Missouri's defense activity.

Eleven of these industries are more than 80% dependent upon DoD funds for their total sales statewide and 37 of them are in the Durable Goods Manufacturing Industry Group. By identifying suppliers to these industries, TPMA isolated key upstream nodes in the Missouri Defense Supply Chain. Among these suppliers, Missouri successfully retains upstream revenue for Corporate Management Offices and Guided Missile/Space Vehicle Manufacturing. On the other hand, the state imports a significant portion of products related to Aircraft Engine Manufacturing and Semiconductor Manufacturing. [Appendix C](#) provides an overview diagram of Missouri's supply chain strengths and weaknesses. Similar diagrams for segments of the defense economy can be found in the [Detailed Upstream Analysis](#) section. These diagrams reveal the Transportation Equipment Manufacturing and Management of Companies and Enterprises sectors to be particularly important suppliers to Key Contracting Industries. Both of these industries are large suppliers to heavily defense-dependent industries, meaning that they could be impacted by defense revenue volatility.

TPMA's consulting team also analyzed the purchasing organizations of Defense contracting companies or, in other words, the "downstream nodes". DoD contracting offices are the primary purchasers of Missouri's defense goods and services. Some contracting offices in Missouri, like the Army Corps of Engineers—Kansas City and Ft. Leonard Wood, provide significant funding for Missouri defense contractors. However, these offices are somewhat overshadowed by purchases from offices in states like Ohio, Maryland, Alabama, Colorado, and Pennsylvania. In addition to sales to the U.S. DoD, Missouri companies also export defense-related commodities to countries in North America, Asia, and Europe. The top three recipients of these exports are Canada, Japan, and Mexico.

Because of defense revenue volatility, the [Defense Diversification Opportunities](#) section explores possible alternative markets for current suppliers of defense contracting firms. Based on supply chain models, these industries—both within and outside Missouri—may be easy targets for purchasing current defense inputs.

Top markets for defense diversification include Light Truck and Utility Vehicle Manufacturing; Software Publishers; and HVAC Equipment/Refrigeration Equipment Manufacturing.

Similar themes of diversification were also echoed in stakeholder interviews. Though industry leaders are aware of the current reliance on Boeing, and defense contracting in particular, many desire to diversify their markets while remaining specialized in their production. These interviews also identified areas of strength within the state's defense economy. There is a strong appetite for collaboration, which works well with the state's technically skilled workforce. Still, there are opportunities to reduce regulatory burden, reduce brain drain, and increase research or capital investment.

Lastly, the results of this report were linked with initiatives underway at the regional level. The defense economy is tied to many targeted clusters throughout the state, including Advanced Manufacturing,

## 2. Executive Summary

### Missouri Defense Supply Chain Mapping Project

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Information Technology, and Professional Services. For Advanced Manufacturing, there is momentum behind increased marketing of the St. Louis region's strengths and provision of additional economic development resources. There is also momentum behind defense industry diversification. This includes identification of international markets—like Australia and Egypt—for defense exports, as well as a concurrent defense research project for the State of Illinois. Overall, continued collaboration between these initiatives can be complemented by the recommendations proposed in this report. Through Connecting, Enabling, Coaching, and Programming, Missouri can build on its current aerospace and advanced manufacturing strengths to build a better future for its companies and its citizens.

## 3. Missouri Defense Contracting Overview

### Missouri Defense Supply Chain Mapping Project

## 3. Missouri Defense Contracting Overview

### Summary

The DoD contracting industry in Missouri includes a vast array of Missouri-based companies and companies that perform work within the state. The data presented here indicate that there are significant opportunities for the Partnership and other state economic development organizations to connect existing contractors, and to connect with contractors who have a limited presence in the state.

Military installations and DoD contractors engage in regular business interactions with states across the US. Missouri is the by far the most frequently location of performance for Missouri-based firms, followed by Kansas and Texas. Locations outside of the state from which Missouri military installations purchase a significant degree of goods and services include California, Virginia, and Texas.

TPMA's consulting team's use of contracting data by industry, product service code, and company all show that Boeing is the largest player within the state, which over time has led to a constellation of supporting companies that support Boeing but rarely compete with them on major defense contracts. Boeing is primarily engaged in manufacturing work but it also conducts a small degree of services and R&D work as well. The level of DoD contracts won by Boeing varies year to year but there has been no significant trend of Boeing performing more of its contracts out-of-state from FY13-16.

Approximately 85% of DoD contracting companies identified within Missouri are classified as small businesses, but small businesses made up roughly 16% of all awarded contracts. This indicates that while small businesses make up the majority of those awarded defense contracts, the actual value is much lower.

### Explanation of Geography Related to DoD Contracting Data

Defense contracting data are detailed and highly nuanced, which on the one hand produces a rich data source for analysis but also presents many questions about the appropriate way to categorize and analyze these data. Defense contracts provide at least three (sometimes more) geographic locations for each contract including the following:

- **Contracting Office.** Location of the DoD installation that purchases the product or service
- **Contract Location.** Principal location of the company or division that is awarded the contract
- **Place of Performance.** The principal location where work is performed by a company

As one would imagine, there is significant geographic clustering among these distinct categories. Defense contractors and subcontractors tend to locate around military installations so they can visit sites and develop relationships with defense organizations. Generally speaking, contractors also tend to perform work near their corporate headquarters to reduce transportation costs; this is especially true for small and medium sized businesses. Though these trends may be generally true, it does not explain the behavior of all small and medium sized companies and it does not adequately explain the behavior of large firms. Large companies will frequently have a division or headquarters office in one city, and perform maintenance and services work on-site at a military installation. Large companies also tend to have multiple manufacturing locations throughout the globe, determining where to produce and assemble products based on efficiencies and company strategy. Striking the right balance with these

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

data is particularly important for Missouri, considering Boeing's recent announcement that its Defense, Space & Security business unit is relocating its headquarters to Arlington, Virginia throughout 2017.<sup>20</sup>

Due to these nuances, TPMA's consulting team parsed contracting data in several different ways depending on the purpose of each component of our analysis. A general description of how TPMA's consulting team leveraged these data for different purposes is listed below:

- **When identifying businesses to participate in regional collaborations and industry councils, contract location is the most important** because these companies have a clear presence within the region including influential C-suite executives.
- **When seeking to assess regional economic impact, place of performance** is the preferred method for analyzing data, because the highest number of employees will be engaged at that site for the duration of the project.
- **When analyzing supply chains, both contract location and place of performance** are significant. It is impossible to say with precision whether production inputs will be sourced closer to a company's corporate headquarters or the place of contract performance. The answer varies based on the unique situation of the company in question. For this reason, when analyzing supply chains TPMA's consulting team examined both contract location and place of performance to cast a wide net of defense companies engaged in commerce within Missouri.
- **When analyzing defense dependency, once again, both contract location and place of performance** are used. The reason for including companies by place of performance is clear, these contractors perform work and pay workers in the process, which is exactly the population we are intending to monitor with defense dependency analysis. There is also warrant for including companies by contract location. DoD contracting data only identifies *primary* place of performance, however, companies that list their primary place of performance outside of Missouri could be engaged in some degree of manufacturing and assembly within the state.

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<sup>20</sup> Brown, L. (2016, December 13). Boeing moving defense HQ from St. Louis to D.C. area. Retrieved June 8, 2017, from [http://www.stltoday.com/business/local/boeing-moving-defense-hq-from-st-louis-to-d-c/article\\_029c405c-5f9b-5445-9008-3f8084708306.html](http://www.stltoday.com/business/local/boeing-moving-defense-hq-from-st-louis-to-d-c/article_029c405c-5f9b-5445-9008-3f8084708306.html)

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

#### Economic Development Strategies Related to Geographic Location of Contracts

To further assist in digesting this complicated data, the chart below demonstrates several quadrants in which all defense contractors can be classified. The two axes indicate whether the work was contracted and performed within the state. Listed in each quadrant is the recommended economic development strategy for businesses in that category, except for the bottom right box which relates to companies that have no current presence within Missouri and are therefore not considered a high priority.

Figure 3.1: Economic Development Strategies Based on Contractors' Geographic Characteristics

		Contracting Location	
		In-State	Out-of-State
Place of Performance	In-State	Retain & Grow	Recruit additional manufacturing to Missouri
	Out-of-State	Draw more manufacturing into state	--

For businesses contracting work in-state and performing work in state, the strategy is most clear. Ensure that economic developers understand the needs of these businesses and address them so these companies are not considering leaving the state or expanding elsewhere.

When contracts are owned by in-state companies and performed out-of-state, the situation is somewhat nuanced. Certain contracts make more logistical sense to be executed elsewhere, particularly when it comes to maintenance, installation, and construction services occurring at a particularly military installation. For example, a Missouri based construction company obtained a \$49 million contract for “repair of a hospital of infirmary” in Okaloosa County, Florida. One cannot reasonably expect a building to be transported to Missouri for the duration of its repair. On the other hand, there are also manufacturing and R&D companies that theoretically could perform their operations in Missouri but choose not to. These are the cases where economic development organizations could meet with businesses to discuss what is lacking within Missouri that is preventing them from performing those contracts in state. For one example, in FY16 the World Wide Technology Corporation (WWT) of Maryland Heights, Missouri performed a \$13.8 million contract in Harford, Maryland, for the development of an automated data processing (ADP) software.<sup>21</sup>

<sup>21</sup> Given NAICS code is 334111: Electronic Computer Manufacturing and the given Federal Product Service Code is 7030: ADP Software. Further details about the particular contract would need to be discussed with WWT.



### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

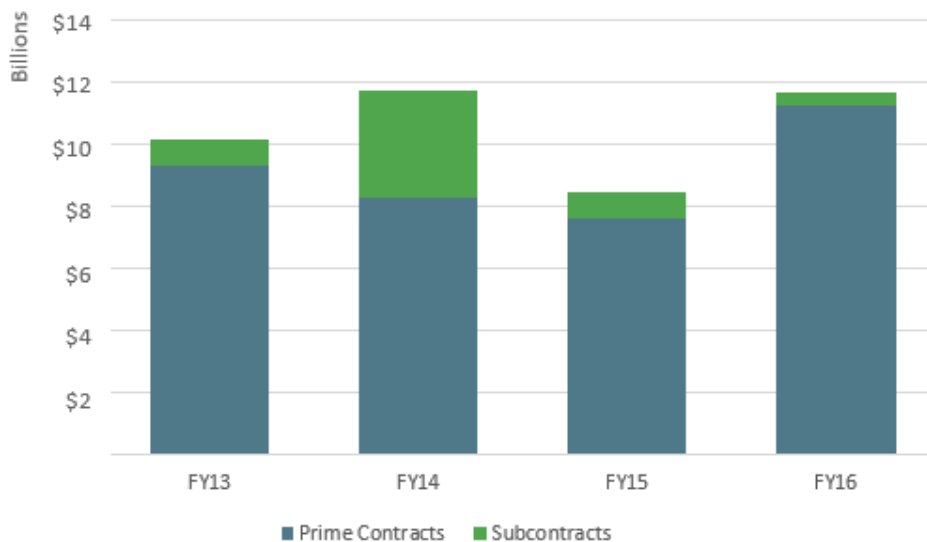
When contracts are owned by companies that are out-of-state but performed in-state, this may be the most difficult situation to act upon. The influential executives at those companies are not located in Missouri, and may have little knowledge of its assets. Nevertheless, more than likely there are some executive staff from these businesses who spend time in the state in order to supervise the performance of these contracts. Furthermore, businesses that perform work in a different location from their place of contract are often large-scale defense contractors that have significant operations in multiple states, and therefore may have little loyalty to a particular geographic area. The recommendation for such situations is for economic developers to use whatever reasonable in-roads that exist to initiate conversations about the performance of future defense contracts in Missouri.

#### Annual Contracting Trends

Including all contracts from DoD to companies either located or performing work in Missouri, the state has averaged around \$10.5 billion in contracting each of the past four fiscal years. Of this total, 86.9% of contracts are prime contracts, with the remaining portion going to Tier I subcontractors, which describes companies that provide a direct product or service in assistance to the prime contractor. Importantly, prime contractors are not required to report Tier II subcontracts, or subcontracts below \$25,000 in value, so subcontracting figures are likely to be somewhat underestimated.<sup>22</sup> Figure 3.2 displays trends in each of these contracting categories over time. From FY13-16, contracting in Missouri has been somewhat volatile, with subcontracting peaking in FY14 and prime contracting peaking in FY16.

Figure 3.2: Prime and Subcontracts Performed or Located in Missouri, FY13-16

DoD contracts average \$10.5 billion, with the majority of funding going to **prime contractors**



<sup>22</sup> Additionally, a 2014 Government Accountability Office (GAO) report that tested the consistency of prime contracting data was unable to assess subcontract information, so the reliability of subcontracting data has not been proven. For the full report, see GAO (2014). Data Transparency: Oversight Needed to Address Underreporting and Inconsistencies on Federal Award Website. For more information on contracting data consistency, see [Appendix A](#).

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

Figure 3.3 breaks down the \$10.5 billion combined average over the past four fiscal years in terms of where prime and subcontractors are located or performing work. From FY13-16, the majority of Missouri DoD activity (81.2%) consisted of Missouri-based companies performing contracts at locations within the state. In comparison, \$1.56 billion annually (or 14.8%) consisted of Missouri-based companies performing work outside the state. Lastly, non-Missouri companies performed \$420 million each year within the state; this represents around 4% of all Missouri contracting activity.

Figure 3.3: FY13-16 Average Annual Contracts by Place of Performance and Contract Location

		Contracting Location	
		In-State	Out-of-State
Place of Performance	In-State	\$8.52 Billion	\$0.42 Billion
	Out-of-State	\$1.56 Billion	--

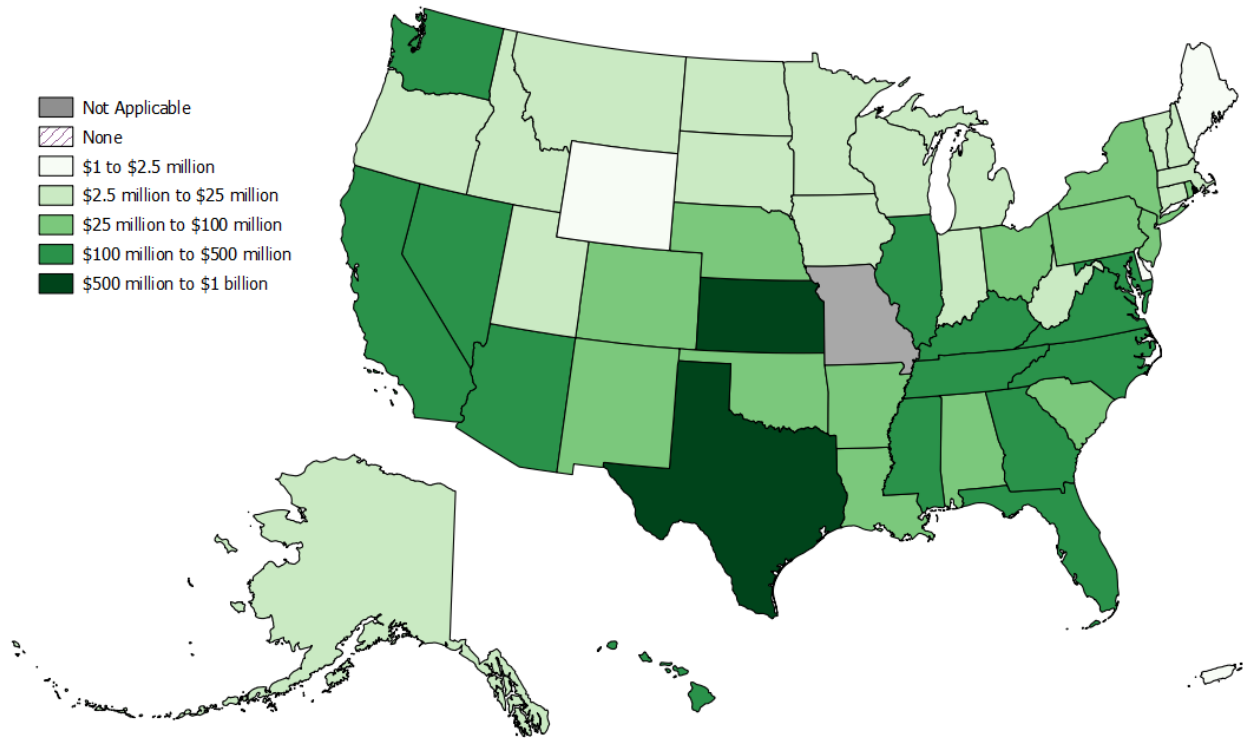
In total, Missouri-based companies performed \$34.1 billion of DoD contracts within the state from FY13-16. As demonstrated by Figures 3.4 and 3.5, this far overshadows the impact of companies from other states on the Missouri defense economy. For example, Figure 3.4 demonstrates that Missouri-based companies performed over \$500 million of DoD prime and subcontracts in Kansas and Texas from FY13-16. Most of work performed in Kansas was contracting by Fort Leavenworth or the Kansas City Army Corps of Engineers, while the majority of work performed in Texas was contracted for by the Fort Worth Army Corps of Engineers. Other neighboring states, like Illinois, Kentucky, and Tennessee, also received substantial work from Missouri companies, with over \$100 million in contracts over those four years. However, no state approached the \$34.1 billion that Missouri companies performed within their home state over that span of time.

### 3. Missouri Defense Contracting Overview

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Figure 3.4: Value of DoD Work Performed Outside Missouri by Missouri Companies, FY13-16

Missouri-based companies performed over \$500 million of DoD prime and subcontracts in **Kansas and Texas**



Another interesting point of comparison is to review how other states' work is distributed between the three categories demonstrated in Figure 3.3. In the state of Indiana, where TPMA's consulting team recently completed a similar project, a slightly lower proportion of contracts were to companies located in-state that also performed the contracts in-state (81.2% for Missouri and 73.2% for Indiana). The more substantial difference is that in Indiana had almost twice as many contracts performed in-state and contracted out-of-state as those contracted out-of-state and performed in-state. On the other hand, in Missouri, the ratio is nearly four to one in favor of work contracted in-state and performed out-of-state. Like Missouri, Indiana has a strong base of manufacturers that make it a good candidate for executing DoD manufacturing contracts. However, it does not host one of the nation's largest DoD contractors, so much of the work performed there is contracted out-of-state. The difference makes the importance of Boeing within Missouri clear. Boeing controls much of the DoD contracts, whether they are performed in-state or not.

Of the \$34.1 billion in DoD contracts performed by Missouri based companies, approximately \$22.8 billion, or 66.8% is attributable to Boeing. While Boeing keeps a significant amount of manufacturing within the state, it is not a trend that the Partnership should rely on, especially considering trends

### 3. Missouri Defense Contracting Overview

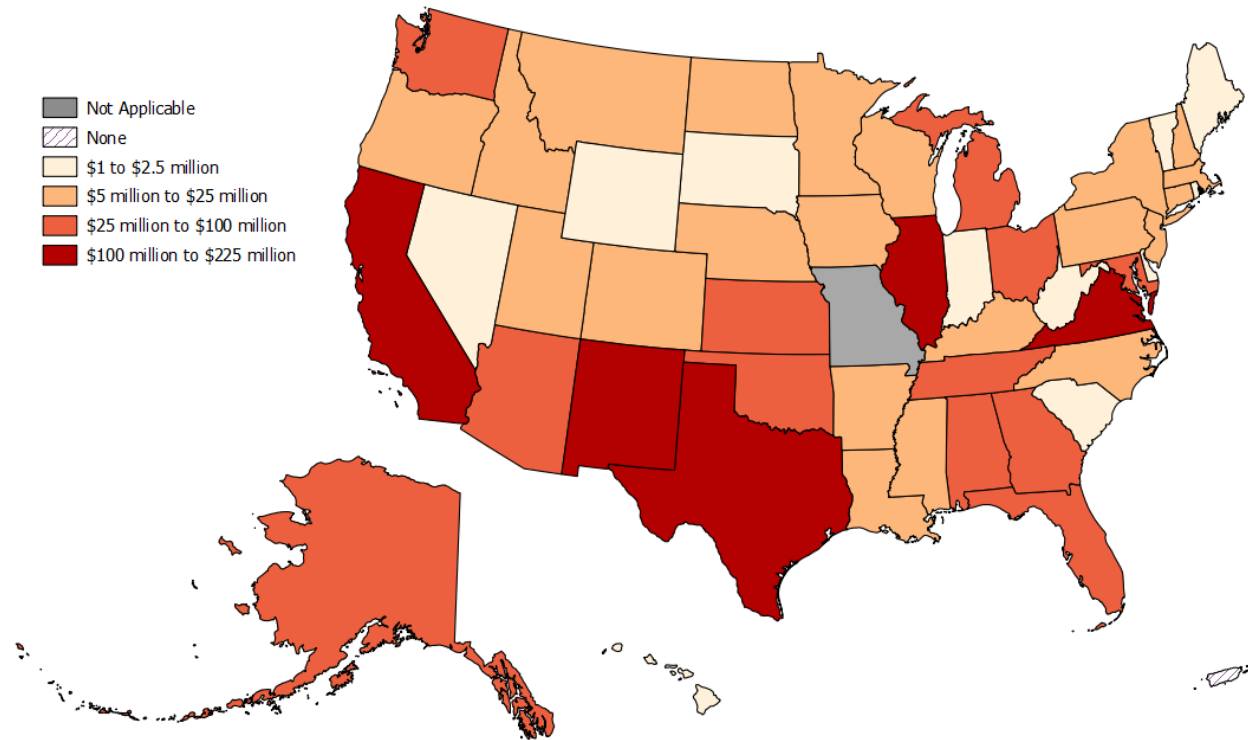
#### Missouri Defense Supply Chain Mapping Project

regarding the announced transitions within DoD from the current manufacturing of the F-16, F/A-18 to the next generation of combat aircraft (F-22 and F-35).<sup>23</sup>

Even less activity is performed within Missouri by companies located in other states. In this category, the top contributors are companies in California, Virginia, and Texas, respectively. However, no state had more than \$213 million performed within Missouri from FY13-16. Of course, this does not mean that DoD activity is not happening in other states, just that large defense contractors in other states are not participating in Missouri's defense economy to the same degree as Missouri-based companies. Additionally, because many large DoD contractors have branch locations across the country, many contracting companies with locations within the state may have their headquarters elsewhere.

Figure 3.5: Value of DoD Work Performed in Missouri by Companies in Other States, FY13-16

Large defense contractors in other states are not participating in Missouri's defense economy to the same degree as Missouri-based companies



<sup>23</sup> Defense Adjustment and Advanced Manufacturing, May 2016, AECOM. Retrieved May 19, 2017, from <https://stlpartnership.com/wp-content/uploads/2017/04/St-Louis-Report-FINAL-PRINTABLE.pdf>

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

#### Industry Trends

The direct impact of DoD contracting on Missouri is highly concentrated in just a few industries. Chief among them is Aircraft Manufacturing, which received over \$14 billion in prime and subcontracting from FY13-16—33.5% of all Missouri contracting activity. The top 10 industries are shown in Table 3.1. The second-most Missouri contracts were awarded for Commercial and Institutional Building Construction, followed by Other Aircraft Parts and Auxiliary Equipment Manufacturing. Some of these industries primarily receive prime contracts—like Aircraft Manufacturing and Ammunition Manufacturing, while others—like Guided Missile and Space Vehicle Manufacturing receive more subcontracts.

Table 3.1: Top 10 Industries with DoD Contracts Performed or Located in MO, FY13-16

NAICS	Industry Description	Industry Group	Total Contracting, FY13-16 (millions)	Prime Contracts, FY13-16 (millions)	Subcontracts, FY13-16 (millions)
<b>336411</b>	<b>Aircraft Manufacturing</b>	<b>Durable Goods Manufacturing</b>	<b>\$14,076.6</b>	<b>\$13,922.0</b>	<b>\$154.6</b>
236220	Commercial and Institutional Building Construction	Construction & Extraction	\$3,880.4	\$2,097.4	\$1,783.1
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	Durable Goods Manufacturing	\$3,738.0	\$3,713.2	\$24.8
336414	Guided Missile and Space Vehicle Manufacturing	Durable Goods Manufacturing	\$3,199.0	\$655.5	\$2,543.4
332993	Ammunition (except Small Arms) Manufacturing	Durable Goods Manufacturing	\$2,212.5	\$2,189.4	\$23.1
541330	Engineering Services	Information, Professional, & Scientific	\$2,030.7	\$1,978.8	\$51.9
446110	Pharmacies and Drug Stores	Other Services & Trade	\$1,539.0	\$1,539.0	\$0.0
332992	Small Arms Ammunition Manufacturing	Durable Goods Manufacturing	\$1,197.6	\$1,195.9	\$1.8
524114	Direct Health and Medical Insurance Carriers	Finance, Insurance, & Management	\$1,087.5	\$1,087.5	\$0.0
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	Durable Goods Manufacturing	\$724.8	\$702.0	\$22.9

Table 3.1 also shows the industry group corresponding to each of the top 10 industries. These industry categories were assigned to each industry based on their corresponding 2-digit and 3-digit sector-level

### 3. Missouri Defense Contracting Overview

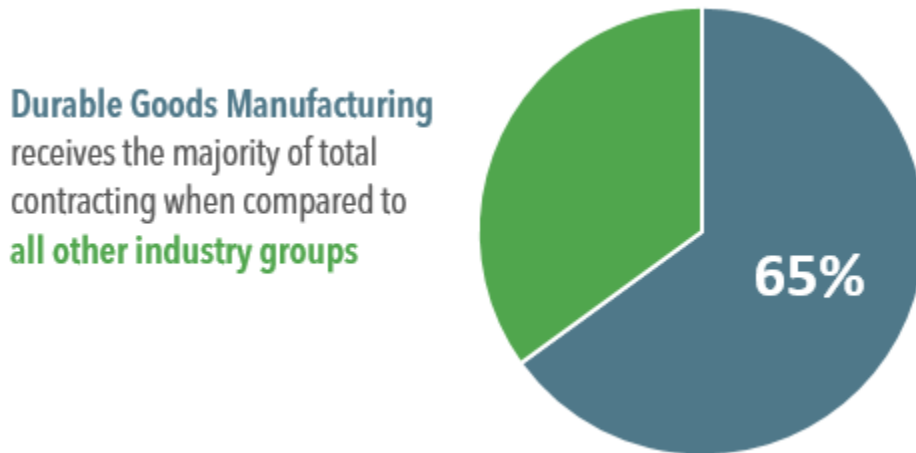
#### Missouri Defense Supply Chain Mapping Project

classifications in the North American Industry Classification System (NAICS).<sup>24</sup> Based on this categorization, eight industry groups were created, as shown in Table 3.2. Among the top 10 industries in Table 3.1, six belong to the Durable Goods Manufacturing group. As shown in Table 3.2, this industry group received far more DoD contracts from FY13-16 than any other industry sector. Despite Aircraft Manufacturing’s overall dominance, this industry group is also somewhat diverse; a total of 202 industries within this group received at least one DoD contract in the last four years. Following Durable Goods Manufacturing, the Information, Professional, & Scientific and Construction & Extraction industry groups are second and third in total contracting in Missouri.

Table 3.2: FY13-16 Contracting by Defense Industry Group

Industry Group	Total Contracting, FY13-16 (millions)	Number of Unique Industries Receiving Contracts
<b>Durable Goods Manufacturing</b>	<b>\$27,310.4</b>	<b>202</b>
Information, Professional, & Scientific	\$4,917.3	57
Construction & Extraction	\$4,721.3	46
Other Services & Trade	\$2,757.6	169
Finance, Insurance, & Management	\$1,087.5	2
Admin, Support, & Waste Management	\$548.7	43
Non-Durable Manufacturing	\$397.6	79
Transportation, Warehousing, & Utilities	\$267.1	33
Unclassified	<b>-\$1.5</b>	N/A
<b>All Industry Groups</b>	<b>\$42,005.9</b>	<b>632</b>

Figure 3.6: FY13-16 Contracting by Defense Industry Group



<sup>24</sup> Each category was delineated primarily at the 2-digit NAICS level. Admin, Support, & Waste Management includes 56 and 92; Construction & Extraction includes 11, 21, and 23; Durable Goods Manufacturing includes 321, 327, and 33; Finance, Insurance, & Management includes 52 and 55; Information, Professional, & Scientific includes 51 and 54; Non-Durable Manufacturing includes 31 and 322-326; and Transportation, Warehousing, & Utilities includes 22, 48, and 49. Other Services & Trade is a miscellaneous category that includes 42-45, 53, 61, 62, 71, 72, and 81.

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

In addition to assigning contracts an industry code, the DoD also assigns each contract a Federal Product or Service Code (PSC). These alphanumeric codes describe specific activities performed for government contracts in a more detailed manner than industry classifications. They are grouped into three types: Products, Services, and R&D. Table 3.3 shows the top 10 contracting codes for prime contracts.<sup>25</sup>

Overall, the top PSC is for production of fixed wing aircraft, followed by Bombs and Other Medical Services. Among the top 10 PSCs in Missouri, six are for products and four are for services. The top R&D activity during this span was for Weapons – Advanced Development, 24<sup>th</sup> overall with \$206 million in total contracting. To maintain relevant and cutting edge in DoD contracting, the Partnership should pursue the innovation activities from the recommendations section to increase the degree of activity in R&D contracts within the state.

Table 3.3: FY13-16 Contracting by Federal Product or Service Code, Prime Contracts Only

PSC	FPS Description	Type of Code	Total Contracting, FY13-16 (millions)
<b>1510</b>	<b>Aircraft, Fixed Wing</b>	<b>Product</b>	<b>\$13,499.5</b>
1325	Bombs	Product	\$2,048.2
Q999	Other Medical Services	Service	\$1,692.2
1680	Miscellaneous Aircraft Accessories Comps	Product	\$1,637.2
1560	Airframe Structural Components	Product	\$1,549.2
1305	Ammunition Through 30 Mm	Product	\$1,194.4
Q201	General Health Care	Service	\$1,104.7
Y1DA	Construction of Hospitals and Infirmaries	Service	\$686.5
K016	Mod of Aircraft Components	Service	\$498.1
1410	Guided Missiles	Product	\$461.0

#### Company Trends

From Fiscal Year '13- '16 there were 2,552 businesses operating within Missouri that were awarded defense contracts. The following Company Trends analysis will examine company characteristics in order to provide the Partnership with data to assist with future programming to support companies that are contracting with the defense industry. This analysis will examine companies:

- By primary industry sector
- Classified as importers and/or exporters
- Classified as small businesses
- Classified as woman and/or minority-owned
- By awarded contract value

This data will help the Partnership determine how best to assist Missouri-based businesses that have opportunities to contract with DoD. The 2,552 businesses are aggregated into eight broad industry sectors. The majority of businesses fall within Other Services & Trade (27.7%) and Durable Goods

<sup>25</sup>Since prime contractors are not required to assign FPS codes to their subcontractors, data is only available for prime contracts.

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

Manufacturing (23.2%). However, when looking at the total value of awarded defense contracts, the greatest percentage is found within Durable Goods Manufacturing, with 73.5% of all awarded contracts. It should be noted that many of the defense contracts within this sector are likely attributed to the Boeing Company, which is a major defense contractor operating within Missouri that is primarily classified as a manufacturer. Thus, Missouri workers within the defense sector will likely be impacted by changes within DoD contracts related to manufacturing. However, there are emerging opportunities with small businesses contracting with DoD. Based on these trends, the Partnership should continue to focus on assisting entrepreneurs and small businesses with securing DoD contracts.

Table 3.4: Missouri Businesses Awarded Defense Contracts FY13-16 by Broad Industry

Industry Group	Number of Businesses	Business % of Total	Total Contract Value FY13-16 (millions)	Contract Value % of Total
Other Services & Trade	708	27.7%	\$3,111.5	7.7%
Durable Goods Manufacturing	592	23.2%	\$29,598.2	73.5%
Construction & Extraction	409	16.0%	\$4,198.6	10.4%
Information, Professional, & Scientific	342	13.4%	\$2,694.1	6.7%
Admin, Support, & Waste Management	293	11.5%	\$119.1	0.3%
Non-Durable Manufacturing	105	4.1%	\$374.5	0.9%
Transportation, Warehousing, & Utilities	58	2.3%	\$194.1	0.5%
Not Identified <sup>26</sup>	38	1.5%	-\$1.7	0.0%
Finance, Insurance, & Management	7	0.3%	\$.02	0.0%
<b>Total</b>	<b>2,552</b>	<b>100.0%</b>	<b>\$40,288.4</b>	<b>100.0%</b>

<sup>26</sup>There are 38 companies that do not have an assigned industry code.

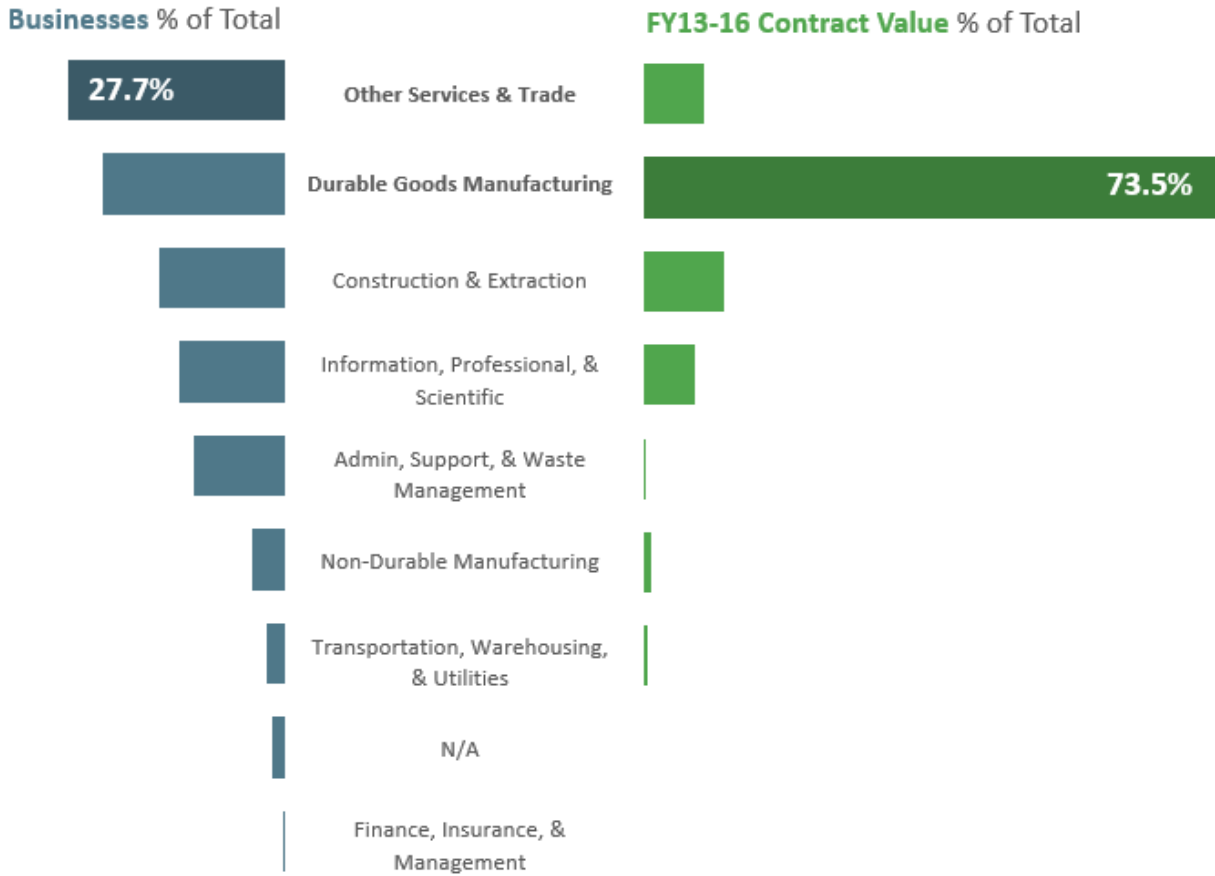


### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

Figure 3.7: Missouri Businesses Awarded Defense Contracts FY13-16 by Industry Group

Durable Goods Manufacturing receives over 73% of total **DoD contract values**



In terms of sheer numbers, defense contractors in Missouri tend to be small, privately-owned, and acquire their inputs from domestic sources. Most of the businesses from FY13-16 are classified as privately owned, with 2,247 or 88.0% of all businesses<sup>27</sup>. Around 5.3%, or 136 are known to be publicly-owned. Less than 10% of the companies are classified either as importers, exporters or both. A very small number, 45 (less than 2%), are foreign-owned.

Over 85% of the companies are classified as small businesses—those with less than 100 employees. However, these businesses received only 15.9% of all contract value. This indicates that while small businesses make up the majority of those awarded defense contracts, the value of contracts they receive is much lower. Part of this can be attributed to the large contract values awarded to Boeing.

<sup>27</sup> Note, data specific to each company, such as public/private; small/large; import/export; woman-owned, etc., is not available for a small number of companies (for example 169 companies do not have data available regarding private/public ownership). Thus, totals will not always equal 100%. However, the analysis provides an as accurate census of these data characteristics as is possible.

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

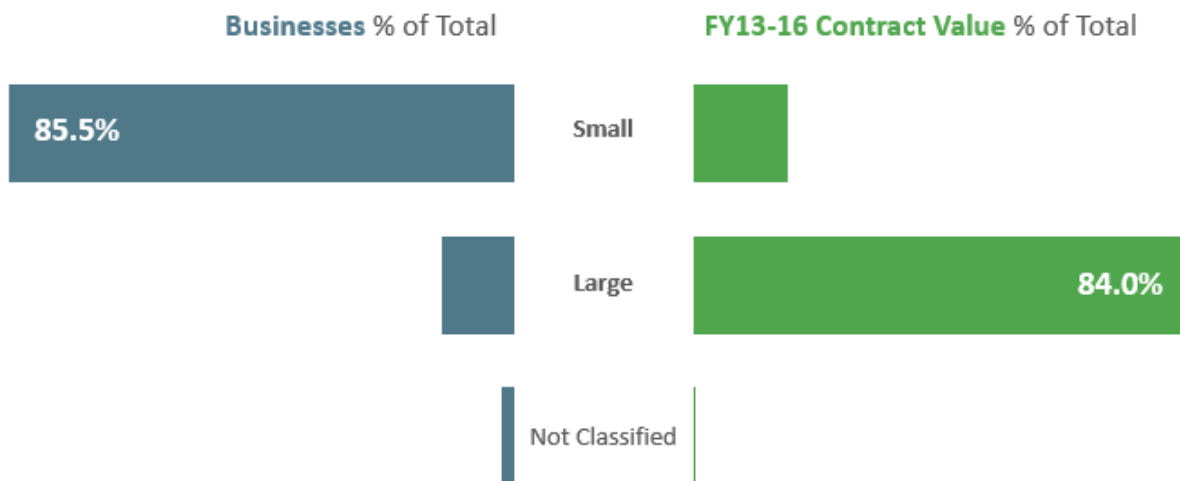
However, as indicated in [1. Strategic Recommendations](#), there are significant opportunities to not only continue to inform small businesses within the state about opportunities to contract with DoD, but to grow the amount awarded. Opportunities to address this include having the Partnership work with export assistance programs through the US Commercial Service (USCS) and the US Small Business Administration’s (SBA) State Trade Expansion Program.

Table 3.5: Missouri Businesses Awarded Defense Contracts FY13-16 by Large and Small Businesses

Business Type	Total Contract Value FY13-16 (millions)	% of Total Contract Value
Large	\$33,826.8	84.0%
Small	\$6,391.4	15.9%
Not Classified	\$70.2	0.2%
<b>Total</b>	<b>\$40,288.4</b>	<b>100.0%</b>

Figure 3.8: Missouri Businesses Awarded Defense Contracts FY13-16 by Business Type

Defense contracts are mostly awarded to small businesses & large businesses receive the majority of defense funding



Compared to the 85.5% of contracting companies that are small businesses, only 300 (11.8%) of the total 2,552 active establishments could be identified as having a female CEO, and only 208 (8.9%) were identified as minority-owned. Furthermore, only 450 (17.6%) of establishments were identified as women-owned. These women-owned businesses received just 4.0% of Missouri’s total value in defense contracts. For these businesses, the majority receiving awards are classified as Other Services and Trade. However, by contract value, the greatest amount awarded from FY13-16 was within Construction and Extraction:

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

Table 3.6: Missouri Businesses Awarded Defense Contracts FY13-16 Broad Industries by Woman-Owned Businesses

Industry Group	Number of Woman-Owned Businesses	Total Contract Value FY13-16 (millions)	% of Total Contract Value
Other Services & Trade	122	\$125.7	7.8%
Construction & Extraction	92	\$921.8	57.1%
Durable Goods Manufacturing	82	\$182.2	11.3%
Admin, Support, & Waste Management	74	\$29.6	1.8%
Information, Professional, & Scientific	57	\$279.6	17.3%
Non-Durable Manufacturing	15	\$15.6	1.0%
Transportation, Warehousing, & Utilities	8	\$58.5	3.6%
<b>Total</b>	<b>450</b>	<b>\$1,613.0</b>	<b>100.0%</b>

Because of data availability, these figures may underestimate true ownership statistics among defense contracting firms. To provide context, we can look beyond contracting data to state-level statistics about firm ownership from the U.S. Census. These statistics indicate that state-wide minority and women business ownership may be lower within the industries in which defense contracting is common. Three sectors of the Missouri economy received more than \$2.0 billion in defense contracting from FY13-16: Manufacturing; Construction; and Professional, Scientific, & Technical Services. According to the US Census Survey of Business Owners, the 130,000 firms within these sectors (a figure which includes defense contractors as well as non-contractors) had much lower rates of minority and women business ownership than the Missouri average. Given these trends within the industries that are receiving the most defense contracting revenue, it is likely that defense contracting firms are also disproportionately male and non-minority owned.

Table 3.7: Ownership Characteristics of Missouri Businesses in Defense-Related Industry Sectors

NAICS	Industry Sector Description	FY13-16 Contracting (millions)	Total Firms in Sector	% Minority	% Women
31-33	Manufacturing	\$27,708.0	11,173	6.3%	38.3%
23	Construction	\$4,700.2	63,860	7.4%	19.7%
54	Professional, Scientific, and Technical Services	\$4,332.0	55,285	9.4%	42.0%
<b>Total, Three Industry Sectors</b>		<b>\$36,740.2</b>	<b>130,318</b>	<b>8.2%</b>	<b>30.8%</b>
<b>Total, All Industry Sectors</b>		<b>\$42,005.9</b>	<b>480,084</b>	<b>13.4%</b>	<b>46.3%</b>

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

Lastly, as indicated in the recommendations, R&D projects offer a means for small and medium sized businesses to assist DoD in developing new weapons systems and technologies that could build new capacity for DoD manufacturing within Missouri. Businesses classified as R&D make up only 2.4% of all Missouri businesses receiving contracts from FY13-16. Around 87% of businesses within R&D are classified as small business, while around 14% are woman-owned. Businesses classified as R&D received \$154.78 million, or 0.4% of all funding.

#### Boeing Company Contracting Trends

Behind Lockheed Martin, Boeing is the second largest defense contractor within the United States.<sup>28</sup> The company manufactures military aircraft, including the Apache, the Chinook, and Osprey, as well as commercial aircraft such as the 787 Dreamliner. Boeing also manufactures satellites, missile defense systems, and launch systems. Major customers include DoD and the National Aeronautics and Space Administration (NASA).

Boeing operates within several segments, including:

- Boeing Commercial Airplanes (including the 737, 747, 767, 777, and 787)
- Boeing Defense, Space & Security (BDS)
  - Boeing Military Aircraft
  - Network & Space Systems (N&SS)
  - Global Services & Support
- Boeing Capital Corporation (BCC)

Boeing's revenue reached \$96 billion in 2015. This growth was due to a 10% increase in revenues from the Commercial Airplanes segment. Boeing is a global firm, and sales increased primarily in the Oceania region, Europe, the Middle East, and China. Much of the company's revenue growth is due to the new 787 Dreamliner.

Anticipated cutbacks from the DoD is forcing the company to focus more on technologies in the areas of C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance), cyber and space technologies, special operations, and unmanned airborne systems (USA).

In 2014, the company made two significant acquisitions, including Ventura Solutions (a company that provides hardware and software engineering solutions, headquartered in Annapolis Junction, MD.) and AerData Group B.V. (a company that provides aviation software solutions for lease management, engine fleet planning, and records management, headquartered in the Netherlands). Of the two acquisitions, Ventura Solutions may have the greatest impact on Boeing's Missouri operations, as the newly acquired company will be a part of Boeing Network & Space Systems.<sup>29</sup>

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<sup>28</sup> Business Insider. Accessed June 19, 2017, from [www.businessinsider.com/the-top-9-biggest-defense-contractors-in-america-2016-5/#2-the-boeing-company-2](http://www.businessinsider.com/the-top-9-biggest-defense-contractors-in-america-2016-5/#2-the-boeing-company-2)

<sup>29</sup> Boeing.com. Accessed June 19, 2017, from [www.boeing.mediaroom.com/2014-06-27-Boeing-Acquires-Government-Software-Development-and-Services-Firm-Ventura-Solutions](http://www.boeing.mediaroom.com/2014-06-27-Boeing-Acquires-Government-Software-Development-and-Services-Firm-Ventura-Solutions)

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

Boeing is a major employer within the state, employing 37,324 across 44 locations<sup>30</sup>. In Fiscal Year '16, the company performed 6,263 contracts in Missouri, which represented 13.3% of all contracts. However, by contract value, the total amount performed in state by Boeing was \$7,758 million, which made up around 76% of the value of all contracts in 2016. Major products manufactured by Boeing within the state include the F/A-18, E/A-18 and F-15. Because DoD is expected to move to the next generation of combat aircraft, such as the F-22 and F-35, this makes the state vulnerable to future spending cuts related to current aircraft production.<sup>31</sup>

Figure 3.9: FY16 In-State Performance by Contract Value



The 6,263 contracts Boeing performed in state during FY16 represented 31 NAICS codes across three broad sectors, Manufacturing, Services, and R&D. These contracts were awarded by seven different contracting agencies and 60 different contracting offices across 17 states. Manufacturing, specifically Aircraft Manufacturing, made up the largest sector by funding. Engineering and R&D make up a relatively lower percentage of funding.

<sup>30</sup> Hoovers.com, Dun & Bradstreet, accessed June 13, 2017.

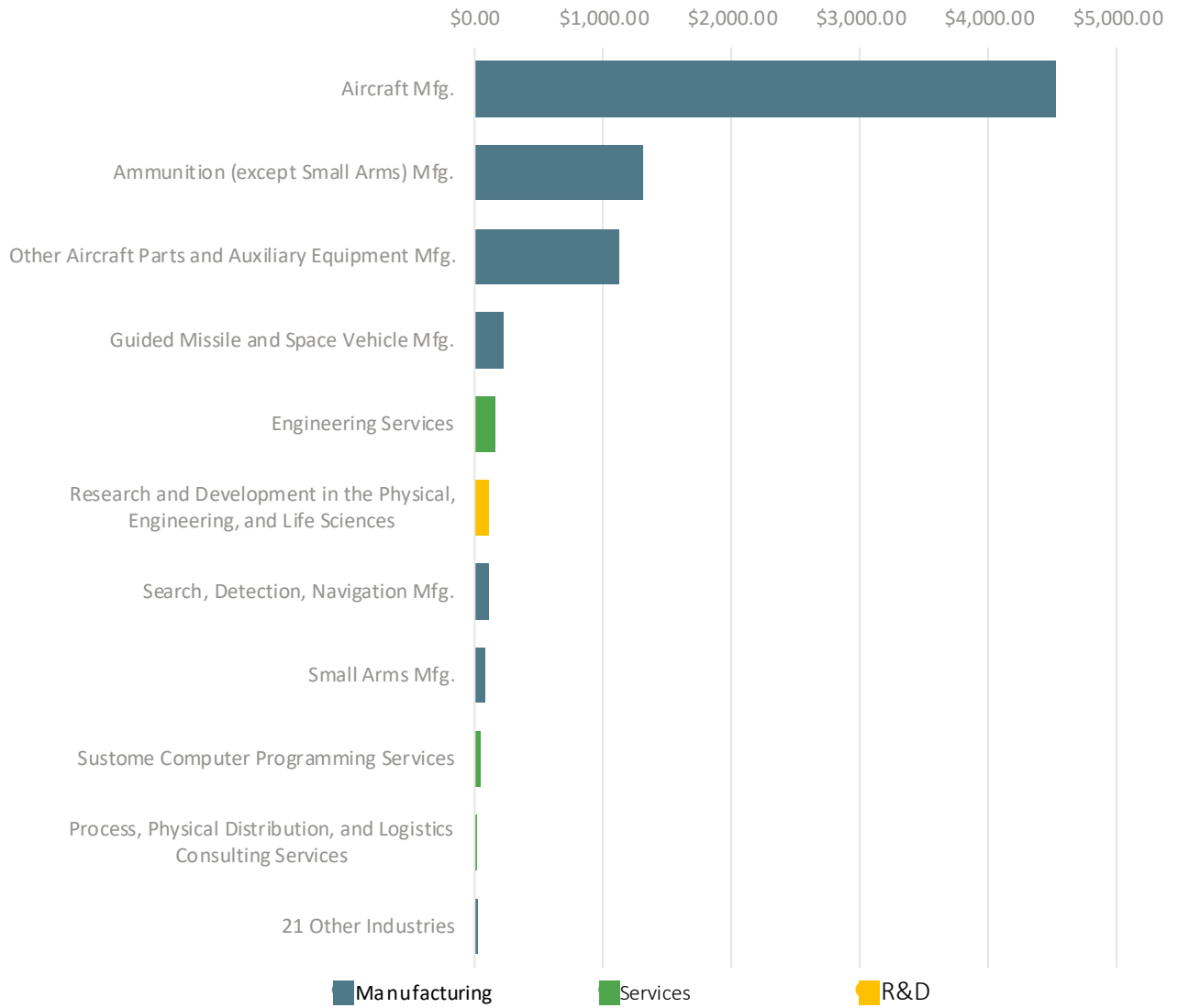
<sup>31</sup> Defense Adjustment and Advanced Manufacturing, AECOM, May 2016.

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

Figure 3.10: Boeing In-State Performance Contracting by NAICS Sector FY16

Most of Boeing's in-state contracting is for **manufacturing**



### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

In addition to in-state work, there were 1,854 contracts awarded in Fiscal Year '16 to Boeing that were performed out of state. As with in-state performance, the largest amount by contract value was in Manufacturing, specifically Aircraft Manufacturing and Other Aircraft Parts and Auxiliary Equipment Manufacturing.

Figure 3.11: Boeing Out-of-State Performance Contracting by Broad Sector FY16

Most of Boeing's out-of-state contracting is for **manufacturing**, followed by **R&D** and then **Services**

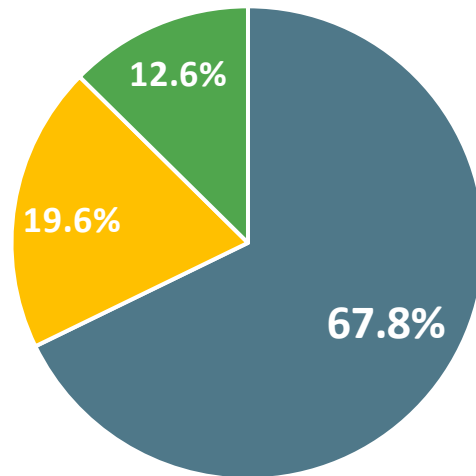


Table 3.8: Boeing Out-of-State Performance by NAICS, FY16

Industry Description	Mfg. (Millions)	R&D (Millions)	Services (Millions)	Total (Millions)
Aircraft Manufacturing	\$77.5	\$32.2	\$0.0	\$109.7
Other Aircraft Parts and Auxiliary Equipment Mfg.	\$44.9	\$0.0	\$0.0	\$44.9
Other Support Activities for Air Transportation	\$0.0	\$0.0	\$11.8	\$11.8
Computer Systems Design Services	\$0.0	\$0.0	\$5.4	\$5.4
Engineering Services	\$0.0	\$0.0	\$3.7	\$3.7
Research and Development in the Social sciences and Humanities	\$0.0	\$3.2	\$0.0	\$3.2
Flight Training	\$0.0	\$0.0	\$1.9	\$1.9

Historically, the number of contracts awarded to Boeing have mostly been performed in-state. From FY13-16, the percentage of contracts performed out of state dropped from 22.5% in 2013 to a low of 17.6% in 2015. However, from FY15-16, the number rose to 22.8%. Boeing's recent announcement that it is moving its Defense, Space, & Security business headquarters to Arlington, VA throughout 2017 may indicate that the trend towards out-of-state performance may continue. One way for the Partnership to address this is to develop an export assistance program similar to Virginia Leaders in Export Trade (VALET) that would assist Missouri based businesses working within the defense sector.

### 3. Missouri Defense Contracting Overview

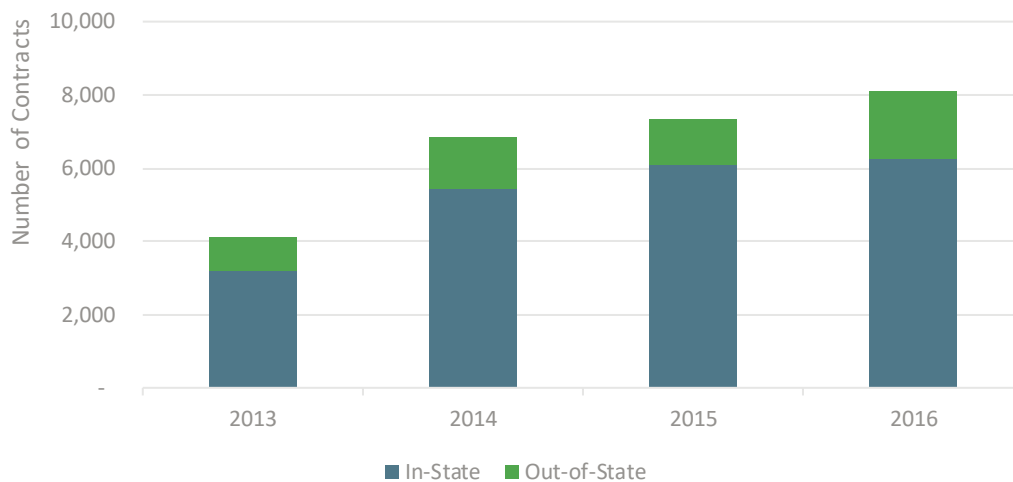
#### Missouri Defense Supply Chain Mapping Project

Table 3.9: FY16 Boeing In-State vs. Out-of-State Performance.

Fiscal Year	Contracts Performed In-State	Contracts Performed Out-of-State	Total	% Out-of-State
2013	3,199	930	4,128	22.5%
2014	5,409	1,433	6,842	20.9%
2015	6,067	1,292	7,359	17.6%
2016	6,263	1,854	8,117	22.8%

Figure 3.12: Boeing In-State Performance vs Out-of-State Performance by Number of Contracts FY13-16

Boeing performs mostly **in-state** contracts



However, when looking at the value of Boeing contracts performed out-of-state, the total awarded amount is much lower. While the contracted value of work performed out-of-state was just over \$180 million in 2016, it represented 2.3% of the value of all awarded work performed by Boeing. By contrast, the total number of performed out-of-state contracts was 22.8% in 2016.

Table 3.10: FY16 Boeing In-State vs. Out-of-State Performance by Contract Value

Fiscal Year	In-State Funding (Millions)	Out-of-State Funding (Millions)	Total (Millions)	% Out-of-State
2013	\$3,261.0	\$177.1	\$3,438.1	5.2%
2014	\$4,687.3	\$121.4	\$4,808.7	2.5%
2015	\$4,501.2	\$217.1	\$4,718.3	4.6%
2016	\$7,758.2	\$180.5	\$7,938.7	2.3%

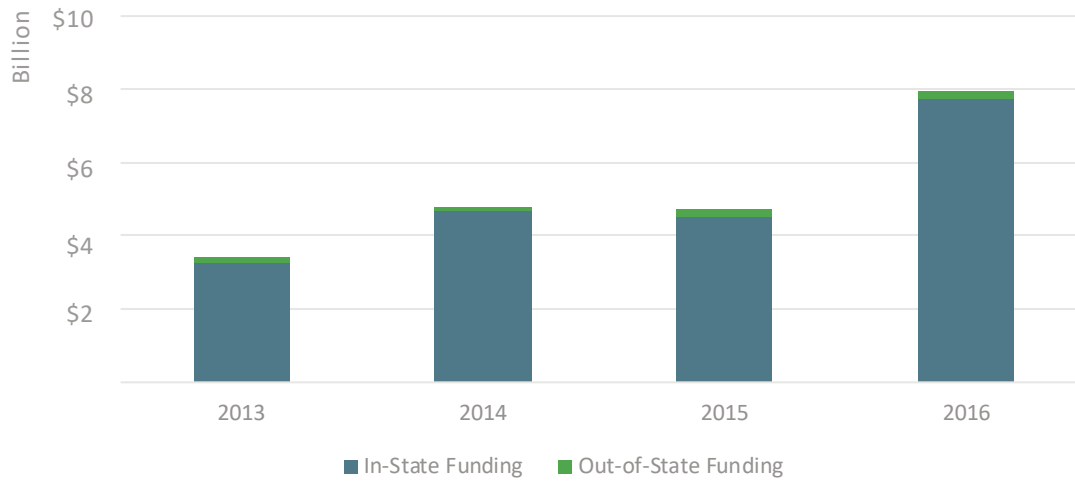


### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

Figure 3.13: Boeing In-State Performance vs Out-of-State Performance by Total Contract Value FY13-16

The majority of Boeing's funding comes from **in-state** contracts



### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

##### Top Contracting Companies

At the company level, Boeing dominates Missouri’s defense contracting. The implications of this dominance will be examined more closely in this section, but Table 3.11 makes it highly evident. Of the \$42 billion Missouri-related DoD prime and subcontracting from FY13-16, Boeing participated in \$23.6 billion, or over 56%.<sup>32</sup> The vast majority of this was for prime contracts, as the company received nearly \$6 billion prime contracts each year. This is not true of the second largest contractor, DRS Sustainment Systems, which received the majority of its \$2.9 billion contract dollars from subcontracting. The fact that many defense contractors will serve as both prime contractors and sub-contractors indicates that DoD contractors are willing to collaborate when it makes business sense. Further bolstering these relationships through developing DoD contracting organizations may keep more DoD subcontracting dollars in-state. Other significant contractors shown in Table 3.11 include Express Scripts, Inc; Alliant Techsystems Operations LLC; and Worldwide Technology Inc. The regional reports delivered along with the supply chain map will highlight the specific geographic location of each of these businesses.

Table 3.11: Top 10 DoD Contracting Companies Located in Missouri, FY13-16

Company Name	City	Total Contracting, FY13-16 (millions)	Average Annual Prime Contracting (millions)	Average Annual Subcontracting (millions)
<b>Boeing Company, The</b>	<b>St. Louis</b>	<b>\$23,616.6</b>	<b>\$5,901.7</b>	<b>\$2.4</b>
DRS Sustainment Systems Inc	St. Louis	\$2,904.3	\$98.1	\$628.0
Express Scripts, Inc.	St. Louis	\$2,626.5	\$656.6	\$0
Alliant Techsystems Operations LLC	Independence	\$1,654.1	\$413.3	\$0.2
World Wide Technology Inc	Maryland Heights	\$1,437.6	\$342.6	\$16.7
Clark McCarthy Healthcare Partners II	St. Louis	\$666.3	\$166.6	\$0
Bart's Electric Company, Inc.	Liberty	\$560.2	\$0	\$140.0
Korte Construction Company	St. Louis	\$350.5	\$87.6	\$0
J.E. Dunn Construction Company	Kansas City	\$335.4	\$83.8	\$0
Kingston Environmental Services, Inc.	Kansas City	\$275.1	\$0	\$68.8

In addition to the large role that in-state companies play in Missouri’s DoD economy, out-of-state companies contributed \$420 billion to the state’s overall defense economy in the past four fiscal years. The top 10 contractors from outside the state are shown in Table 3.12, led by Computer Sciences Corporation (CA); Tsay/Ferguson-Williams, LLC (NM); and MW Builders (TX). Though the feasibility will vary depending on the case, the Partnership and other state EDOs should consider inviting these companies to participate in the programs and events explained in the recommendations section, in order to learn more about the assets offered within the state.

<sup>32</sup> Please note: the figure represents the proportion of total contracts both contracted and performed in Missouri over this period. For contracts just performed in Missouri, the proportion is higher (74%).

### 3. Missouri Defense Contracting Overview

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Table 3.12: Top 10 Non-Missouri Companies Performing DoD Work within Missouri, FY13-16

Company Name	Primary State	Total Contracting, FY13-16 (millions)	Average Annual Prime Contracting (millions)	Average Annual Subcontracting (millions)
Computer Sciences Corporation	California	\$169.5	\$42.4	\$0
Tsay/Ferguson-Williams, LLC	New Mexico	\$130.0	\$32.5	\$0
MW Builders, Inc.	Texas	\$68.7	\$17.2	\$0
Caddell Construction Co. (De), LLC	Alabama	\$35.2	\$8.8	\$0
Raytheon Company	Arizona	\$32.6	\$8.1	<\$0.1
General Dynamics Ordnance and Tactical Systems, Inc.	Florida	\$29.1	\$7.3	\$0
K&K Industries, Inc.	Michigan	\$27.4	\$6.9	\$0
Environmental Chemical Corporation	California	\$26.1	\$6.5	\$0
CTS Cement Manufacturing Corporation	California	\$25.6	\$0	\$6.4
CB&I Federal Services LLC	Louisiana	\$24.2	\$6.1	\$0

In addition to analyzing overall industry activity, it is also helpful to analyze how work is distributed by companies in various industries. These data can reveal whether there are multiple companies competing for contracts or if they tend to be dominated by a small number of large companies. When a small number of large companies dominate defense contracts, this signals that diversification efforts are particularly important because the loss of one business could have a significant impact on the region. This is exactly the case in Missouri, where among the top five prime contracting industries, Boeing leads in four industries. In two of the four industries, Boeing receives over 97% of Missouri’s DoD contracts, and it tops 75% in all four.

The same is not the case in the construction industry however. Within Commercial and Institutional Building Construction Clark McCarthy Healthcare Partners II and Korte Construction Company are the top contract recipients. In this industry, prime contracts are much more evenly distributed than the other four; the top two contractors account for less than half of all contracts.

Table 3.13: Top Contractors for the Five Largest Prime Contracting Industries in MO, FY13-16

Prime Contracting NAICS	Industry Description	Prime Contracting, FY13-16 (millions)	Top Contractors within NAICS	Company Prime Contracting within NAICS (millions)	% of Total
336411	Aircraft Manufacturing	\$13,922.0	<b>1. Boeing Company, The</b>	\$13,895.1	<b>99.8%</b>
336411	Aircraft Manufacturing	\$13,922.0	2. Essex Industries	\$13.1	0.1%
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	\$3,713.2	<b>1. Boeing Company, The</b>	\$3,608.8	<b>97.2%</b>

### 3. Missouri Defense Contracting Overview

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Prime Contracting NAICS	Industry Description	Prime Contracting, FY13-16 (millions)	Top Contractors within NAICS	Company Prime Contracting within NAICS (millions)	% of Total
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	\$3,713.2	2. Seyer Industries, Inc.	\$28.1	0.8%
332993	Ammunition (except Small Arms) Manufacturing	\$2,189.4	<b>1. Boeing Company, The</b>	\$1,725.8	<b>78.8%</b>
332993	Ammunition (except Small Arms) Manufacturing	\$2,189.4	2. Alliant Techsystems Operations LLC	\$454.8	20.8%
236220	Commercial and Institutional Building Construction	\$2,097.4	1. Clark McCarthy Healthcare Partners II	\$666.3	31.8%
236220	Commercial and Institutional Building Construction	\$2,097.4	2. Korte Construction Company	\$339.4	16.2%
541330	Engineering Services	\$1,978.8	<b>1. Boeing Company, The</b>	\$1,529.5	<b>77.3%</b>
541330	Engineering Services	\$1,978.8	2. Burns & McDonnell Engineering Company, Inc.	\$79.5	4.0%

Similar trends are clear among subcontract recipients. Though Boeing is not one of the largest subcontract recipients, contract awards are still highly concentrated with just a few companies within the five largest subcontracting industries. Among Guided Missile and Space Vehicle Manufacturing Subcontractors, DRS Sustainment Systems was awarded 97.0% of all contract revenue. Similarly, Genesis Environmental Solutions received 99.3% of all Industrial Building contract dollars in Missouri from FY13-16.

Once again however, the Commercial and Institutional Building Construction industry is more competitive; Bart's Electric Company, Inc. and Kingston Environmental Services, Inc. split just 46.5% of the FY13-16 revenue in this industry.

Table 3.14: Top Contractors for the Five Largest Subcontracting Industries in MO, FY13-16

Subcontracting NAICS	Industry Description	Subcontracting, FY13-16 (millions)	Top Contractors within NAICS	Company Subcontracting within NAICS (millions)	% of Total
336414	Guided Missile and Space Vehicle Manufacturing	\$2,543.4	<b>1. DRS Sustainment Systems, Inc.</b>	\$2,465.9	<b>97.0%</b>
336414	Guided Missile and Space Vehicle Manufacturing	\$2,543.4	2. Eaglepicher Technologies, LLC	\$47.9	1.9%

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

Subcontracting NAICS	Industry Description	Subcontracting, FY13-16 (millions)	Top Contractors within NAICS	Company Subcontracting within NAICS (millions)	% of Total
236220	Commercial and Institutional Building Construction	\$1,783.1	1. Bart's Electric Company, Inc.	\$555.1	31.1%
236220	Commercial and Institutional Building Construction	\$1,783.1	2. Kingston Environmental Services, Inc.	\$275.1	15.4%
236210	Industrial Building Construction	\$198.1	<b>1. Genesis Environmental Solutions, Inc.</b>	\$196.6	<b>99.3%</b>
236210	Industrial Building Construction	\$198.1	2. Universal Technologies, LLC	\$0.8	0.4%
541512	Computer Systems Design Services	\$180.2	1. Cerner Corporation	\$137.9	76.6%
541512	Computer Systems Design Services	\$180.2	2. World Wide Technology, Inc.	\$20.3	11.3%
336411	Aircraft Manufacturing	\$154.6	<b>1. G K N Aerospace North America Inc.</b>	\$139.7	<b>90.3%</b>
336411	Aircraft Manufacturing	\$154.6	2. Seyer Industries, Inc.	\$2.3	1.5%

Another way to analyze defense economy diversity is by looking at the number of Missouri businesses in defense industries over time. To assess these changes, TPMA’s consulting team utilized the National Establishment Time Series Database (NETS), a comprehensive database of all business establishments in each state over time. For each business establishment in operation since 1990, it catalogs the location, industry classification, and year opened or closed, among many other statistics. In order to assess trends in the number of defense establishments throughout Missouri over time, TPMA’s consulting team identified all establishments classified as belonging to the 10 largest defense industries in the state — those identified in Table 3.1 Figure 3.15 displays the number of Missouri establishments within these industries that have closed and opened each year since 1990. These industries exhibited net business growth nearly every year from 1992 through 2008. As Figure 3.15 demonstrates, volatility increased during the Great Recession, with business closings reaching its peak in 2009.<sup>33</sup> However, a positive effect followed the Great Recession, as business openings peaked in 2010. The number of Missouri businesses in these industries grew from 3,616 at the beginning of 1990 to 4,712 at the end of 2013—after reaching a peak of 5,214 at the end of 2011.

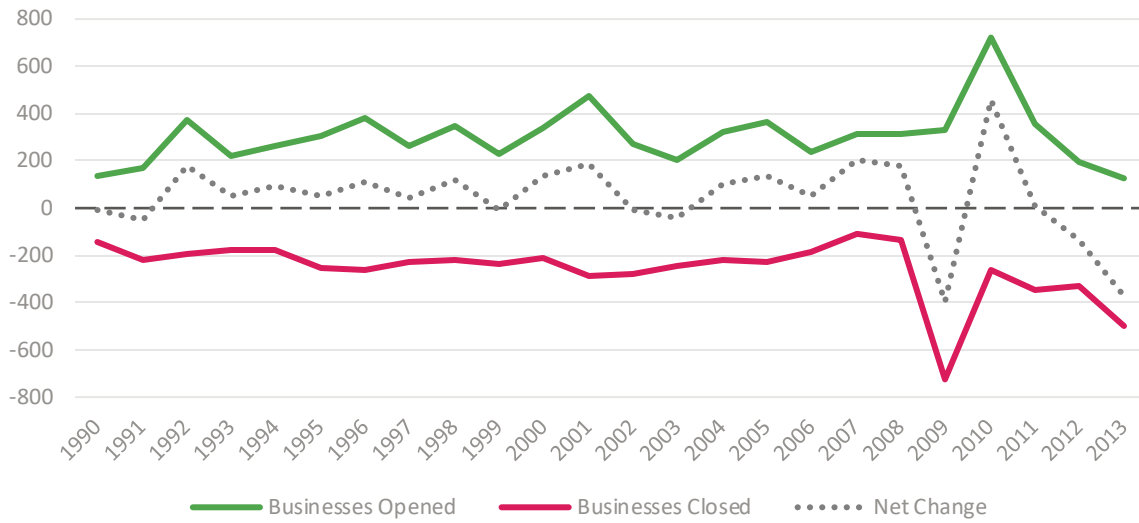
<sup>33</sup> TPMA's analysis of data from the National Establishment Time Series (NETS) database. Includes all business establishments located in Missouri since 1990 and associated with the 10 NAICS shown in Table 3.1.

### 3. Missouri Defense Contracting Overview

#### Missouri Defense Supply Chain Mapping Project

Figure 3.14: Missouri Business Trends in Top 10 FY13-16 Contracting Industries

Businesses **closing** and **opening** peaked around the Great Recession



### 4. Missouri's Defense Supply Chain

#### Summary

This report expounds upon the contracting summary data provided in [3. Missouri Defense Contracting Overview](#) to outline the flow of goods from upstream suppliers and producers to defense contractors and the US or foreign offices that purchase their products. It also examines the regional distributions of contracting revenue through Missouri, and contracting data might be leveraged to diversify Missouri's defense economy.

Among upstream industries—suppliers for defense contracting industries—**Missouri is especially strong in Business Services and Aircraft Manufacturing. However, some key supply chain components are being heavily imported from out of state.** These components include aircraft engines, semiconductors, and iron and steel milling, among others.

Additionally, analyzing supply chain flows among prominent defense industries revealed both defense-dependent sections of the Missouri economy and places where DoD contracting supports targeted cluster growth. Upstream supplying industries that are supported by heavily defense-dependent industries are potentially vulnerable to fluctuations in DoD contracting revenue. **For Missouri, the Transportation Equipment Manufacturing sector and the Management of Companies and Enterprises sector might be particularly impacted by defense contracting changes.** On the other hand, many prominent DoD contracting industries are part of targeted clusters and support cluster development through their purchasing patterns. Advanced Manufacturing, which is being highlighted by both state and regional economic development organizations, is particularly impacted. It is important to note that not all industries within the Advanced Manufacturing sector are affected by DoD contracting. Given the proclivity of businesses in this cluster to utilize automation and advanced technologies, the Advanced Manufacturing industry is, in general, likely more resilient to negative economic stimulus than many other types of manufacturing.

In terms of downstream impacts, the goods and services produced by Missouri's defense companies are being sold to DoD contracting offices across the country. In fact, five states come before Missouri in their total volume of defense contracts. This list is led by Ohio, Maryland, and Alabama. Goods are also being exported around the world. Among heavily defense-related industries, Missouri businesses overwhelmingly export their goods to Canada. Among Missouri's DoD contracting offices, Fort Leonard Wood and the Army Corps of Engineers in Kansas City both provided nearly \$350 million to in-state businesses. Overall, the Army Corps of Engineers in Kansas City provided nearly three times more contracts than Fort Leonard Wood, but it gave most of its contracts to out-of-state firms.

At the sub-state level, the St. Louis region dominates defense contracting. It leads the state in total contracts received, total revenues received, and total number of active defense firms. However, there are some sectors in which other areas of the state lead the way. By contractor location, the Kansas City region received the most DoD contracts in Admin, Support, & Waste Management; Construction & Extraction; and Non-Durable Goods Manufacturing, while Southwest Missouri led the way in Transportation, Warehousing, & Utilities contracting. By location of contracts performed, Central Missouri led the way in several categories.

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

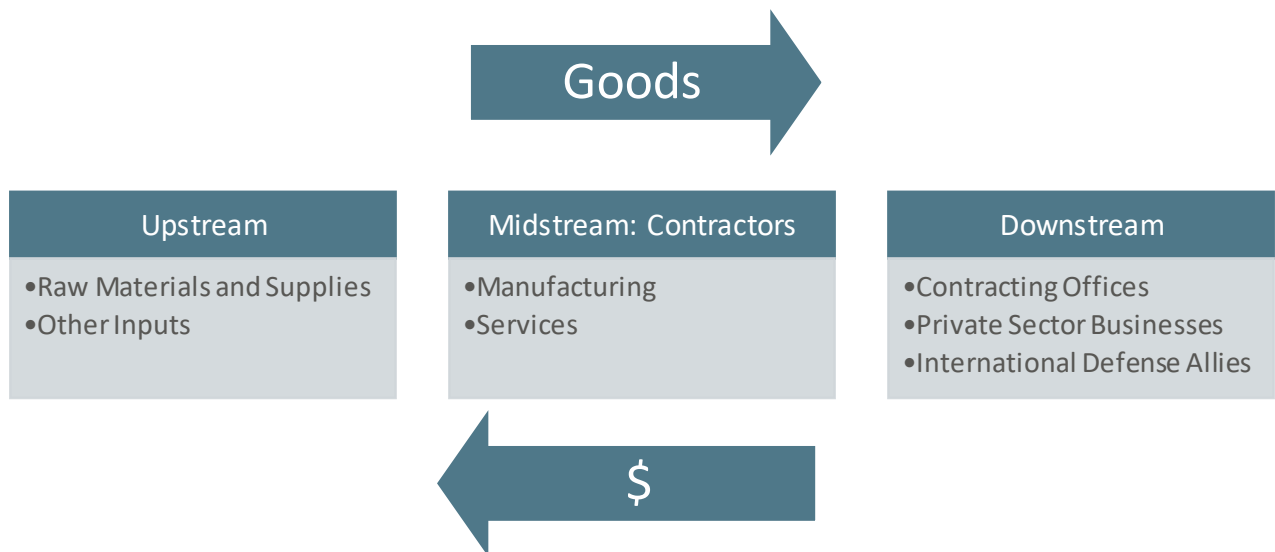
Lastly, while it may be difficult to diversify the sales of heavily defense-dependent contractors (like weapons manufacturers) within Missouri, their suppliers may have more opportunities to sell to other industries. Some potential downstream purchasers for these products include the auto industry, plastic products, and air conditioning equipment manufacturing.

#### Supply Chain Overview

The first step to diversifying an economy is understanding how it functions, which includes an analysis of the full supply chain that supports defense contracts. Overall, DoD contracting activities and key trends over time are explored in [3. Missouri Defense Contracting Overview](#), but defense contracting impacts Missouri's economy well beyond dollars paid directly to defense contractors. Outside of prime and subcontracting transactions, DoD activity has ripple effects on the jobs and incomes in many other supporting industries as well.

Government contractors are part of a broader defense supply chain that includes everything from extraction of raw materials to food and business services. Each component's path through the supply chain can be conceptualized as a flow of goods from "upstream" suppliers and manufacturers to "downstream" defense consumers and purchasers of those goods. The diagram below depicts this flow of goods in a simplified manner.

Figure 4.1: Simplified Supply Chain Flow Map



To understand the upstream and downstream nodes of the defense supply chain, connections must be drawn from defense contracting industries to the specific industries—both in-state and outside Missouri—that supply them, as well as the defense agencies and offices that provide them with contracts. The analysis that follows provide details about the top defense supplier industries, areas of leakage to out-of-state firms, and paths from contracting offices to specific contracting industries. In addition to the analysis presented in this report, the regional reports delivered in tandem with this report provide detailed statistics on each region of the state including the economic "ripple effects" of DoD contracts in terms of jobs, earnings, and sales.



## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

#### Upstream Nodes

##### Key Contracting Industries

All analysis of upstream nodes is based on the initial list of Missouri’s top defense contracting industries. This list identified 73 key industries with either more than \$5 million of annual contracting or greater than 5% dependency on DoD contracts—meaning that DoD contracting makes up greater than 5% of the industry’s annual state-wide sales.<sup>34</sup> From there, TPMA’s consulting team analyzed statistics about the goods these industries purchase as inputs for production. This led to information about both supplier industries in Missouri and supplies that are sourced from businesses outside the state (i.e. supply chain leakage). Upstream nodes are explored on both an aggregate and individual basis. In the [Top Supplier Industries](#) and [Supply Chain Leakage](#) sections, analysis is associated with *all 73 industries combined*, rather than any particular DoD contracting industry. In the [Detailed Upstream Analysis](#) section, the supply chains of individual industries are compared to others within industry categories.

These 73 industries represent \$10.1 billion, or 95.7%, of Missouri’s annual inflation-adjusted DoD revenue. Thus, the upstream supply chain analysis based on these industries includes the vast majority of all DoD contracting activity pertaining to the State of Missouri.

Tables 4.1 and 4.2 provide detailed distributions of the 73 key defense industries by defense-dependency and industry group. In addition, a table of key characteristics of all 73 industries is provided in [Appendix B](#). The majority of industries in the list were more than 5% dependent upon DoD contracts for their revenue in Missouri over the past four years. However, the list does contain 11 exceptions to this rule.<sup>35</sup> Naturally, industries at the top of this list in the >80%; 60-79.9%; and 40-59.9% groups should receive greater attention in diversification efforts because they are most vulnerable to adverse changes in DoD contracting.

Table 4.1: Distribution of Key Defense Contracting Industries by Dependency Category

Dependency Category	Number of Industries
>80%	11
60-79.9%	1
40-59.9%	4
20-39.9%	8
10-19.9%	22
5-9.9%	16
2-4.9%	8
1-1.9%	1
<1%	2
<b>All Selected Industries</b>	<b>73</b>

<sup>34</sup> This dependency ratio was calculated based on estimates from multiple sources. Therefore, it inherently contains some level of error. To account for potential variance in each individual estimate, dependency ratios are discussed here in broad categories, rather than presenting raw estimates. However, the 5% dependency level is viewed as a significant indicator of the relevance of DoD contracts for a particular industry.

<sup>35</sup> To be added to the selected list with less than 5% defense dependency, an industry must have more than \$5 million in annual inflation-adjusted defense contracting, and be in a key Manufacturing or Information, Professional, and Scientific Industry.

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In addition to defense dependency categories, all contracting industries were grouped into eight broader categories, described in [3. Missouri Defense Contracting Overview](#). The distribution of these groups, along with the annual contracting revenue associated with each, is provided in the table below.

Table 4.2: Distribution of Key Defense Contracting Industries by Industry Group

Industry Group	Average Annual Contract Values (FY13-16)	Number of Industries
Durable Goods Manufacturing	\$6,750.99	37
Information, Professional, & Scientific	\$1,196.20	15
Construction & Extraction	\$1,116.47	4
Other Services & Trade	\$525.03	7
Finance, Insurance, & Management	\$271.87	1
Admin, Support, & Waste Management	\$90.85	2
Non-Durable Manufacturing	\$80.68	6
Transportation, Warehousing, & Utilities	\$19.79	1
<b>All Selected Industries</b>	<b>\$10,051.88</b>	<b>73</b>

#### Top Supplier Industries

Table 4.3 identifies the top 30 industries from which Missouri’s contracting industries make in-state defense-related purchases.<sup>36</sup> These industries have a strong presence in Missouri and are large suppliers for the industries in which DoD contracting is most concentrated. To indicate the strength of the in-state supply chain for each of these suppliers this table also displays the percentage of those purchases that are in-state or imported from out-of-state.

Table 4.3 demonstrates that defense contracting supports a large number of jobs in industries across the economic spectrum. This is particularly true with industries that have a long-term heritage within the state that has allowed for the development of rich supply chains, such as Aircraft Manufacturing. This is why clustering of industries is such a popular and effective means of economic development. At the same time, regions with highly mature economic clusters present a vulnerability, in that if the revenue within a single industry is reduced many other industries will be adversely effected as well. The challenge with any effort at diversification, therefore, is to retain the unique strength of the region’s industrial assets yet at the same time seek to reposition those assets to different uses.

Importantly, Table 4.3 also indicates the portion of purchases within each industry that defense contractors import from outside of Missouri. This indicates the degree to which supply chains are clustered within the state. For example, Other Aircraft Parts and Auxiliary Equipment Manufacturing, and Insurance Agencies and Brokerages, each have a large degree of imports from out-of-state. This indicates that defense contractors largely source their supplies in these industries from outside Missouri. However, industries with high proportions of in-state purchases should receive extra attention

<sup>36</sup> To form a more realistic picture of defense-related supply chain purchases, modeled supplier connections for all 73 key contracting industries were weighted by the respective industry’s total contracting activity. This method was used for all tables and figures in the Upstream Nodes section of the report.

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in any diversification efforts. Some examples of these would be Guided Missile and Space Vehicle Manufacturing; Aircraft Manufacturing; and Engineering Services.

Table 4.3: Top 30 Missouri Industry Suppliers for Key Contracting Industries

NAICS	Supplier Description	In-State Purchases (millions)	% In-State Purchases	% Imported Purchases	Total Purchases (millions)
551114	Corporate, Subsidiary, and Regional Managing Offices	\$273.6	86.9%	13.1%	\$315.0
336414	Guided Missile and Space Vehicle Manufacturing	\$209.2	97.0%	3.0%	\$215.6
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	\$158.2	58.5%	41.5%	\$270.4
336411	Aircraft Manufacturing	\$95.2	88.8%	11.3%	\$107.2
541330	Engineering Services	\$42.4	77.1%	22.9%	\$54.9
524210	Insurance Agencies and Brokerages	\$39.1	69.6%	30.4%	\$56.3
517110	Wired Telecommunications Carriers	\$38.6	87.3%	12.7%	\$44.2
541110	Offices of Lawyers	\$32.1	77.3%	22.7%	\$41.6
561320	Temporary Help Services	\$30.4	78.1%	21.9%	\$39.0
522110	Commercial Banking	\$26.4	87.6%	12.4%	\$30.1
326199	All Other Plastics Product Manufacturing	\$25.8	64.2%	35.8%	\$40.2
541512	Computer Systems Design Services	\$25.4	73.8%	26.2%	\$34.4
518210	Data Processing, Hosting, and Related Services	\$24.2	93.2%	6.8%	\$26.0
425120	Wholesale Trade Agents and Brokers	\$22.0	44.1%	55.9%	\$49.8
531110	Lessors of Residential Buildings and Dwellings	\$20.1	69.6%	30.4%	\$28.8
541611	Administrative Management and General Management Consulting Services	\$15.6	46.5%	53.5%	\$33.6
484121	General Freight Trucking, Long-Distance, Truckload	\$14.4	62.2%	37.8%	\$23.1
531120	Lessors of Nonresidential Buildings (except Miniwarehouses)	\$14.1	80.3%	19.7%	\$17.5
336992	Military Armored Vehicle, Tank, and Tank Component Manufacturing	\$13.7	86.4%	13.6%	\$15.9
533110	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	\$13.3	43.5%	56.6%	\$30.5
722511	Full-Service Restaurants	\$12.9	88.1%	11.9%	\$14.6

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NAICS	Supplier Description	In-State Purchases (millions)	% In-State Purchases	% Imported Purchases	Total Purchases (millions)
541990	All Other Professional, Scientific, and Technical Services	\$12.1	69.4%	30.6%	\$17.5
322211	Corrugated and Solid Fiber Box Manufacturing	\$12.0	69.1%	30.9%	\$17.3
531210	Offices of Real Estate Agents and Brokers	\$11.6	50.6%	49.4%	\$23.0
332710	Machine Shops	\$11.4	46.7%	53.3%	\$24.4
334413	Semiconductor and Related Device Manufacturing	\$11.1	10.6%	89.4%	\$104.7
332312	Fabricated Structural Metal Manufacturing	\$11.0	39.4%	60.6%	\$28.0
423830	Industrial Machinery and Equipment Merchant Wholesalers	\$10.7	83.4%	16.6%	\$12.8
336412	Aircraft Engine and Engine Parts Manufacturing	\$10.5	4.5%	95.5%	\$236.0
561422	Telemarketing Bureaus and Other Contact Centers	\$10.5	80.2%	19.8%	\$13.1
N/A	All Other	\$952.8	46.9%	53.2%	\$2,033.4

### Supply Chain Leakage

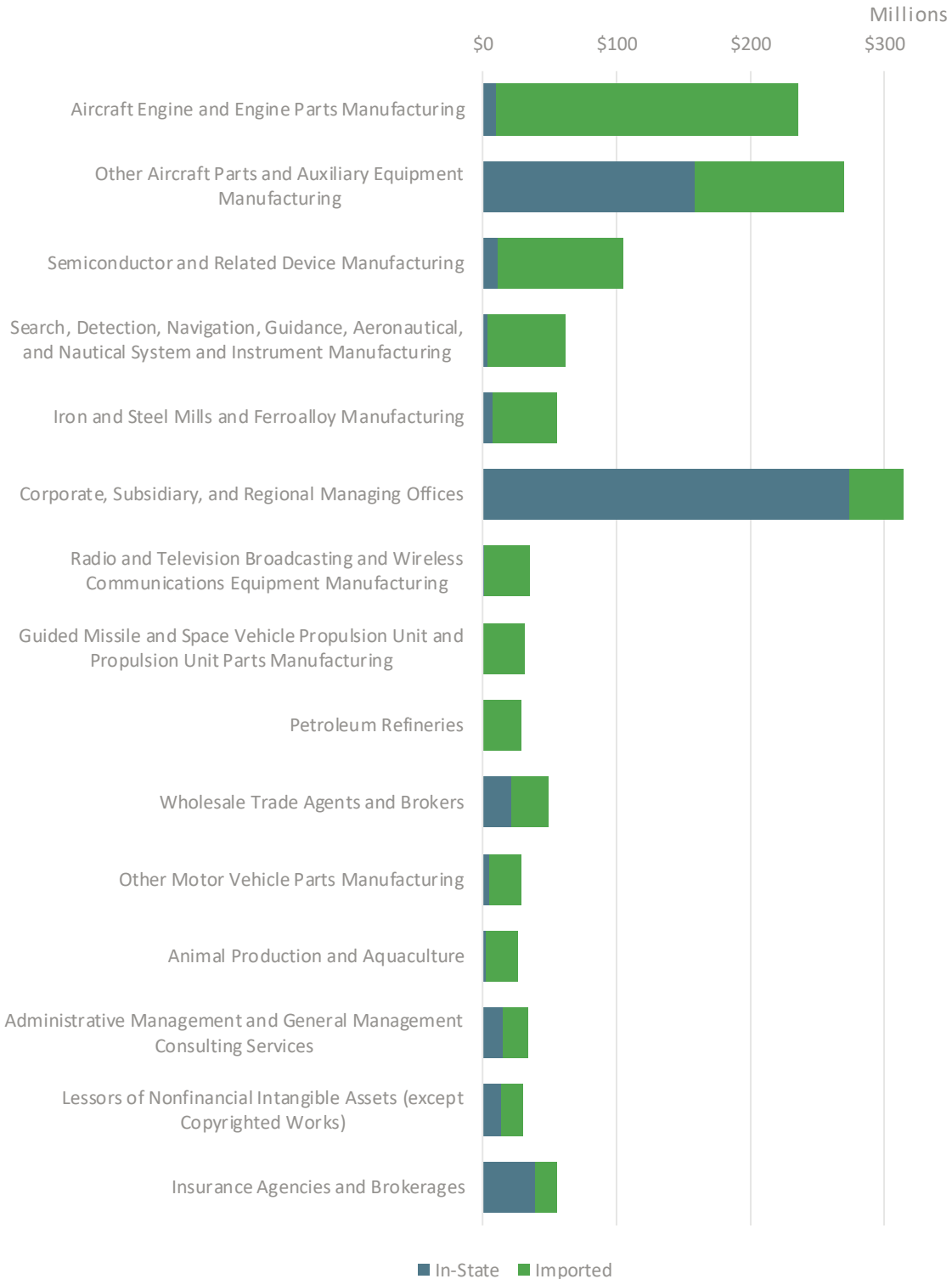
Figure 4.2 displays the same data as Table 4.3 above, but is sorted by quantity of imported purchases. Once again, it is weighted by defense activity among purchasing—or contracting—industries. This means that the supply chain of Aircraft Manufacturing, Missouri’s largest contracting industry, factors more heavily in these estimates than the supply chains of other industries. By considering imports instead of in-state purchases, Figure 4.2 reveals the defense suppliers that are most lacking within Missouri’s economy. These industries are necessary for defense contractors to produce their goods and services, but are not currently being supplied by Missouri-based businesses. In some industries on the list, like Aircraft Engine and Engine Parts Manufacturing; Semiconductor and Related Device Manufacturing; and Search, Detection, and Navigation Instrument Manufacturing, a high percentage of products are imported from outside the state. In these industries, it could be said that defense contracting dollars are “leaking” outside the state to non-Missouri companies. Though the primary intention of this analysis is to provide advice on diversification, another potential benefit from studying supply chains is noticing areas of leakage that can be plugged in order to increase the economic potency of existing clusters. Shoring up these gaps in the defense supply chain is one step that Missouri can take to improve its defense economy.

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Figure 4.2: Most-Imported Defense-Related Supply Industries

**Imported supply industries** represent defense contracting dollars “leaking” outside the state to non-Missouri companies



## 4. Missouri Defense Supply Chain

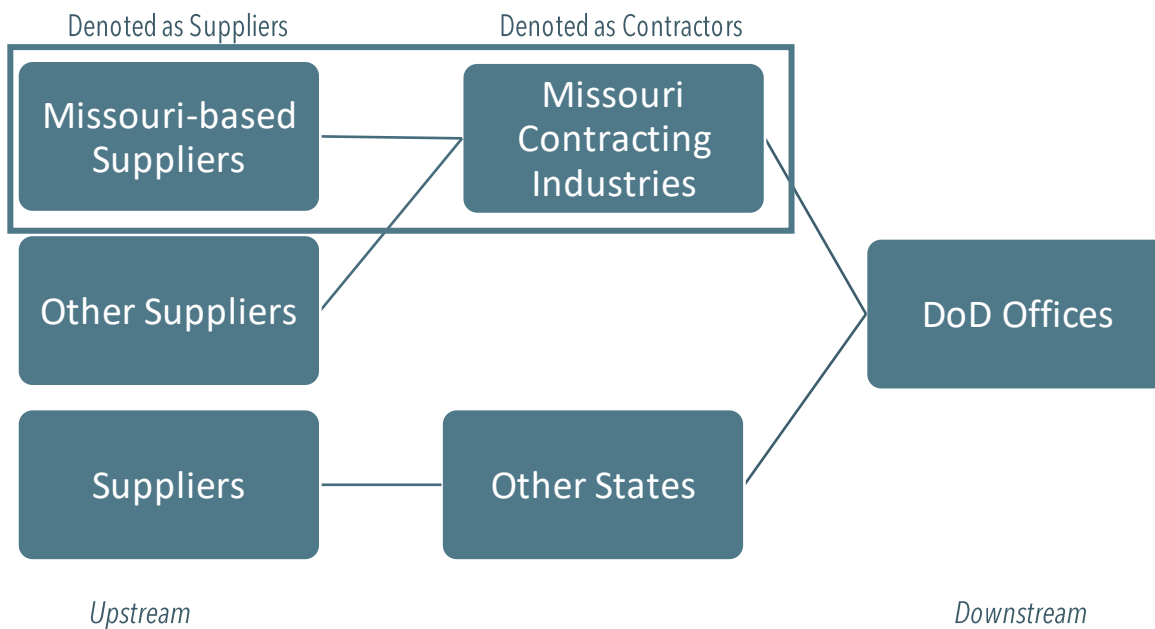
### Missouri Defense Supply Chain Mapping Project

#### Detailed Upstream Analysis

Following initial analysis of suppliers and leakage from defense contracting industries, TPMA’s consulting team conducted more detailed analyses on the supply chains of the 73 selected industries. As described previously, these industries were selected based on their dependence on DoD contracts for total revenue within Missouri and/or their overall volume of DoD contracting. Additionally, each industry was categorized into one of eight defense industry groups. Using these categorizations, TPMA’s consulting team analyzed detailed in-state supply chains for the 73 selected industries. Thus, the supply chain charts that follow describe purchases from businesses in DoD-contracting industries within Missouri to other Missouri-based firms. This analysis starts by presenting supply chain diagrams for industries that are heavily dependent upon defense contracting, followed by the supply chains for each industry group. As with the rest of the upstream supply chain analysis, total dollar amounts are weighted by defense contracting volumes in order to display the relative influence of DoD on different sectors of Missouri’s economy. Each diagram shows defense contracting industries on the right (by 6-Digit NAICS) and suppliers to these industries on the left (by 2 or 3-digit NAICS).<sup>37</sup>

These following supply chain map diagrams show only one section of the full defense economy picture, the part indicated in the blue box below.

Figure 4.3: Relationship between Suppliers, Contracting Industries and DoD Contracting Offices



Lastly, in addition to the diagrams provided in this section, a full picture of Missouri’s defense supply chain is provided in [Appendix C](#). This diagram demonstrates both the significance of Durable Goods

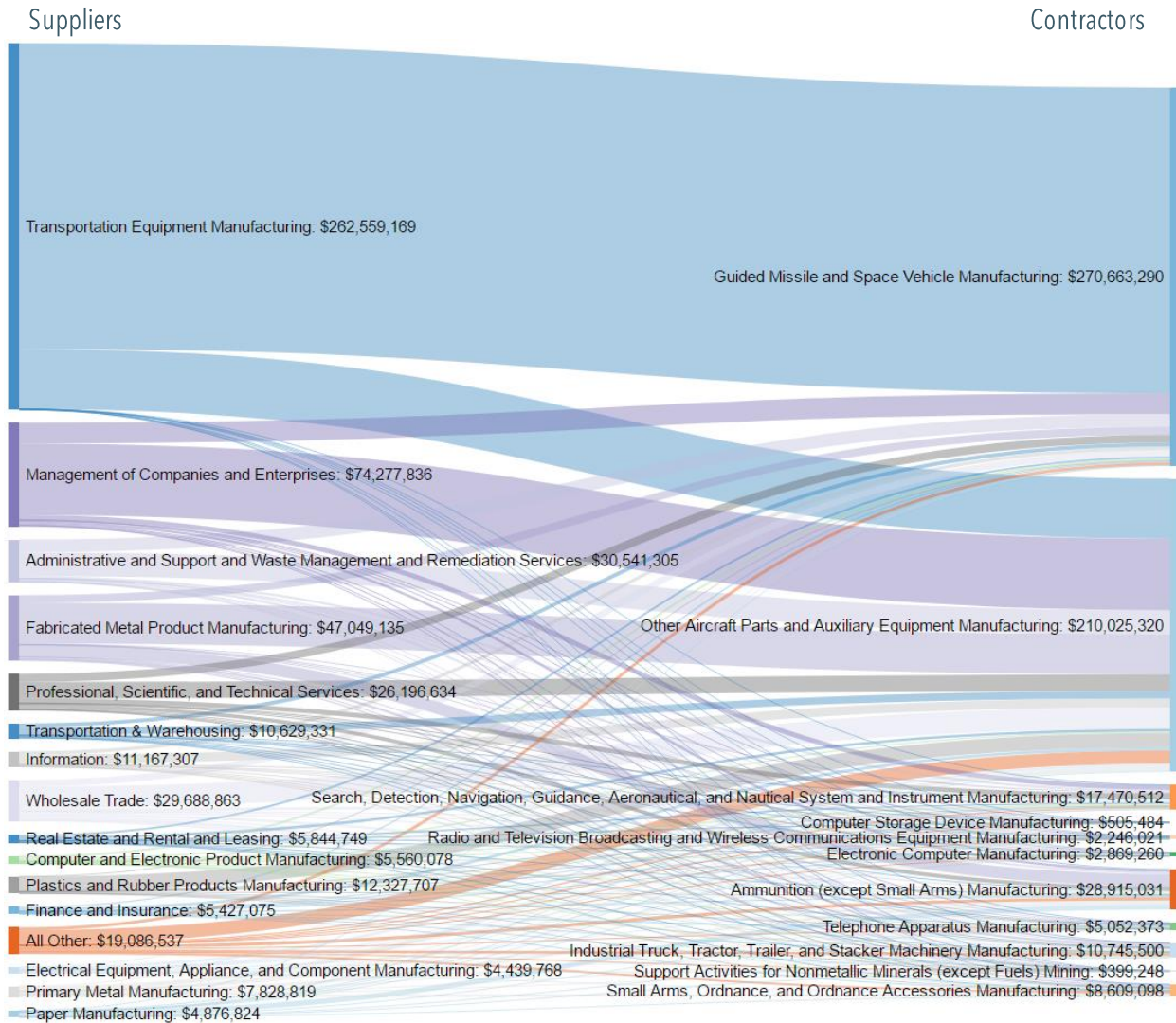
<sup>37</sup> Due to differences in data availability at the time they were created, the data used to construct these diagrams may have minor differences (<1% total) with the data in preceding tables. However, the majority of variance between the diagrams and tables comes from the difference between contracting dollars received and dollars spent on supplies for each industry.

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Manufacturing for Missouri’s defense economy, and the relative significance of Missouri goods (shown in orange) for maintaining the state’s defense economy supply chain.

Figure 4.4: Greater than 80% Dependent Industries

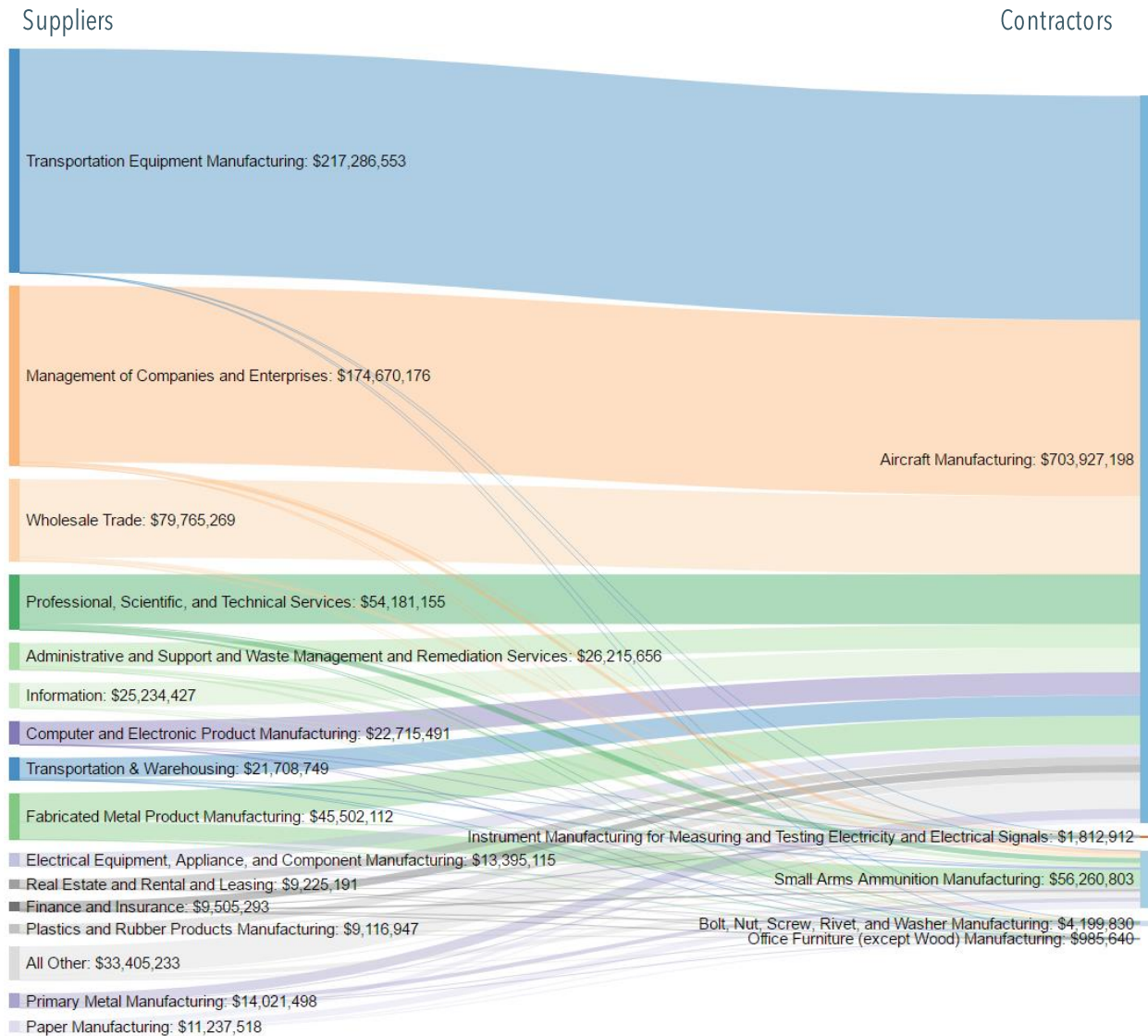


The first category considered in the detailed supply chain analysis is contracting industries that sell more than 80% of their products to DoD. **Of all groups analyzed in this chapter, these industries and their suppliers are the most vulnerable to fluctuations in defense spending.** Missouri’s most defense-dependent industries purchase the most supplies from the Transportation Equipment Manufacturing sector. This means that each year, this sector supplies \$250 million of goods that are used for production of defense products by industries that heavily rely on DoD funding for their survival in Missouri. If DoD suddenly stopped giving contracts in Missouri, the Missouri Transportation Equipment Manufacturing sector would feel an estimated \$250 million loss. Other suppliers to heavily dependent industries include Management of Companies and Enterprises; Fabricated Metal Product Manufacturing; and Administrative Support and Waste Management.

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## Missouri Defense Supply Chain Mapping Project

Figure 4.5: 40-79% Dependent Industries



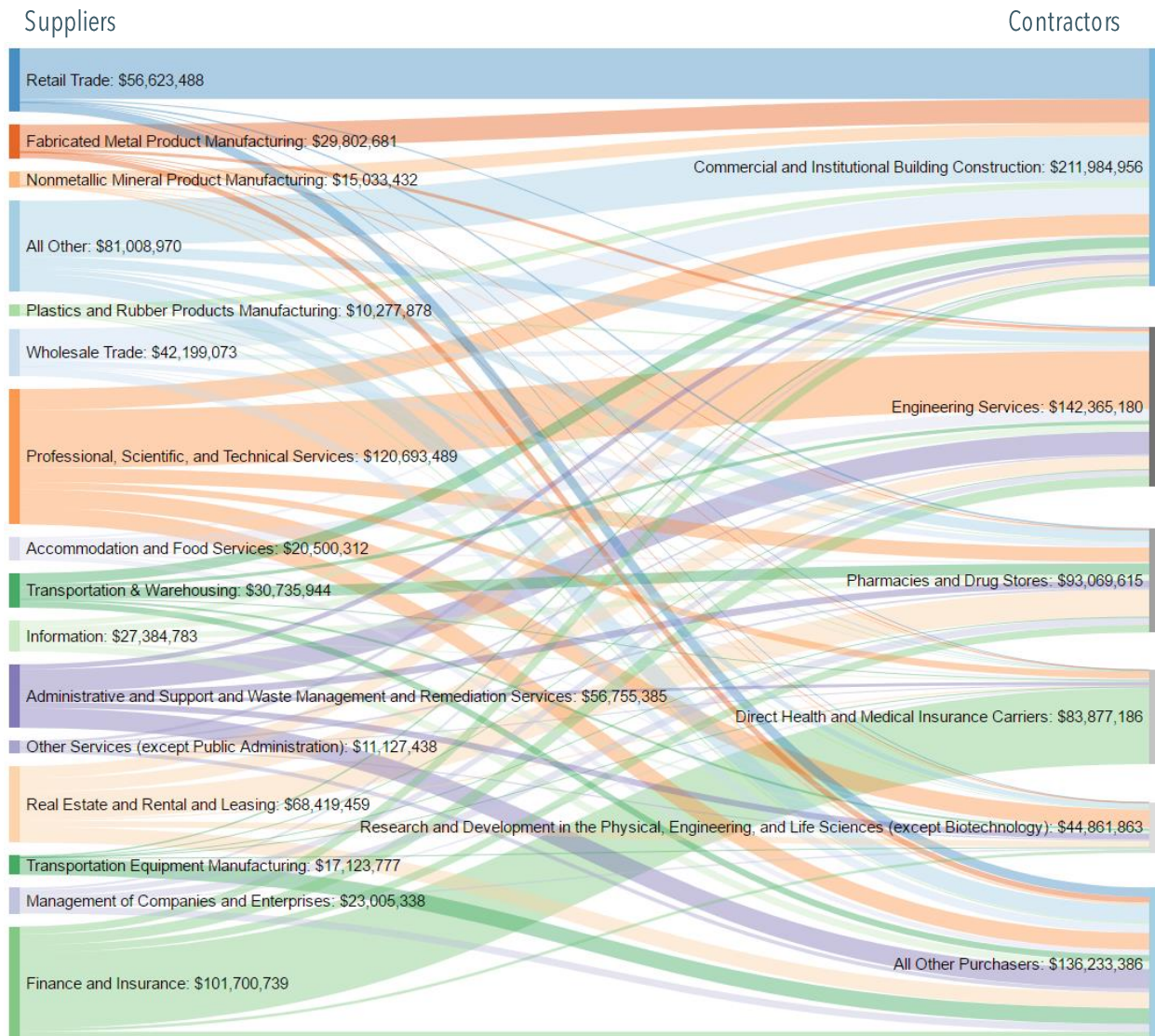
Transportation Equipment Manufacturing and Management of Companies and Enterprises also receive a large amount of purchases from contracting industries that are moderately dependent upon DoD contracting for their Missouri sales. For this set of industries, however, several other sectors play a prominent supply role. These include Wholesale Trade; Fabricated Metal Product Manufacturing; and Professional, Scientific, and Technical Services. Considering the industries on the right side of the diagram, if DoD contracting abruptly ceased in Missouri, the Aircraft Manufacturing industry (and other purchasers shown in Figure 4.5) would be more likely to survive than industries in the 80% dependency range, but the supplying sectors shown in Figure 4.5 would still feel significant losses.



## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Figure 4.6: 10-39% Dependent Industries



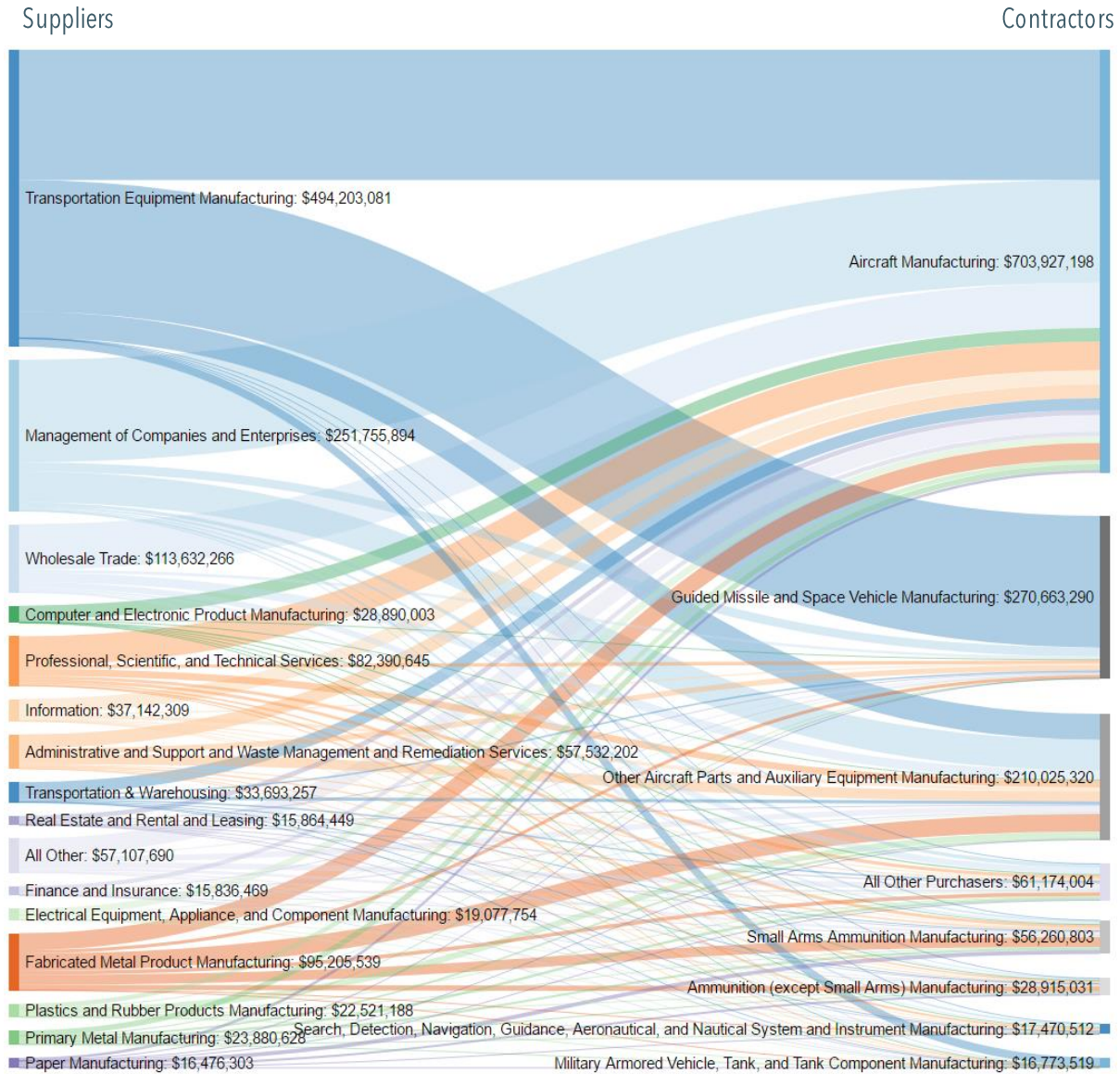
There is somewhat more diversity among suppliers to those industries that are slightly defense dependent because this category includes a larger and more diverse set of purchasers—30 of the 73 key contracting industries. The largest DoD contractor among this group is Commercial and Institutional Building Construction, but this industry diversifies its purchases from Missouri firms between Retail Trade; Fabricated Metal Product Manufacturing; Wholesale Trade; and several other industry sectors. Among all suppliers to slightly defense-dependent industries, the Professional, Scientific, and Technical Services sector leads the way with \$120.7 million, but several others are impacted as well:

- Finance and Insurance: \$101.7 million
- Real Estate and Rental and Leasing: \$68.4 million
- Administrative and Support and Waste Management and Remediation Services: \$56.8 million
- Retail Trade: \$56.6 million

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### Missouri Defense Supply Chain Mapping Project

Figure 4.7: Durable Goods Manufacturing Industries



The Office of Economic Adjustment (OEA) is most concerned about maintaining the manufacturing supply chain supporting DoD because manufacturing facilities are capital intensive, technically complex, and difficult to initialize. As such, Figure 4.7 is critical for understanding priorities for federal agencies. Incidentally, the Durable Goods Manufacturing industry group is also the largest, in terms of annual contracts, of all DoD contractors within the state (see Table 3.4).

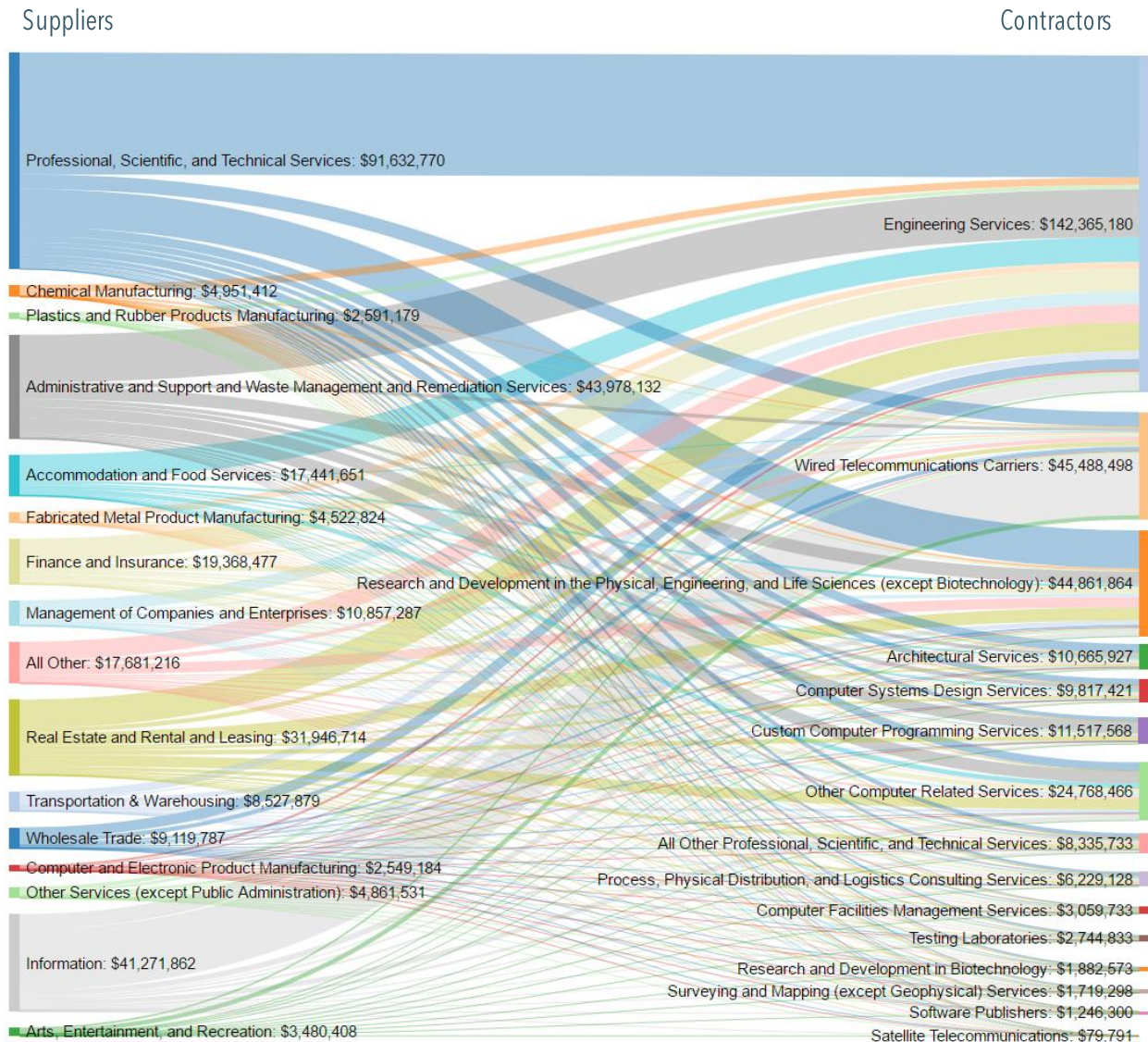
The group of Durable Goods Manufacturers is led by Aircraft Manufacturing. Contractors in these industries most frequently purchase from businesses in the Transportation Equipment Manufacturing; Management of Companies and Enterprises; and Fabricated Metal Product Manufacturing sectors. Following Aircraft Manufacturing, this group is led by Guided Missile and Space Vehicle Manufacturing and Other Aircraft Parts and Auxiliary Equipment Manufacturing, but it includes a wide variety of

## 4. Missouri Defense Supply Chain

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defense contracting industries. Many of the 37 industries within this Industry Group are part of targeted clusters such as Advanced Manufacturing and Energy Solutions.<sup>38</sup> Additionally, Boeing plays a significant role in this industry group. For more on Boeing, see the discussion in [Boeing Company Contracting Trends](#).

Figure 4.8: Information, Professional, & Scientific Industries



As mentioned, the OEA is most concerned about protecting technically complex and capital-intensive industries from business disruptions. The Information, Professional, & Scientific Industry Group includes

<sup>38</sup> In order to identify targeted clusters, TPMA's consulting team consulted three sources: the [Missouri Department of Economic Development](#); the [Missouri Economic Research and Information Center](#); and [SLEDP](#) sector strengths.

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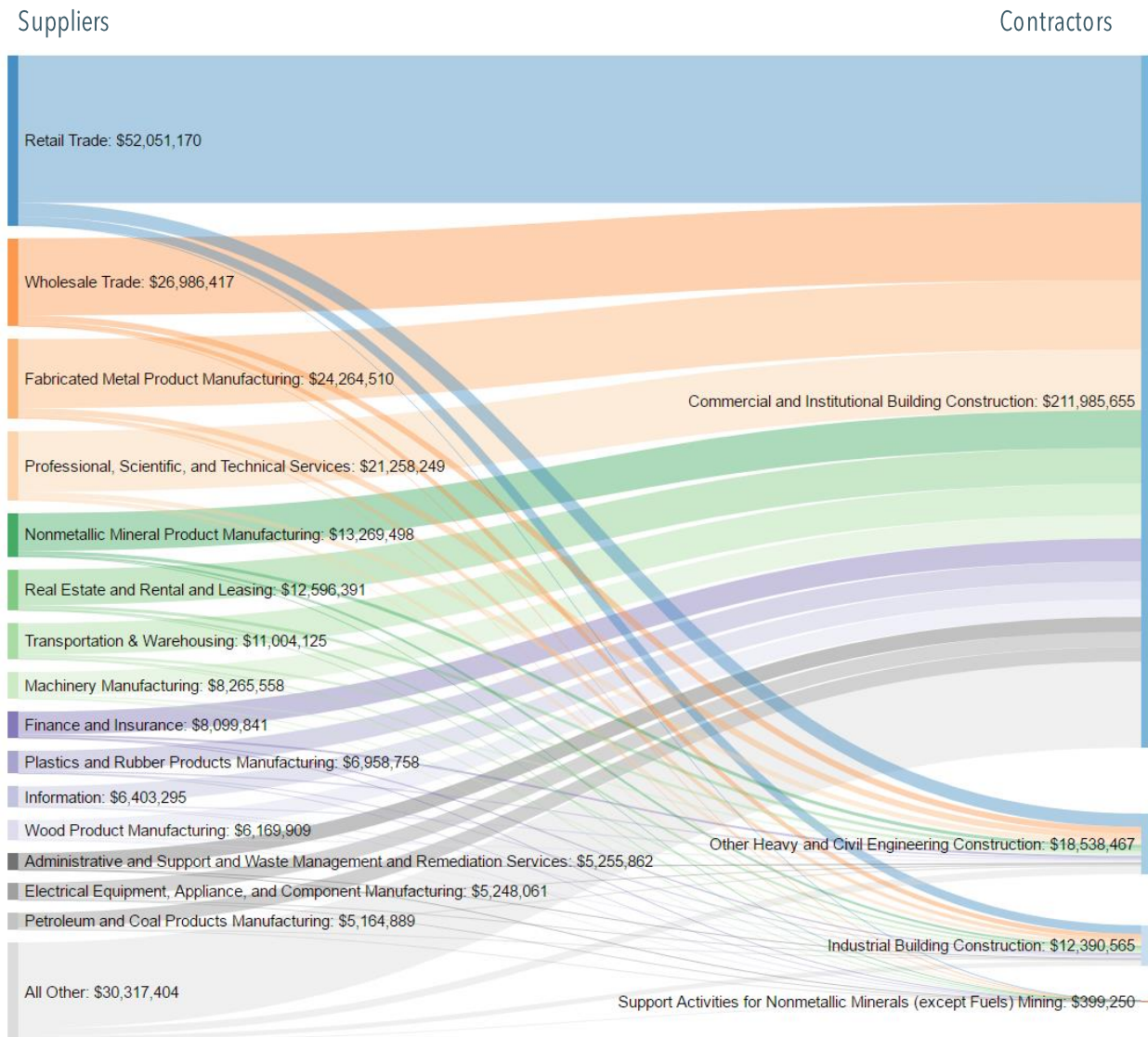
sectors with these same characteristics, particularly those involved in research & development, and engineering services.

Industries within the Information, Professional, & Scientific Industry Group heavily source from other industries within the from the Professional, Scientific, and Technical Services sector. However, this industry group has a very diverse supply chain overall. Additional major suppliers include Administrative Services and Waste Management; Information; and Real Estate and Rental and Leasing. On the right side of Figure 4.8, three contracting industries make more than \$25 million annually in defense-driven purchases to Missouri-based suppliers. These industries are Engineering Services; Wired Telecommunications Carriers; and Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology). Like industries in the Durable Goods Manufacturing Industry Group, many Information, Professional, & Scientific industries belong to at least one targeted economic development cluster. These include Advanced Manufacturing, Biosciences, Energy Solutions, Financial Solutions, and Health Sciences and Services, among others.

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Figure 4.9: Construction & Extraction Industries

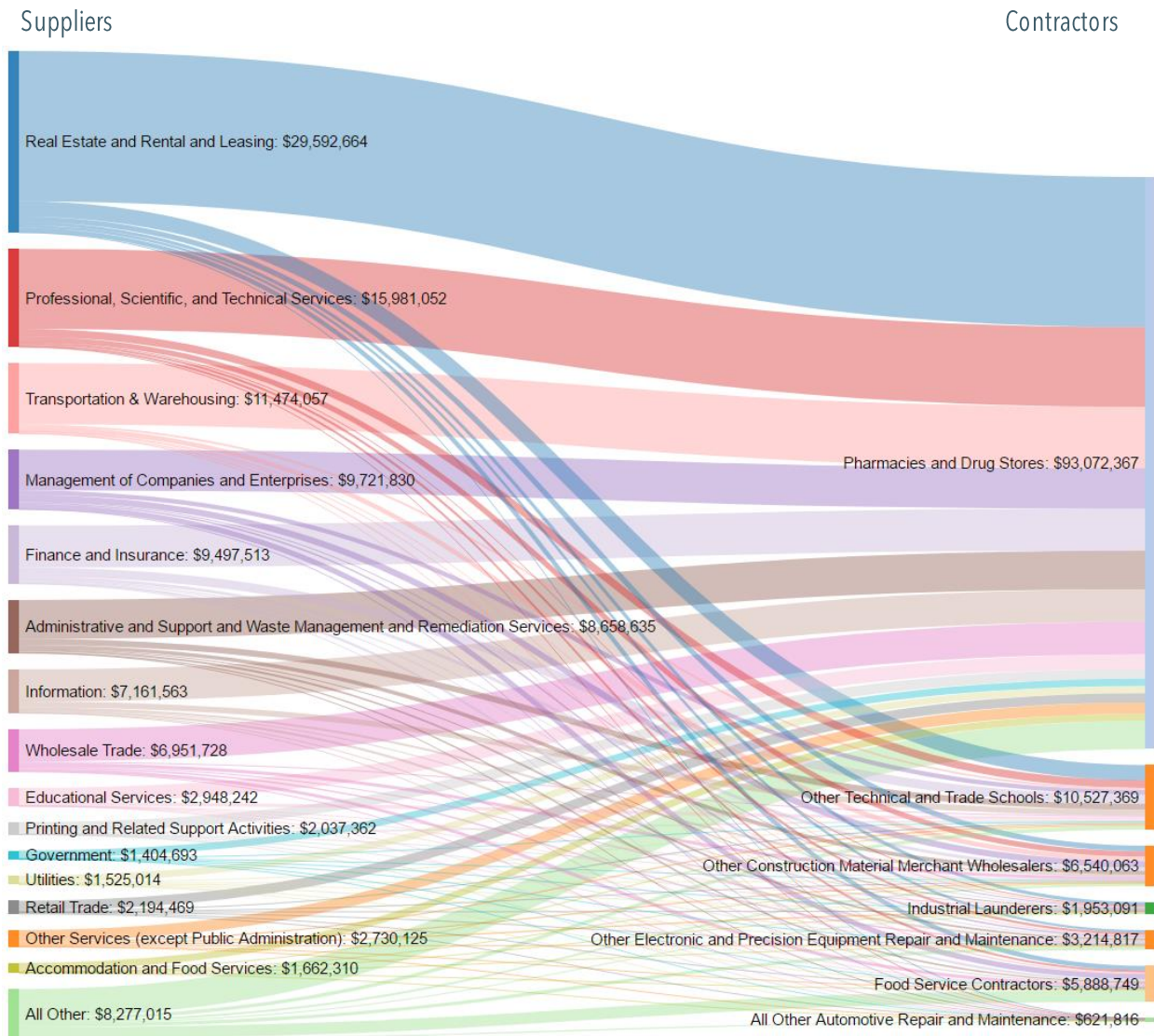


Missouri’s industries in the Construction & Extraction Industry Group also receive a large amount of DoD contract dollars. Overall, Commercial and Institutional Building Construction dominates DoD-driven purchasing within the state, primarily supporting the Retail Trade, Wholesale Trade, and Fabricated Metal Product Manufacturing sectors. However, the All Other category also represents a significant source of supplies for these industries. The chart above only shows the top 15 supplying sectors; therefore, the All Other category represents the total supplies provided by sectors beyond these top 15. The relative size of this category indicates the varied impact that Construction & Extraction businesses have on Missouri’s defense economy. While none of the major contracting industries in the Construction & Extraction group are part of targeted clusters, they do purchase from industries in clusters like Transportation & Logistics, Advanced Manufacturing, and Energy Solutions.

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Figure 4.10: Other Services & Trade Industries

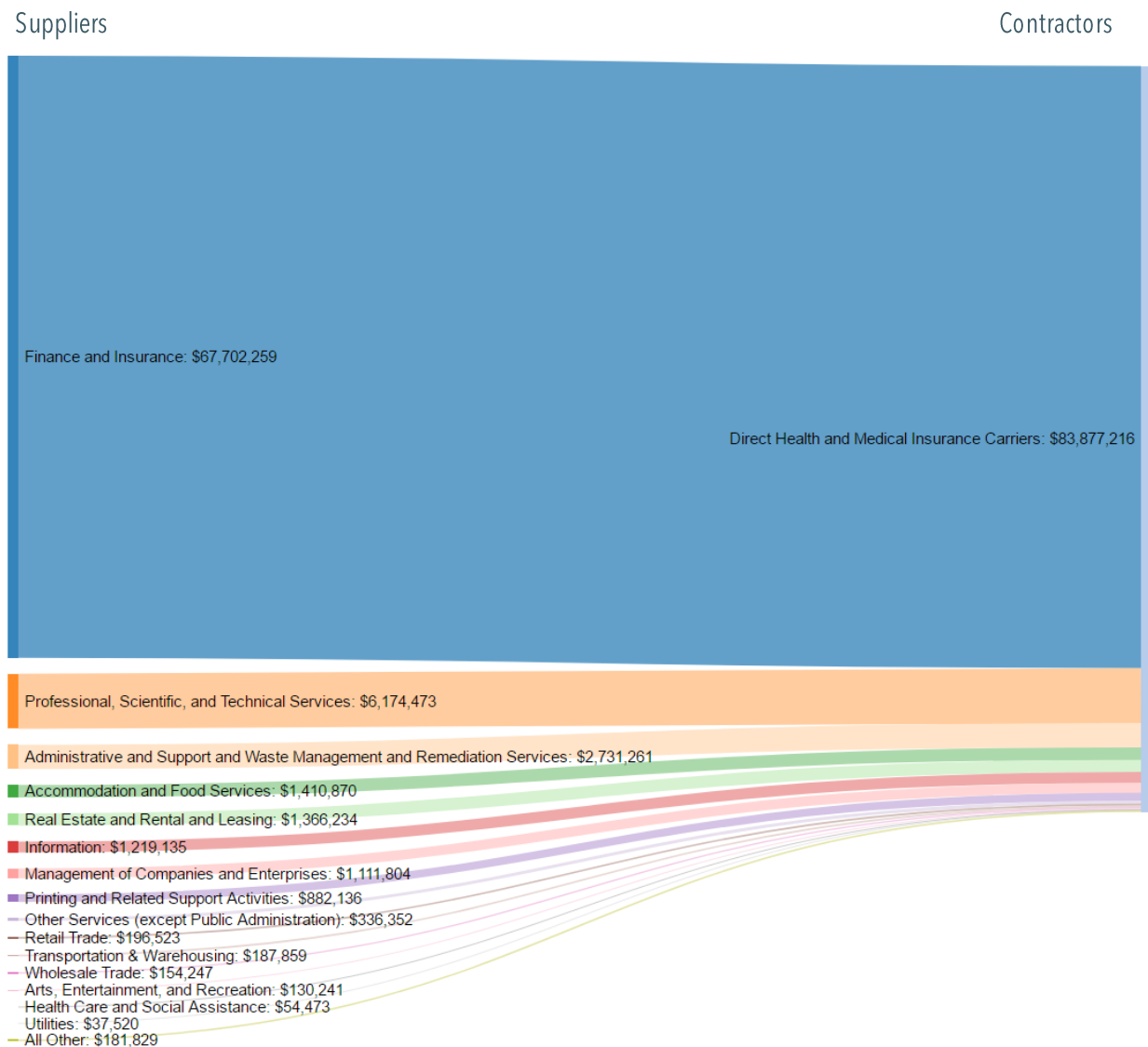


The Other Services & Trade Industry Group is a miscellaneous category of industries that do not fit into other industry categories. Because of this, most of the industries within this group do not belong to any industry clusters targeted by regional or statewide economic development organizations. However, its supply chain is quite diverse and, due to the large contracting volume of the Pharmacy and Drug Store industry in Missouri, this group still plays an important role in Missouri's defense economy. Its largest suppliers are from the Real Estate and Rental and Leasing sector, followed by the Professional, Scientific, and Technical Services sector and the Transportation and Warehousing sector.

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Figure 4.11: Finance, Insurance, & Management Industries



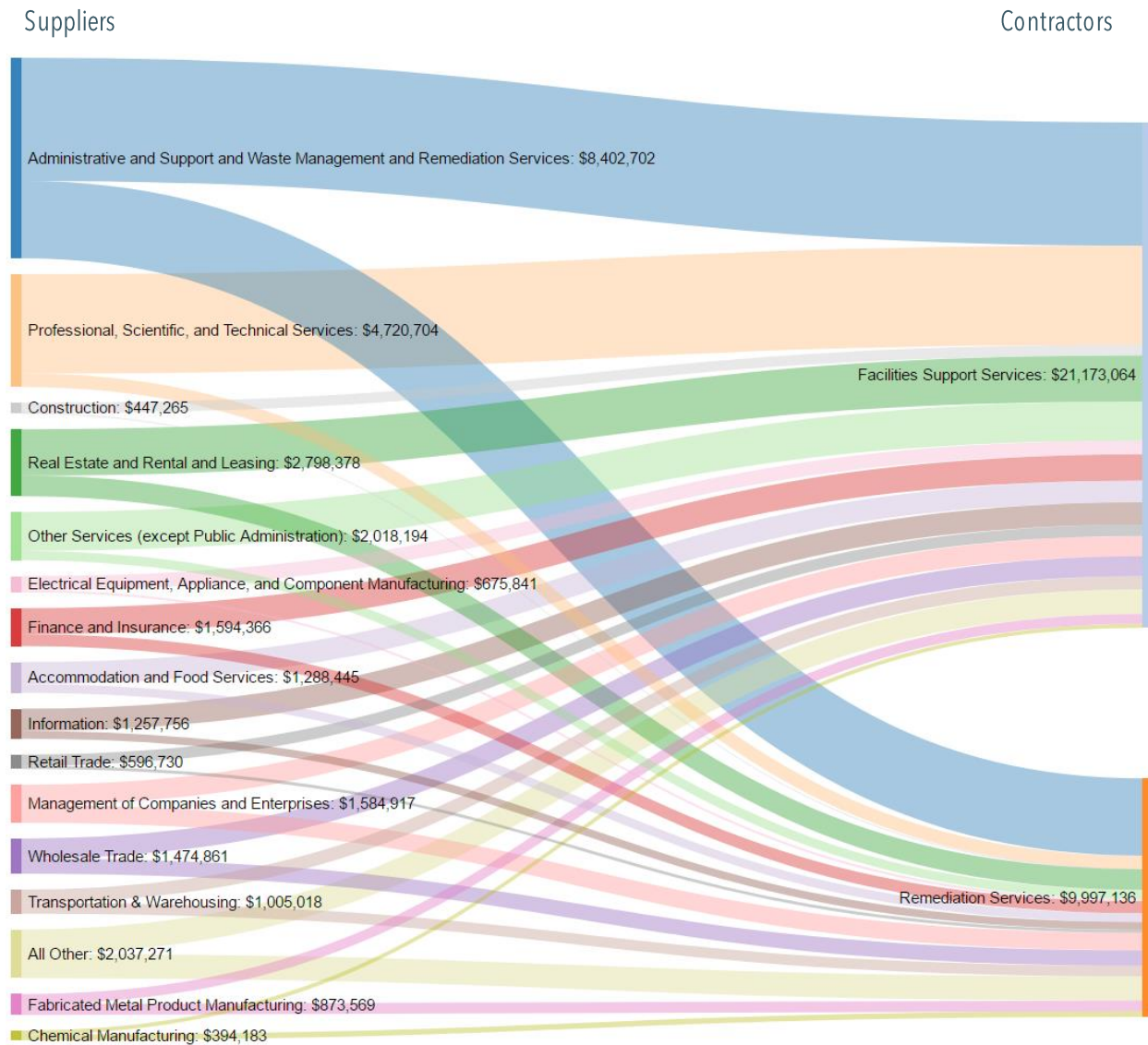
Among the Finance, Insurance, & Management Industry Group, the only prominent contracting industry is Direct Health and Medical Insurance Carriers. Dominated by Express Scripts, this industry receives \$272 million annually in inflation-adjusted DoD contracting revenue, and redirects nearly \$84 million of that revenue towards suppliers in the State of Missouri. This industry's supply chain is less diverse than others. The majority of its purchases come from the Finance and Insurance sector, but the Professional, Scientific, and Technical Services sector also plays a role in its supply chain. Of course, the Direct Health and Medical Insurance Carriers industry also belongs to the Financial Solutions/Financial and Professional Services industry cluster, which is identified as a targeted cluster by the Missouri Department of Economic Development and the Missouri Economic Research and Information Center.<sup>39</sup>

<sup>39</sup> In order to identify targeted clusters, TPMA's consulting team consulted the Missouri DED, MERIC, and SLEDP. See previous footnote for more details.

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Figure 4.12: Administrative, Support, & Waste Management Industries



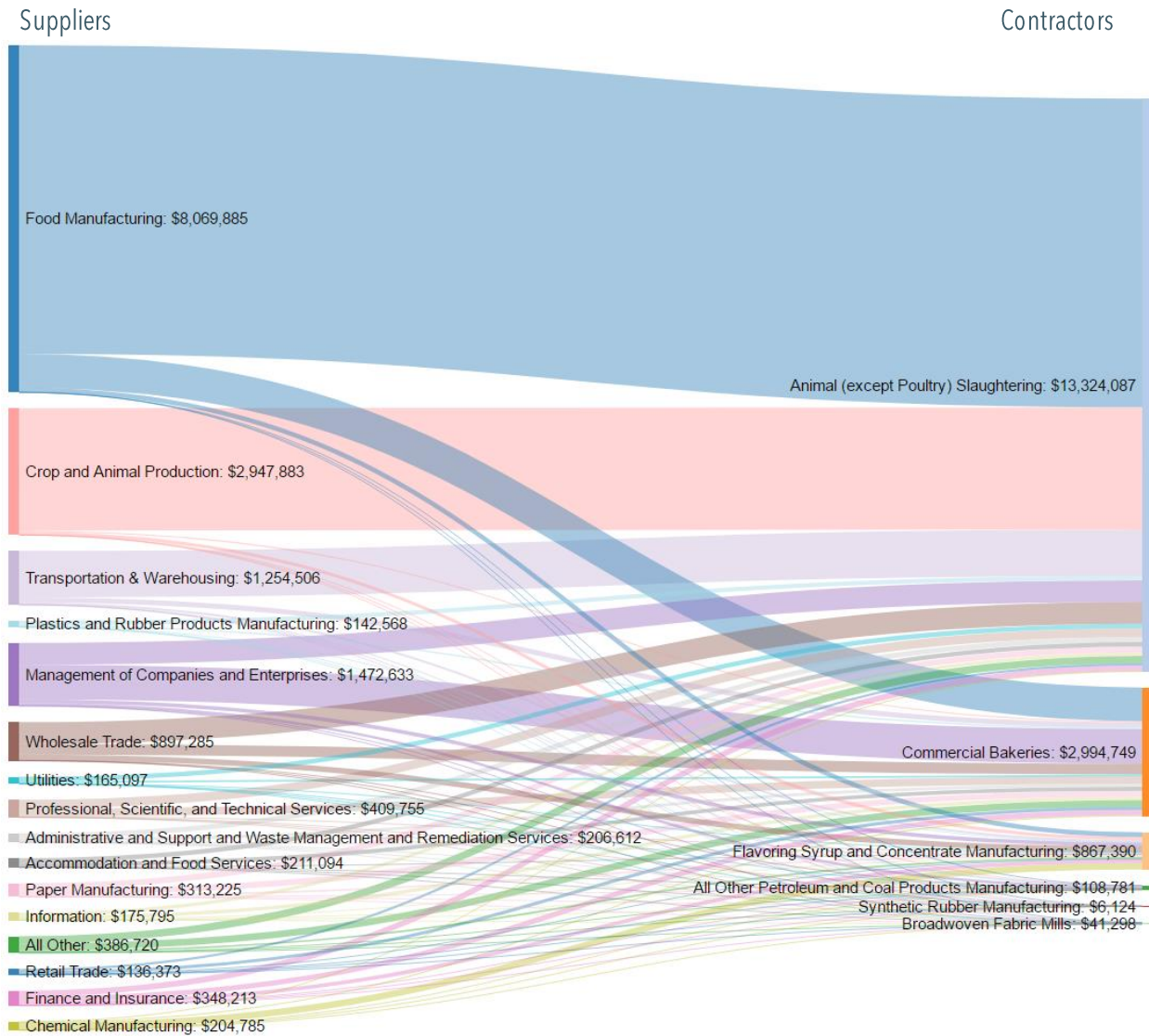
The sixth largest industry group, Admin, Support, & Waste Management, has a relatively diverse supply chain. The two prominent contracting industries within this group combine for more than \$30 million in annual purchases to Missouri industries related to defense production. The most supplies for this group come from Administrative and Support and Waste Management and Remediation Services, with \$8.4 million. However, nine other industries supply more than \$1 million annually to defense contractors in this industry group. Thus, contracting within the Admin, Support, & Waste Management Industry Group has wide-ranging impacts on the Missouri Defense economy, though it does not match most other Industry Groups in total volume.



## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Figure 4.13: Non-Durable Manufacturing Industries

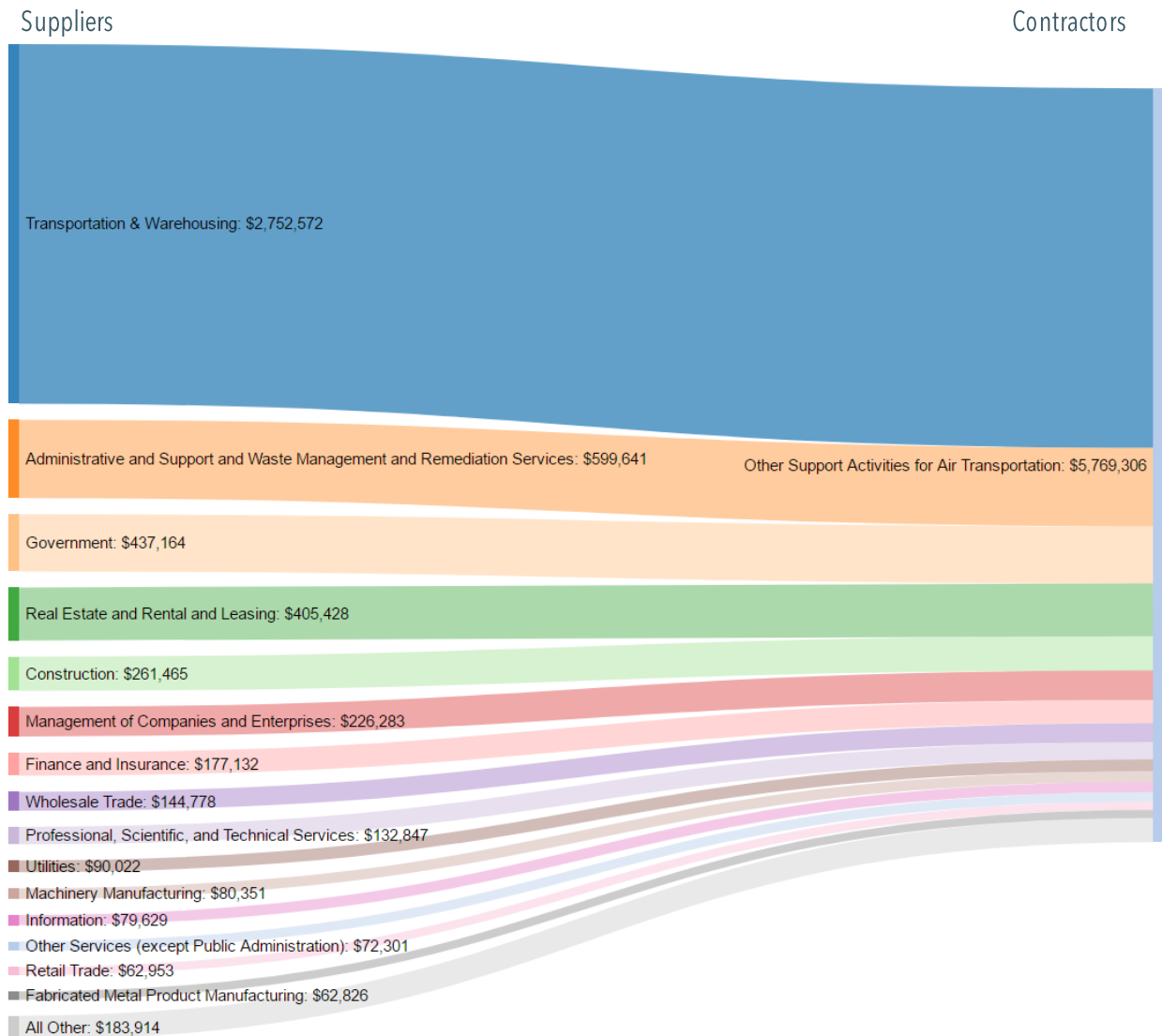


Though the Non-Durable Goods Manufacturing Industry Group plays a much smaller role in Missouri’s defense economy than its Durable Goods counterpart, six industries from this group still merit inclusion in the list of 73 prominent contracting industries. The largest of these industries, which produce goods that are consumed more quickly, is Animal (except Poultry) Slaughtering, with \$63 million in inflation-adjusted DoD contracts annually from FY13-16. This translates to over \$13 million in defense-driven purchases to Missouri industries. Overall, Food Manufacturing is the largest supplier to both Animal Slaughtering and the Non-Durable Manufacturing Group. This sector is followed by Crop and Animal Production and Management of Companies and Enterprises, both with over \$1 million annually in defense-related sales. Overall, this industry group is not closely aligned with target industry clusters in Missouri.

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Figure 4.14: Transportation, Warehousing, & Utilities Industries



Lastly, only one industry from the Transportation, Warehousing, & Utilities Industry Group was identified as a prominent defense contractor for Missouri, and no industries were identified from the Admin, Support, & Waste Management Industry Group. This industry was Other Support Activities for Air Transportation, which received over \$19.8 million annually in Missouri DoD contracts and was approximately 8% dependent upon defense revenues for its total Missouri sales. Its supply chain is shown above; the Transportation and Warehousing sector is its largest supplier, followed by Administrative and Support and Waste Management and Remediation Services. Additionally, this industry is part of the Transportation and Logistics cluster, a targeted cluster identified by the Missouri Department of Economic Development (DED) and Missouri Economic Research Information Center (MERIC).

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

#### Downstream Nodes

In contrast with upstream nodes, downstream nodes describe the places and institutions that provide funding for Missouri’s defense economy. For the most part, this consists of either DoD contracting offices or defense-related exports to other parts of the world. For Missouri businesses and industries, these institutions are the customers for the products and services they provide. By analyzing the defense economy in terms of downstream nodes, Missouri can track whether customer needs are changing and monitor purchasing patterns over time.

#### Sales to DoD Contracting Offices

Missouri business are awarded DoD contracts from defense offices in a variety of states. As demonstrated by Table 4.4 and Figure 4.15, the top office locations for prime-contractor DoD activity performed or located in Missouri are Ohio, Maryland, Colorado, Alabama, and Pennsylvania. Overall, only 5.0% of Missouri prime contracting activity comes from DoD offices located within the state, while offices in five other states provide a higher percentage of Missouri DoD activity. Conversely, some nearby states provided funding for less than \$10 million of DoD activity from FY13-16. From offices in Michigan specifically, Missouri actually lost DoD contract money during that span.

Table 4.4: Top Ten States Providing Missouri DoD Contracts<sup>40</sup>

Contracting Office State	FY13-16 Missouri DoD Activity (millions)	% of Total
Ohio	\$9,214.3	21.9%
Maryland	\$8,049.9	19.2%
Alabama	\$3,069.4	7.3%
Colorado	\$2,705.8	6.4%
Pennsylvania	\$2,158.5	5.1%
<b>Missouri</b>	<b>\$2,101.3</b>	<b>5.0%</b>
Illinois	\$2,045.6	4.9%
Virginia	\$2,040.6	4.9%
Florida	\$1,839.8	4.4%
Utah	\$1,719.2	4.1%
All Other	\$7,061.5	16.8%

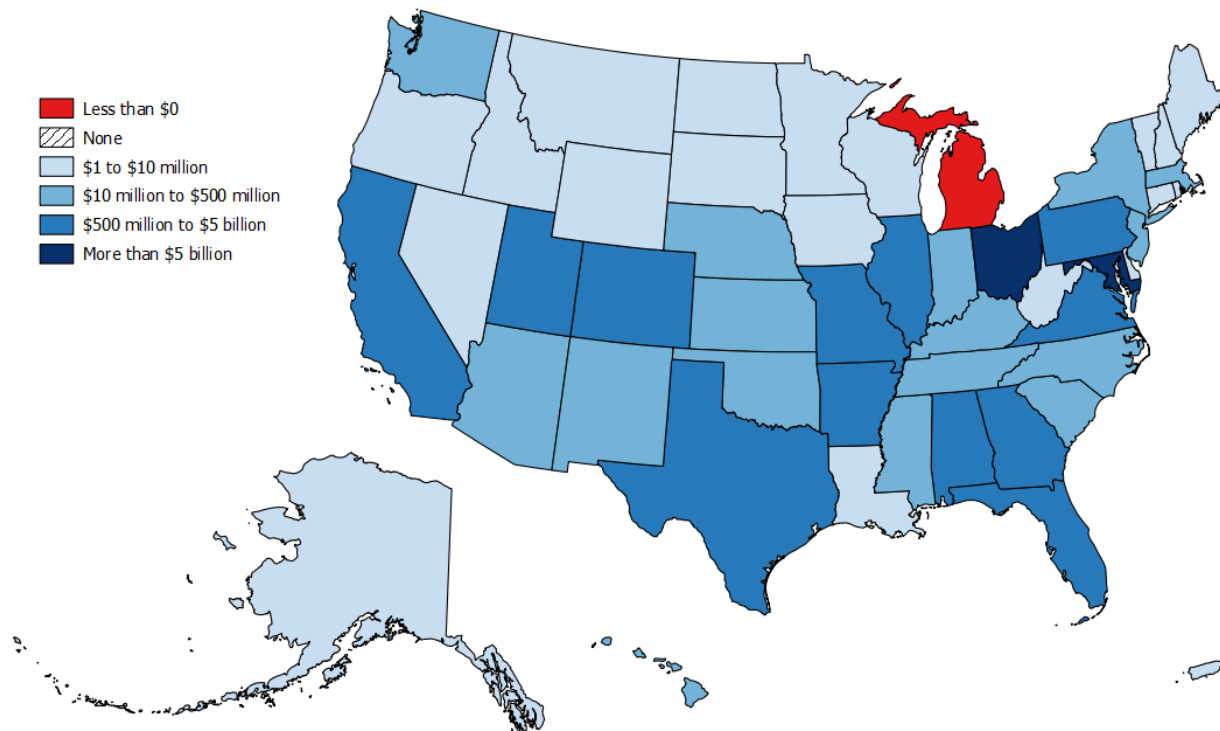
<sup>40</sup> Includes both contracts performed in Missouri and contracts performed outside of Missouri that were awarded to Missouri-based firms.

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Figure 4.15: Location of Contracting Office for Missouri DoD Activity, FY13-16<sup>41</sup>

The top office locations for prime-contractor DoD activity performed or located in Missouri are **Ohio, Maryland, Colorado, Alabama, and Pennsylvania**



#### Sales to DoD Contracting Offices in Missouri

Among Missouri-based offices offering prime contracts to Missouri companies, The Army Corps of Engineers in Kansas City and Fort Leonard Wood led the way with nearly \$350 million in contracting. The Army Corps of Engineers, St. Louis and Whiteman Air Force Base also play a significant role. Overall, only five offices provided more than \$5 million in contracts to Missouri companies from FY13-16. The Defense Contract Management Agency, which helps administer DoD contracts and monitor their progress, had over \$30 million in retracted contract dollars over the four-year span.

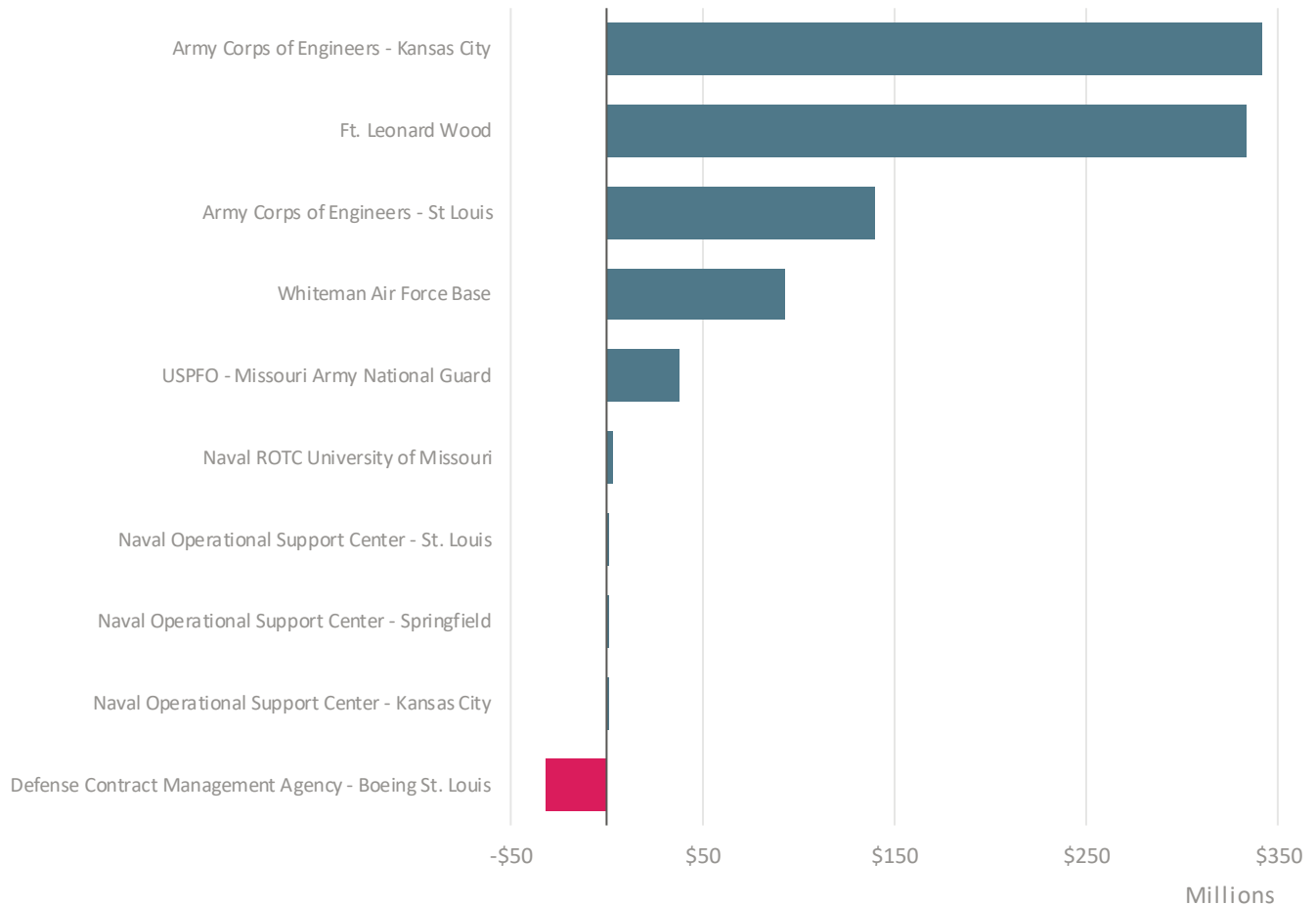
<sup>41</sup> Includes both contracts performed in Missouri and contracts performed outside of Missouri that were awarded to Missouri-based firms. Prime contracts only.

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Figure 4.16: Prime Contracts Received by Missouri Companies from Missouri Contracting Offices, FY13-16

Army Corps of Engineers in Kansas City and Fort Leonard Wood provide nearly \$350 million in **contracting**

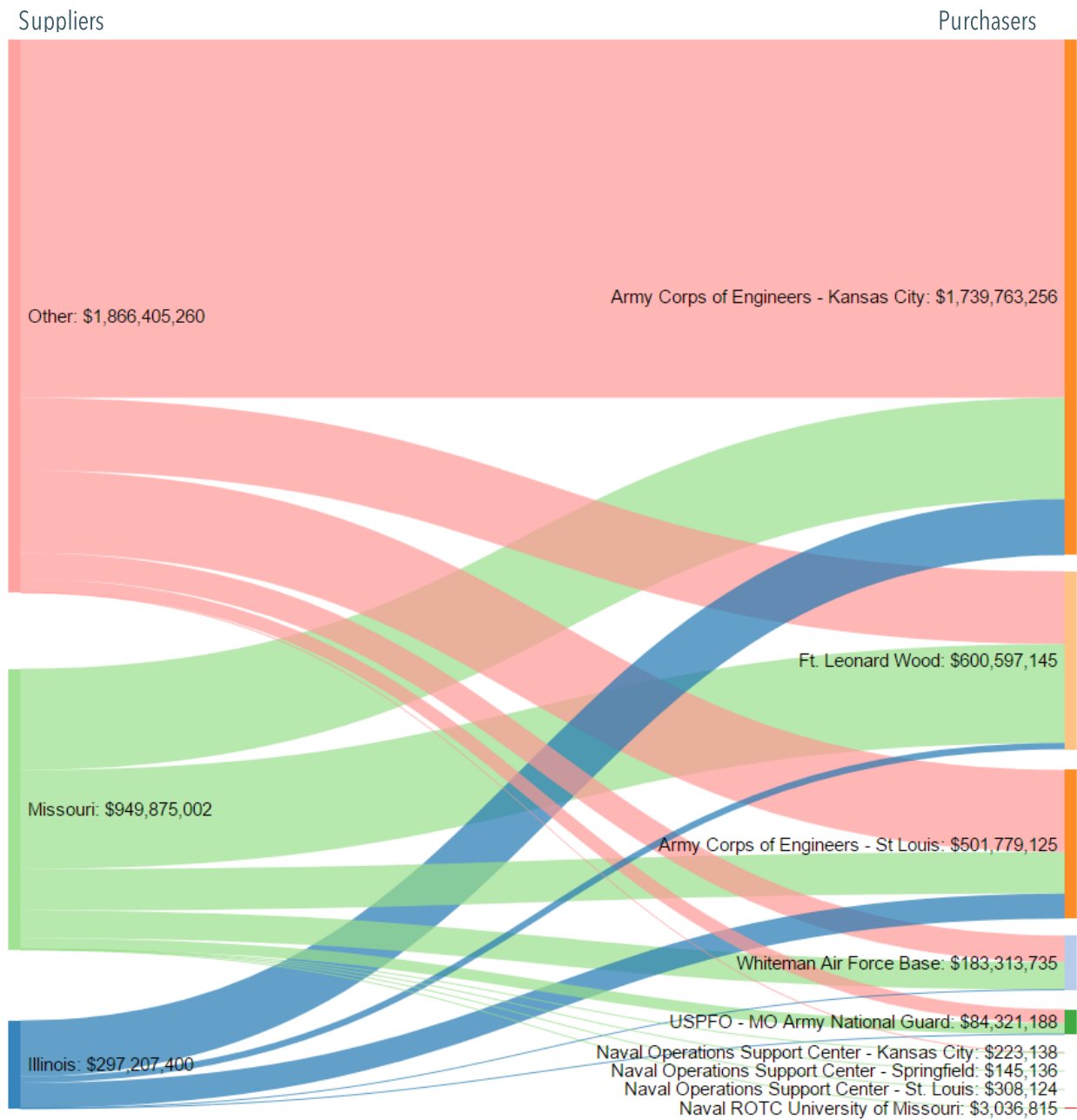


By looking downstream at contracting offices, one can also analyze potential DoD revenues that are being missed by Missouri businesses. The Figure 4.17 shows the FY13-16 prime contracting flows from Missouri based Contracting Offices to businesses in Missouri, Illinois, and other states. As the diagram demonstrates, a considerable portion of contracts from these offices are going to businesses in Illinois and elsewhere around the country. This is especially true for the Army Corps of Engineers in Kansas City, which awarded 69.5% of its total FY13-16 contracts to states outside of Illinois and Missouri. However, the next largest contract provider, Ft. Leonard Wood, gave 55.6% of its contracts to Missouri companies. The third largest Missouri contracting office—the Army Corps of Engineers in St. Louis—may expect to see a surge in contracting in the next few years as it assists with the relocation of the National Geospatial-Intelligence Agency’s offices to a new facility St. Louis. For more information on Contracting Offices, detailed tables of Contracting Offices’ distributions by industry and state can be found in [Appendix D](#).

# 4. Missouri Defense Supply Chain

## Missouri Defense Supply Chain Mapping Project

Figure 4.17: Prime Contracting Flows from Missouri Offices to Businesses in Missouri, Illinois and Elsewhere



## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

#### Exports

Another way of analyzing downstream nodes is by looking at export data. USA Trade Online tracks commodity exports from each state to countries around the world each year by 4-Digit NAICS. To analyze Missouri's defense-related exports by region, TPMA's consulting team selected the six commodity-related NAICS with more than \$50 million in annual contracting. These NAICS are presented in the table below.

Table 4.5: International Exports by 4-digit NAICS for Selected DoD Related Industries

4-Digit NAICS	Industry Description	Annual Contracting (millions)
3364	Aerospace Products and Parts	\$5,255.8
3329	Other Fabricated Metal Products	\$897.4
3345	Navigational/Measuring/Medical/Control Instrument	\$205.8
3342	Communications Equipment	\$97.8
3339	Other General Purpose Machinery	\$66.5
3116	Meat Products and Meat Packaging Products	\$63.2

According to USA Trade, Missouri's total exports within these five industries in 2016 totaled approximately \$3 billion. This does not mean that Missouri had \$3 billion dollars in *defense* exports but rather that these five industries that are highly-supported by defense revenues are also very export oriented. Summaries of the distributions of these exports by continent and country are provided below. Overall, Canada buys the most defense-related commodities from Missouri, followed by Japan and Mexico. Based on previous [report](#) by TPMA's consulting team regarding potential international trading targets, the following list of countries represent prioritized trading partners for Missouri's defense companies. Overall, the best opportunities for export are likely in Asia, followed by the Middle East and Europe.<sup>42</sup>

- Australia (Asia)
- Egypt (Middle East)
- France (Europe)
- India (Asia)
- Israel (Middle East)
- Saudi Arabia (Middle East)
- Singapore (Asia)
- South Korea (Asia)
- United Arab Emirates (Middle East)
- United Kingdom (Europe)

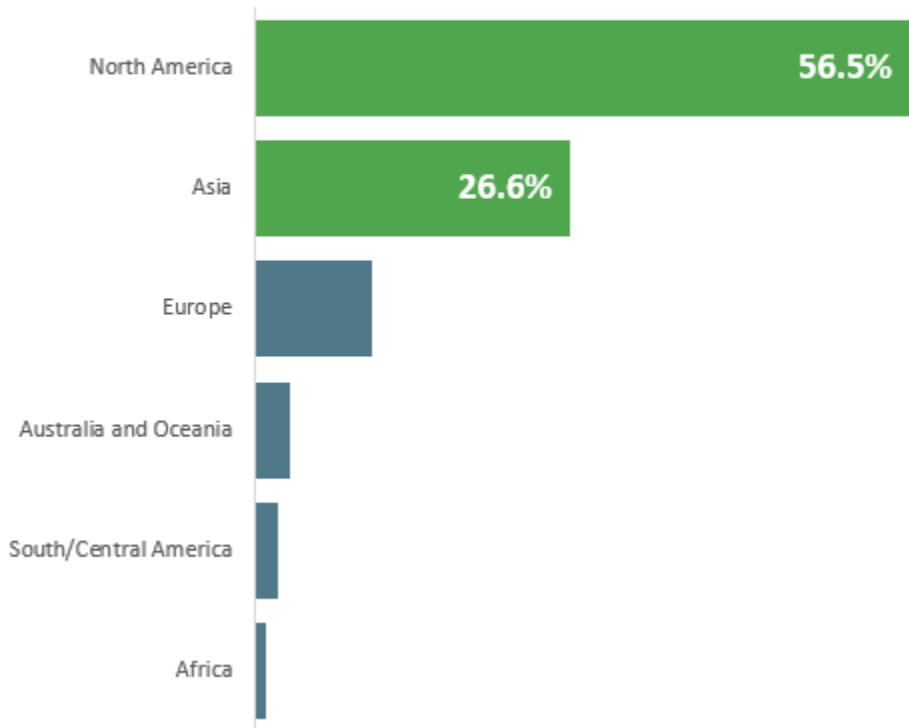
<sup>42</sup> "Defense Diversification Strategy", TPMA, November 16, 2016.

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

Figure 4.18: Missouri Defense Commodity Exports by Continent<sup>43</sup>

**North America** and **Asia** receive the majority of Missouri's defense commodity exports

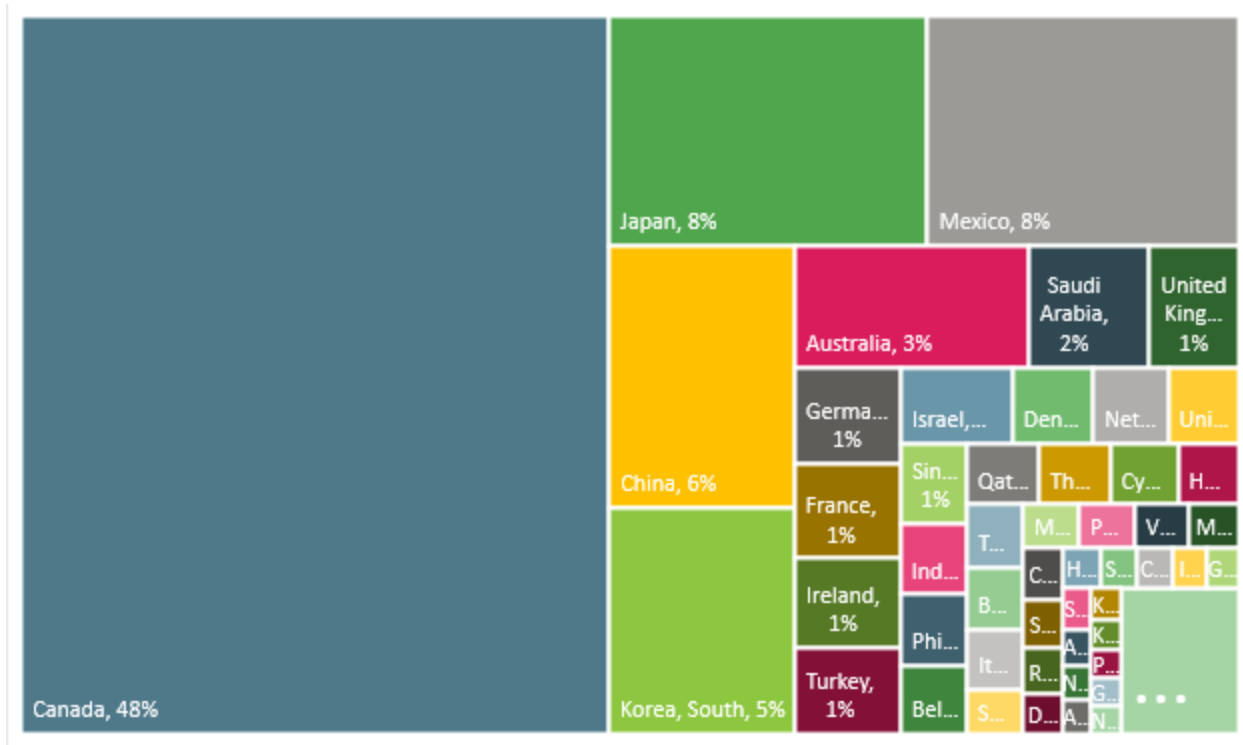


<sup>43</sup> USA Trade Online (2016). Missouri Exports by NAICS Commodities: 3364, 3329, 3345, 3342, 3339, and 3116.



Figure 4.19: Missouri Defense Commodity Exports by Country<sup>44</sup>

Almost 50% of Missouri's defense commodity exports go to **Canada**



### Critical Contracting Paths throughout Missouri

Thus far, Missouri's defense economy has been analyzed on a statewide basis, in terms of industries, exports, and contracting offices. However, the impacts of DoD contracting on Missouri's economy are not evenly distributed throughout the state. This point is illustrated well by the following maps, which show the portion of total FY13-16 inflation-adjusted DoD contract revenue that was received by each of the Missouri Economic Development Council's economic regions. Figure 4.20 shows contracts in terms of contractors located in each region—the first map—and contracts performed in each region—the second map. In both cases, the clear majority of total contract dollars went to Region 5—the greater St. Louis area.

<sup>44</sup> Ibid.

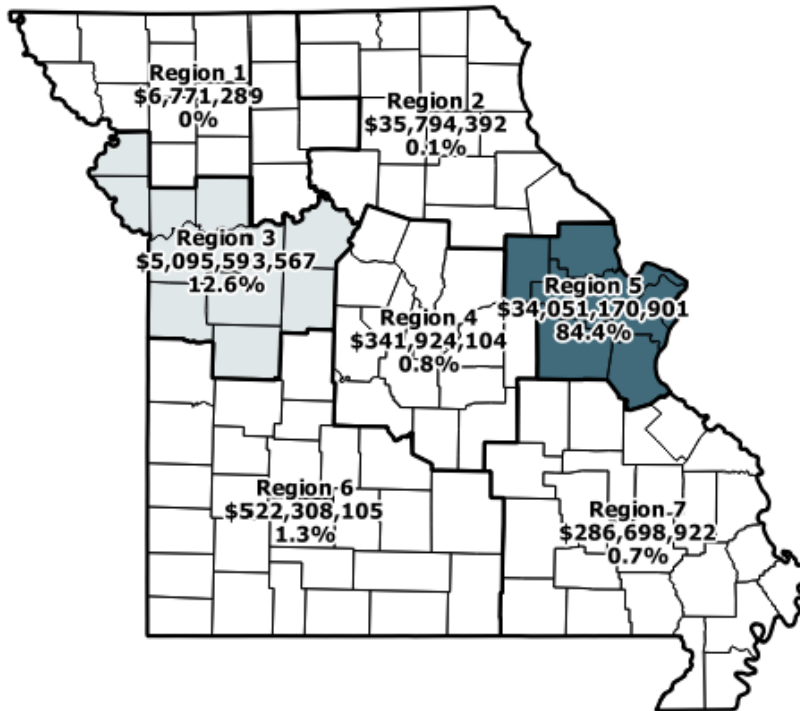
## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

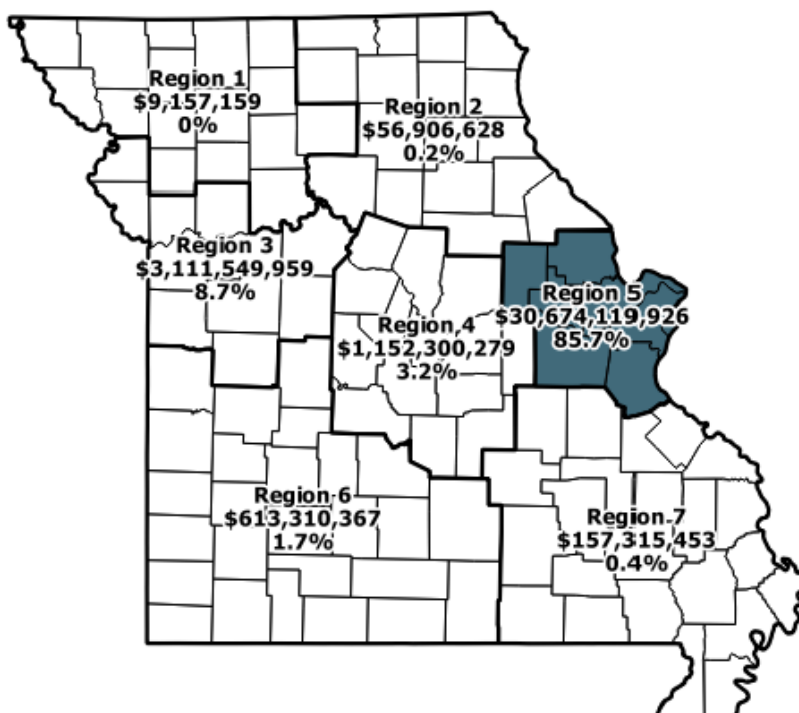
Figure 4.20: Total FY13-16 Contract Revenue by Region

Over 80% of Missouri's total contract dollars go to **Region 5 - the greater St. Louis area**

### By Contract Location



### By Place of Performance



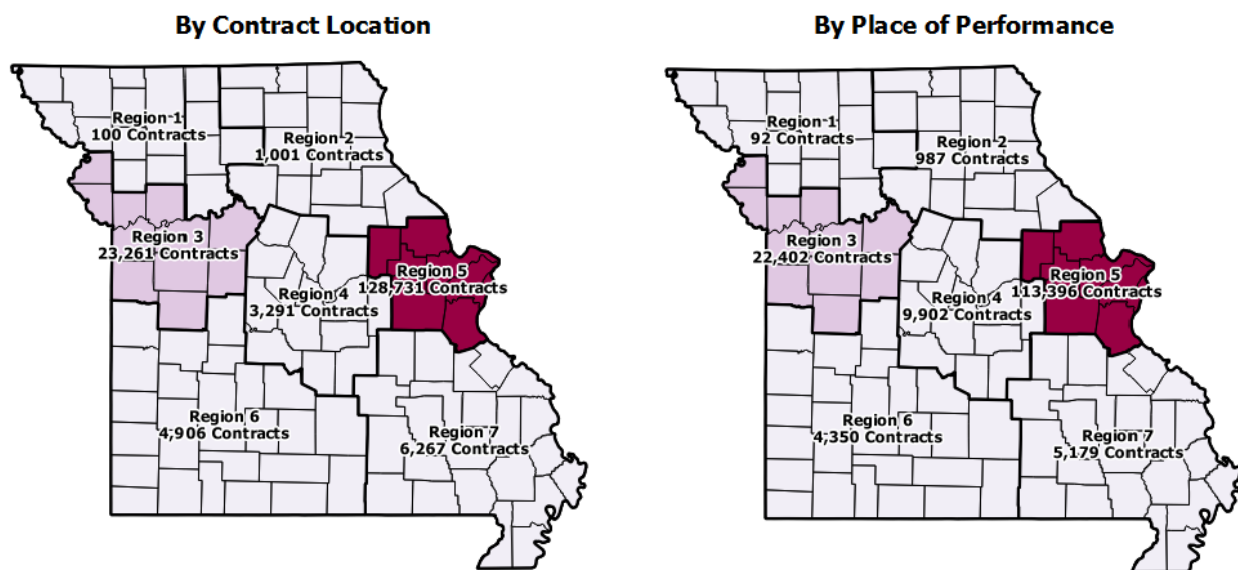
## 4. Missouri Defense Supply Chain

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Similarly, Region 5 received the largest number of total DoD contracts from FY13-16, with more than five times as many as the next closest region, Region 3. As evidenced by data on both contracts received and total contracting dollars, some parts of the state do not fully participate in Missouri's defense economy. Region 1, for example, only received 100 contracts (92 by place of performance) during the 4 years of analysis. This gave the region a total of only \$6.7 million in contract revenue by contract location. Despite these broad trends however, there is some variance in the distribution of contracting revenue throughout the state between industry groups. The distribution of contract revenue by region for each Defense Industry Group is shown in [Appendix E](#).

Figure 4.21: FY13-16 DoD Contracts by Region

The majority of DoD contracts go to **Region 5 - the greater St. Louis area**

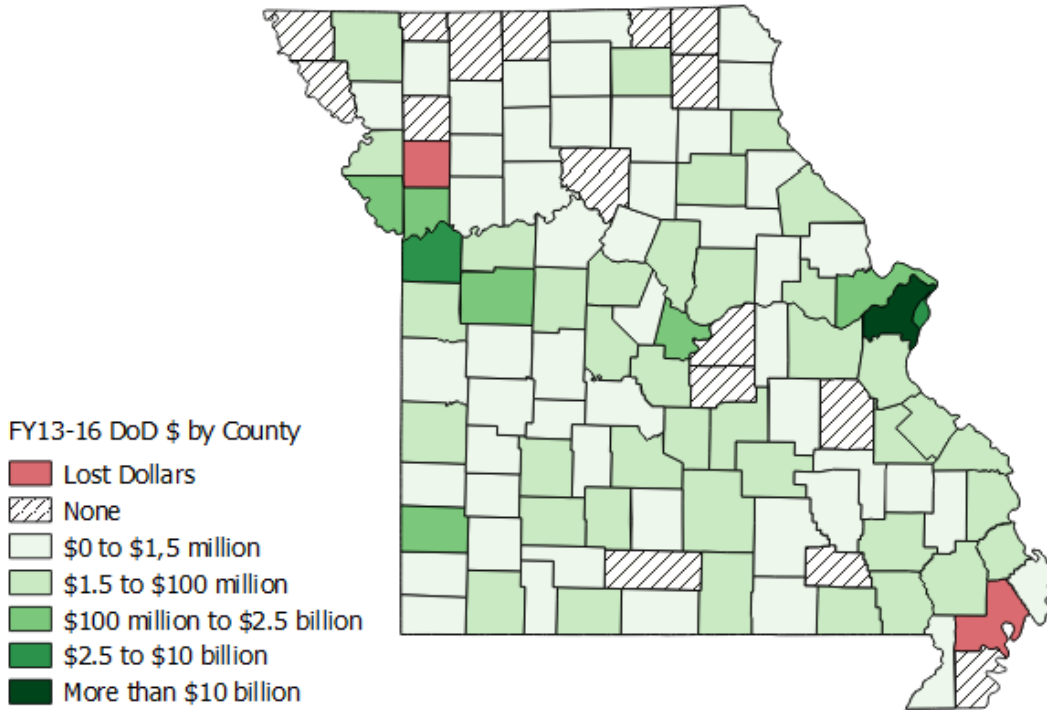


Lastly, the map below shows the distribution from FY13-16 DoD revenue to Missouri companies by County. This allows for slightly more granular analysis of which areas are receiving the largest defense contracts. As it indicates, St. Louis County is not only the state's leader in contracting revenue, but it is far above every other county. From FY13-16, St. Louis County received over \$24 billion in defense revenue both performed and located within the county, while no other county received over \$6 billion in either category. After the considerable drop-off from St. Louis County to St. Louis City, Jackson, Clay, and St. Charles counties come in 3<sup>rd</sup>, 4<sup>th</sup>, and 5<sup>th</sup> in terms of FY13-16 revenue by contract location. For contracts performed within the county, St. Louis County is followed by St. Louis City, Jackson, Pulaski, and Johnson Counties, in that order.

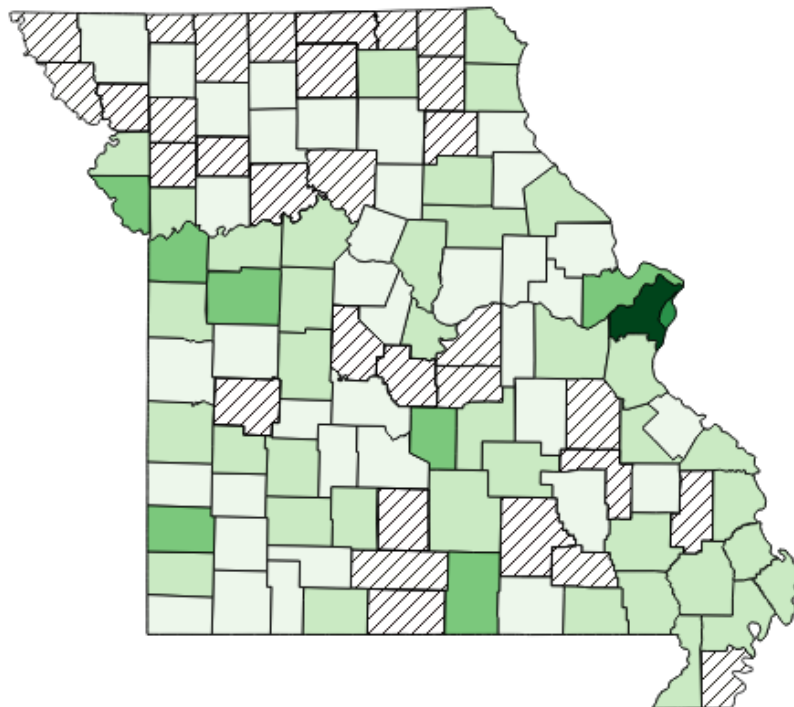
Figure 4.22: FY13-16 DoD Contracts by County

The majority of DoD contracts go to **St. Louis County**

### By Contract Location



### By Place of Performance

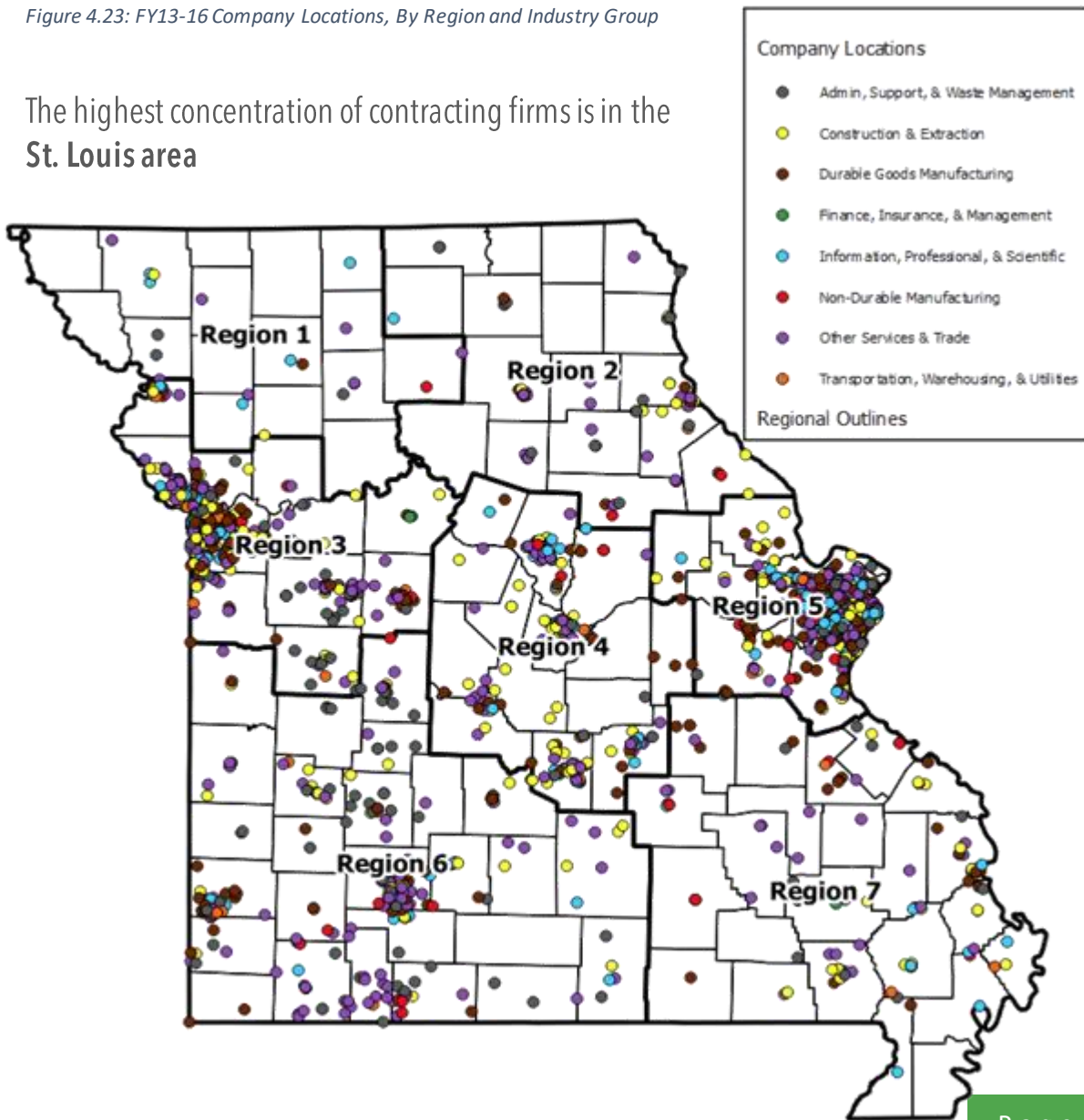


### Analysis of Firm-Level Impacts

The St. Louis area also has the highest concentration of contracting firms. In fact, nearly twice as many active defense-contracting firms (600) are located in the city of St. Louis as the next closest Missouri city, Kansas City (316). The map below shows the distribution of contracting firms throughout the state, by Region and Industry Group. This provides a visualization of the heavy concentration of contracting firms in St. Louis, Kansas City, and—to a lesser extent—Springfield and Columbia. In addition, it illustrates the sparseness of contracting companies in MEDC Regions 1 and 2 of the state. Lastly, it demonstrates that while the Durable Goods Manufacturing and Information, Professional, & Scientific Industry groups rank 1<sup>st</sup> and 2<sup>nd</sup> in total DoD contract revenue from FY13-16, they rank only 2<sup>nd</sup> and 5<sup>th</sup>, respectively, in active defense establishments. Instead, Other Services & Trade leads the way with 708 of the 2,552 total establishments.

Figure 4.23: FY13-16 Company Locations, By Region and Industry Group

The highest concentration of contracting firms is in the St. Louis area



## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

#### Defense Diversification Opportunities

##### The Challenge of Defense Diversification

The challenge of diversification in the defense industry is that many final products have such a narrow and prescribed use that they cannot be easily adapted to suit different purposes. For example, an F/A 18 Hornet is specifically designed as a fighter jet and attack aircraft that can take off and land on an aircraft carrier. Defense weapons have highly sophisticated supply chains that require many specific parts, highly trained specialists, and often several months or years to produce an end product. For example, together the F/A 18 Super Hornet and EA 18G Growler work with 800-supplier spread across 44 states and the St. Louis manufacturing plant can produce two of such machines per month.<sup>45</sup> Boeing aggressively markets these planes to allied nations such as Denmark, Australia, and Malaysia. In a previous [report](#), TPMA's consulting team provided analysis of the best opportunities for this form of diversification.<sup>46</sup> Outside of selling the same product to a different audience, there is little that can be done to diversify markets for these finished products. However, the deep and complicated supply chain that supports such weapons systems presents many opportunities to diversify markets for Tier II suppliers to companies such as Boeing.

##### Approach to Defense Diversification Options

To provide insight into diversification options for suppliers to final defense products, TPMA's consulting team conducted a supply chain analysis of 6-digit NAICS codes receiving defense contracts within the state that were deemed most difficult to diversify into commercial markets. Secondly, TPMA's consulting team examined the list of the supplying industries and selected those that can clearly serve as intermediate inputs for other manufactured goods. For example, Light Truck and Utility Vehicle Manufacturing produces a finished product, but Bolt, Nut, Screw, Rivet, and Washer Manufacturing produces products that can be applied to many different purposes. Thirdly, TPMA's consulting team analyze industries that require those inputs in order to produce *different* final products. To ensure that both local and non-local opportunities were examined, the analysis was separated into potential in-state markets and potential national markets.

Based on NAICS definitions and our knowledge of the state economy it is clear which industries are producing military grade weapons and which are not. The list used is contained below:

- 336411: Aircraft Manufacturing
- 336413: Other Aircraft Parts and Auxiliary Equipment Manufacturing
- 336414: Guided Missile and Space Vehicle Manufacturing
- 332993: Ammunition (except Small Arms) Manufacturing
- 334511: Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
- 336992: Military Armored Vehicle, Tank, and Tank Component Manufacturing
- 332994: Small Arms, Ordnance, and Ordnance Accessories Manufacturing

Despite being a fairly small group of industries, this group composes 91.2% of all manufacturing related defense contracts over FY13-16, and 60.2% of all contracts (manufacturing and otherwise) over the

<sup>45</sup> CNBC. (2017, May 08) Boeing Company. Retrieved June 13, 2017, from <http://fa-18.com/>; from <http://www.cnbc.com/2017/05/08/super-hornet-production-set-to-double-as-trump-gives-program-a-boost.html>

<sup>46</sup> TPMA. (2016, November 16). Defense Diversification Strategy.

## 4. Missouri Defense Supply Chain

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same period. In other words, this small group covers the critical mass of difficult to diversify defense-related industries within the state. A few solid diversification options for suppliers to these industries could pay dividends in preserving jobs within the state.

After reviewing the in-state supply chain of the group of industries listed above, 170 supplying industries were left that could be adapted to different uses. TPMA’s consulting team used EMSI supply chain data to review how these industries serve as suppliers to industries other than the seven key defense industries listed above. Sales of these inputs were weighted according to their importance as existing defense suppliers, to ensure that the effects of large industries that relatively small defense suppliers were not overemphasized.

The tables below present data for the best options for market diversification within Missouri. Dollar values represent the amount that each of these industries purchase from the 170 identified intermediate suppliers. The indicator in the final column indicates the level of job growth for the given industry over the prior five years. Up arrows indicate very positive growth; side to side arrows indicate positive but unexceptional growth; down arrows indicate job loss. All else being equal, opportunities for diversification with in-state companies is preferable to companies out-of-state, because locality reduces transportation costs for buyers, economic developers can utilize existing relationships, and such activities will have a larger economic impact on Missouri residents.

Table 4.6: Best Non-Defense Industries to Purchase Defense Inputs within Missouri

NAICS	Industry Description	Value of Annual Input Purchases by Missouri Companies (\$ M)	Industry Growth in Missouri
336112	Light Truck and Utility Vehicle Manufacturing	\$1,899.61	↑
333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	\$366.47	↓
325199	All Other Basic Organic Chemical Manufacturing	\$292.21	↓
311111	Dog and Cat Food Manufacturing	\$235.65	↑
312120	Breweries	\$234.53	↑
326199	All Other Plastics Product Manufacturing	\$226.51	↔
518210	Data Processing, Hosting, and Related Services	\$219.42	↓
238220	Plumbing, Heating, and Air-Conditioning Contractors	\$203.67	↑
336360	Motor Vehicle Seating and Interior Trim Manufacturing	\$125.08	↑
325611	Soap and Other Detergent Manufacturing	\$122.07	↑
336390	Other Motor Vehicle Parts Manufacturing	\$117.18	↑

## 4. Missouri Defense Supply Chain

### Missouri Defense Supply Chain Mapping Project

NAICS	Industry Description	Value of Annual Input Purchases by Missouri Companies (\$ M)	Industry Growth in Missouri
331420	Copper Rolling, Drawing, Extruding, and Alloying	\$100.66	↑
323111	Commercial Printing (except Screen and Books)	\$63.00	↓
332322	Sheet Metal Work Manufacturing	\$59.66	↑
336320	Motor Vehicle Electrical and Electronic Equipment Manufacturing	\$24.13	↓

Among the top 15 options for diversification are four industries in the wider automotive manufacturing cluster, headlined by Light Truck and Utility Vehicle Manufacturing, which purchases over \$1.8 billion in defense related inputs per year, and which is growing rapidly due to notably GM production increases in Clay County and St. Charles County over the past five years. Despite minor job loss in recent years, Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing also presents a strong opportunity that is less centralized with a smaller number of employers. Such manufacturers are spread out across the state with particularly strong pockets in St. Charles; Franklin; St. Louis; and Laclede Counties.

As indicated, in-state markets present the best diversification opportunities, but the nation at large can avail a greater variety of export options. Several the best options are the same as those noted as opportunities within the state including Light Truck and Utility Vehicle Manufacturing, All Other Plastic Products Manufacturing, and Other Motor Vehicle Parts Manufacturing. There are other opportunities as well including Software Publishers, Automobile Manufacturing, and Wired Telecommunications Carriers, among others.

Table 4.7: Best Non-Defense Industries to Purchase Defense Inputs within the United States

NAICS	Industry Description	Value of Annual Input Purchases by Missouri Companies (\$ M)	Industry Growth in Missouri
336112	Light Truck and Utility Vehicle Manufacturing	\$69,431.91	↑
511210	Software Publishers	\$44,543.13	↑
336111	Automobile Manufacturing	\$32,808.86	↑
326199	All Other Plastics Product Manufacturing	\$30,317.06	↑
517110	Wired Telecommunications Carriers	\$25,428.59	↔
336390	Other Motor Vehicle Parts Manufacturing	\$24,008.28	↑
331110	Iron and Steel Mills and Ferroalloy Manufacturing	\$17,895.57	↓



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NAICS	Industry Description	Value of Annual Input Purchases by Missouri Companies (\$ M)	Industry Growth in Missouri
336350	Motor Vehicle Transmission and Power Train Parts Manufacturing	\$13,372.16	↑
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	\$12,005.96	↔
518210	Data Processing, Hosting, and Related Services	\$11,868.62	↑
332710	Machine Shops	\$10,786.25	↓
336370	Motor Vehicle Metal Stamping	\$10,564.05	↑
332312	Fabricated Structural Metal Manufacturing	\$8,615.27	↔
332322	Sheet Metal Work Manufacturing	\$8,398.03	↑
334111	Electronic Computer Manufacturing	\$5,593.28	↑

## 5. Interview Key Themes

### Missouri Defense Supply Chain Mapping Project

## 5. Interview Key Themes

A total of 24 people from government, not-for-profit, and private industry were interviewed from all over Missouri, with the majority of interviewees located in the St. Louis region. Interviewees were identified by a variety of sources, including the leadership at The Partnership, federal contract databases, and interviewees themselves. TPMA's consulting team diligently worked with SLEDP leadership and defense experts to identify and contact recommended interviewees and regional economic development leaders to schedule and conduct the interviews. Interviews were conducted confidentially, though a summary of key themes observed are explained below.

Table 5.1: Individuals Interviewed by Organization and Location

Name	Organization	Region
Bill McCoy	Great Rivers Chapter of NDIA	St. Louis
Christine Murray	Kansas City Chamber of Commerce	Kansas City
Christopher Jacks	Orbital ATK	Jefferson City
David Feather	Honeywell/KCP	Kansas City
Doyle Edwards	Brewer's Science	Rolla
Greg Smith	St. Louis Regional Chamber	St. Louis
Jason Eschenbrenner	Eaglepicher Technologies, LLC	Joplin
Jay Bell	MAST Technology	Blue Springs
Joe Driskell	Missouri Military Advocate-State of Missouri	St. Louis
John Frederick	Boeing	St. Louis
John Nations	Bi-State Development	St. Louis
John Stanley	MRI Global	Kansas City
Kathy Osborn	Regional Business Council	St. Louis
Kim Inman	Missouri Association of Manufacturers	Springfield
Lee Langerock	Independence Economic Development	Independence
Mary Below	Great Rivers Chapter of NDIA	Sikeston
Mary Lamie	Bi-State Development	St. Louis
Michael Donnelly	Express Scripts	St. Louis
Mike Dubois	Kit Bond Strategies	St. Louis
Pat Daly	Sierra Bullets	Sedalia
Rob O'Brien	Joplin Area Chamber of Commerce	Joplin
Ron Nowlin	Eaglepicher Technologies, LLC	Joplin
Ron Poertner	GMP Metal Products	St. Louis
Steve Johnston	Community Alliance of St. Joseph	St. Joseph

**The main driver for the defense supply chain project came from the region's dependence on Boeing.**

- According to DoD OEA's Defense Spending by State, Fiscal Year '15 report, Boeing is the top defense contractor in Missouri by almost \$6 billion. The next highest defense contractor is Express Scripts, which did \$478.2 million in defense contracting in FY15.

## 5. Interview Key Themes

### Missouri Defense Supply Chain Mapping Project

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- In 2013 when analysts examined the forecasts for some of the Boeing planes, including the F-18, there were no orders past 2016. These planes equaled \$4.5-\$5 billion of the regional economy and that would be disappearing. Boeing has done certain things to offset these effects, such as gaining more orders for new planes, and moving some commercial plane production to this plant.
- The impact of the defense industry is very well-known in the region; therefore, the Partnership is not looking for just a web-based supply chain map that shows these effects.

**The goal of the supply chain mapping project is to help manufacturers that are part of the defense supply chain in the St. Louis region become more resilient to defense spending fluctuations.**

- One staff member from The Partnership stated that the map may not actually be that useful to OEMs looking for suppliers, but the goal would be for it to be useful for manufacturers to find other customers.
- There is also a secondary goal regarding entrepreneurial activities. This examines the question, “How do we take individuals ideas and experiences and help them turn that into an actual business?”
- Part of the consulting team’s methodology will be to bring together as many manufacturers as possible to share the information and spread it among their own networks. This is the purpose of the Regional Advanced Manufacturing Partnership (RAMP).

**The St. Louis region has a variety of industry groups working together towards this common goal.**

- All levels of individuals who were interviewed were in support of and advocating for the Partnership's efforts in this project.
- The Supply Chain Mapping effort helps give the Partnership resources to identify and reach out to companies that are part of the defense supply chain.

**There is a mix of perspectives on the sense of urgency to diversify.**

- Some interviewees revealed that Missouri manufacturers may be hesitant to change and may require shocking evidence to show why this is important.
- Companies that are doing well will continue, while the struggling companies are the ones to focus on.
- Some believe there needs to be more awareness, but efforts are increasing with the establishment of RAMP and the Missouri Military Advocate.

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*“The establishment of RAMP and the Missouri Military Advocate is a direct response to the urgent need of a state-wide defense diversification effort.”*

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**One identified asset in Missouri is collaboration.**

- Unique to Missouri is the characteristic in which most manufacturers choose to work hand-in-hand. While companies may bid against one another, once a manufacturer wins a contract, they will often work together with other manufacturers.

## 5. Interview Key Themes

### Missouri Defense Supply Chain Mapping Project

#### **Missouri's defense manufacturing workforce is robust with complex, technical skills, and experience.**

- An overwhelming common workforce asset in the defense industry is the workforce and their work ethic, experience, and sense of patriotism.
- The second-most common asset identified was Missouri's cost of doing business, as electricity costs are inexpensive and taxes are low.
- Boeing can attract a skilled workforce because they pay well, but this could also be a primary disadvantage, potentially causing companies to move jobs, due to competition from Boeing.
- With a decline in federal contracts, the impact could cause a loss of talent that is hard to regain once it is lost.
- Tremendous science and engineering schools exist in the state, but they are not always geared toward defense-related research. However, the human health, nutrition, and animal science expertise across the state is valuable as there are defense uses.
- Because many workers in the industry are also former military, the state should continue to build off the tax deductions currently available within the state for the military and encourage veterans to retire here.

#### **Regulations are burdensome, which adds to cost of doing business for defense companies.**

- Regulations are expensive and challenging. With strict regulations and inconsistent funding from federal defense budgets, businesses tend to not engage in federal contracts.
- ITAR (International Traffic in Arms Regulations) can be challenging. These regulations make it difficult for companies to sell outside of the US, while competing companies outside the US do not have the same restrictions. There is no "buy American" program for the defense industry.
- Certifications for the defense industry are becoming more important in order for companies to be competitive.

#### **Currently, the state and St. Louis region are placing a strong emphasis on entrepreneurship and technology across all sectors, including defense.**

- Many interviewees identified a need for the establishment of a formal network for entrepreneurs or business-to-business connections in the defense space.
- Some we interviewed want to identify ways to form an aerospace research institute in the state.

#### **Threats to growing the defense industry and diversification vary, but generally are focused on the size of the defense procurement budget, workforce, and product specialization.**

- Some interviewees stated that the current Right-to-Work status of Missouri might be detrimental to business attraction, retention, and expansion. While Governor Eric Greitens signed Missouri's right-to-work bill in February 2017, opponents are attempting to block the legislation.
- Challenges with generating a pipeline of an attractive workforce inhibit growth and competitiveness.
- Some interviewees stated it is difficult to recruit upper management and skilled engineers due to both high labor costs and quality of place challenges in parts of Missouri, particularly the rural areas.

## 5. Interview Key Themes

### Missouri Defense Supply Chain Mapping Project

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- The lack of air service, especially without a major international hub presents a challenge for companies competing globally.
- Infrastructure is becoming something that needs to be addressed in order to be more competitive.
- Brain drain is an issue in building a strong pipeline of workers, as it is difficult to recruit and retain workers.
- Particularly in the St. Louis region, a stronger focus on business retention and expansion is needed.
- Many defense products are not streamlined, therefore current manufacturers cannot fulfill orders in new markets without alterations to current products and re-engineering.
- Multiple businesses make different elements of products but it takes a long time to get back into the business once they leave. Ramping up manufacturing is expensive. National defense manufacturing takes time, and therefore resources.
- Manufacturers also struggle to develop new opportunities. Most are used to doing it on their own, and they have never been dependent on another organization for help. Thus, many manufacturers may be skeptical of working with organizations to help diversify their own products. Without knowing what defense cuts are coming, it is difficult for manufacturers to know what markets they should be considering.
- The ability for suppliers to get the capital they need to expand their operations is challenging, particularly for small to medium sized firms.

#### **One prominently identified need is the connection of small businesses to other businesses.**

- The National Defense Industry Board and other associations are important to increase awareness to the fact that Missouri is a strong defense economy. Current initiatives need to be enhanced.
- The Missouri Military Advocate is the one who should lead the effort state-wide.

#### **Resources utilized and/or needed.**

- Many companies are not aware of existing state resources that are available.
- Many companies are skeptical of government programs and concerned there may be too much government oversight, or that effective programs will be terminated with little notice.
- The creation of a resource center where a company could receive assistance with conducting business internationally or learning about exporting is strongly recommended.
- Companies would be interested in assistance to navigate ITAR in order for them to diversify into commercial applications.
- Procurement seminars that are put on by congress are available, and many of the university extension centers put on private sector trade shows.

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*“How can we source from low cost countries without breaking regulations in regards to ITAR? We want to better understand the regulations and how to take advantage of them.”*

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## 5. Interview Key Themes

### Missouri Defense Supply Chain Mapping Project

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#### **Diversification goals.**

- Companies are interested in diversifying within aerospace, beyond aerospace, and expanding the existing customer base. Overall, they do want to stay specialized but recognize the need to diversify beyond the defense industry. Markets many companies are pursuing include commercial aircraft, medical, and oil and gas.
- International markets are a target for several companies interviewed. Markets in the Asian Pacific and the Middle East were identified as potential opportunities for the defense industry to offset costs.
- Other opportunities mentioned include automotive, commercial aircraft, increasing automation, building automation, and driverless cars and trucks.

## 7. Coordination with Illinois Supply Chain Mapping

### Missouri Defense Supply Chain Mapping Project

## 6. Linking to the Current Network

### Association with Missouri Industry Clusters

According to the Missouri Economic Research and Information Center, the state has seven target industries:

- Advanced Manufacturing
- Biosciences
- Energy Solutions
- Financial Solutions
- Health Sciences and Service
- Information Technology and Logistics
- Transportation and Logistics

Further the state is divided into 10 regions. Figure 6.1 displays the regions and their respective target industries<sup>47</sup>:

Figure 6.1: Missouri Partnership Regions and Target Industries

Regions	Industries
Cape Girardeau/Southeast	Advanced Mfg.; AgTech; Financial and Professional Services
St. Louis Region	AgTech; Financial Services; Advanced Mfg.; Defense; Health Innovation; and Distribution
Hannibal/Kirksville/Northeast	Advanced Mfg.; Information Technology; Distribution; and Food (AgTech)
Poplar Bluff/South Central	Advanced Manufacturing
Columbia/Jefferson City/Central	Health Innovation; Information Technology; Financial and Professional Services; Advanced Manufacturing; and AgTech
St. Joseph/Northwest	AgTech; Advanced Manufacturing; Distribution; and Financial and Professional Services
Springfield/Ozark	Distribution; Advanced Manufacturing; and Information Technology (more said, but doesn't line up w/other regions)
Sedalia/Warrensburg/West Central	AgTech; Defense; and Distribution
Kansas City	Advanced Mfg.; AgTech; and Distribution
Joplin/Southwest	Distribution; Advanced Mfg.; Professional Services; Information Technology

The majority of Missouri businesses awarded defense contracts are classified within Advanced Manufacturing, Information Technology, and Professional Services. Although Defense is a category defined by the Missouri Partnership for some of the regions, many of the businesses awarded defense contracts would be classified here as well. Based on this point, all ten regions are focused on target industries to some degree that include companies working in the defense sector.

<sup>47</sup> Source: Missouri Partnership

## 7. Coordination with Illinois Supply Chain Mapping

### Missouri Defense Supply Chain Mapping Project

#### Literature Review

The Partnership is keenly interested in understanding the effect of DoD contracting and Defense companies upon the St. Louis regional economy. As such, there were several prior analyses that TPMA's consulting team relied upon for background when completing this analysis. A summary of each are provided below.

**AECOM: Defense Adjustment and Advanced Manufacturing Action Plan and Metro St. Louis Export Plan**  
Beginning in fall of 2015 through the spring of 2016, AECOM completed a Defense Adjustment and Advanced Manufacturing Action Plan and Export Plan. The purpose was to formulate a plan to diversify beyond dependence on defense spending, with an emphasis on strategies leading to the emergence of an enhanced regional advanced manufacturing ecosystem.

The report reviewed regional context and drivers and highlights the trends and importance of the aerospace industry. Location quotients indicate that aerospace manufacturing is uniquely concentrated in St. Louis, with the 3<sup>rd</sup> highest concentration of such activity in the country, behind only Wichita and Seattle. In a regional aerospace supply chain, roughly 17,000 were identified as being directly associated with aerospace manufacturing. AECOM through a Strengths, Weaknesses Opportunities & Threats (SWOT) and gap analysis identified five apparent gaps.

- The advanced manufacturing ecosystem identified through this effort is just now emerging
- Availability of advanced equipment in the St. Louis region is lacking; other hubs of aerospace manufacturing reportedly have access to larger numbers of higher capacity multi-axis machining equipment to work with "hard" metals such as titanium
- Regional and national awareness of military aerospace and advanced manufacturing capabilities in St. Louis is not apparent
- Community organizations across the St. Louis region do not yet appear to appreciate their role to play in supporting advanced manufacturing, with emphasis on education and workforce linked to advanced manufacturing
- Multiple disconnects between Advanced Manufacturers and the public workforce system are apparent

The report included two core recommendations. First, SLEDP, regional partners, and the RAMP Steering Committee should identify initial leaders to create a framework for the advanced manufacturing ecosystem. Second, organizational capacity should be built, allowing growth from the initial leadership to a team that sustains private support and funding to advance a regional agenda. Broader policy guidance was given in the areas of workforce needs, growth strategies, and economic development.

#### TPMA: Defense Diversification Strategy

As a means of preventing economic disruption due to projected decreases in Boeing's production of C-17, F-16, and F-18 aircraft and laying the foundation for diversification efforts, the Partnership hired TPMA's consulting team to provide research and guidance on international defense sector markets, linkages among defense and commercial sectors, and the potential transferability of products between defense and other sectors in appropriate international markets. TPMA's consulting team created three resource guides as a tool for defense manufacturers to diversify their products in international markets and then provided recommendations to the Partnership and regional manufacturers.



## 7. Coordination with Illinois Supply Chain Mapping

### Missouri Defense Supply Chain Mapping Project

First, TPMA's consulting team created an asset map of international trade organizations and resources in the St. Louis region. Second, TPMA's consulting team conducted an international market analysis to identify potential international markets where local companies could break into the defense industry. Data was gathered from industry statistics, recent trends, industry outlook, market segmentation, and trade flows plus interviews with defense industry experts.

The analysis highlighted important industry trends:

- Reduced defense spending in the Western world, due to budget deficits and the winding down of combat operations
- Defense spending growth in non-Western countries, with emerging markets in China and Russia. Non-NATO defense spending increased at an annualized 2.7% over the past five years
- Over the next five years, spending trends are expected to continue. Flat growth in the West, but opportunities with the F-35 stealth fighter, UAV's, missiles and avionics. Non-NATO defense spending will continue
- Naval shipbuilding in the US has been stable and increasing, despite combat operations ending and attempts to reduce budget deficits
- Over the next five years, the shipbuilding and submarine industry is forecast to grow with continued economic growth and geopolitical tensions in Asia
- Commercial Aircraft industry benefited from air travel in emerging markets and is turning toward more-efficient aircraft to contend with volatile fuel prices
- Air travel in emerging markets and fleet replacement in developed ones will continue to drive demand in Global Commercial Aircraft Manufacturing. However, the industry faces an economic slowdown, lower oil prices, a stronger dollar, increased interest rates, and potential oversupply

The analysis also identified recent trends in Missouri's defense exports. Missouri's two largest exports between 2013 and 2015 were parts of airplanes or helicopters (other than propellers, rotors, under-carriages) (\$668 million) and Bombs, grenades, torpedoes, mines and similar munitions of war; other ammunition and projectiles (\$408 million). Exports of airplane and helicopter parts declined between 2013 and 2015, while exports of ammunition increased. Exports of Missouri defense goods declined between 2013 and 2015. South Korea, Singapore, Australia, Saudi Arabia, and Japan received largest amount of Missouri defense goods between 2013 and 2015.

Third, based on the International Market Analysis and contextual factors, TPMA's consulting team identified ten best-fit trade partners for St. Louis-area Defense companies.

- Australia
- Egypt
- France
- India
- Israel
- Saudi Arabia
- Singapore
- South Korea
- United Arab Emirates
- United Kingdom

Finally, TPMA's consulting team provided recommendations around defense diversification strategy via international trade.

- Connecting with the US Commercial Service
- Partnering with regional universities on international programs
- Exploring comparable cities for case studies on international programs

## 7. Coordination with Illinois Supply Chain Mapping

### Missouri Defense Supply Chain Mapping Project

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- Creating an ecosystem of diversification amongst all advanced manufactures
- Researching and evaluation additional commercial opportunities with existing regional advanced manufacturers
- Developing and marketing an international profile/brand of the St. Louis region
- Continuing to monitor trends regarding global defense spending and defense posture

## 7. Coordination with Illinois Supply Chain Mapping

### Missouri Defense Supply Chain Mapping Project

## 7. Coordination with Illinois Supply Chain Mapping

In addition to conducting the supply chain mapping process for Missouri, TPMA’s consulting team was also tasked with coordinating with supply chain mapping efforts occurring concurrently in Illinois. Region 5 and the city of St. Louis, in particular, lead the state in terms of defense contracts. Given the close proximity of this region to communities in Illinois, such as East St. Louis and Belleville, it is essential to the optimal use of OEA resources to coordinate efforts between these two bordering states. Consulting analysis in Illinois are being conducted in partnership between the Strategic Development Group (SDG), of Bloomington, Indiana and its subcontractor PQR Energy, of Indianapolis, Indiana.

The University of Illinois was awarded a \$5.5 million grant from the US Department of Defense (DoD), Office of Economic Adjustment (OEA) to assist Illinois communities that have been adversely impacted by changes in federal defense spending. The Illinois Defense Industry Adjustment (DIA) Program is a partnership between the University of Illinois System, the Voorhees Center at the University of Illinois at Chicago (UIC), and the Quad Cities Chamber of Commerce, with support from several local community partners across the state.

### Illinois DIA Mission & Goals

The purpose of developing Illinois’ first statewide supply chain map to analyze the flow of goods and services into and out of the state, while gathering data that will help companies uncover new markets and identify additional opportunities in existing ones. This allows companies to better understand how they fit within these supply chains, as well as how much of their business (even unknowingly) is reliant on federal defense spending.

The Illinois DIA Program supports the state’s defense and manufacturing industries by delivering resources and providing new insights that help companies and communities grow, diversify, and become more resilient. The aspects of this effort include a:

- “Pilot project” in the Quad Cities (Davenport and Bettendorf in Iowa and Rock Island and Moline in Illinois)
- Statewide focus on Defense Supply Chain Analysis

The grant funding was designed to develop a data-driven approach to quantifying the breadth of its defense sector – as well as its potential vulnerability – amid a changing defense spending landscape. The broad goals are to:

- Collect critical data about the state’s defense sector
- Assist defense communities by putting that data to work locally
- Develop and implement a statewide DIA strategy that strengthens the Illinois economy

Goals for the program include the following:

- Comprehensive mapping of the state’s defense assets and defense/manufacturing industry supply chains
- Integration of new insights with existing reports, data sets, and technology roadmaps
- Capacity building and technical assistance including: data review, analysis and interpretation, community engagement, knowledge sharing, and strategic planning
- Conduct a pilot program in Quad Cities to accelerate local defense adjustment activities

## 7. Coordination with Illinois Supply Chain Mapping

### Missouri Defense Supply Chain Mapping Project

- Develop and implement data-driven response strategies in other defense communities

#### Target Audiences

Target audiences for the analysis include defense contractors, especially manufacturers, communities and elected leaders. While Illinois has historically deep ties to manufacturing with global companies like John Deere or Caterpillar, the state is not traditionally regarded as a nexus for defense contracting. A close look shows significant overlap between the state's defense and manufacturing supply chains with approximately 90% of the state's overall manufacturing output attributed to small and medium sized firms, many of whom are also critical to the nation's defense supply chain.

#### Illinois Supply Chain Mapping Regions

By comprehensively mapping the state's defense and industrial supply chains, the project is identifying core regional capabilities and advantages that will help Illinois companies and entire communities compete globally.

The project is working with five Illinois communities who have clear links to the defense industry based on the presence of key military assets (e.g. bases, training facilities), high concentration of manufacturers, or both.

- Quad Cities (the pilot region)
- Northeast Illinois
- Rockford
- Peoria
- Southwest Illinois

#### *Quad Cities Region*

Perched along the Mississippi River at the Illinois-Iowa border, the Quad Cities – which consist of Rock Island and Moline on the Illinois side and Davenport and Bettendorf on the Iowa side – are anchored by the Rock Island Arsenal. With leadership from the Quad Cities Chamber of Commerce, the Illinois Manufacturing Excellence Center (IMEC), the Quad Cities Manufacturing Lab, and the Center for Industrial Research and Service at Iowa State University, the region recently launched the Quad Cities Manufacturing Innovation Hub, a virtual hub that bundles business services and technical assistance to companies in the region, many of which are closely linked with the Rock Island Arsenal.

#### *Northeast Illinois Region*

The Chicago Metropolitan Statistical Area (MSA) is located at the southernmost part of Lake Michigan and includes the Great Lakes Naval Base training facility. With leadership from the Chicago Metro Metal Consortium (CMMC), an EDA-designated "manufacturing community," CMMC convenes metal manufacturers and relevant stakeholders to develop matchmaking events and facilitate information sharing that lead to new business opportunities for manufacturers in the region, many of which may be linked to broader defense supply chains. Lake County Partners, a trusted nonprofit service provider and business outreach organization, also has ties to the Great Lakes Naval Base, which is located in Lake County, the third largest in the state.

#### *Rockford Region*

Located near the northern border of Illinois, Rockford is home to a sizable and active aerospace cluster. The region's over 250 companies and 11 Tier I suppliers provide products to the global aerospace,

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### Missouri Defense Supply Chain Mapping Project

aviation and defense industry, presenting a tremendous opportunity for that region's growth prospects. With leadership from the Rockford Area Economic Development Council and other local stakeholders including higher education institutions (e.g. Northern Illinois University and Embry Riddle -Aeronautical University) and industry (e.g. UTC Aerospace Systems and Woodward), Rockford area leaders continue working to define a clear strategy for growing the aerospace cluster and is ripe for large scale community adjustment.

#### *Peoria Region*

Though often regarded as the "Earthmoving Capital of the World" given the presence of large Original Equipment Manufacturers (OEM) like Caterpillar, the Peoria area in Central Illinois is also home to the 182<sup>nd</sup> Airlift Wing of the Illinois National Guard, which maintains and operates eight C-130 Hercules aircraft capable of transporting large amounts of personnel and equipment over long distances.

#### *Southwest Illinois Region*

Located in the southwestern tip of Illinois just east of St. Louis, the Southwest Illinois region is home to Scott Air Force Base, base of operations for the 375th Air Mobility Wing. Scott AFB also is currently a proposed site for the new NGA West Campus, part of the National Geospatial-Intelligence Agency. The Southwest Illinois region has a strong network of manufacturers and defense contractors, including Boeing, which has had a significant impact on the broader economy. The Leadership Council Southwestern Illinois oversees a Military Affairs Committee that focuses on preserving and enhancing Scott Air Force Base and its adjacent communities through education and awareness building.

#### The Illinois Statewide Supply Chain Analysis Dashboard

The statewide project focused on developing a new approach to understanding and using supply chain data, but builds upon the asset mapping and action plan developed for the Quad Cities as core defining elements of the work plan. The SDG project team is accomplishing the objectives of supply chain mapping and sharing information by:

- Creating a set of unique supply chain mapping tools to spot trends, risks and opportunities for defense contractors and non-defense manufacturers
- Working with the Illinois DIA leadership to put those tools in the hands of state and regional leaders responsible for growth and prosperity
- Working with state and regional officials to ensure they are prepared to get the greatest value from these new tools

To accomplish these objectives, the SDG is creating a comprehensive system of supply chain data, tools and insights that can be turned over to the Illinois DIA leadership team, so that they can leverage these unique tools in support of state officials and regional authorities to:

- Identify defense industry dependent communities
- Consider potential impacts of defense adjustment on employers
- Conduct statewide assessment of the defense-related economic base
- Inform regional defense asset mapping and economic adjustment and diversification plans

The project is comprised of six (6) primary tasks.

## 7. Coordination with Illinois Supply Chain Mapping

### Missouri Defense Supply Chain Mapping Project

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#### Task 1. Define Solution Requirements

Develop solution requirements and align them with the Illinois DIA leadership. The first step was to develop a firm requirements document that spelled out the supply chain mapping solution that would be developed to meet statewide needs. The supply chain map would be a complex data set with an intuitive interface, which allows Illinois DIA team members to analyze data and take action. Deliverables included:

- A detailed project plan with responsibilities, timeframes and dependencies
- A storyboard to outline the functionality to be provided by this solution
- The database requirements needed to support the agreed-upon functionality
- A plan for working with State and Regional Leaders throughout the project

#### Task 2. Build the Online Solution

After the requirements were defined, SDG immediately began to develop the system architecture, acquiring the necessary data and components, and building out the Supply Chain Map (SCM). Key design features include:

##### *Managing Data*

- Building a secure database in the commercial cloud
- Industrial-strength multi-user structure
- Restricted access to sensitive data

##### *Taming Complexity*

- More than 30 million records from around 15 sources
- Substantial process to extract, transform, and load data from disparate sources
- Using data cleansing services

##### *Automatic Data Updates*

- Frequently extracting, transforming and loading data from many sources

##### *Visualizing the Data*

- Using business intelligence software
- No coding required
- Ability to “slice and dice” the data
- Controls allow for easy filtering and sorting
- High level dashboard

A key design objective of the SCM was to permit the DIA team to easily maintain the data and make modifications to the screens without requiring custom programming.

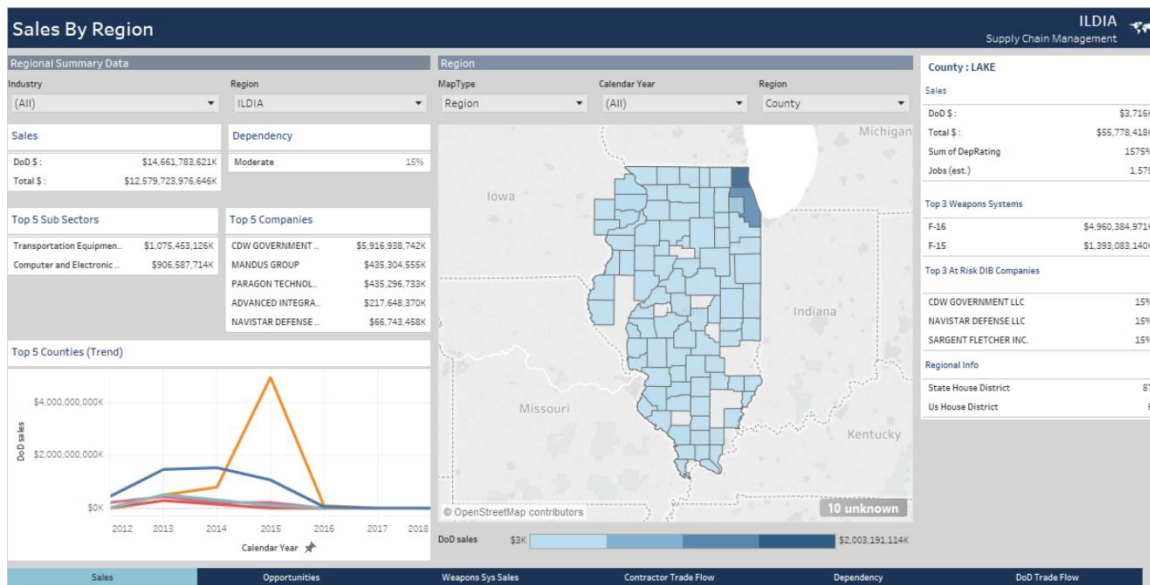
- The final result will be a tool that the DIA team can access from their smart phones, tablets or PCs. Although this access is not required by the RFP, it requires no extra programming because of SDG’s data architecture and visualization engine
- The supply chain map, the database, and tools for importing data and configuring presentation software are all being developed to permit the Illinois DIA team to edit, view and analyze the data
- The solution also permits user creation of business intelligence visualizations that let the DIA team engage with their supply chain and state and regional leaders in new and constructive perspectives based both on hard data and on derived knowledge from the qualitative analysis

## 7. Coordination with Illinois Supply Chain Mapping

### Missouri Defense Supply Chain Mapping Project

As of June 2017, this task is ongoing. One sample dashboard view is presented below:

Figure 7.1: Sample Dashboard for Illinois Supply Chain Mapping Project



### Task 3. Data Collection & Primary Research

In parallel with the SCM program architecture development, SDG launched a series of qualitative and primary and secondary research efforts. Results from these efforts will be fed into the database, as appropriate, generate select stand-alone research products, and provide insights for the economic and workforce analysis. These include:

#### Interviews and Group Meetings with Defense Contractors

- Developing the qualitative research instrument to be used in interviews with the region's prime defense contractors, subcontractors, manufacturing OEM's and SMEs
- Identifying the pool of defense contractors and manufacturers for potential interviews
- Conduct group meetings and interviews with a representative sample
- Analyze the findings, incorporate them into the database where appropriate and present them to the regional leaders and the DIA team leadership

#### Survey All Defense Contractors

- Develop the survey instrument
- Identification of target email list
- Development of survey strategy
- Survey all Illinois Defense Contractors (launch planned for July 2017)

#### Cluster Analysis

- Development of high-level state and 5-target region cluster profiles. This analysis was based on third party data not included in the system database
- Ability to view defense contractors in Brookings "High Tech" industry groupings
- Ability to generate Industry Location Quotients on the fly for the state or targeted region (in development)

## 7. Coordination with Illinois Supply Chain Mapping

### Missouri Defense Supply Chain Mapping Project

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- Alignment of state and 5-target region Defense Industry clusters with high level cluster profiles (date to be determined)
- Defense Contractor competitive implications from the cluster analysis (date to be determined)

#### Task 4. Supply Chain Analysis

Although the data are still being combined, and the solution remains to be completed, preliminary data analyses have begun. These initial inquiries are identifying issues and opportunities that may not have been considered in the requirements phase. This allows the team to more easily adjust without incurring significant costs or time.

A key part of the early analysis is identifying the Illinois regions/industries where defense activity is located, including those most at risk from defense cuts. This permits an early exploration of approaches to mitigate that risk. These and other preliminary analysis activities are ongoing until the solution is finalized. At that point, many of these analyses will be finalized into the online solution or written up in stand-alone reports or memos.

#### Task 5. Regional Activities

The project is conducting outreach to local economic development organizations, DoD supply chain participants and defense contractors in each region to identify specific approaches for market diversification and the best areas for innovation. Based on SDG's analysis of the SCM, and results of the Quad Cities Pilot, this outreach will support the DIA team in developing approaches and recommendations for new market expansion opportunities for Illinois-based defense contractors, with a special focus on manufacturers and on small-and-medium sized enterprises.

#### Task 6. Facilitate Use of the Supply Chain Map (SCM)

The SDG will support the use of the supply chain solution and tools by the DIA team, and state and regional leaders once the SCM is complete. The SDG project team is assessing best practices, pitfalls, and lessons learned from other DIA engagements.

When the technology solution is completed, SDG will work with the University of Illinois, DIA partners and the five regions to develop pilot programs. These programs will focus primarily on assisting SMEs. The SCM will be used to identify their strengths and their opportunities for market diversification as early as possible in the process.



## Appendix A: Data Sources and Processes

### Key Data Sources

This report draws upon the following set of data sources:



**Economic Modeling Specialists, Inc. (EMSI)** – A nationally recognized proprietary database that combines historic labor market information from 90+ data sources, EMSI includes detailed information on industries, occupations, demographics, wages, companies, and the most industry-comprehensive economic impact model available. It also informs the supply-chain data analysis by providing insights into what is currently being produced within Missouri and where there is opportunity for more activities within particular sub-industries. Supply chain analysis in this report uses the industry-leading depth of EMSI's supply-chain model (over 1,000 six-digit industries) combined with insights and aggregate trends from DoD procurement data.



**IBISWorld** – TPMA's consulting team maintains a subscription to IBISWorld, a market research provider of industry-specific business intelligence. This provides us with a concise understanding of economic conditions at the national and global level focused on the target industries for the analysis.

**Other Local Sources** – To create the list of defense contracting companies in Missouri, this report utilizes resources gained from the St. Louis Economic Development Partnership and its partners. These resources include Boeing's list of Missouri-based Vendors and contact information from the National Defense Industry Association's Great Rivers Chapter. These resources also informed the stakeholder interview section of this report.

**National Employment Time Series (NETS) and Dun & Bradstreet Establishment Data** – The most complete, accurate source of proprietary establishment and company analytics available, NETS is a specialized resource developed in concert by Dun & Bradstreet and Walls & Associates. The system fills in all "gaps" associated with D&B's original data to assure that coverage is dramatically enhanced and the accuracy of all revenue and employment data is maximized. NETS includes secondary and tertiary industry activity for each establishment to assist in the identification of a state's or region's true sector and cluster dimensions, credit analyses, corporate subsidiary and parentage relationships, related establishments, address and geocoded location, federal contracting activity, establishment legal structure, foreign ownership, minority or women ownership, and import or export indicators. These data can be tracked for each establishment over the entirety of the last quarter-century. In addition, TPMA's consulting team maintains a standing subscription to Dun & Bradstreet's proprietary data on firm dynamics, including up-to-date information about Missouri firms within defense-related supply chains.

**Business Development Zone, LLC (BDZ)** – BDZ maintains one of the most distinctive information resources in the world of federal government contracting, the DIBBS Navigator. This resource provides intelligence about federal defense contractors, sub-contracting, and contracting offices—derived from federal procurement data systems. In addition to the local sources described above, this database serves as the chief source of information about all contracting between Missouri companies DoD. This source provides information about prime contracts, sub-contracts, Missouri-based contracting offices, and contracting dollar flows in and out of the state.

**Other Unique Public Resources Systems** – In addition to the range and depth of unique public information resources. Specific federal data sources for trade, foreign investment, capital, infrastructure, shipping, education and workforce development, economic development, and other subjects, were deployed as relevant.

#### Key Processes Summary

This document provides a summary of the processes that were used to pinpoint the presence of defense contractors throughout Missouri and describe their supply chains. The analysis started with identification of defense companies and industries. Next, TPMA’s consulting team will built a map of Missouri’s defense supply chain, complemented by data sources at the business and industry levels. Economic context was added by analyzing industry trends and integrating the supply chain analysis with company-level attributes. Lastly, the defense economy analysis looked downstream to analyze how cross-state flows of funding impact Missouri’s economy.

#### Company Names and Locations

Starting with data from Business Development Zone (BDZ) on defense contracts and sub-contracts received by firms in the State of Missouri from FY ‘13-’16. TPMA’s consulting team identified the state’s full breadth of defense companies and defense industries. Because the accuracy of federal contracting data has been questioned by analysis from the Government Accountability Office (GAO),<sup>48</sup> all company details were confirmed by integrating this data with other information sources, like the local sources and NETS database described in the [Key Data Sources](#) section. The result of this initial process was a list of defense establishments, their locations, their industries, where they fit in the defense supply chain, and other biographical information about each firm.

#### Business Ownership Conditions

Biographical information helped TPMA’s consulting team identify the extent to which defense contractors include woman or minority-owned businesses and the frequency with which they are foreign-owned. This information, which came from the National Establishment Time Series (NETS) database, was also supplemented with data from the United States Census Survey of Business Owners. The Survey of Business Owners provides statistics about business ownership by ethnicity, gender, veteran status, company size, and industry.

#### Industry and Company Roles within Supply Chain

At the industry level, the list of primary contracting industries was augmented with regional, state, and national definitions of key industries for the defense cluster. Based on Missouri’s most prominent defense industries, a core list of industries was constructed using the methodology described in the [Key Contracting Industries](#) section. The complete Missouri supply chain was built around this list of core industries. To construct this supply chain map, TPMA’s consulting team merged BDZ and EMSI data, identifying funding flows between contracting offices, prime contracting industries, subcontracting industries, and industries that supply defense contractors. At the conclusion of this process, the top defense contracting companies were placed within the context of these supply chain nodes so that their specific roles can be identified.

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<sup>48</sup> GAO (2014). Data Transparency: Oversight Needed to Address Underreporting and Inconsistencies on Federal Award Website. Retrieved from: <http://www.gao.gov/assets/670/664536.pdf>

## Appendix A: Data Sources and Processes

### Missouri Defense Supply Chain Mapping Project

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#### Economic Context

To provide economic context to the supply chain maps, each industry group was compared to local economic target clusters. Additionally, the context of Boeing and national defense contracting trends was added using news sources and specific analysis of contracting data.

#### Contracting Fund Flows

To add another layer to the supply chain analysis and overall description of Missouri's defense cluster, TPMA's consulting team analyzed federal funding flows in and out of the state. This analysis was based on company place of performance data, company location data, and contracting office location data from Business Development Zone. Each of these analyses was performed at the level of the individual contracting action, allowing a clearer picture of Missouri defense contracting activity to be presented.

## Appendix B: Table of All 73 Key Defense Contracting Industries

Table B.1: Details on 73 Key Defense Contracting Industries

NAICS	Industry Description	Industry Group	Total Contracts, FY13-16	Defense Dependency Category
336411	Aircraft Manufacturing	Durable Goods Manufacturing	\$14,076,617,747	40-59.9%
236220	Commercial and Institutional Building Construction	Construction & Extraction	\$3,880,445,197	20-39.9%
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	Durable Goods Manufacturing	\$3,738,010,106	>80%
336414	Guided Missile and Space Vehicle Manufacturing	Durable Goods Manufacturing	\$3,198,959,905	>80%
332993	Ammunition (except Small Arms) Manufacturing	Durable Goods Manufacturing	\$2,212,504,086	>80%
541330	Engineering Services	Information, Professional, & Scientific	\$2,030,720,651	10-19.9%
446110	Pharmacies and Drug Stores	Other Services & Trade	\$1,539,005,555	20-39.9%
332992	Small Arms Ammunition Manufacturing	Durable Goods Manufacturing	\$1,197,625,122	40-59.9%
524114	Direct Health and Medical Insurance Carriers	Finance, Insurance, & Management	\$1,087,477,656	10-19.9%
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	Durable Goods Manufacturing	\$724,802,009	>80%
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	Information, Professional, & Scientific	\$581,134,185	10-19.9%
517110	Wired Telecommunications Carriers	Information, Professional, & Scientific	\$542,902,864	1-1.9%
541519	Other Computer Related Services	Information, Professional, & Scientific	\$382,815,801	10-19.9%
541511	Custom Computer Programming Services	Information, Professional, & Scientific	\$361,597,224	5-9.9%
237990	Other Heavy and Civil Engineering Construction	Construction & Extraction	\$360,928,162	20-39.9%
334210	Telephone Apparatus Manufacturing	Durable Goods Manufacturing	\$264,711,397	>80%
541512	Computer Systems Design Services	Information, Professional, & Scientific	\$253,035,030	2-4.9%

Appendix B: Table of All 73 Key Defense Contracting Industries  
Missouri Defense Supply Chain Mapping Project

NAICS	Industry Description	Industry Group	Total Contracts, FY13-16	Defense Dependency Category
311611	Animal (except Poultry) Slaughtering	Non-Durable Manufacturing	\$252,986,631	2-4.9%
561210	Facilities Support Services	Admin, Support, & Waste Management	\$230,942,372	20-39.9%
333924	Industrial Truck, Tractor, Trailer, and Stacker Machinery Manufacturing	Durable Goods Manufacturing	\$229,659,388	>80%
236210	Industrial Building Construction	Construction & Extraction	\$216,467,410	10-19.9%
541990	All Other Professional, Scientific, and Technical Services	Information, Professional, & Scientific	\$208,229,038	5-9.9%
334111	Electronic Computer Manufacturing	Durable Goods Manufacturing	\$187,927,051	>80%
336992	Military Armored Vehicle, Tank, and Tank Component Manufacturing	Durable Goods Manufacturing	\$186,866,306	20-39.9%
611519	Other Technical and Trade Schools	Other Services & Trade	\$174,773,273	20-39.9%
335911	Storage Battery Manufacturing	Durable Goods Manufacturing	\$158,425,772	5-9.9%
722310	Food Service Contractors	Other Services & Trade	\$151,187,198	5-9.9%
541310	Architectural Services	Information, Professional, & Scientific	\$149,831,111	5-9.9%
332994	Small Arms, Ordnance, and Ordnance Accessories Manufacturing	Durable Goods Manufacturing	\$147,430,962	>80%
333318	Other Commercial and Service Industry Machinery Manufacturing	Durable Goods Manufacturing	\$135,293,644	5-9.9%
562910	Remediation Services	Admin, Support, & Waste Management	\$132,446,252	10-19.9%
423390	Other Construction Material Merchant Wholesalers	Other Services & Trade	\$131,365,495	20-39.9%
334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	Durable Goods Manufacturing	\$113,422,686	>80%
541614	Process, Physical Distribution, and Logistics Consulting Services	Information, Professional, & Scientific	\$108,813,031	10-19.9%
332722	Bolt, Nut, Screw, Rivet, and Washer Manufacturing	Durable Goods Manufacturing	\$83,784,206	40-59.9%
488190	Other Support Activities for Air Transportation	Transportation, Warehousing, & Utilities	\$79,150,328	5-9.9%
334419	Other Electronic Component Manufacturing	Durable Goods Manufacturing	\$59,480,412	2-4.9%

## Appendix B: Table of All 73 Key Defense Contracting Industries

### Missouri Defense Supply Chain Mapping Project

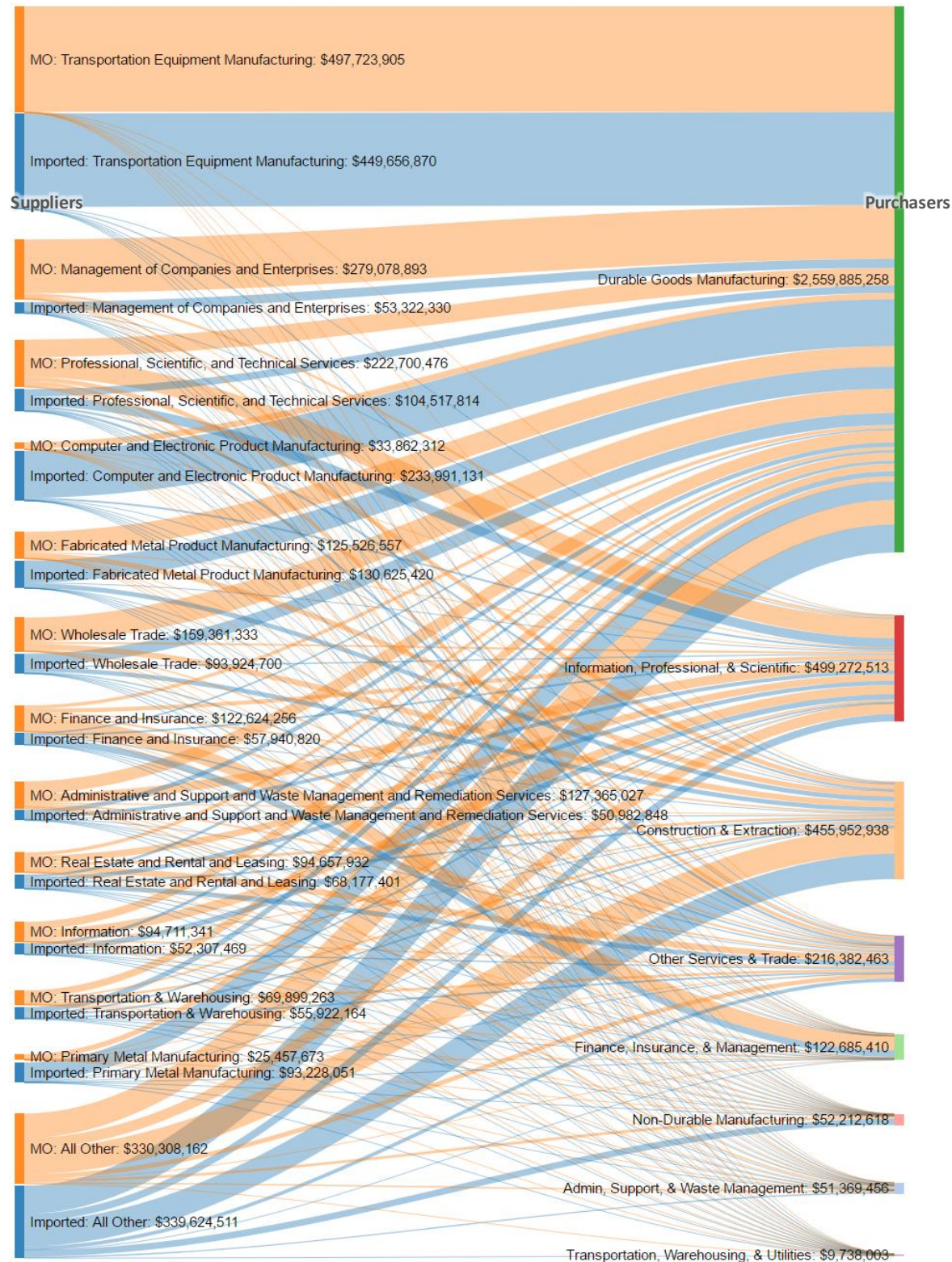
NAICS	Industry Description	Industry Group	Total Contracts, FY13-16	Defense Dependency Category
811219	Other Electronic and Precision Equipment Repair and Maintenance	Other Services & Trade	\$58,903,813	10-19.9%
541513	Computer Facilities Management Services	Information, Professional, & Scientific	\$47,494,442	5-9.9%
334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals	Durable Goods Manufacturing	\$45,076,234	60-79.9%
311812	Commercial Bakeries	Non-Durable Manufacturing	\$44,819,419	2-4.9%
541380	Testing Laboratories	Information, Professional, & Scientific	\$40,700,029	2-4.9%
336212	Truck Trailer Manufacturing	Durable Goods Manufacturing	\$36,046,507	2-4.9%
335314	Relay and Industrial Control Manufacturing	Durable Goods Manufacturing	\$34,600,006	10-19.9%
334519	Other Measuring and Controlling Device Manufacturing	Durable Goods Manufacturing	\$30,190,774	10-19.9%
812332	Industrial Launderers	Other Services & Trade	\$29,158,318	5-9.9%
541370	Surveying and Mapping (except Geophysical) Services	Information, Professional, & Scientific	\$28,132,077	5-9.9%
511210	Software Publishers	Information, Professional, & Scientific	\$26,597,045	<1%
332510	Hardware Manufacturing	Durable Goods Manufacturing	\$22,839,369	10-19.9%
311930	Flavoring Syrup and Concentrate Manufacturing	Non-Durable Manufacturing	\$22,749,276	5-9.9%
339112	Surgical and Medical Instrument Manufacturing	Durable Goods Manufacturing	\$22,188,682	2-4.9%
336611	Ship Building and Repairing	Durable Goods Manufacturing	\$21,888,099	2-4.9%
335912	Primary Battery Manufacturing	Durable Goods Manufacturing	\$21,887,241	10-19.9%
541711	Research and Development in Biotechnology	Information, Professional, & Scientific	\$21,339,184	<1%
811198	All Other Automotive Repair and Maintenance	Other Services & Trade	\$15,741,378	10-19.9%
337214	Office Furniture (except Wood) Manufacturing	Durable Goods Manufacturing	\$13,852,806	40-59.9%
333314	Optical Instrument and Lens Manufacturing	Durable Goods Manufacturing	\$13,776,277	5-9.9%

Appendix B: Table of All 73 Key Defense Contracting Industries  
Missouri Defense Supply Chain Mapping Project

NAICS	Industry Description	Industry Group	Total Contracts, FY13-16	Defense Dependency Category
213115	Support Activities for Nonmetallic Minerals (except Fuels) Mining	Construction & Extraction	\$8,053,296	>80%
334118	Computer Terminal and Other Computer Peripheral Equipment Manufacturing	Durable Goods Manufacturing	\$6,339,927	20-39.9%
334112	Computer Storage Device Manufacturing	Durable Goods Manufacturing	\$5,397,504	>80%
334310	Audio and Video Equipment Manufacturing	Durable Goods Manufacturing	\$4,206,282	10-19.9%
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	Durable Goods Manufacturing	\$2,637,866	10-19.9%
333316	Photographic and Photocopying Equipment Manufacturing	Durable Goods Manufacturing	\$2,584,419	10-19.9%
324199	All Other Petroleum and Coal Products Manufacturing	Non-Durable Manufacturing	\$1,736,154	10-19.9%
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing	Durable Goods Manufacturing	\$1,654,551	10-19.9%
517410	Satellite Telecommunications	Information, Professional, & Scientific	\$1,441,170	10-19.9%
334514	Totalizing Fluid Meter and Counting Device Manufacturing	Durable Goods Manufacturing	\$1,220,006	10-19.9%
334412	Bare Printed Circuit Board Manufacturing	Durable Goods Manufacturing	\$1,019,376	10-19.9%
335110	Electric Lamp Bulb and Part Manufacturing	Durable Goods Manufacturing	\$945,947	5-9.9%
313210	Broadwoven Fabric Mills	Non-Durable Manufacturing	\$326,800	5-9.9%
325212	Synthetic Rubber Manufacturing	Non-Durable Manufacturing	\$102,291	10-19.9%
337920	Blind and Shade Manufacturing	Durable Goods Manufacturing	\$77,067	5-9.9%
337125	Household Furniture (except Wood and Metal) Manufacturing	Durable Goods Manufacturing	\$11,050	5-9.9%

## Appendix C: Full Defense Supply Chain–Purchases from Key Contracting Industries

Figure C.1: Full Defense Supply Chain for Key Contracting Industries





## Appendix D: Distributions from Contracting Offices by Industry Group and State, FY13-16

Table D.1: Army Corps of Engineers – Kansas City

Industry Group	Illinois	Missouri	Other
Admin, Support, & Waste Management	\$55,245	\$9,828,945	\$431,336,260
Construction & Extraction	\$186,273,488	\$259,541,468	\$621,035,529
Durable Goods Manufacturing	\$146,303	\$557,203	\$5,054,170
Finance, Insurance, & Management	\$0	\$5,888	\$0
Information, Professional, & Scientific	\$2,233,784	\$70,195,097	\$144,659,536
Non-Durable Manufacturing	\$2,136	\$118,379	\$98,669
Other Services & Trade	\$0	\$1,573,372	\$1,029,648
Transportation, Warehousing, & Utilities	\$0	\$97,468	\$6,243,238
Unclassified	\$0	\$0	-\$322,571
<b>Total</b>	<b>\$188,710,957</b>	<b>\$341,917,819</b>	<b>\$1,209,134,480</b>

Table D.2: Army Corps of Engineers – St. Louis

Industry Group	Illinois	Missouri	Other
Admin, Support, & Waste Management	\$7,598,735	\$16,813,250	\$107,309,083
Construction & Extraction	\$53,164,946	\$90,819,266	\$64,045,125
Durable Goods Manufacturing	\$3,426,440	\$10,585,844	\$11,918,694
Finance, Insurance, & Management	\$0	\$14,000	\$0
Information, Professional, & Scientific	\$18,446,333	\$12,809,632	\$90,749,214
Non-Durable Manufacturing	\$53,271	\$1,219,309	\$404,619
Other Services & Trade	\$875,620	\$6,116,086	\$2,522,097
Transportation, Warehousing, & Utilities	\$712,357	\$1,815,427	\$339,831
Unclassified	\$0	\$19,949	\$0
<b>Total</b>	<b>\$84,277,702</b>	<b>\$140,212,761</b>	<b>\$277,288,662</b>

Table D.3: Defense Contract Management Agency – Boeing St. Louis

Industry Group	Illinois	Missouri	Other
Durable Goods Manufacturing	\$0	\$1,562,769	-\$5,430,305
Information, Professional, & Scientific	\$0	-\$25,496,470	\$0
Other Services & Trade	\$0	-\$3,790,137	\$0
Unclassified	\$0	-\$4,080,928	\$0
<b>Total</b>	<b>\$0</b>	<b>-\$31,804,764</b>	<b>-\$5,430,305</b>

## Appendix D: Distributions from Contracting Offices by Industry Group and State Missouri Defense Supply Chain Mapping Project

Table D.4: Fort Leonard Wood

Industry Group	Illinois	Missouri	Other
Admin, Support, & Waste Management	\$9,552,526	\$8,715,748	\$147,606,828
Construction & Extraction	\$6,491,293	\$52,083,379	\$29,531,421
Durable Goods Manufacturing	\$523,129	\$2,144,370	\$21,105,088
Information, Professional, & Scientific	\$1,058,859	\$1,426,163	\$35,699,927
Non-Durable Manufacturing	\$3,995,428	\$3,278,546	\$2,614,874
Other Services & Trade	\$249,974	\$133,639,514	\$8,494,482
Transportation, Warehousing, & Utilities	\$0	\$132,377,207	\$9,075
Unclassified	\$0	-\$685	\$0
<b>Total</b>	<b>\$21,871,209</b>	<b>\$333,664,241</b>	<b>\$245,061,695</b>

Table D.5: Naval Operational Support Center – Kansas City

Industry Group	Illinois	Missouri	Other
Other Services & Trade	\$0	\$109,675	\$113,463

Table D.6: Naval Operational Support Center – Springfield

Industry Group	Illinois	Missouri	Other
Other Services & Trade	\$0	\$145,136	\$0

Table D.7: Naval Operational Support Center – St. Louis

Industry Group	Illinois	Missouri	Other
Other Services & Trade	\$0	\$308,124	\$0

Table D.8: Naval ROTC – University of Missouri

Industry Group	Illinois	Missouri	Other
Other Services & Trade	\$0	\$3,036,815	\$0

## Appendix D: Distributions from Contracting Offices by Industry Group and State

### Missouri Defense Supply Chain Mapping Project

Table D.9: USPFO – Missouri Army National Guard

Industry Group	Illinois	Missouri	Other
Admin, Support, & Waste Management	\$0	\$64,507	\$4,547,559
Construction & Extraction	\$403	\$27,720,210	\$791,156
Durable Goods Manufacturing	\$384,992	\$2,280,792	\$13,873,109
Information, Professional, & Scientific	\$17,629	\$3,709,945	\$6,574,677
Non-Durable Manufacturing	\$0	\$116,216	\$2,301,611
Other Services & Trade	\$153,641	\$3,651,021	\$6,938,859
Transportation, Warehousing, & Utilities	\$0	\$112,792	\$11,082,071
<b>Total</b>	<b>\$556,664</b>	<b>\$37,655,483</b>	<b>\$46,109,041</b>

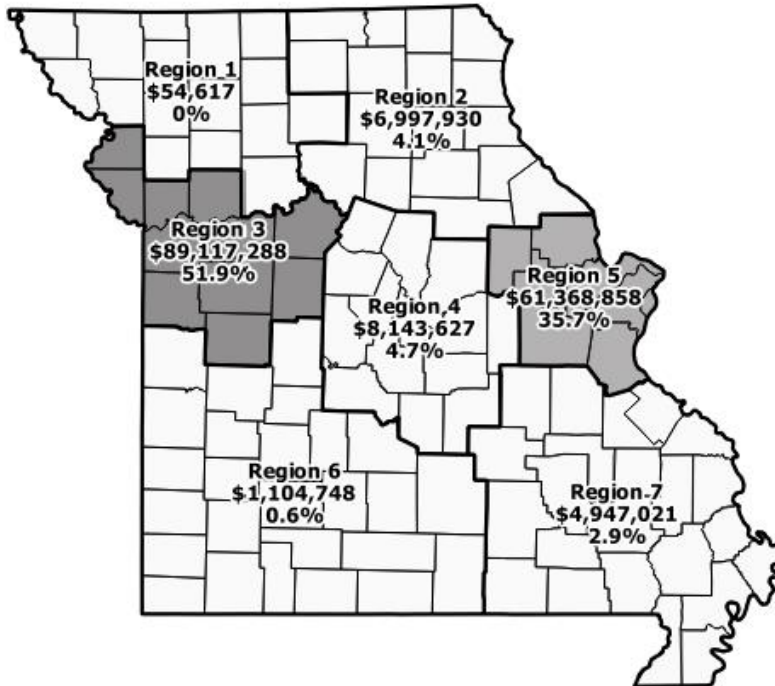
Table D.10: Whiteman Air Force Base

Industry Group	Illinois	Missouri	Other
Admin, Support, & Waste Management	\$2,788	\$2,773,811	\$10,833,641
Construction & Extraction	\$884,805	\$76,442,580	\$3,241,305
Durable Goods Manufacturing	\$669,004	\$5,146,341	\$21,999,824
Information, Professional, & Scientific	\$18,500	\$5,031,044	\$17,941,727
Non-Durable Manufacturing	\$105,308	\$96,541	\$3,418,110
Other Services & Trade	\$102,420	\$3,280,883	\$31,044,544
Transportation, Warehousing, & Utilities	\$8,043	\$53,747	\$218,769
<b>Total</b>	<b>\$1,790,868</b>	<b>\$92,824,948</b>	<b>\$88,697,919</b>

## Appendix E: Distribution of Contracting Revenue by Industry Group

Figure D.1: FY13-16 Contracts Received by Region: Administrative, Support, & Waste Management

### By Contract Location



### By Place of Performance

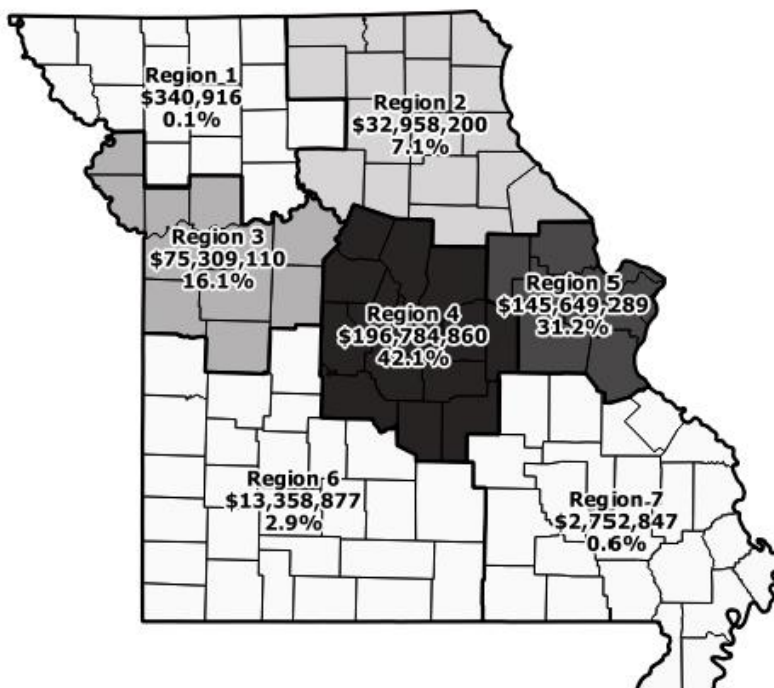
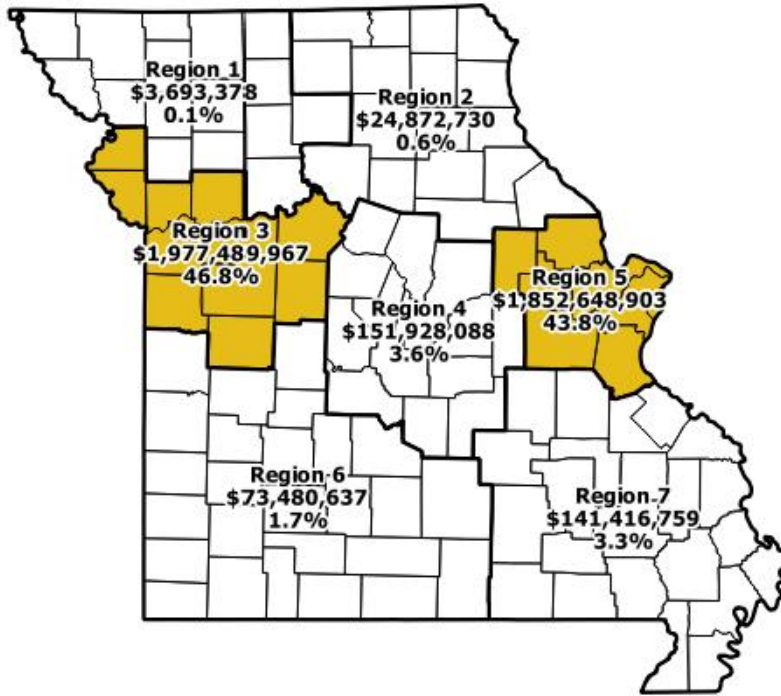


Figure D.2: FY13-16 Contracts Received by Region: Construction & Extraction

**By Contract Location**



**By Place of Performance**

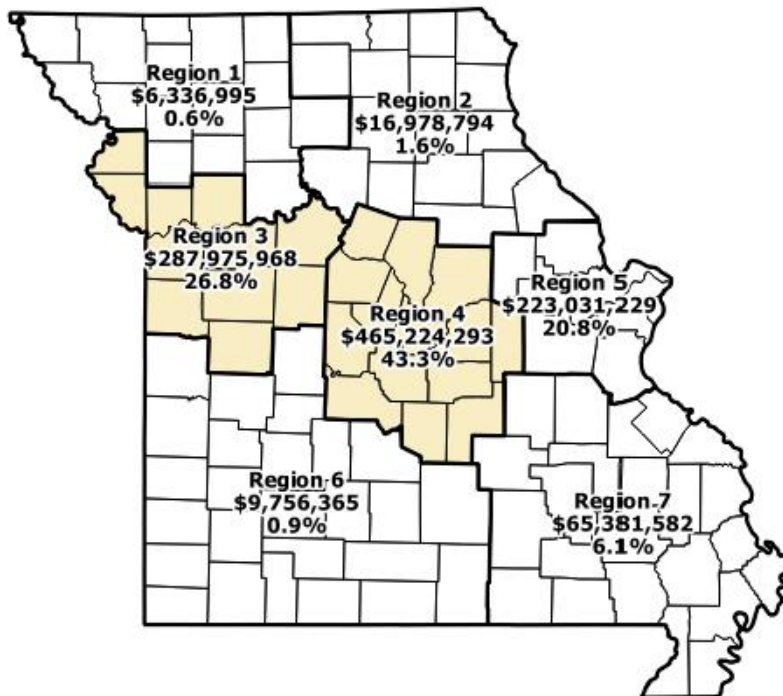
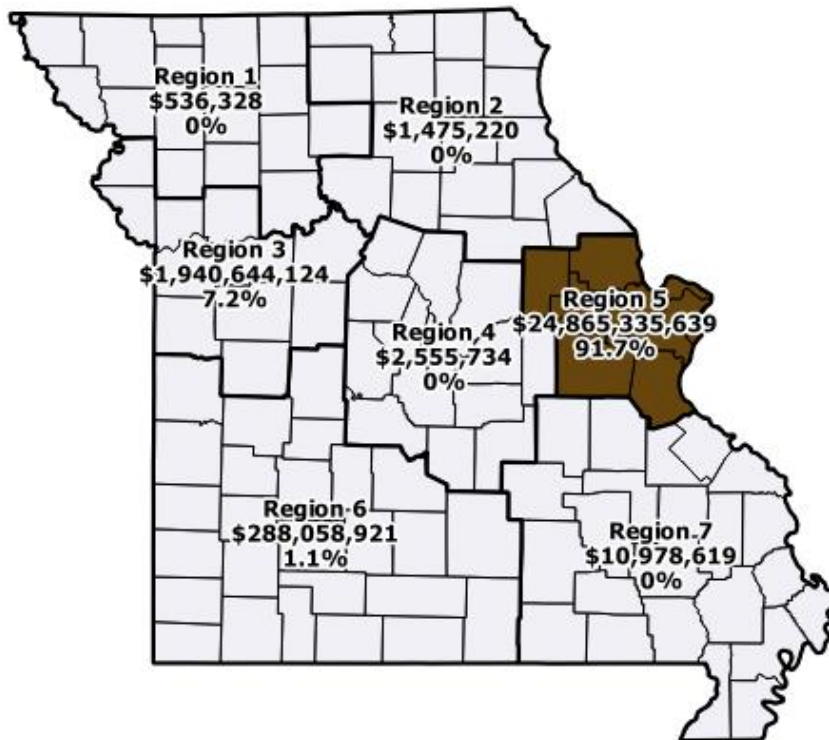


Figure D.3: FY13-16 Contracts Received by Region: Durable Goods Manufacturing

### By Contract Location



### By Place of Performance

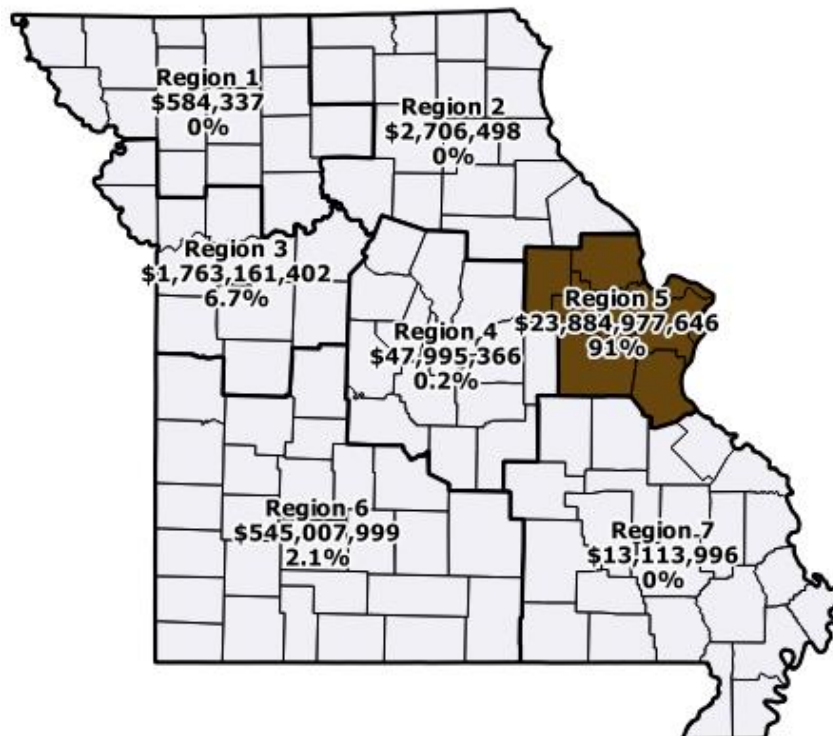


Figure D.4: FY13-16 Contracts Received by Region: Finance, Insurance, & Management

### By Contract Location

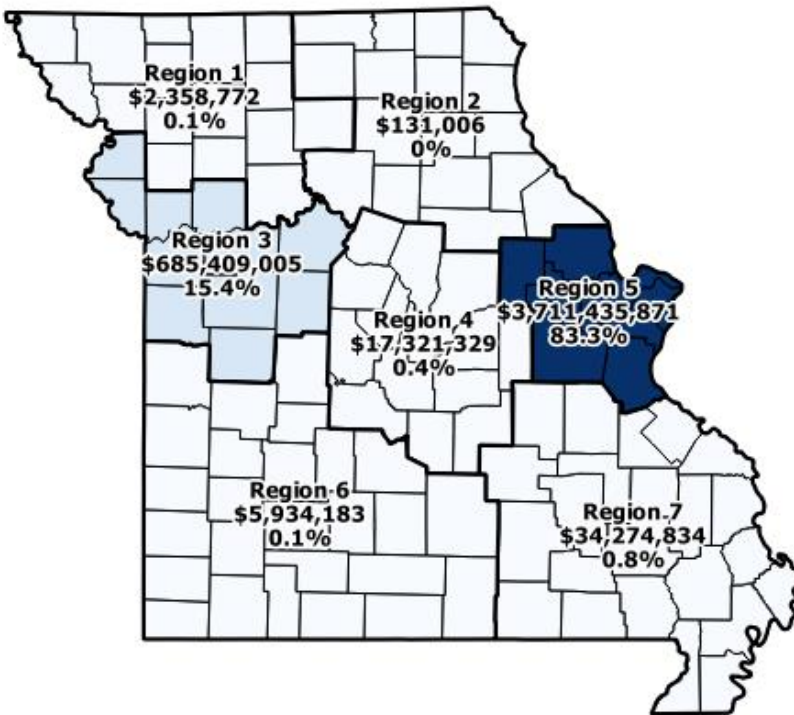


### By Place of Performance



Figure D.5: FY13-16 Contracts by Region: Information, Professional, & Scientific

**By Contract Location**



**By Place of Performance**

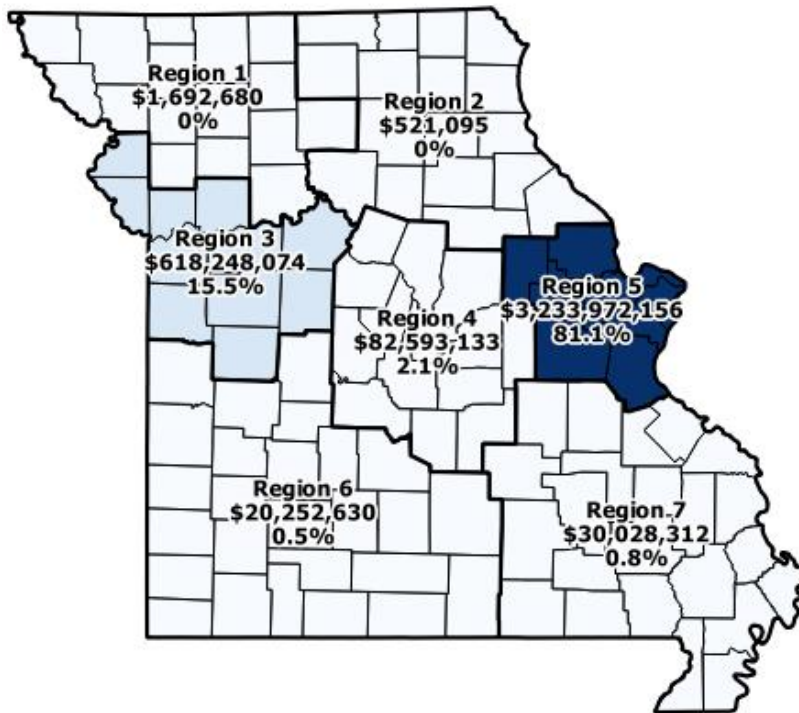
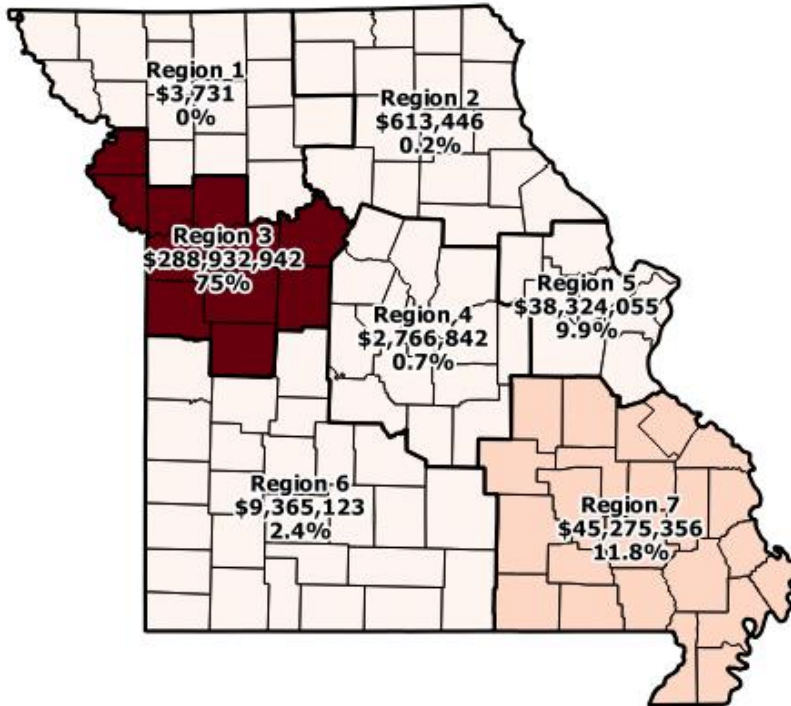




Figure D.6: FY-13-16 Contracts by Region: Non-Durable Goods Manufacturing

**By Contract Location**



**By Place of Performance**

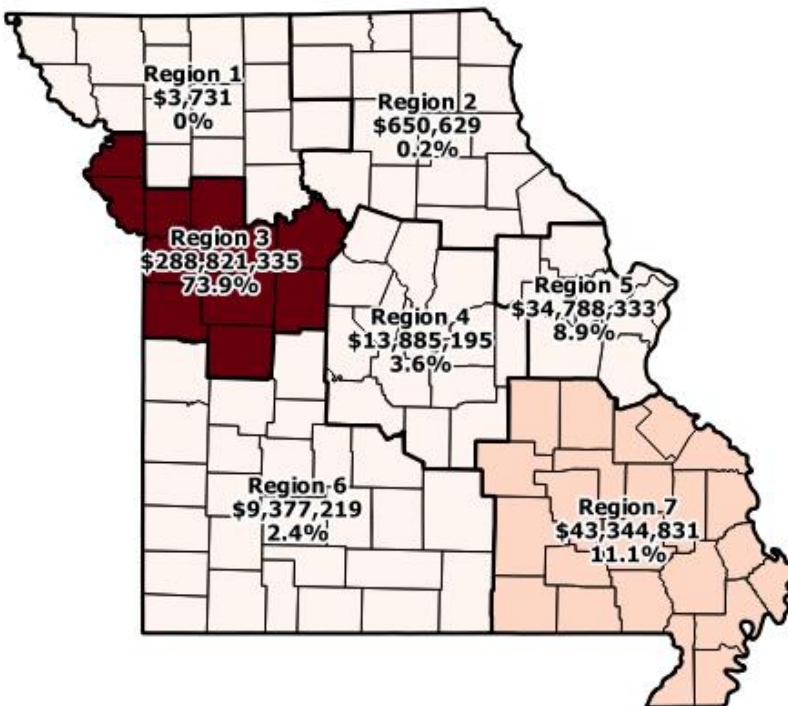
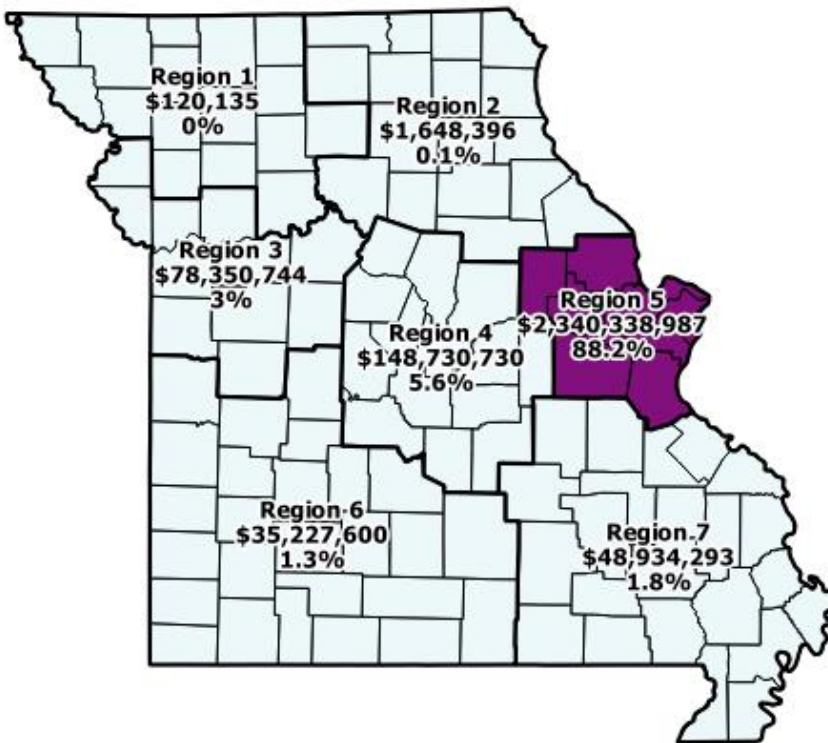


Figure D.7: FY13-16 Contracts by Region: Other Services & Trade

### By Contract Location



### By Place of Performance

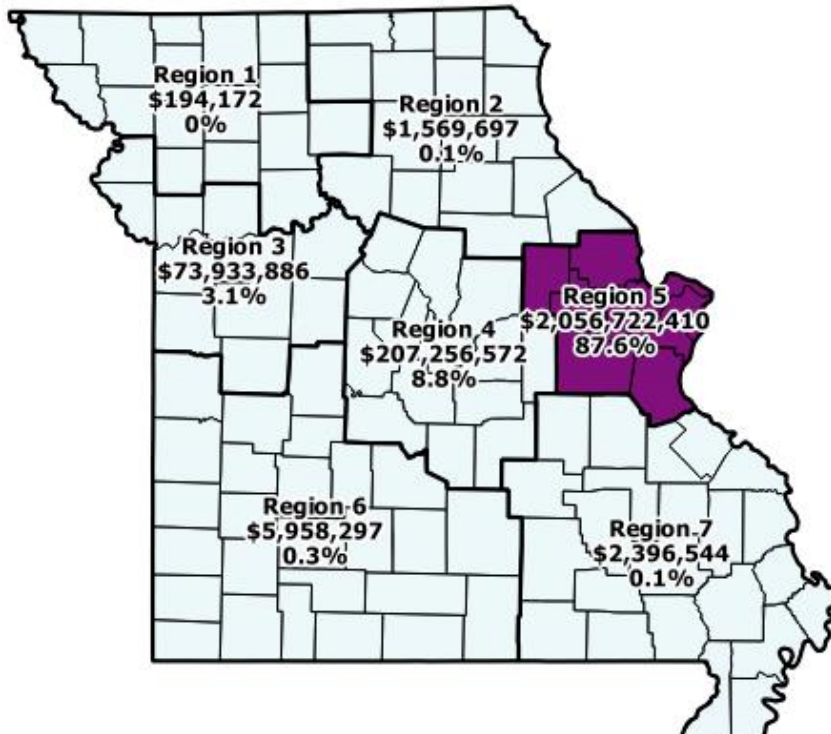
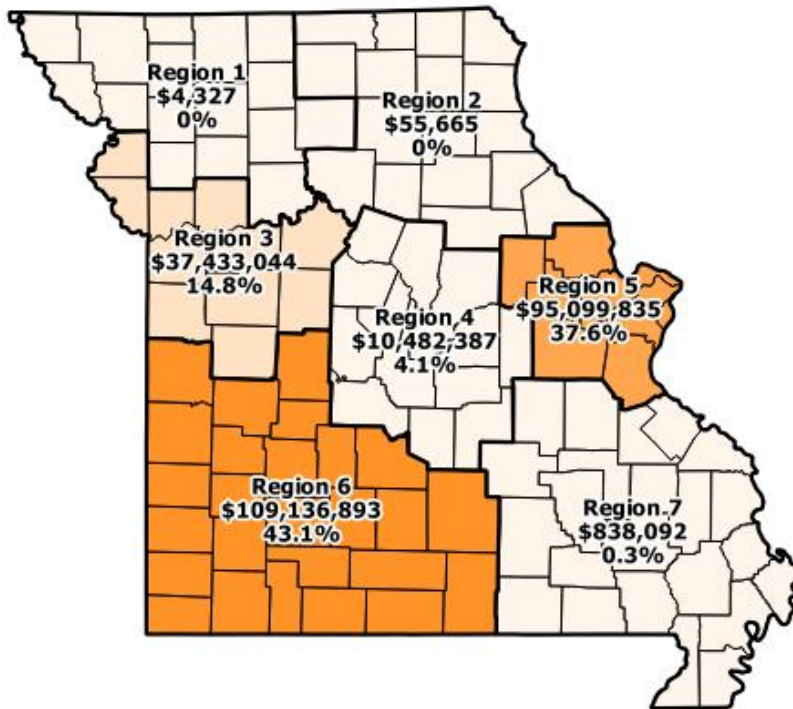
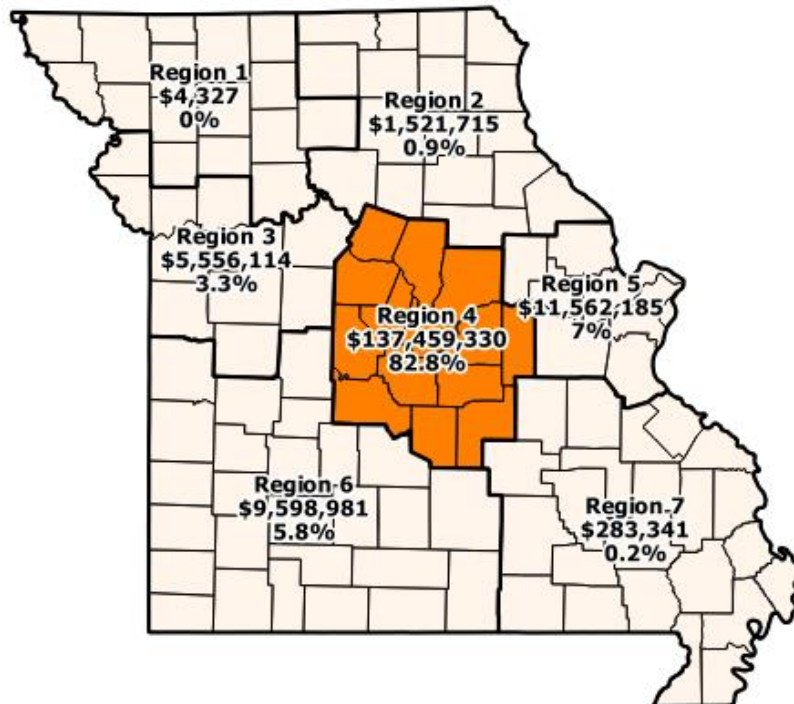


Figure D.8: FY13-16 Contracts by Region: Transportation, Warehousing, & Utilities

### By Contract Location



### By Place of Performance



## Appendix F: St. Louis MSA Universities and Colleges Committed to Research and Development

- [St. Louis University- Parks College of Engineering, Aviation, and Technology](#)
  - BS, MS Aerospace Engineering
  - PhD Aerospace & Mechanical Engineering
  - BS Computer Engineering
  - BS, MS Electrical Engineering
  - BS Mechanical Engineering
  - BS Physics
  - BS, MS Engineering Physics
  - BS Aviation management
  - BS Flight Science
  - BS Global Aviation
  - PhD Aviation
- [Washington University in Saint Louis](#)
  - BS, MS, PhD Computer Science
  - BS, MS, PhD Computer Engineering
  - MEng in Computer Science & Engineering
  - Graduate Certificate in Data Mining and Machine Learning
  - BS, PhD Electrical Engineering
  - BS, PhD Systems Science & Engineering
  - BS, PhD, MS, MEng Mechanical Engineering
  - PhD, MS Aerospace Engineering
  - BS Chemical Engineering
  - BS Applied Science
  - PhD, MEng Energy, Environmental, and Chemical Engineering
- [University of Missouri-St. Louis](#)
  - BA, BS, MS, PhD Chemistry
  - BA, BS, MA, PhD Mathematics
  - BA, BS, PhD Physics & Astronomy
  - BS, MS Computer Science
- [University of Missouri College of Engineering](#)
  - BS, MS, PhD Chemical Engineering
  - BS, MS, PhD Civil Engineering
  - BS, MS, PhD Computer Engineering
  - BS, MS, PhD Electrical Engineering
  - BS, MS, PhD Industrial Engineering
  - BS Information Technology
  - BS, MS, PhD Mechanical & Aerospace Engineering
- [Missouri University of Science and Technology](#)
  - BS Applied Mathematics

## Appendix F: St. Louis MSA Universities and Colleges Committed to R&D Missouri Defense Supply Chain Mapping Project

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- BS, BA Chemistry
- BS Computer Science
- BS Information Science & Technology
- BS, Physics
- BS, BA, PhD Aerospace Engineering
- BS Architectural Engineering
- BS, MS, PhD Ceramic Engineering
- BS, MS, PhD, DE Chemical Engineering
- BS, MS, PhD, DE Civil Engineering
- BS, MS, PhD Computer Engineering
- BS, MS, PhD, DE Electrical Engineering
- BS, MS, PhD Engineering Management
- MS, PhD Explosives Engineering
- MS Manufacturing Engineering
- BS, MS, PhD, DE Mechanical Engineering
- BS, MS, PhD Metallurgical Engineering
- BS, MS, PhD Nuclear Engineering
- MS, PhD Systems Engineering
- [Harris Stowe State University](#)
  - BS Information Sciences & Computer Technology
  - BS Mathematics
- [Fontbonne University](#)
  - BS Applied Mathematics
  - BS, MS Computer Science
  - BS Cybersecurity
  - BS Engineering
- [Lindenwood University](#)
  - BS Chemistry
  - BS Computer Information Systems
  - BS Computer Science
  - BS Information Technology
  - BS Cybersecurity
  - BA, BS Mathematics
- [Maryville University](#)
  - BS Actuarial Science
  - BS Chemistry
  - BS Computer Science
  - BS Engineering
  - BS Mathematical Science
- [Webster University](#)
  - BS Chemistry
  - BS Computer Science
  - BS Information Technology
  - BS Cybersecurity

- BS Information Management
- BS Information Systems
- BS Mobile Computing
- BS Data Analytics
- Ranken Technical College
  - AS Advanced Manufacturing
  - AS Building Systems Engineering Technology
  - AS Control Systems Technology
  - AS Diesel Technology
  - AS Electrical Systems Design Technology
  - AS Electrical Automation Technology
  - AS Industrial Technology
  - AS Internet & Web-Based Technology
  - AS Information Technology
  - AS High Performance Racing Technology
  - AS Precision Machining Technology
  - CP Automotive Fleet Management
  - CP Control Systems Technology
  - CP Computer Networking
  - CP Electrical Automation
  - CP Electrical Construction Design Management
  - CP Fabrication and Welding Technology
  - CP High Performance Racing
  - CP Industrial Technology
  - CP Precision Machining
  - CP Solar Photovoltaic Technology
- St. Louis Community College
  - CS Computer Applications
  - AS Computer Science
  - AAS, CP Cyber Security
  - AAS, CP Network Engineering
  - CP Network Security
  - CP Aviation Maintenance
  - CS Computer Aided Design
  - AAS Computer Aided Manufacturing
  - AAS, CP, CS Diesel Technology
  - AAS Electrical/Electronic Engineering Technology
  - AAS Mechanical Engineering Technology
  - CS Precision Machining Technology
  - AS Engineering Science
- St. Charles Community College
  - AAS Computer Programing
  - AAS, CS Cybersecurity
  - AAS Network Security

- CS Computer Security
- CA Data Management
- CS Programing
- CA Programing Languages
- CS Systems Administration
- AS Chemistry
- CS Advanced Welding
- CS Basic Welding
- CA Computer Aided Drafting
- CA Entry Level Welding
- CA, CS Manufacturing Technology
- East Central College
  - AS Chemistry
  - Computer Information Systems/Networking
  - AS Engineering
  - Industrial Engineering Technology/Industrial Maintenance
  - AAS Precision Machining Technology
  - CS, AAS Welding