

Working Paper



Arizona State Freight Plan

(ADOT MPD 085-14)

Phase 3 Working Paper Transportation Equipment Manufacturing Profile and Transportation Performance Needs

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Working Paper

This working paper is one of 10 focusing on key Arizona economic sectors. Its purpose is to document the economic profile, outlook and transportation performance needs of Arizona's transportation equipment manufacturing sector. This working paper will later inform system improvement needs to increase Arizona's economic competitiveness and growth. This working paper is provided for comment and discussion and should not be interpreted as final.

Acknowledgements

The CPCS team would like to thank the Arizona Department of Transportation (ADOT) for its guidance and input in developing this working paper. The team also recognizes the considerable contribution of the individuals consulted in the transportation equipment manufacturing sector in the development of this working paper.

Opinions

Unless otherwise indicated, the opinions herein are those of the author and do not necessarily reflect the views of ADOT or the State of Arizona.

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Executive Summary

Economic and Traffic Profile

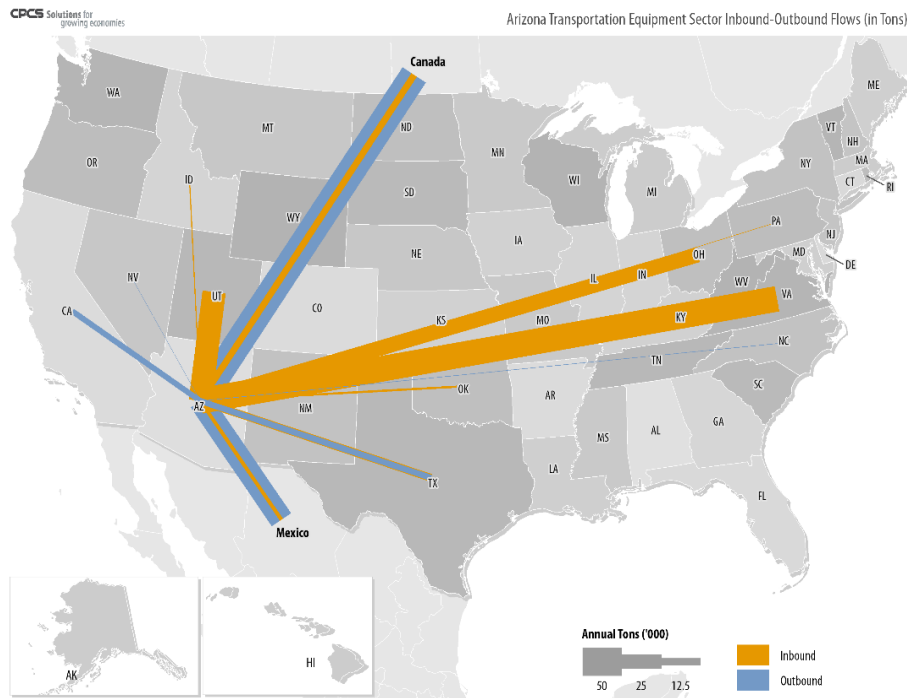
The transportation equipment manufacturing sector in Arizona is dominated by companies involved in the aerospace industry, which is in turn closely linked to the defense industry. The State's existing strength in this industry is driven in part by the strong presence of military facilities in the state, as well as by the state's warm and dry climate, which allows for ideal testing of equipment under extreme desert conditions.

	Measure	Transportation Equipment Sector	Arizona (Statewide)
Economy	GDP (2012, \$ million)	\$5,202	\$271,503
	GDP Annualized Growth (1997-2012)	4.7%	4.9%
Jobs	Employment (2013)	29,944	2,619,055
	Compensation per Employee (2013)	\$114,095	\$57,393
Transportation	Total Commodity Flows (2012, Mt)	.2	138.2
	Top Origin (2012, Mt)	Virginia (.1 Mt)	California (9.5 Mt)
	Top Domestic Destination (2012, Mt)	Mexico (.04 Mt)	Mexico (5.6 Mt)
	Intrastate Flows (2012, Mt)	.01	101.8
	% Truck (2012)	97.1%	87.2%
Source: CPCS analysis of data from Bureau of Economic Analysis and 2012 Commodity Flow Survey			

Arizona hosts many of the largest aerospace and defense companies in the world, including Raytheon, Honeywell, and Boeing, as well as many smaller and medium-sized companies supplying parts and repairs to the sector.

Arizona-based manufacturers are important suppliers to the domestic commercial airline and defense industry (e.g. U.S. Air Force), and also contribute significantly to state exports. In 2014, the sector generated \$3.7 billion of exports, with Europe and Asia being the largest international clients.

In terms of traffic flows, the largest volume of inbound traffic originates in Utah, Ohio and Virginia. Canada and Mexico, followed by California and Texas, account for the majority of outbound traffic.



Supply Chain Structure and Transportation Performance Needs

The vast majority of manufacturing in the transportation equipment manufacturing sector takes place in the Phoenix and Tucson areas, where the industry's most prominent manufacturers are located.

The supply chain for the sector is complex, with many firms supplying parts for various stages of manufacturing, and involvement from an active maintenance, repair and overhaul (MRO) support sector. Many companies in the industry operate on a "just-in-time" manufacturing basis where transit time and reliability are critical to supply chain competitiveness. A combination of trucking (typically less than truckload) and air transportation is used to move relatively high value parts to, from and within Arizona. Rail is used only on an exceptional basis, which reflects the high value-to-weight ratio of the components moved in the sector.

Notable Barriers and Related Priority Improvements to Enhance Competitiveness and Growth

The large and well-established aerospace companies operating in Arizona have mastered their supply chain systems very well, and face few challenges in terms of transportation impacts on their business operations. These companies have the supply chain planning expertise, steady traffic volumes, and financial stability to negotiate effectively with common carriers on price, reliability and transit time. For smaller companies and suppliers, cost becomes relatively more important than reliability and transit time.

Consultations revealed very few challenges or barriers to transportation performance in the sector. The comments received indicated the primary challenges to transportation performance relate to traffic from urban congestion, busy highways between Tucson and Phoenix, delays at the Mexican border, and truck driver shortages (an issue mentioned by carriers used by manufacturers).

Acronyms and Abbreviations

ACA	ARIZONA COMMERCE AUTHORITY
ADOT	ARIZONA DEPARTMENT OF TRANSPORTATION
CFS	COMMODITY FLOW SURVEY
GDP	GROSS DOMESTIC PRODUCT
JPAC	JOINT PLANNING ADVISORY COUNCIL
LTL	LESS THAN TRUCKLOAD
MAP-21	MOVING AHEAD FOR PROGRESS IN THE 21 ST CENTURY
MPD	MULTIMODAL PLANNING DIVISION (OF ADOT)
MRO	MAINTENANCE REPAIR AND OVERHAUL COMPANIES
PAG	PIMA ASSOCIATION OF GOVERNMENTS

1

Introduction

Key Messages

The Arizona Department of Transportation, Multimodal Planning Division, retained a team led by CPCS Transcom, Inc. to assist in the development of Arizona's State Freight Plan.

The aim of this working paper is to establish the freight transportation performance needs, outlook, and economic contribution of Arizona's transportation equipment manufacturing sector (defined here as NAICS Code 336). This will later inform the analysis of broader transportation system based needs and priorities.

This working paper was developed in large part through stakeholder consultations and analysis of the transportation equipment manufacturing sector data.

1.1 Introduction: Why an Arizona State Freight Plan?

Arizona's economic potential is supported by the state's transportation infrastructure, which connects sources of production to markets.

When transportation infrastructure and related services are efficiently designed and competitively positioned, businesses benefit from lower transportation costs, faster and better transportation services, and increased reliability, which in turn contribute to their own competitiveness and growth, and that of the broader region.

Jurisdictions with access to competitive transportation infrastructure and services are at a competitive advantage in attracting investment, creating jobs and realizing economic growth. Arizona's State Freight Plan can help enable this outcome.

To this end, the ADOT's Multimodal Planning Division (MPD), is developing Arizona's State Freight Plan which will provide strategic guidance to enhance Arizona's economic competitiveness and facilitate economic growth.

1.2 Project Objectives

The State Freight Plan will define immediate and long-range investment priorities and policies that will generate the greatest return for Arizona's economy, while also advancing other key transportation system goals, including national goals outlined in MAP-21. It will identify freight transportation facilities in Arizona that are critical to the State's economic growth and give appropriate priority to investments in such facilities.

The State Freight Plan will ultimately provide Arizona with a guide for assessing and making sound investment and policy decisions that will yield outcomes consistent with the state's visions, goals, and objectives, and notably, promote regional competitiveness and economic growth.

1.3 Purpose of this Working Paper

Since it is economic activity – particularly from goods movement sectors - that drives demand for freight transportation infrastructure and services, optimization of the state's freight transportation system, and related strategies, goals and investments, must start by addressing the transportation performance needs of the sectors moving freight. Yet, the transportation performance needs of freight can differ by sector and commodity group, locations and even company.

For this reason, the team identified 10 key freight sectors in Arizona for specific focus: wholesalers and retailers, food and beverage, high-tech manufacturing, general manufacturing, transportation equipment manufacturing, transportation and logistics, mining (except oil and gas), energy (oil and gas), agriculture, and forestry.

The purpose of this working paper is to provide a focused assessment of the transportation performance needs, outlooks and economic contribution of the transportation equipment manufacturing sector (defined here as NAICS Code 336).

Specifically, it addresses the following key questions:

- At a high level, what is the profile and economic contribution of the transportation equipment manufacturing sector to Arizona's economy?
- How do the supply chains of Arizona's transportation equipment manufacturing sector utilize the transportation system and what are the major origins, destinations, intermediate points, and final products of these chains?
- How are transportation equipment manufacturing sector supply chains structured, managed, and what are the primary drivers of transportation decisions and related performance needs?
- What are the key trends in the transportation equipment manufacturing sector, how are these influencing freight flows, and what are the implications, opportunities and challenges for the competitiveness of Arizona's freight system going forward?

1.4 Methodology

This working paper is informed by a combination of literature review, data collection and analysis, and consultation with transportation equipment manufacturing stakeholders. Documents reviewed are footnoted throughout the working paper, as appropriate. A list of individuals consulted is provided in Appendix A (unless the stakeholder has specifically requested non-attribution).

1.5 Limitations

This working paper is in many cases informed by data and input provided by third parties. CPCS has verified this information to the extent possible through analysis and cross-checking with other sources but cannot guarantee the accuracy of data received from third parties.

2

Transportation Equipment Manufacturing Sector Profile

Key Messages

- Transportation equipment manufacturing sector is dominated by companies involved in the aerospace industry. Activity is clustered overwhelmingly in Phoenix and Tucson.
- Over \$7 billion of goods were shipped domestically in the sector, including movements to, from and within Arizona. In value terms, California is the largest single originator of inflow traffic and destination for outbound domestic traffic.
- Producers in the state exported \$3.7 billion of equipment in 2014, with the most important destinations being Europe and Asia.
- Producers in the state imported \$3 billion in goods to the sector in 2014, with the largest origin being imports from Mexico – a reflection of the important maquiladora industry in the country.

2.1 Overview of Transport Equipment Manufacturing Sector

The transportation equipment manufacturing sector in Arizona is overwhelmingly dominated by companies involved in the aerospace industry, which is in turn closely linked to the defense industry. Arizona's existing strength in the aerospace and defense industry is driven in part by the strong presence of military facilities in the state, as well as by the state's warm and dry climate, which allows for testing of equipment under extreme desert conditions.

Much of the equipment associated with aerospace and defense systems would be considered "high-tech", a sector reviewed in a separate working paper. For the purposes of supply chain analysis, this paper includes high-tech companies involved primarily in aerospace and defense, in part because of the close relationship between aerospace and defense, as well as having similar suppliers and end clients (e.g. government defense clients). High-tech companies that are active largely outside of the defense and aerospace industry sectors (e.g. semi-conductors, IT software, etc.) are covered separately in the high-tech sector working paper.

Arizona ranked fourth nationwide in aerospace industry payroll and fourth in aerospace revenues, as of 2012.¹ Companies in the state manufacture more guided missiles and space vehicles than any other U.S. state, and the state ranks in the top ten for aeronautical and navigation equipment, aircraft, aircraft engines and parts, and guided missile parts.²

There are 83 airports in Arizona, including Phoenix Sky Harbor, which is ranked among the 10 busiest commercial airports in the country. This number also includes airports located within four major U.S. Army facilities which provide a steady client base for aerospace and defense companies in the region: the Luke Air Force Base and its 56th Fighter Wing (the largest fighter wing in the world), the Yuma Proving Ground (one of the largest military installations in the world), the Fort Huachuca unmanned aerial systems training facility (the largest of its kind in the world), and the Davis-Monthan Air Force Base in Tucson.³

Arizona hosts many of the largest aerospace and defense companies in the world, including Raytheon (9,600 employees), Honeywell (9,500 employees), Boeing (4,300 employees) and Orbital ATK (1,650 employees), as well as many smaller and medium-sized companies supplying parts and repairs to the sector.⁴

¹ Deloitte, "The Aerospace and Defense Industry in the U.S. A financial and economic impact study", March 2012.

² Arizona Commerce Authority, "Arizona's Aerospace and Defense Industry", June 2015.

³ Arizona Commerce Authority website, Aerospace and Defense sub-page, consulted May 2015.

⁴ Refers to employees in Arizona in 2015. Source: www.azcentral.com, "Arizona Republic 100: State's Largest Employers", April 19 2015.

2.2 Economic Profile and Importance to Arizona's Economy

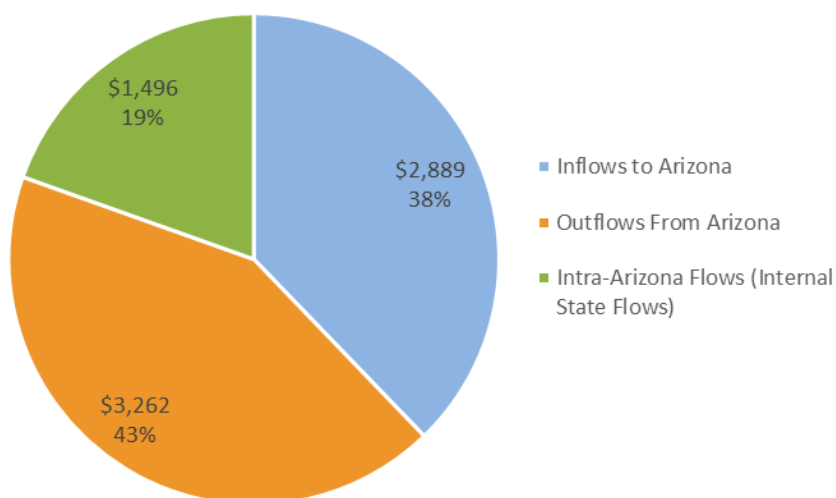
2.2.1 GDP and Trade

The transportation equipment manufacturing sector in Arizona contributed \$5.2 billion to the State's gross domestic product (GDP) in 2012, representing 1.9 percent of the State's total economic output. Since 1997, GDP in the transportation equipment manufacturing sector has grown at a rate of 4.7 percent per annum, slightly under the overall state average of 4.9 percent GDP growth per annum.⁵

2.2.2 Commodity Flows

Overall, \$7.7 billion of goods in the transportation equipment manufacturing sector travelled into, out of, or within the State of Arizona in the year 2012. Of this, \$2.9 billion of goods originated in other states and were destined to Arizona, \$3.3 billion originated in Arizona and were destined for other states, and \$1.5 billion in goods travelled within the state of Arizona.

Figure 2-1: Value of Flows Into, out of, and Within Arizona in 2012 (\$millions)

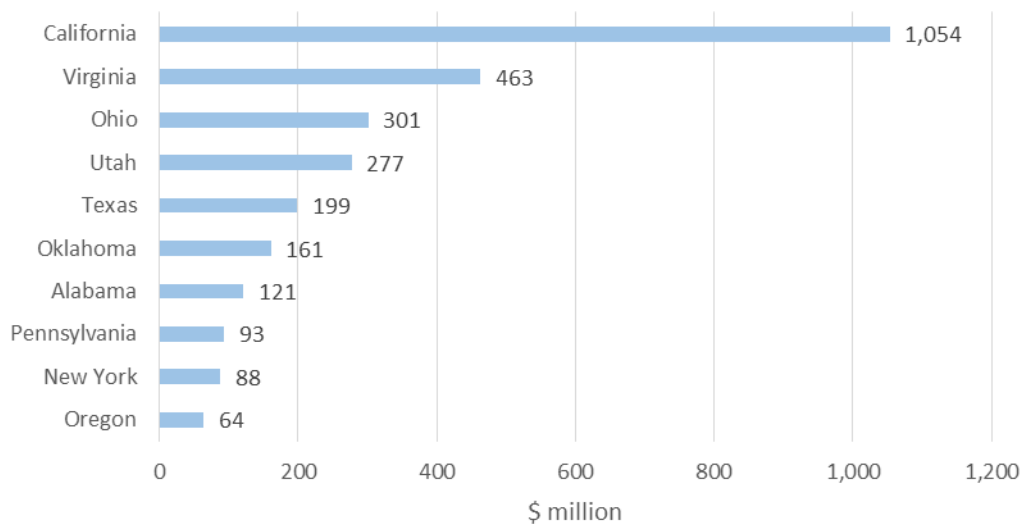


Source: CPCS analysis of Commodity Flow Survey, 2012.

Origins of Inflows to Arizona

The figure below summarizes the origins of transportation equipment that was shipped to Arizona from other states. In 2012, California was the largest origin of transportation equipment products destined for Arizona with \$1.1 billion in products shipped to Arizona, followed by Virginia and Ohio at \$463 million and \$301 million, respectively.

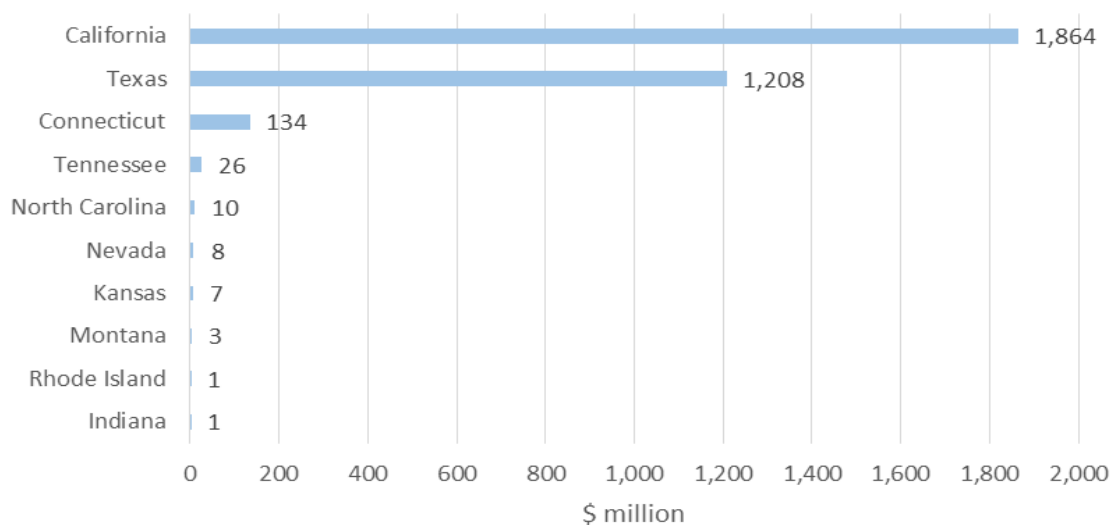
⁵ Bureau of Economic Analysis Regional Economic Accounts, GDP by State. GDP in current dollars.

Figure 2-2: Value of Top 10 Transportation Equipment Inflows to Arizona by State or Origin (2012)

Source: CPCS analysis of Commodity Flow Survey, 2012.

Destinations of Outflows From Arizona to Other States

The figure below summarizes the destination of transportation equipment originating in Arizona. California was the largest destination of Arizonan transportation equipment products, where \$1.9 billion worth of products originating in Arizona were destined. Some of these flows may have been subsequently destined for international destinations through ports located in California, though not a large amount (based on our consultations). A review of international trade flows by volume to and from Arizona is contained in Section 2.2.3.

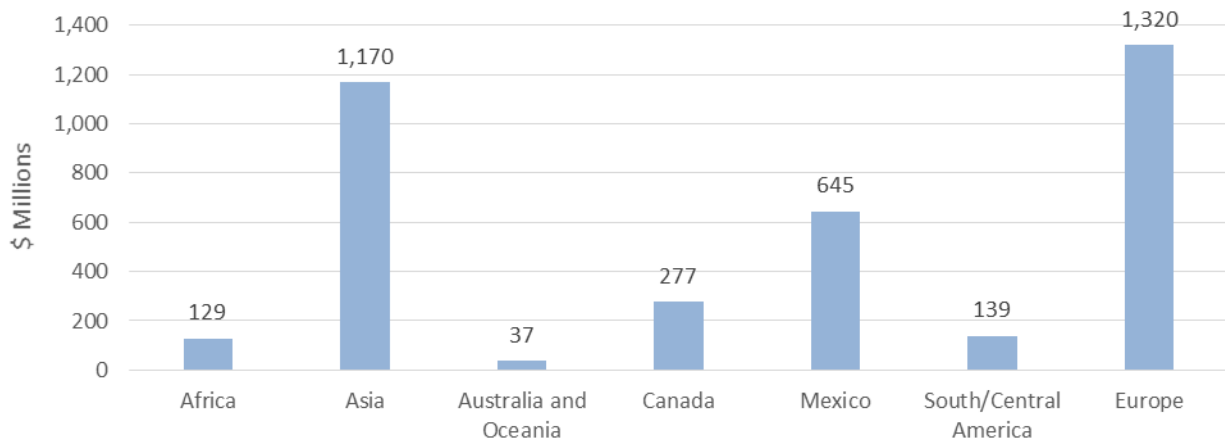
Figure 2-3: Value of Top 10 Transportation Equipment Outflows from Arizona by State of Destination (2012)

Source: CPCS analysis of Commodity Flow Survey, 2012

2.2.3 International Trade

International exports from Arizona in the transportation equipment manufacturing sector totalled \$3.7 billion in 2014. The largest destinations for exports of goods from the transportation equipment manufacturing sector were Europe and Asia (see Figure 2-4).

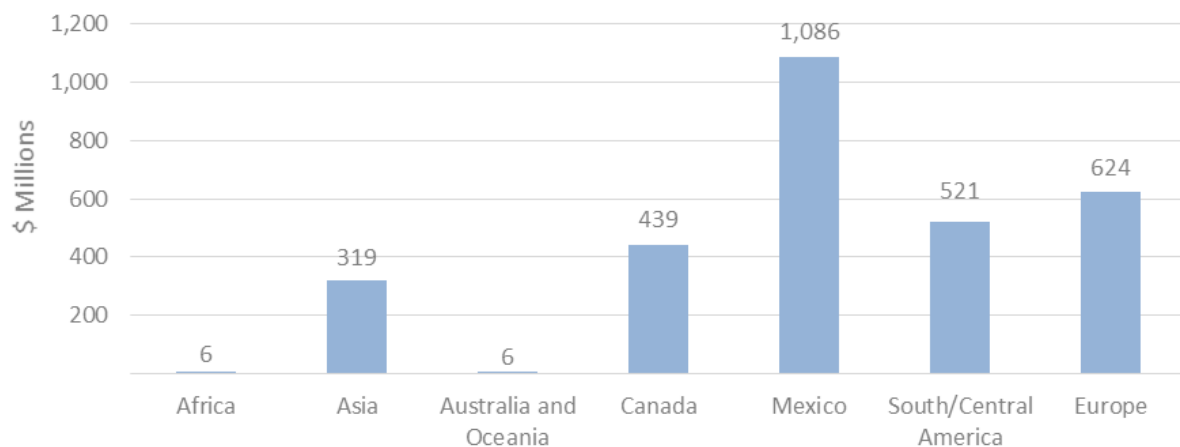
Figure 2-4: Destinations of Arizonan Exports in the Transportation Equipment Manufacturing Sector (2014)



Source: CPCS analysis of United States Census Bureau Electronic Export Information. Accessed April 2015.

The state imported \$3 billion of goods from the same sector, the largest origin being imports from Mexico. This is a reflection of the important role played by many manufacturers of parts and components for the transportation equipment manufacturing sector in Mexico (see text box at end of this section).

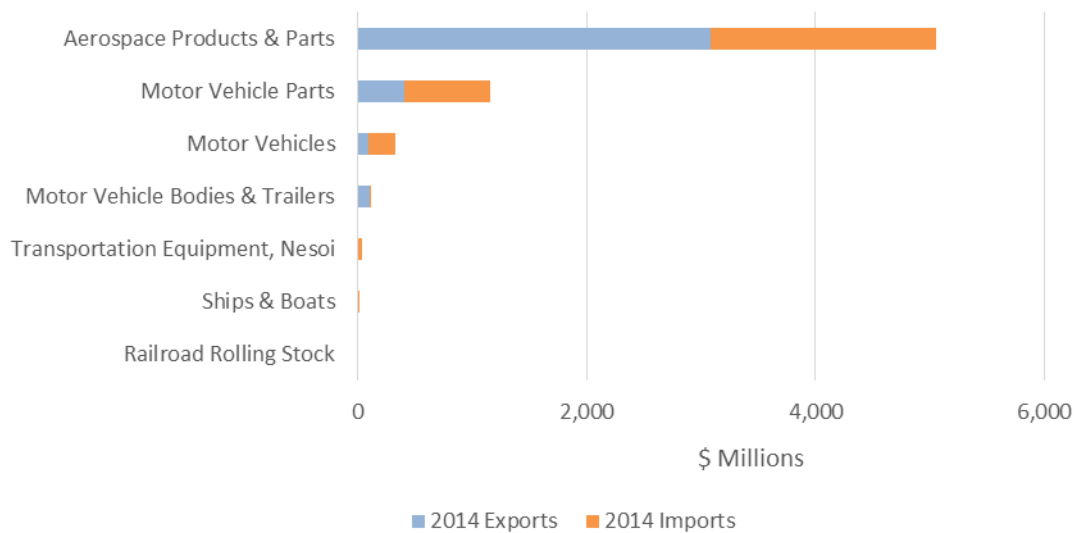
Figure 2-5: Origins of Arizonan Transportation Equipment Manufacturing Sector Imports (2014)



Source: CPCS analysis of United States Census Bureau Electronic Export Information. Accessed April 2015.

Figure 2-6 illustrates the top traded products in the transportation equipment manufacturing sector. The aerospace products and parts industry is the largest generator of international trade, the majority of which is exports. Imports of motor vehicles and motor vehicle parts are also important.

Figure 2-6: Top Traded Products in the Transportation Equipment Manufacturing Sector (2014)



Source: CPCS analysis of United States Census Bureau Electronic Export Information. Accessed April 2015.

Mexico's Transportation Equipment Manufacturing Sector

Transportation equipment manufacturing is the most important category of manufactured commodities currently exported from Mexico, accounting for 16 percent of all manufacturing maquiladora establishments, 32 percent of employment, and 44 percent of total revenues.⁶ This importance is reflected in the trade flows with Arizona in two areas: aerospace parts and auto manufacturing. Of note, in 2014, Sonora had 45 aerospace manufacturing plants with 7,500 employees, the majority of which are operated by American, French, and British companies. Rolls Royce, General Electric, Honeywell, Pratt & Whitney, Boeing and Airbus are some of the industry leaders driving demand of aerospace products manufactured in the region.

The auto production industry in Mexico is also growing very quickly; between 2004 and 2014, Mexico's auto production doubled from 1.4 million units to 3.2 million units (while auto production in the U.S. and Canada declined)⁷. Of note, there is a large Ford Plant in Hermosillo, Sonora, producing over 300,000 vehicles per year⁸, as well as other auto manufacturing plants across the country, owned by General Motors, Chrysler/Fiat, Honda, Nissan, Toyota and Volkswagen.⁹

⁶ Vera Pavlakovich-Kochi, "IMMEX – Mexico's Export-Oriented Manufacturing and Services", March 30, 2015. www.azeconomy.org.

⁷ USA Today, "More car manufacturing jobs move south – to Mexico", June 15, 2015.

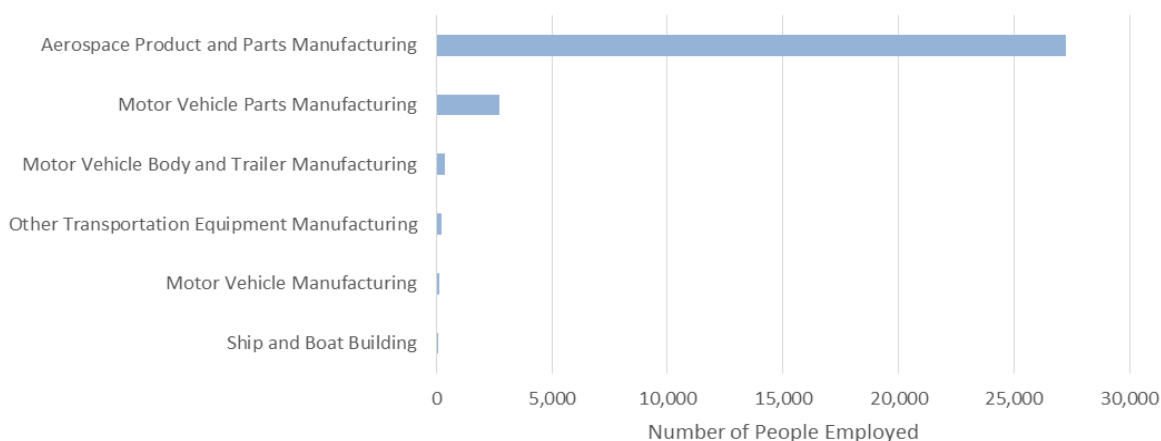
⁸ InterVISTAS Consulting Group, "Phoenix Regional Air Cargo Planning Study: Final Report", prepared for Phoenix Sky Harbor International Airport, January 2014.

⁹ Reuters, "Ford to invest \$1.3 billion in northern Mexico plant", March 30, 2012.

2.2.4 Employment and Wages

In 2013 the sector employed 29,944 people in Arizona, representing 1.1 percent of total employment in the State.¹⁰ The largest industry generating employment in the transportation equipment manufacturing sector is the aerospace product and parts manufacturing sector, employing over 27,000 people in Arizona, almost 90 percent of all people employed in the sector.

Figure 2-7: Breakdown of Employment in the Transportation Equipment Manufacturing Sector in Arizona (Q1 2014)



Source: CPCS analysis of Quarterly Workforce Indicators dataset, United States Census Bureau

The total wages and salaries paid to employees in 2013 was \$3.4 billion dollars¹¹, making the average annual earnings per employee in 2013 approximately \$114,095 for the sector.

2.3 Locations and Traffic Profile

The transportation equipment manufacturing sector generates 162,000 tons of domestic freight annually, which is a tiny share (.1 percent) of overall freight tonnages in Arizona. In value terms by comparison, these shipments are equivalent to just over 4 percent of domestic freight values in Arizona. By weight, most of the shipments are inbound (83 percent), with 14 percent outbound and 3 percent intrastate shipments.

The numbers presented here are obtained from Commodity Flow Survey (CFS), 2012. CFS only accounts for domestic movements, including domestic shipments as well as the domestic components of international supply chains.¹² The volumes presented below illustrate 162,000 tons of domestic flows (inbound, outbound, intrastate) for the sector, in comparison to 136

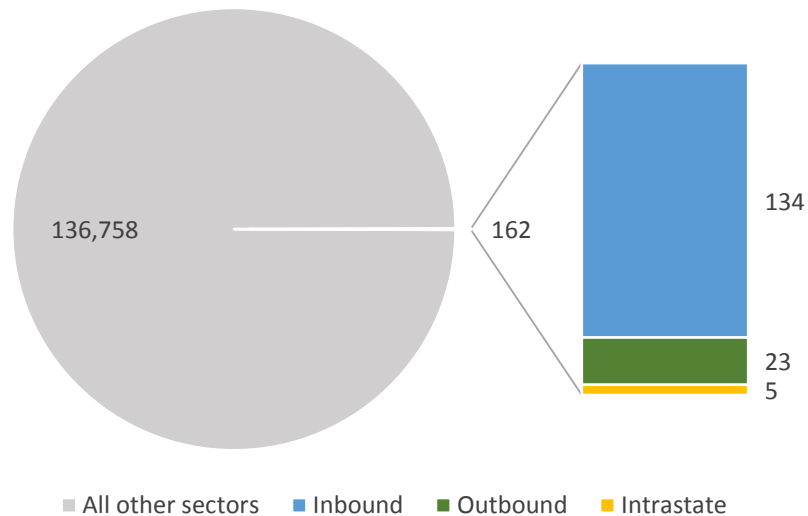
¹⁰ Bureau of Economic Analysis Regional Economic Accounts, Personal Income and Employment by State. Wages and Salaries by NAICS Industry. Excludes self-employment.

¹¹ Bureau of Economic Analysis Regional Economic Accounts, Personal Income and Employment by State. SA6N Wages and Salaries by NAICS Industry

¹² In CFS, the sum of individual state volumes is slightly lower than the national volume which is due to data suppression and rounding in individual state-to-state movements. For consistency across all the graphics (maps and charts), this paper presents the total of state level volumes.

million tons of flows from all other sectors of the economy. The sector flows exclude wholesale and retail shipments which are part of a separate working paper on the wholesale and retail sector.

Figure 2-8: Arizona Transportation Equipment Sector Volume ('000 Tons), 2012



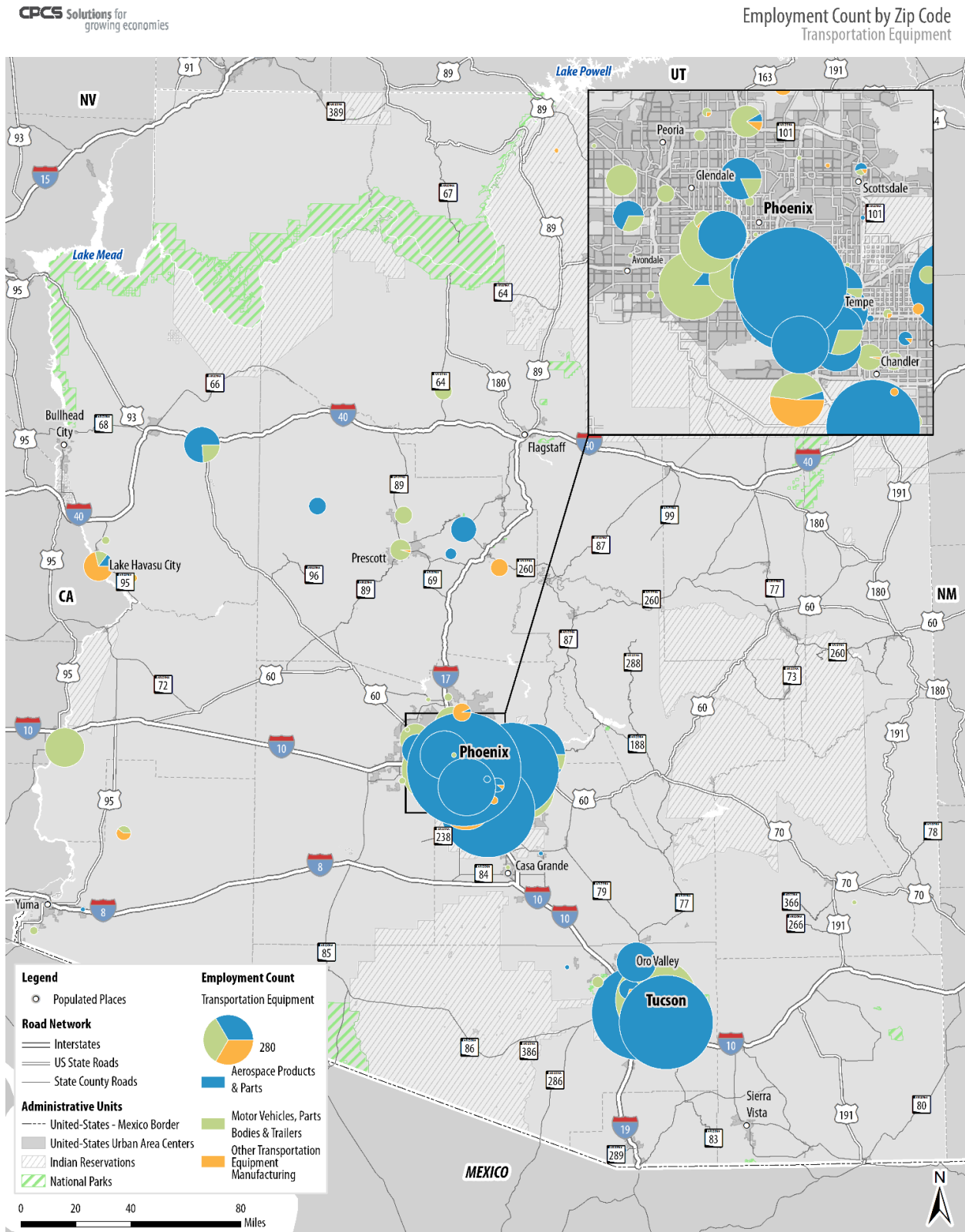
Source: CPCS analysis of Commodity Flow Survey, 2012.

2.3.1 Activity Clusters

The activity clusters of the transportation equipment manufacturing sector can be illustrated by looking at the geographic distribution of employment in the sector (Figure 2-9). Employment is overwhelmingly concentrated in Phoenix and Tucson. The manufacture of Aerospace Products and Parts are clustered in south-east part of Phoenix, around Tempe and Chandler as well as in Tucson (home to Raytheon, one of the sector's largest employers).

Motor Vehicles and Parts are concentrated in the south-west part of Phoenix and also in Tucson and to a smaller extent in Ehrenberg, at the border with California. Some equipment manufacturing activities are located in north and south of Phoenix and in Lake Havasu City.

Figure 2-9: Arizona Transportation Equipment Manufacturing Sector Employment Clusters

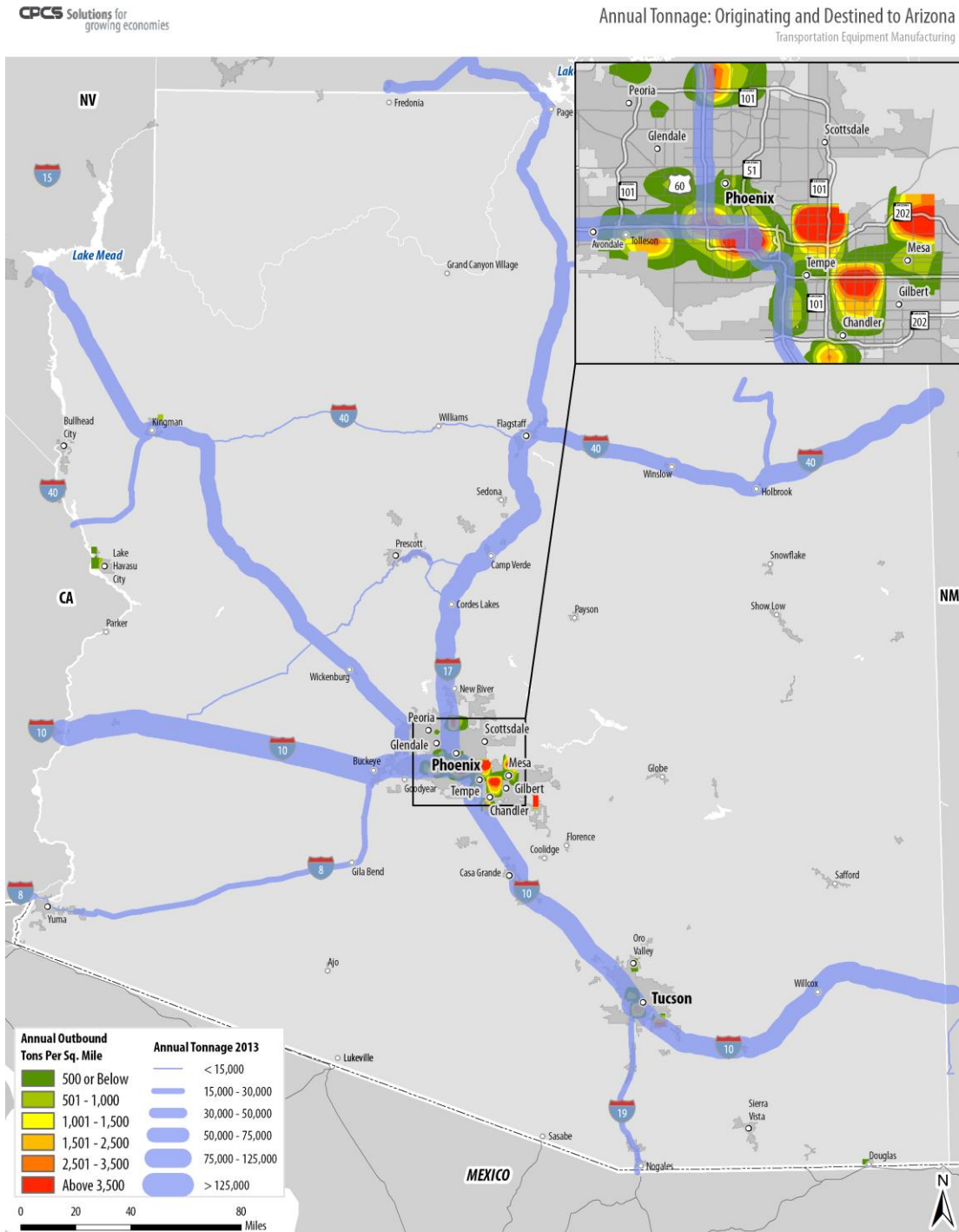


Source: CPCS analysis of County Business Pattern Data, 2013 by U.S. Census Bureau.

Figure 2-10 combines transportation equipment sector commodity flow on highways with their area of production. The clusters were identified from kernel density estimation in ArcGIS using Global Insight's Freight Finder dataset. The estimated outbound volumes produced by this sector is predominantly clustered in southern part of Phoenix and south east of Tucson. In Phoenix the clusters are located near Sky Harbour, Tempe, Chandler, Mesa, Tolleson and Deer Valley.

The commodity flow information was extracted from Global Insight's Transearch dataset for 2013. Only Arizona-generated (originated or destined) flows are shown in the map which excludes any through traffic. The major corridors used by this sector are I-10 and I-17 leading to I-40 eastward.

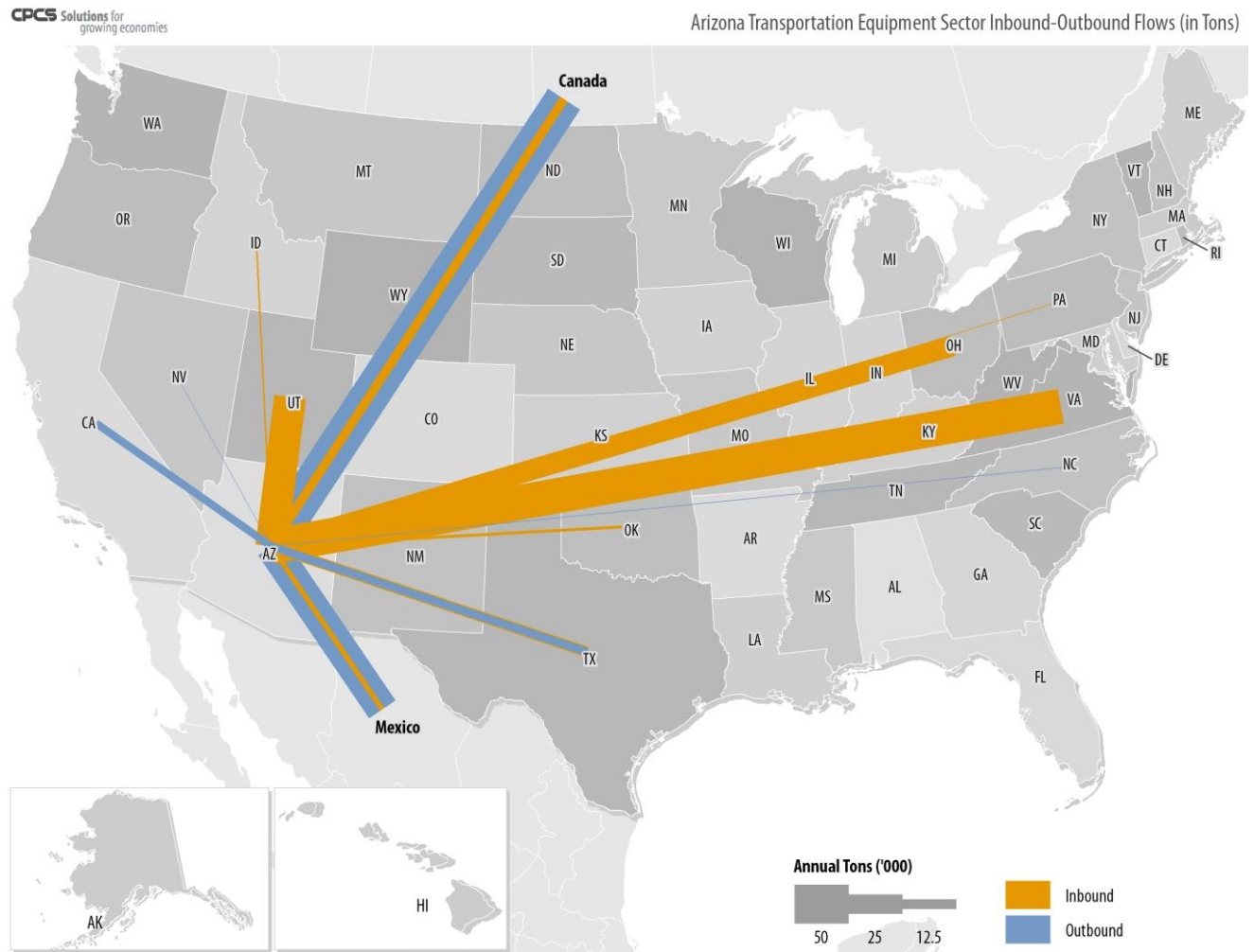
Figure 2-10: Arizona Transportation Equipment Sector Freight Cluster and Commodity Flow



2.3.2 Major Origins and Destinations

The figure below shows the major origins and destinations of traffic in the sector. The largest volume of inbound traffic originates in Utah, Ohio and Virginia. Canada and Mexico, followed by California and Texas, account for the majority of outbound traffic.

Figure 2-11: Arizona Transportation Equipment Manufacturing Sector Inbound-Outbound Tonnages



Source: CPCS analysis of Commodity Flow Survey, 2012. The import/export figures were obtained from Freight Analysis Framework 3 estimates for 2012

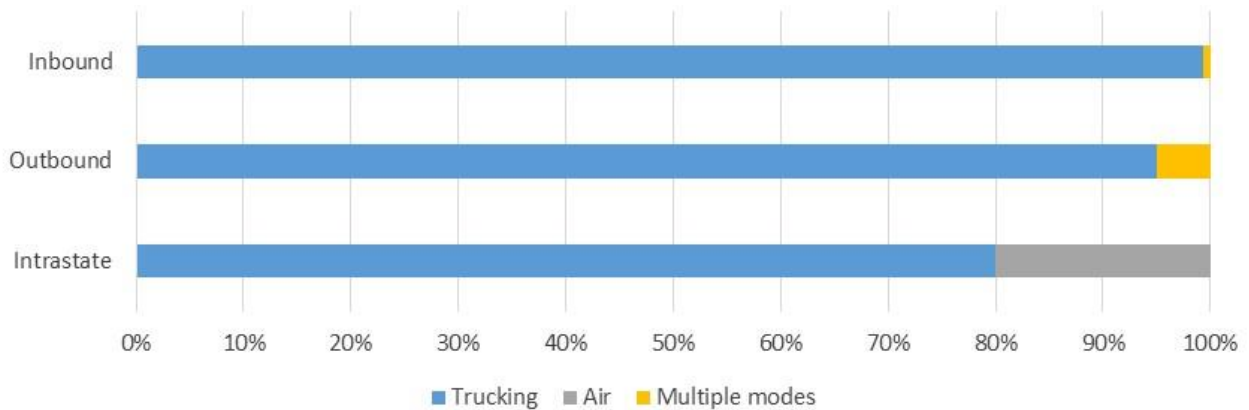
2.3.3 Modal Breakdown

Trucking is the primary mode of shipment for all types of domestic shipments – inbound, outbound and intrastate.¹³ Some of the inbound and outbound shipments are multimodal, involving trucking and air cargo. Approximately 20 percent of intrastate shipments (1,000 Tons) are done by air cargo, which could include movement of finished aircraft to client site (e.g. from an aircraft manufacturing plant to a U.S. air force base). Rail transportation represents a trivial

¹³ In the CFS dataset, the individual mode volumes do not add up to the aggregate “All Mode” which is due to data suppression and rounding at detailed mode level.

component of freight flows for this sector, likely because of the high value-to-weight ratio of the components moved. The average value per ton of freight in the transportation equipment manufacturing sector is \$47,203, in contrast to an average value of \$1,379 per ton for all of Arizona's sectors combined.¹⁴

Figure 2-12: Arizona Transportation Equipment Sector Volume (Tons) by Mode, 2012



Source: CPCS analysis of Commodity Flow Survey, 2012.

¹⁴ CPCS analysis of Commodity Flow Survey, 2012

3

Supply Chain Structure and Transportation Performance Parameters

Key Messages

- The supply chain for the sector is complex, with many firms supplying parts for various stages of manufacturing, and involvement from an active maintenance, repair and overhaul (MRO) support sector.
- Trucking (less than truckload) and air cargo are the primary modes used, with negligible volumes moving by rail.
- The large and well-established aerospace companies have mastered their supply chain systems very well, and face few challenges in terms of transportation impacts on their business operations.
- The notable challenges mentioned in consultation included: road congestion in urban centres where many leading companies are located; delays at the Mexican/U.S. ports of entry; and shortages of truck drivers.

3.1 Supply Chain Structure

The supply chain structure for production of aerospace equipment is complex insofar as there are often literally dozens of firms supplying parts required to manufacture an end product – from engine parts to fuselage to seat belts to landing gear and navigation equipment.

That being said, the larger aerospace companies operating in Arizona have their supply chain management down to an exact science. These companies have well-established and predictable supply chain operations and inventory management systems, many of which have been established for decades.

While aerospace companies used to produce many of their input parts in-house, most components of transportation equipment manufacturing are now competitively outsourced to specialized firms, located in Arizona, across the U.S., Europe and internationally (notably in Mexico).

Indeed, Mexican *maquiladoras* – once associated simply with low-cost textile assembly sweatshops – are producing increasingly higher value and sophisticated products. These *maquiladoras* stand to become even more important to the sector as U.S. manufacturers (in the aerospace sector and other sectors) begin to shift manufacturing production closer to home (nearshoring) in reaction to rising costs in China and higher transportation costs. For example, the *maquiladora* zone near Tijuana has an estimated 50 firms active in the aerospace and defense industry, and Honeywell Aerospace employs approximately 350 people in the design, engineering and testing of aircraft components in Mexicali.¹⁵

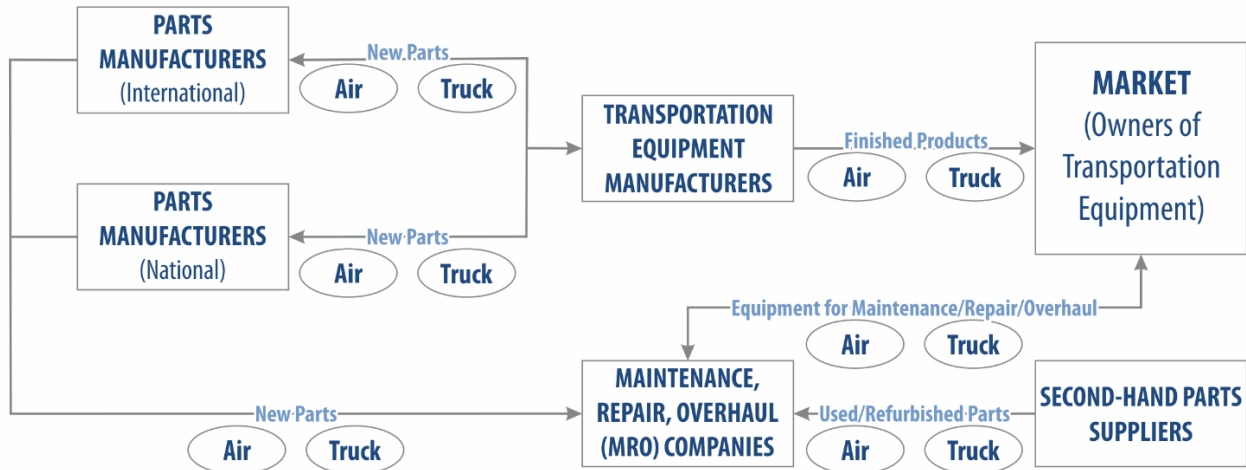
Based on our literature review and consultations, intermediate products and parts are shipped to the manufacturing factories/plants by trucking and air cargo, with no shipments by rail. Very high value, sensitive and or time-constrained products are shipped by air, with the remainder shipped by trucking. In most cases, common carrier courier companies (UPS, Fedex) are used extensively, packages are relatively small, and loads are less than truckload (LTL). In some instances, certain components of the end product will be shipped back and forth between manufacturers and suppliers for incremental value adding activities, before final assembly at the manufacturer's site. Once a product is finished, it is shipped to clients by truck or air. For example, a new helicopter may be trucked to Phoenix Sky Harbour, and then loaded onto a cargo aircraft to be flown to a customer overseas.

The supply chain for the transportation equipment manufacturing sector (focused on the aerospace and defense industry) is presented below. Though technically not transportation equipment manufacturing, the diagram includes the important maintenance, repair and overhaul (MRO) industry in Arizona¹⁶, which services the needs of the owners of transportation

¹⁵ The Economist Magazine, "Mexico's Maquiladoras: Big maq attack", October 26, 2013.

¹⁶ The MRO sector would be included under NAICS code 481190 which covers specialized services for air transportation.

equipment. To carry out their activities, MRO companies either source parts directly from suppliers¹⁷, or use parts which are provided by the equipment owners directly.



3.2 Transportation Performance Parameters

Due to their well-established supply chains and relatively high-value products, most aerospace manufacturers are able to negotiate effectively on all three parameters of transportation performance: cost, transit time and reliability.

Some of the larger companies in the sector operate on a just-in-time basis, whereby reliability is a critical component of competitiveness. Some of these larger companies expect products to arrive within a 12-hour window (or less) of being needed on an assembly line, and thus depend heavily on reliable transit time.

“Our two biggest concerns are transit time and cost. Reliability is a given – if we have shippers that cannot maintain reliability, we don’t use them.” – Arizona MRO Company Manager

The cost of transportation services does not appear to be a major performance parameter (relative to reliability and transit time). As noted above, leading aerospace companies have their shipments down to an exact science. They know their suppliers and home markets extremely well, and have routine transportation routings which they follow regularly and consistently to move many of their products. This stability, as well as the typically high value of their products, enables them to attract and pay for the best carriers who value the guaranteed traffic.

¹⁷ ISO Parts is an example of a parts stocking distributor used extensively by the aerospace and defense industry (www.iso-parts.com)

Furthermore, aerospace companies often move products between manufacturing centres located in urban clusters, which gives trucking companies a better chance of securing head-haul and back-haul loads. Consistent routings and carriers (e.g. same truck, same carrier) can also enable more efficient passage through customs border crossings (e.g. to / from Mexico).

Overall, this consistency enables larger manufacturers to attract trucking companies on a regular basis with little difficulty (and at a reasonable cost). For smaller companies and suppliers, cost becomes relatively more important than reliability and transit time.

3.3 Barriers to Transportation Performance

Consultations revealed very few challenges or barriers to transportation performance from the perspective of aerospace product manufacturing. Indeed, many of the companies consulted mentioned they were satisfied with the current condition of the roads and the level of regulation of the sector.¹⁸

The limited comments received from stakeholders are summarised below.

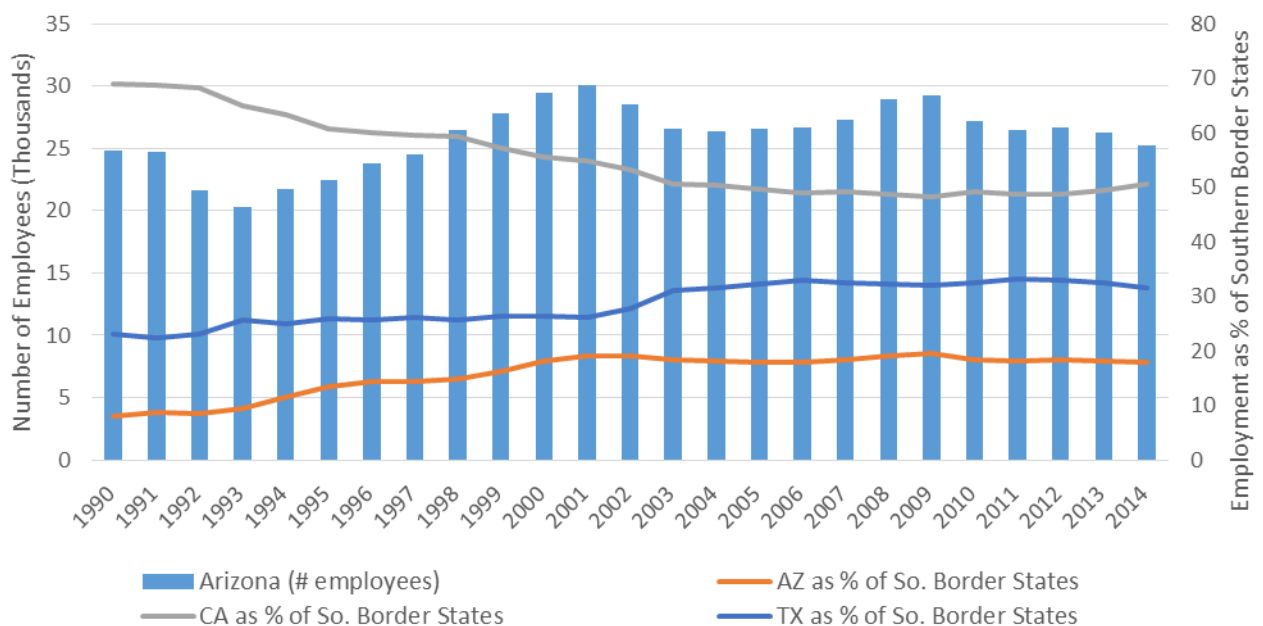
- **Urban congestion:** As many of the aerospace companies are based in Phoenix and Tucson, and most move their product by truck, urban congestion was noted as one challenge to transit time and reliability. There can be considerable traffic in and around the outskirts of Phoenix (notably around Sky Harbour International Airport), as well as on the heavily travelled highway between Phoenix and Tucson. Stakeholders mentioned the need for I-10 to be 3-lanes the whole way between the two cities, as there are too many commercial vehicles competing with personal vehicles in the two-lane sections.
- **Delays at Mexican / U.S. Border:** Relative to movement between U.S. states, stakeholders noted that there can be unpredictable delays when moving products across the Mexican/U.S. border, notably at Nogales (the busiest Port of Entry for the sector). However, these delays are largely originated from Mexican customs requirements, as opposed to U.S. Customs and Border Protection.
- **Truck driver shortages:** Stakeholders mentioned that the common carriers they use for trucking mention their own challenges in hiring experienced and reliable truck drivers. There is a general concern in the trucking industry (serving the aerospace sector and beyond), that the pipeline of qualified drivers is growing thin and this could have a significant impact on freight movement in the coming decade.

¹⁸ A number of stakeholders commented that Arizona's transportation sector was less heavily regulated than California's which was seen as an asset to doing business in the state.

3.4 Trends and Implications

The aerospace product and parts manufacturing sector represents one of the faster growing industries in the manufacturing production system between the NAFTA partners. As illustrated in the figure below, employment in the Aerospace Products and Parts Manufacturing sector has increased since NAFTA came into effect (1994). Furthermore, Arizona's share of employment in the sector relative to the southern border states of California and Texas increased from 8% to 18% between 1990 and 2014. This provides an indication of Arizona's capacity to build and sustain an emerging transborder industry cluster.

Figure 3-1: Aerospace Product and Parts Manufacturing Annual Employment and Employment as % of Southern Border States (1990-2015)



Source: CPCS analysis of Bureau of Labour Statistics data, as re-published by the Economic and Business Research Center of the University of Arizona. Data is for NAICS 3364 Aerospace Product and Parts Manufacturing.

Due to increasing cross-border supply chain integration, Mexican manufacturing operations are expected to continue to play a growing role in the supply of parts and increasingly sophisticated equipment to the sector. Insofar as these flows are channeled towards manufacturing of equipment in Arizona, freight flows across the border will increase, potentially in both directions.

The manufacturing of unmanned vehicles is a growing industry that Arizona is well positioned to take part in. In particular, unmanned aircraft are increasingly being used in (or considered for) a number of non-military applications, such as for aerial photographs, cargo delivery, search and rescue, and in the agriculture sector. If Arizona continues to position itself as a leading manufacturing hub in this growing sector, freight flows would increase accordingly.

The 2011 Budget Control Act – also known as sequestration – imposed Government-wide funding caps across virtually all major federal government spending programs, including the

Department of Defense. These funding caps have already had, and are expected to continue to have, an impact on the volume and size of contracts available to Arizona's military aircraft, defense and associated supply companies. The extent to which overall freight flows decline based on this sequestration will also depend on export levels of aerospace and defense products from the State to customers in other parts of the world.

4

Sector Priorities for Transportation System Performance Improvement

Key Messages

Priority improvement needs for the sector include the following:

- Addressing urban congestion issues related to road traffic, including expanding I-10 and I-17 in urban areas
- Establishing a congestion information portal to increase reliability of freight shipments
- Supporting the trucking industry to address the shortage in available and skilled truck drivers
- Construction of the Aerospace Parkway and Sonoran Corridor

4.1 Priority Improvements Needs

As noted above, the transportation system and associated supply chain for the transportation equipment manufacturing sector are reported by that sector to work quite well in Arizona. Specific areas for improvements are noted below.

- **Expand I-10 and I-17:** Between Phoenix and Tucson I-10 should be expanded to three lanes across the full connection. In the urban areas of Phoenix, I-17 should also be expanded. These changes would increase the speed, flow and transit time of traffic between the important economic centres of Phoenix and Tucson.
- **Establish congestion information portal:** ADOT could establish some kind of electronic portal where information on traffic congestion hot spots and bottlenecks, accidents and route variances could easily be communicated in real time to transporters and shippers. This would increase the reliability of freight shipments.
- **Support to address truck driver shortage:** ADOT could consider ways in which support could be provided to address the shortage of truck drivers in the industry, possibly through partnership with regional Associations in the state, such as the Arizona Trucking Association.

Aerospace Parkway and Sonoran Corridor – Tucson

In 2013, Pima County prepared a White Paper identifying key investments to support their Aerospace and Defense Corridor Economic Development Initiative¹⁹, an initiative with the objective of retaining and growing aerospace and defense jobs in the Tucson region. One of the key recommendations related to transportation was to establish a high-speed transportation link between I-19 with I-10, in the form of an “Aerospace Parkway” running south of Tucson International Airport (where Raytheon – the region’s largest employer – is based). Of note, the 2013 Freight Transportation Framework Study²⁰ carried out by the Joint Planning Advisory Council (JPAC) also supports this concept and notes that the Tucson International Airport area is one of the most appropriate areas in the Sun Corridor for an Import Distribution Center.

Construction on the Aerospace Parkway started in March 2015, with a first phase realigning the East Hughes Access Road approximately 2,500 feet south of its current alignment and renaming it Aerospace Parkway. Pima County purchased nearly 400 acres of privately owned land to make room for the realignment, which is expected to facilitate a possible expansion of Raytheon (whose facility is adjacent to the current Hughes Access Road), as well as attracting new defense and aerospace business to the area. The Pima Association of Governments (PAG) Regional Council has also approved a resolution to support further expansion in the area, by constructing a 22-mile “Sonoran Corridor” connecting I-10 and I-19 (and directly connecting with the new

¹⁹ Chuck Huckelberry, Pima County Administrator, “Aerospace and Defense Corridor Economic Development Initiative Planning and Implementation: Piecing the Puzzle into a Coherent Strategy”, February 13, 2013.

²⁰ Parsons Brinckerhoff, KDA Creative and RCLCo, “Freight Transportation Framework Study Final Report, Technical Memorandum II – Sun Corridor Supply Chain Opportunities”, 2013.

Aerospace Parkway). At an estimated cost of more than \$600 million, the project would be subject to securing funding from county, federal and state sources. The initiative would create a logistics corridor including access to rail, the Interstate system air freight, the University of Arizona Tech Parks, and the intermodal center at the port of Tucson.²¹

²¹ Pima Association of Governments, "PAG Regional Council Supports Resolution for Future Sonoran Corridor", January 22, 2015; and Arizona Daily Star, "Construction starts on industry-friendly Aerospace Parkway", March 31, 2015.

Appendix A: List of Stakeholders Consulted

Name	Title	Organization
Jeff Miller	VP Global Business Development	Able Engineering (MRO company)
Jim McCorry	Business Development Manager	AGM Container Controls
John Keating	Chief Commercial Officer	Ascent Aviation Services Corp (MRO company)
Confidential	Confidential	Boeing
Dave Dozor	President / CEO	Dozor Enterprises Inc
Confidential	Confidential	Honeywell Aerospace
Curtis Spencer	President / CEO	IMS Worldwide Inc.
Bryan Warren	Sales Manager	Joker Machine (manufacturer / distributor of motorcycle parts)
Greg Emerson	Operations	Marana Aerospace Solutions (MRO company)
Tim Strow	Project Manager, Freight Transportation Framework Study	Maricopa Association of Governments
Luis Ramirez	President	Ramirez Advisors Inter-National LLC (Mexico-Arizona trade expert)
John Patterson	Director, Public Relations & Community Relations	Raytheon
Confidential	Supply Chain Specialist	Raytheon
Confidential	Supply Chain Specialist	Sargent Aerospace & Defense
Fernando Jimenez	International Trade Specialist	U.S. Commercial Service (USCS)