Tech Memo 2. Economic Impact Methodology

2.1. Introduction

The Colorado public-use airport system supports and contributes to the state and regional economies of Colorado. The airports themselves are important job centers and gateways for out-of-state visitors to reach all corners of the state. Both the operation of airports (including airport administration, airport tenants, and construction activity) and visitor spending from those using both commercial airline service and general aviation (GA) aircraft and airports contribute to the state's economy. This memo outlines the methodology used to capture the total in-state economic impacts of the Colorado public-use airport system.

Colorado has been estimating the contribution of its airports to the state economy approximately every five years since 1996. Over that time span, the Colorado and national economies have changed, and modeling tools and state-of-the-art analytical practices have evolved. However, the basis of measurement – direct impacts and multiplier impacts – has remained constant and the core measures of economic impacts have been airport administration, airport tenants, airport construction, and spending from commercial service and GA visitors.

The major differences in this study from the preceding study published in 2013 are as follows:

- Regional economies are defined more acutely in 2020 with 15 regions, including a special updated region for Denver International Airport (DEN) compared to 2013 which identified six regions, including a separate DEN-specific region.
- "Value Added" has been provided as an additional impact measure.[1]
- Terminology associated with impacts have been modified to make the language less technical to readers.

For clarification, the terminology used in this study compared to the terminology used in the 2013 study is shown in **Table 2.1**.

[1] Value added is a component of business revenues and while it has previously been accounted for in the economic impact analysis, it has not previously been presented. A definition is provided on page 2 of this technical memo.

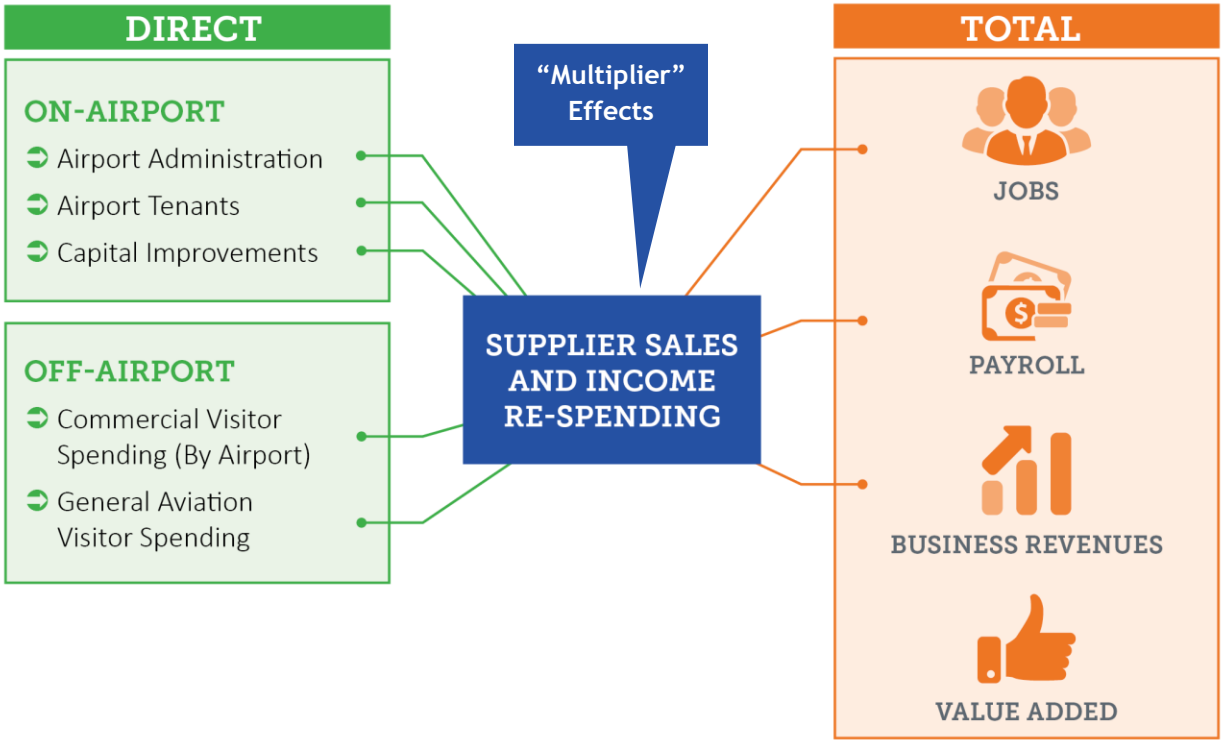
Table 2.1. Terminology Comparison

	2020 CEIS Study	2013 Study
Types of Impacts	Jobs	Jobs/Employment (use varied within study)
	Payroll	Payroll
	Value Added	---
	Business Revenues	Output
Measure of Impacts	Direct	Initial
	Supplier Sales Income Re-Spending	Multiplier
	Total	Total

Source: Economic Development Research Group, Inc. 2019

While Value Added is a new term compared to the prior 2013 study, the same impacts are being measured, even though terminology differs. In particular, supplier sales and income re-spending are two streams of impacts that together make up the "multiplier" effect as it was termed in the 2013 study. These are identified separately in the 2020 study to more precisely demonstrate how airports affect the economy of Colorado. Definitions of terms used in the 2020 study are provided below in the sections "Economic Impact Categories" and "Economic Impact Measures". An illustration of how both the 2013 and 2020 studies account for economic impacts is provided in **Figure 2.1**.

Figure 2.1. 2020 and 2013 Calculation of Total Impacts

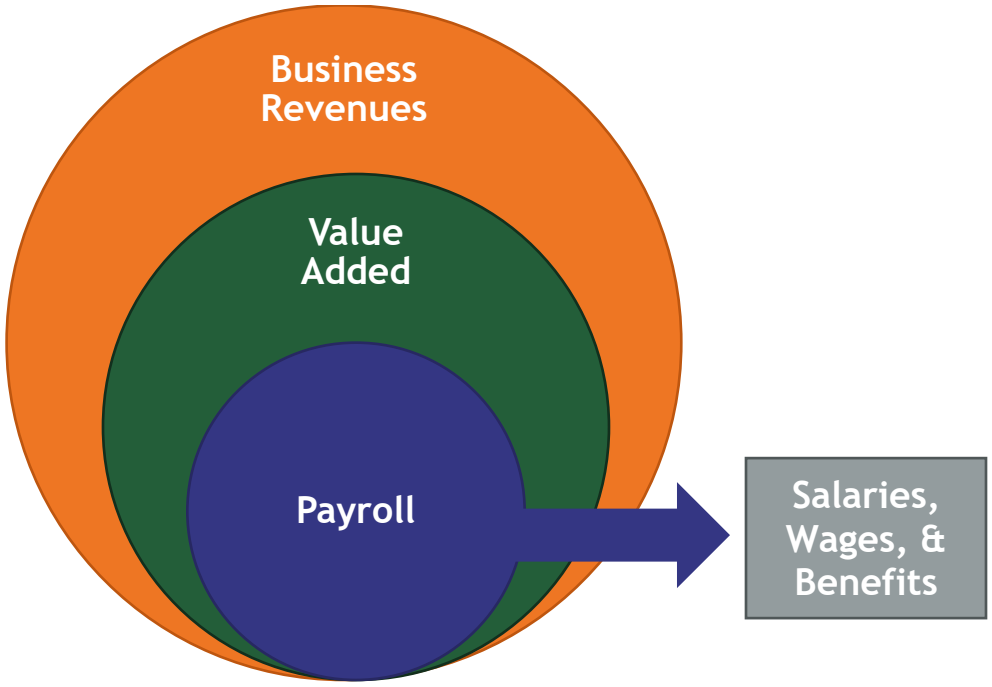


Source: Economic Development Research Group, Inc. 2019

Value added is introduced in the 2020 study to add further depth to profiling the economic impacts of Colorado airports. The term refers to the level of added value contributed by each on-airport and off-airport business analyzed in this study in addition to the value of the goods and services that the businesses purchase. Thus, value added accounts for the components of business revenues that are used to pay workers and taxes, and also accounts for profits and other income streams such as dividends and rents. Value added also accounts for the contribution of businesses and industries to the Colorado State Product (CSP) and the U.S. Gross Domestic Product (GDP).

Figure 2.2 provides a graphical representation of the relationship of the three different dollar measures (not including jobs which are not measured in dollars) and how value added relates to both business revenues and payroll.

Figure 2.2. Economic Impact Measures



Source: Economic Development Research Group, Inc. 2019

2.2. Economic Impact Categories

On-airport and visitor related activities represent the **direct** effects of airport operations on the Colorado economy which include both on and off-airport impacts. These direct effects generate additional impacts, which are composed of supplier-based **purchases of goods and services**, and the impacts of **income** circulating the regional economy from new consumer expenditures. **Supplier impacts** are generated from the purchases of goods and services made by airport-based businesses, on-airport public sector agencies, and businesses in the state's hospitality industries. These purchases are

effectively business sales earned by supplier companies that are located across the state.[2] The **income re-spending** impacts are derived from direct and supplier businesses that hire additional workers to meet the demand for airport and visitor services. Payroll earned by workers in businesses that benefit from direct or supplier business revenues lead to further spending by households. Additional business revenues, payroll, and jobs are supported as this income re-spending circulates within Colorado. When the total economic impacts are presented, they represent the summation of the direct, supplier, and income re-spending effects for the state. In the 2013 study, the supplier and income re-spending effects were combined and presented as multiplier impacts.

2.3. Economic Impact Measures

The direct, supplier, and income re-spending impacts are defined using the following economic measures:

- **Business Revenues**: Direct business revenues incorporate expenditures needed to administer airports, sales of goods and services by airport tenants, budget expenditures by public sector agencies located on airports, the cost of capital expenditures, and visitor spending in Colorado's hospitality-related sectors. This is also commonly referred to as business "output" or sales.
- **Value Added**: Value added measures the economic productivity of each aviation-related business establishment in Colorado (for purposes of the CEIS), calculated as business revenues earned minus the costs of purchasing goods and services from other businesses. Value added is a company or industry contribution to Colorado's Gross Regional (or State) Product, which is a local concept synonymous with Gross Domestic Product (GDP). It includes all labor compensation, profits, and business taxes paid.
- **Payroll**: For this study payroll is defined as total employment compensation, including wages and other benefits (e.g. health care insurance payments, retirement contributions, etc.). Payroll is a subset of value added. This is also known as "labor income" or "total compensation".
- **Jobs**: Jobs are the total number of persons employed that are associated with business revenues and payroll, regardless of whether they are fulltime or part time.

The dollar measures for business revenues, value added, and payroll cannot be added to each other because value added is a component of business revenues and payroll is a further component of value added as previously presented.

2.4. Geographies

This study was conducted on both a regional and statewide basis. The reason for utilizing a regional approach is to provide airport managers and area officials, residents, and stakeholders with a more localized profile of airports' economic impacts than a broadly drawn statewide analysis, and to recognize that local economies vary across Colorado. Productivity factors, cost of living, and salaries differ in metropolitan districts, resort areas, and rural locations from the eastern to western, and northern to southern sections of the state. This means that across Colorado there are different industry mixes, wage rates, business revenues, and sales per employee. A regional approach best reflects these

[2] Only the Colorado-based purchases are presented in the results.

local economic characteristics that are supported by each airport. When direct impacts are estimated, the regional economies are used to determine the relationships of jobs, payroll, value added and business revenue by business activity. For this reason, direct impacts are all estimated at regional levels.

As discussed below in a subsequent section on Data Presentation, direct data obtained from surveys conducted in the CEIS include one of the three measures: jobs, payroll, or business revenues; a handful of survey respondents (whether airports or other tenants/businesses) provide two of three; and only some of the survey respondents provide all three direct measures. Note that value added is always calculated. The economic relationships anchored in the regional economies are used to "fill-in" the direct data for each airport for values not assembled from the data collection efforts presented in "Tech Memo 1: Data Collection Process."

The 14 regions of Colorado's Office of Economic Development and International Trade (OEDIT) were used for the 2020 CEIS in the regional analysis. In addition, a unique region was developed for DEN given its size and standing as Colorado's only large hub airport. Supplier purchases and income re-spending are modeled at both a regional and statewide scale to allow for presentations of regional and statewide impacts for each airport, as well as statewide impacts for the Colorado airport system. Regional impacts of airports consist of the regional direct impacts plus regional multiplier impacts. Statewide impacts are the same regional direct impacts plus multiplier effects for all of Colorado. An explanation of differences in impacts from regional and statewide modeling is presented subsequently.

The counties within each OEDIT region and for the DEN region (which overlaps different OEDIT regions) are listed in **Table 2.2**. The OEDIT Regions are depicted in **Figure 2.3**.

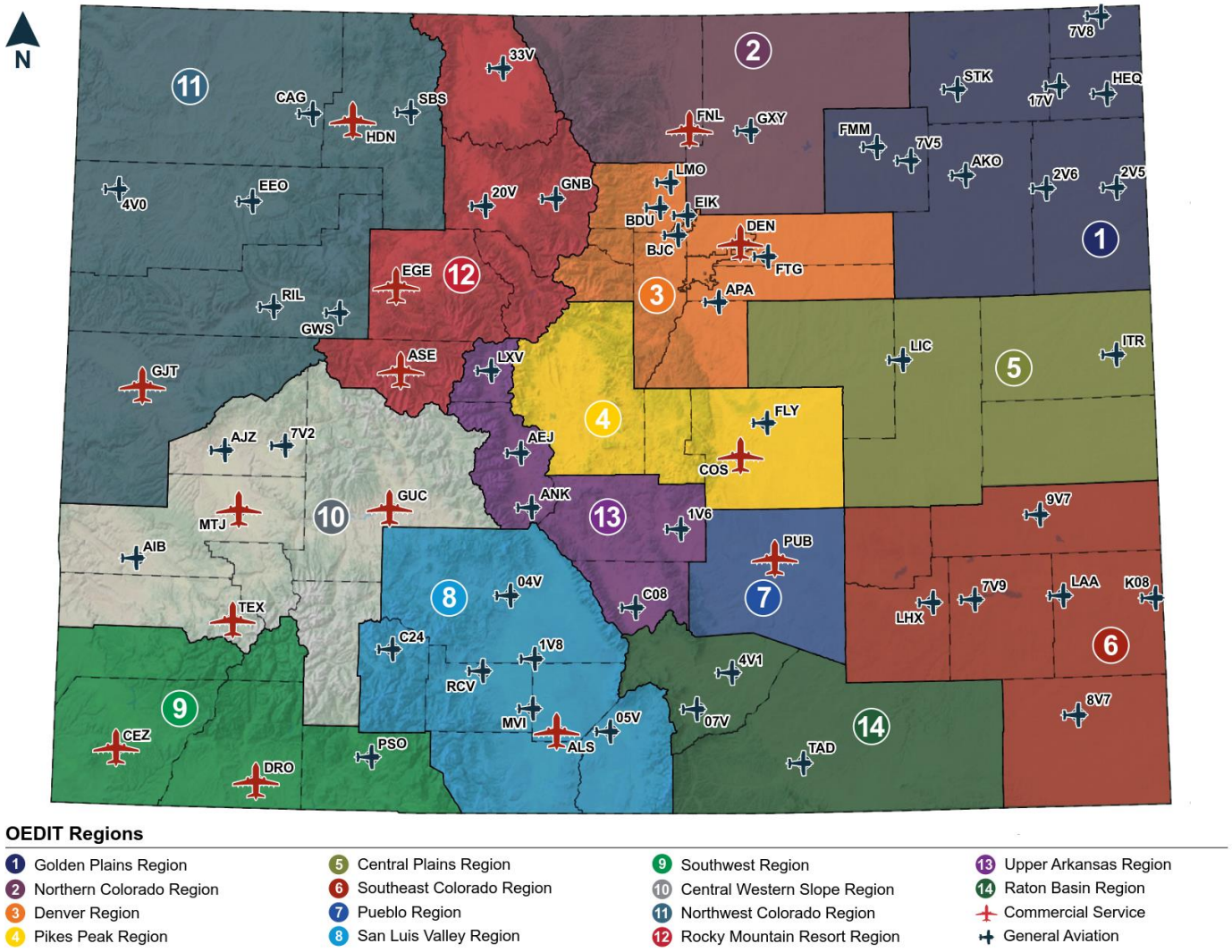
Table 2.2. Counties within Each OEDIT Region

Region	Name	Counties
1	Golden Plains	Logan, Morgan, Phillips, Sedgwick, Washington, Yuma
2	Northern Colorado	Larimer, Weld
3	Denver (excluding DEN)	Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Denver, Douglas, Gilpin, Jefferson
4	Pikes Peak	El Paso, Park, Teller
5	Central Plains	Lincoln, Elbert, Kit Carson, Cheyenne
6	Southeast Colorado	Baca, Bent, Crowley, Kiowa, Otero, Prowers
7	Pueblo	Pueblo
8	San Luis Valley	Alamosa, Conejos, Costilla, Mineral, Rio Grande, Saguache
9	Southwest	Archuleta, Dolores, La Plata, Montezuma, San Juan
10	Central Western Slope	Delta, Gunnison, Hinsdale, Montrose, Ouray, San Miguel
11	Northwest Colorado	Garfield, Mesa, Moffat, Rio Blanco, Routt
12	Rocky Mountain Resort	Eagle, Grand, Jackson, Pitkin, Summit
13	Upper Arkansas	Lake, Chaffee, Fremont, Custer
14	Raton Basin	Huerfano, Las Animas

Region	Name	Counties
Denver International Airport		Adams, Arapahoe, Boulder, Cheyenne, Clear Creek, Denver, Douglas, Eagle, El Paso, Elbert, Gilpin, Grand, Jackson, Jefferson, Kit Carson, Larimer, Lincoln, Logan, Morgan, Park, Phillips, Sedgwick, Summit, Washington, Weld, Yuma

Source: Colorado OEDIT 2018

Figure 2.3. OEDIT Regions in Colorado



OEDIT Regions

1. Golden Plains Region
2. Northern Colorado Region
3. Denver Region
4. Pikes Peak Region
5. Central Plains Region
6. Southeast Colorado Region
7. Pueblo Region
8. San Luis Valley Region
9. Southwest Region
10. Central Western Slope Region
11. Northwest Colorado Region
12. Rocky Mountain Resort Region
13. Upper Arkansas Region
14. Raton Basin Region

Commercial Service
General Aviation

Sources: Colorado OEDIT, Economic Development Research Group, Inc., Denver International Airport, and Kimley-Horn 2019

2.5. Approach to Data Calculation

2.5.1. Overview

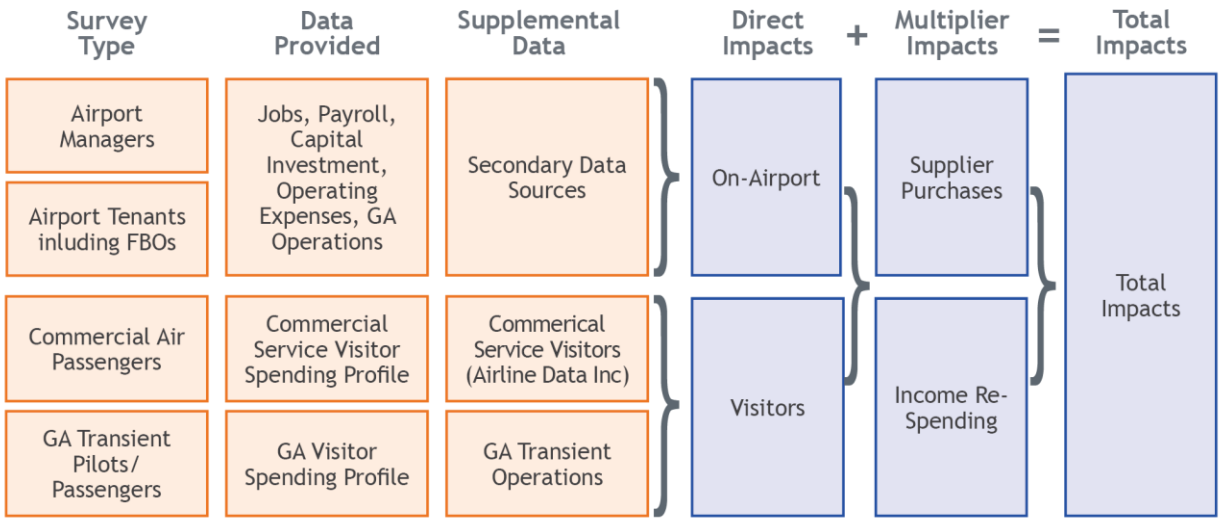
To quantify the economic contribution of Colorado's airports, a variety of primary and secondary data sources were collected. The primary data source for this economic impact study was a series of surveys designed to gather key information for activities generating direct on- and off-airport economic activity. The following groups were surveyed as part of the primary data collection: airport managers, tenants on airport premises, and out-of-state visitors using commercial air transportation service and GA transportation (see Tech Memo 1).

When necessary, additional secondary data were used to fill in any missing information from the surveys for on- and off-airport business activity and visitor spending. These data included establishment-level GIS databases such as Reference USA and ESRI, as well as Federal data sources such as the Bureau of Economic Analysis (BEA) and Federal Aviation Administration (FAA).

The combination of primary and secondary data sources established the foundation for estimating the direct economic impacts of each airport and visitor spending. These data were then integrated into the IMPLAN economic model, which is discussed in detail in **Section 2.6**, to estimate the multiplier effects generated from supplier purchases and employee re-spending.

Figure 2.4 presents an overview of the data collection and economic modeling process.

Figure 2.4. Overview of Data Collection and Economic Modeling Process



Sources: Economic Development Research Group, Inc. and Kimley-Horn 2019

2.5.2. On-Airport Data

As shown in **Figure 2.4**, on-airport impacts consist of those created by airport administration, airport tenants, and construction expenditures. The economic impact analysis of Colorado's airports is anchored by primary data collection from airport managers, on-airport business tenants, and visiting passengers.

Airport Administration. Airport administration includes airport managers, immediate subordinates and staff required to operate airports, including business operations (which may be on the airport or in a city or county office who is the sponsor of the airport), grounds care (including snow removal and lawn care), routine building maintenance, contractors who receive 1099 tax forms from the airport and other jobs. Data received for airport administration often included jobs, payroll, and annual budgets of airports. On occasion only jobs were provided, and regional averages (county level data primarily from the BEA assembled by IMPLAN) were used when needed to estimate payroll and business revenues (equivalent to budget expenditures).[3]

Construction. Capital expenditures as reported by airport managers were averaged across the previous four years (2015-2018). Averaging smooths out any anomalies (schedule, weather, financing, or others) in capital expenditures over the time period which may be very high for some years and lower in others. Additional expenditures were gathered through the airport tenant survey, in which tenants were asked if they had paid for capital improvements such as building out concession space or constructing a hangar. All data were converted into 2018 nominal dollars. Construction data only accounted for expenditures, which were treated as direct business revenues (these are revenues that are received by companies that perform the construction work). IMPLAN regional relationships between construction revenues and jobs, payroll and value added were used to develop the full profile of direct impacts resulting from capital expenditures on construction.

Airport Tenants. As part of the Airport Manager Survey, the managers were asked to provide names and contact information for all tenants, as well as employment estimates if known. These lists obtained from managers were the basis for outreach to the tenants. After multiple rounds of contacting tenants, responses were received for roughly one in seven airport tenants across the Colorado airport system (excluding DEN). To supplement the tenants' survey and to ensure the accounting for all tenants, a Tenant Tracker was developed based on the lists provided by managers. Employment for tenants were based on survey responses, estimates from airport managers, and from the aforementioned secondary data sources such as Reference USA. Of the 720 tenants of Colorado airports (excluding DEN), the observations from each data source were as follows:

- Tenants responding to the survey that were also included in the tenant tracker data: 99
- Tenants that were included in the tenant tracker, but did not respond the survey: 615
- Tenants with survey responses who were not included in the tenant tracker: 6

For tenants with observations in both data sources, the survey data was assumed to reflect a more accurate estimate of employment and description of business activity since the survey response came directly from the tenants themselves. In addition, a portion of the survey responses included total payroll data and tenant-financed construction expenditures which were used if provided.

Each tenant was assigned an industry classification based on their survey responses, description of business activity noted in the tenant tracker, web-based research, and/or coordination with CDOT Division of Aeronautics staff. Classifying each tenant by industry is important to establish the correct

[3] BEA provides estimates of GDP, personal income and employment by state, metropolitan area, and county through its Regional Economic Information System (REIS). These data are used by IMPLAN, LLC and other input/output vendors to develop county-level industry tables.

levels of direct economic activity (jobs, payroll, value added, and business revenues) and to estimate supplier sales and income re-spending associated with each business.

For tenants, two levels of data were obtained per business:

1. Employment (number of jobs) only; or
2. Employment and payroll.

As discussed above under the Geography section, direct values for payroll and business revenues were calculated using IMPLAN if they were not reported through a survey. In instances when employment and payroll were both obtained, the IMPLAN model was adjusted to maintain the same ratio of business revenues to payroll as the shown by the default regional values in the model per region and industry.

Tenant Data Collection for Denver International Airport (DEN). Data collection for DEN was based on the Airport Manager Survey, the Commercial Air Passenger Survey and the GA Transient Pilots and Passengers Survey. However, DEN has developed a strong centralized data management system for its tenants. Data for tenants at DEN were obtained from the Finance Department, which provided the following sources:

- **Security Badge Counts**: The badge data provided by DEN included company names, number of jobs, and type of business in "real-time". Company types were divided into six categories: air carriers, city employees, contractors, Federal employees, tenants, and vendors. Since three of these categories have broad descriptions (contractors, tenants, and vendors), company names were used to further classify their business activity.
- **Real Estate Reports**: Two reports generated by the commercial real estate firm CBRE provided information about: (a) businesses at DEN and (b) businesses within a five-minute drive of the airport. Each report provided business names, an industry classification, the number of employees, and annual sales.
- **Concessions Reports**: The 2018 Revenue Management Concessions Gross Sales Report for DEN provided year-to-date sales for a variety of concessions businesses including retail, food and beverage, banking, insurance, advertising, and personal services.

There was significant coordination with DEN staff to assure that jobs were not double counted among the three sources of data.

2.5.3. Off-Airport Visitor Spending[4]

Facilitating visitor spending is an important contribution of Colorado airports to the economy of the state and its regions. Air visitors arrived by scheduled airline service through one of Colorado's 13 commercial service airports with service in 2018, and used GA aircraft at the 70 CEIS airports, including the 13 commercial service airports and 57 additional airports that supported GA service only. [5]

This study counts visitors to Colorado from other states and from international locations who bring money into the state that is spent to support jobs and payroll in the hospitality sectors including

[4] On-airport spending by visitors and other air passengers is captured as part of the previously discussed tenant analysis.

[5] Northern Colorado Regional Airport (FNL) did not have airline service provided by a scheduled Part 121, Part 135, or Part 380 commercial service airline during 2018.

lodging, restaurants, retail, entertainment, and local transportation services.[6] For GA services, the analysis is limited to transient activity that account for about 16 percent of total GA operations conducted in Colorado. For commercial services, this means that local travelers and passengers that connect through an airport are not counted unless the passengers' final destinations are in Colorado. For example, a visitor connecting through DEN with a final destination at Cortez Municipal (CEZ) will count as a visitor at CEZ, but a connection through DEN to Helena, Montana will not count as a visitor in Colorado. In both cases, spending by passengers in the DEN terminal is counted in the analysis of concessions.

2.5.3.1. Commercial Visitors

Visitor spending data were collected from over 3,100 visitors who arrived in Colorado by airline using one of Colorado's 13 commercial service airports. Of these visitors, nearly 2,900 yielded usable data. These data included elements such as the number of travelers in the party, spending for the trip by the entire party, number of nights stayed, and trip purpose among other items. Spending for 1,505 visitors were recorded at DEN and 1,386 visitors reported their spending at the state's additional 12 commercial service airports. The average spending of all usable commercial service passenger surveys is $1,321 per visitor per trip, and excluding DEN, the average per visitor per trip is $1,673. For DEN, average spending per visitor per trip is $998. Per visitor per trip spending in DEN is lower likely because of the more general mix of visitors at the airport, including one day business trips, stays with family and friends, and the prevalence of resort destinations in other regions of Colorado. It is important to note that for DEN, the average spending of $998 per visitor per trip is weighted by average spending per visitor per trip for domestic visitors (from U.S. locations outside of Colorado) of $978 and spending by international visitors of $1,366 based on the number of domestic and international passengers in 2018.

The number of statewide visitor responses far exceeds a benchmark of 95 percent confidence interval and 5 percent margin of error.[7] Among individual airports, responses received at DEN and Aspen-Pitkin County (ASE) exceeded the 95 percent/5 percent benchmark, while responses from Colorado Springs Municipal (COS), Eagle County Regional (EGE), Gunnison-Crested Butte Regional (GUC), Yampa Valley (HDN), and Montrose Regional (MTJ) achieved a 90 percent confidence interval with margins of error ranging from 5.5 percent to 7.8 percent. Estimates of spending by commercial visitors for these and the remaining commercial service airports were determined by using the statewide results and adjusting based on other visitor spending data and input from the CDOT Division of Aeronautics staff who understand the mix of commercial service providers at Colorado airports.

Counts of domestic and international visitors to the 13 commercial service airports in Colorado were provided by Airline Data, Inc. based on FAA reported data. The spending profiles were applied to the visitor estimates to determine the direct spending by out-of-state tourists coming to Colorado via these commercial service airports. **Table 2.3** shows the number of commercial visitors to Colorado, the average spending per visitor per trip by airport, and the average number of nights spent by the visitors.

[6] Intra-state air travel is not counted because spending by these travelers moves dollars from one part of the state to another and does not expand the economy of Colorado.

[7] Meaning that statistically, it is 95 percent certain that visitor spending will be within plus or minus 5 percent of the reported mean average.

It is important to note that in-person commercial service passenger surveys were conducted in January and February 2019 at nine airports, while airports served by a single airline including San Luis Valley Regional (ALS), Cortez Municipal (CEZ), Pueblo Memorial (PUB), and Telluride Regional (TEX) only had hard copy surveys for visitors to return and were facilitated by airport managers and airline station managers. Telluride Regional (TEX) had very limited commercial airline service at the time that visitor surveys were conducted, and no out-of-state surveys were received during the limited window of the surveys. Also relevant to the analysis, it is not possible to know if the spending reported for respondents that are second homeowners and others that had long-term stays is accurately reflected in the surveys that were received.

Table 2.3. Commercial Service Visitors and Spending Per Visitor Per Trip

Associated City	Airport Name	FAA ID	2018 Visitors	Spending per Visitor Per Trip	Average Number of Nights per Trip
Alamosa	San Luis Valley Regional	ALS	3,379	$475	4.3
Aspen	Aspen-Pitkin County	ASE	189,245	$2,290	7.0
Colorado Springs	Colorado Springs Municipal	COS	378,112	$758	6.4
Cortez	Cortez Municipal	CEZ	3,824	$552	2.4
Denver	Denver International	DEN	9,853,919	$998	4.1
Durango	Durango-La Plata County	DRO	94,058	$1,200	6.6
Eagle	Eagle County Regional	EGE	134,159	$1,930	6.6
Grand Junction	Grand Junction Regional	GJT	97,699	$510	6.3
Gunnison	Gunnison-Crested Butte Regional	GUC	27,521	$1,350	5.8
Hayden	Yampa Valley	HDN	75,131	$1,300	6.4
Montrose	Montrose Regional	MTJ	86,591	$1,325	5.0
Pueblo	Pueblo Memorial	PUB	3,677	$471	2.4
Telluride	Telluride Regional	TEX	942	$1,325	N/A

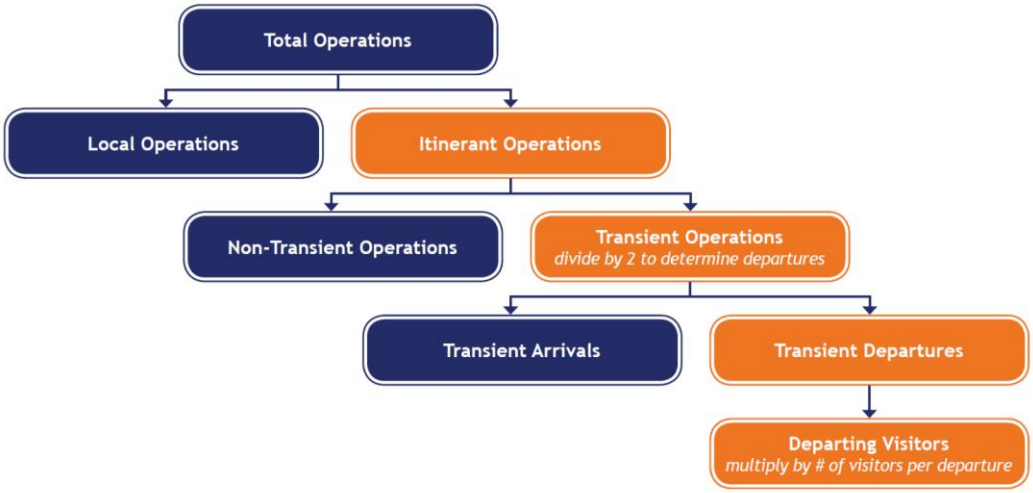
Sources: Commercial Visitor Survey, Airline Data, Inc. and consultations with CDOT Division of Aeronautics staff 2019

2.5.3.2. GA Visitors

GA visitors generate economic activity when they spend money that was generated out-of-state in the local economy of the GA airport they arrive and depart from. As shown in

Figure 2.5, calculating the number of GA visitors by airport starts with examining the total number of GA operations that were recorded in 2018. The number of GA operations were derived from the 2020 Colorado Aviation System Plan (CASP) which utilized data from FAA sources and individual airports. These operations estimates were reviewed with CDOT Division of Aeronautics staff based on their knowledge of activity for validation before proceeding with the remaining steps in estimating GA visitor impacts. For 2018, total GA operations were determined to be over 1.5 million statewide.

Figure 2.5. Method for Determining Transient Departures and Visitors



Sources: Economic Development Research Group, Inc. and Kimley-Horn 2019

Once the total number of GA operations for each airport was determined, the number of itinerant operations was separated from local operations. FAA generally defines an itinerant operation as a landing at an airport by an aircraft arriving from outside the airport area, or a departure from an airport that leaves the airport area. Under this definition, an itinerant operation does not necessarily reflect an operation by a visitor, especially visitors that are from outside Colorado, because the operation could reflect locally based aircraft leaving or returning to their home airport. Itinerant operations were also obtained from FAA sources and individual airports. It is important to note that as a takeoff and a landing are counted as two operations, the number of itinerant operations were divided in half, so that potential visitors and their associated spending are counted only once. Overall, 333,000, or 43 percent of all GA departures in Colorado were estimated to be itinerant in 2018.

In the third step, the number of departing itinerant operations were the basis for estimating the subgroup of itinerant operations that are "transient operations" conducted by out-of-state aircraft. Transient operations represent GA flights that bring out-of-state visitors to Colorado. For this estimation, industry standards of 50 percent of itinerant departures for Commercial Service Airports and 30 percent for airports that support only GA service were utilized. Since most GA airports do not have air traffic control towers and there is no requirement to report activity, there is no accurate method to confirm the percentages, however, these are widely accepted for purposes of estimating GA visitor economic impacts. As a result of these calculations, the total number of transient departures in Colorado was estimated at over 121,000 in 2018, which accounted for 16 percent of all GA departures and 36 percent of itinerant departures.

Finally, airport managers estimated the number of passengers in each transient flight based on fleet mix and the CASP classification of each airport (see

Table 2.4). Using the identified steps, over 599,000 visitors were estimated to have arrived in Colorado using GA aircraft in 2018, an average of almost five visitors per flight.

Table 2.4. Average Passengers per GA Operation by Airport Classification

Airport Classification	Passengers per GA Operation
Commercial Service	4.8
GA Rural	2
GA Regional	5
GA National	6
GA Local	3.5
GA Community	3

Source: Kimley-Horn 2019

The GA Transient Pilot and Passenger Survey (see Tech Memo 1) established a baseline for average GA visitor spending across Colorado of $442 per visitor per trip. This estimate was used to establish a statewide total for GA visitor spending when applied to total statewide transient departures and passengers. However, the GA Transient Pilot and Passenger Survey did not return responses sufficient to estimate spending by airport, OEDIT region, or by different classifications of airports. To address airport-specific spending levels, the following steps were undertaken:

1. Established the statewide baseline of $264.8 million, calculated by multiplying $442 per GA visitor times 599,114 visitors.
2. Adjusted the economic activity and spending rates by airport by comparing the share of Gross State Product (GSP) for each Colorado county that hosts an airport, while using the previously calculated statewide baseline of $264.8 million as an overall control total Airport-specific spending based on the $442 per visitor per trip was adjusted up or down based on per capita GSP in the county that each airport is situated compared to per capita GSP across the state.
3. Reviewed results and adjusted for spending based on airport classification, knowledge of specific airports, and their locations within Colorado counties, such as situated in rural versus urban areas. Finally, the adjusted spending per passenger by category was implemented and estimated the direct and indirect spending impacts.

2.6. Economic Modeling Process

The IMPLAN Version 3 1997 economic model system was used for the CEIS to help gain insight of each airport's multiple contributions to its regional economy and the Colorado economy.[8] IMPLAN is the most widely used input-output model in the United States with data derived from the BEA, Bureau of Labor Statistics (BLS), U.S. Census, and U.S. Department of Commerce to reflect the current economic measures (e.g. jobs, payroll, value added, and business revenues) for over 536 industry classifications,

[8] All dollars were adjusted to 2018 value.

which roughly corresponds to two- to five-digit groups in the North American Industry Classification System (NAICS).

An IMPLAN economic model was calibrated for each Colorado OEDIT region and for the rest of the state. The economies of each OEDIT region vary between industry mix, productivity of industries, and average payroll per job by industry. Therefore, the effects of business revenues in one OEDIT region may differ from the effects of the same level of business revenues in another. Supplier sales and income re-spending "multiplier" effects were calculated for each OEDIT region and the rest of Colorado to produce both OEDIT region specific and statewide effects. For example, the economic impacts of airports in OEDIT Region 1, Golden Plains include: **(a)** direct impacts based on the economy of the Golden Plains region; **(b)** supplier sales and income re-spending multiplier effects within Golden Plains; and **(c)** supplier sales and income re-spending effects in the rest of Colorado, in this example effectively regions 2 – 15. Data at these different spatial scales enable each airport to be profiled by its **regional impact (a + b)** and its **state impact (a + b + c)**. Moreover, airports in each region can be totaled to show the overall impact of Colorado airports by region as well as statewide.

The multiplier effects of supplier sales and income re-spending vary by the combination of counties that constitute regions, and the size and industry mixes of economies in each region. A larger region means that the marketplace for supplier sales and workers' re-spending is larger, and the opposite is true for a smaller region. For example, an airplane repair company at an airport in a rural region that needs to buy a manufactured product may have to make the purchase in a neighboring urbanized county because the industry is not present in a sufficient scale in its home region, in which case the dollars would not be counted in the regional multiplier. Similarly, workers may shop for goods and services in that more urbanized county. However, if that airport (and airplane repair company) were part of a larger region that included the urbanized county, then the purchases and sales would be part of the regional multiplier. For this reason, multiplier effects of supplier sales and income re-spending are larger when modeling impacts across the state of Colorado compared to those in a given sub-state region.

2.6.1. Use of IMPLAN

The IMPLAN modeling system was used in the following three ways during the CEIS:

1. To fill in data gaps to estimate direct impacts. This was partially discussed above and is more fully described below.
2. Calculate value added as parts of direct, supplier sales and income re-spending effects (see Section 2.1 above for an explanation of value added).
3. Apply retail margining to isolate only the economic activity associated with the retail industry.
4. Derive multiplier impacts by estimating the additional economic activity associated with supplier purchases and worker re-spending.

Filling in Data Gaps to Estimate Direct Impacts. IMPLAN was used to estimate payroll and business revenues for on-airport tenants and budget expenditures for public entities that only provided employment totals. IMPLAN was also used to determine employment and payroll values based on visitor spending. Payroll, business sales, and expenditures per worker ratios are derived primarily from county-specific U.S. Department of Commerce and Department of Labor data sets. These ratios reflect a measure of productivity (business output per employee) and income level based on the number of

jobs for each industry on-airport and in hospitality sectors. These ratios are used to fill in any missing measurements from the survey data (e.g. jobs, payroll, or business revenues). For example, in cases where payroll was not directly provided by tenants, it was calculated based on average (mean) payroll per worker by industry and Colorado OEDIT region as reported by IMPLAN. The regional OEDIT values were used over the statewide averages, as the regional values are more reflective of the local economies in which these airports operate and where visitors spend their money.

For any business or economic activity that could not be filled with survey or other existing economic data, IMPLAN was used to estimate the subsequent missing direct jobs, payroll, or business revenues. Adjustments required to fill in the missing direct impacts and aggregate industries for the IMPLAN modeling are described below:

- **Single Industry Payroll Data Provided.** Payroll information reported by tenant or airport manager surveys were used for the direct payroll impacts. The industry-specific default regional ratio of payroll to business revenues from IMPLAN was applied to the payroll data to estimate business revenues. In these cases, jobs were also provided in the survey responses.
- **Single Industry Payroll Data Not Provided.** When payroll information was not reported through tenant or airport manager surveys, regional payroll to job and business revenues to job ratios from IMPLAN were applied to the number of reported jobs. In circumstances when IMPLAN did not account for an industry in an airport's region that a tenant or airport manager identified, the operating assumption was that first-hand collected data is a better representation of the airport and region than the IMPLAN county data sets. In these circumstances, Colorado state data from IMPLAN were used to fill in the missing information since regional data were not available. In these cases, jobs were also provided in the survey responses.
- **Aggregated Industry Payroll Data Provided.** To allocate the payroll data reported by tenant or airport manager surveys within an aggregated industry, the total business revenues were proportioned. For example, in a three-industry aggregation, industry A might account for 50 percent of the regional revenues, industry B: 30 percent, and industry C: 20 percent. The reported payroll information was then allocated based on these calculated percentages. Business revenues were estimated according to the relationship between payroll and business revenues. In these cases, jobs were provided in the survey response. An example of this is an aerospace airport tenant that provided both payroll and employment, and includes three industries: aircraft manufacturing, aircraft engine and engine parts manufacturing, and other aircraft parts and auxiliary equipment manufacturing. Note that all of these industries are included in the 536 classifications that are identified in IMPLAN.
- **Aggregated Industry Payroll Data Not Provided.** If payroll information was not reported by tenant or airport manager surveys, the jobs data was used to estimate payroll. Jobs provided in the survey responses were allocated to each industry within an aggregated industry using the percentages of regional revenues described above (e.g. 50 percent, 30 percent, and 20 percent). Regional IMPLAN payroll to job ratios for individual industries were then applied to these jobs to calculate the payroll for each individual industry. After these calculations were completed, the aggregated industry was then re-totaled to present jobs, payroll, and business revenues. Most airport tenants provided jobs without payroll.
- **Only Revenue Data Provided.** For construction expenditures and visitor spending, the only data collected were spending (which equates to total business revenues) without employment or payroll. Airport managers and tenants were asked to provide construction spending for four years such that an average of construction spending would be represented in this study. Visitors

were asked how much money they spent while in Colorado either when using commercial airline service and/or general aviation. This method of using spending to work backward to determine jobs and payroll is used since airport managers, tenants, and visitors are not able to quantify anything other than spending. Using IMPLAN, the spending or business revenues were used to drive regional and state models to generate jobs and payroll, as well as value added. It is important to note that construction impacts are those in Colorado and the retail expenditures were margined, as described below.

Retail Margining. While spending on retail reflects the value of the item sold, only a portion of the sale is actual revenue for the retail store. This portion, referred to as margin costs, reflects the "mark-up" value that retail stores add to the price of goods to cover their operating costs and profit. Only the mark-up produces revenue and economic activity for local retailers. Revenue generated by that mark-up supports employee payroll and operating costs of the business (e.g., rents, utilities, capital, and other business expenses)—not gross revenue collected by the retail business or industry. To isolate the revenues that accrue to retailers, the margin percentage was applied to the value of all retail goods sold. For example, if retail sales total $1 million, only $300,000 of these sales may be the mark-up earned by retail establishments, since it may have cost the stores $700,000 to purchase the items for sale from wholesalers or distributors. The retail margin rates from the BEA range from 31 percent to 37 percent across CDOT regions. This approach was used to accurately reflect the economic impacts of retail spending. Margining was done when working with retail sales data to estimate jobs and payroll. When jobs were provided for retail establishments on-airports, the jobs represent direct effects after margining has occurred and additional margining was not required.

Derive Multiplier Impacts. IMPLAN is an Input/output (I/O) model that is widely used in economic impact analysis. I/O models trace the flows of money in an economy of varying sizes by the patterns of industry purchases and sales with other industries (for supplier sales effects) and household spending (used to calculate income re-spending effects), which help explain how revenues earned in direct transactions have additional impacts in an economy. For this study the economic geographies were determined to be 15 multi-county regions and at a statewide level. At each geographic level IMPLAN is used to trace the circulation of business revenues to calculate the extent that supplier purchases and income re-spending support jobs and payroll for the people of Colorado, additional revenues for businesses and additional value added, which adds to GSP of Colorado.

Multiplier effects begin with businesses on airport or those engaged directly with visitors that use part of their gross revenues to purchase goods and services from other businesses. For example, a restaurant may buy produce from farmers, dry goods from wholesalers, office equipment at stores or manufacturers, and utilize and pay for accounting services. To the extent that these purchases stay in Colorado, they provide business revenues to other businesses in an airport's home region or to the rest of the state. These revenues are then used by businesses in the supply chain in part to hire workers and pay them wages, and to purchase additional business supplies. Successive rounds of supplier sales occur until the dollars are expelled from Colorado. In instances when airport tenants or hospitality businesses initially purchase goods or services from outside the state, then the dollars are lost to Colorado and are not part of the multiplier effects. Similarly, workers at directly affected businesses or part of the supply chain of the direct businesses use their wages to purchase goods and services (also known as household spending) in Colorado. Purchases run the full gamut of consumer spending, ranging from

furniture to health care and groceries, providing business revenues from income re-spending as long as the dollars used for the purchases stay in state.

2.6.2. Industry Sectoring

Tables 2.5 and **2.6** profile the sectors used for this study out of the 536 that are contained in IMPLAN. Across Colorado airports 47 sectors were used to capture the breadth of on-airport industries and six sectors were used to define visitor spending patterns. The sectors are described and shown below.

On-Airport. Modeling of on-airport and visitor spending impacts spanned the sectors shown in **Table 2.5**. In some cases, generalized descriptions of certain business activities were not specific and therefore were assigned to an aggregated industry (e.g. retail, entertainment, aerospace manufacturing, etc.). Aggregation leads to averaging measures across industries by region, which avoids large inaccuracies when measuring small or large industries in an economic impact study. Across Colorado airports, 53 percent of all tenant jobs are related to companies providing air transportation, aerospace, air freight and aviation support services (e.g., FBOs). Excluding DEN with its relatively high ratio of terminal-related jobs, 69 percent of airport tenant jobs are represented by these sectors.

Table 2.5. Industries and Sectors Modeled for On-Airport Economic Impacts

Industries and Sectors		
Aerospace	Federal government	Oil/gas drilling
Architectural & engineering services	Food & beverage	Other educational services
Auto repair & maintenance	Freight aviation	Photographic services
Aviation	Ground transportation	Real estate
Business & professional associations	Hospitals	Reliant services
Car rental	Hotels	Retail
Cattle ranching	Labor & civic organizations	Retail - Motor vehicle & parts dealers
Commercial rental & leasing	Legal services	Retail – Non-store retailers
Construction	Management consulting services	Security
Crop farming	Management of companies	Services to buildings
Crop spraying	Manufacturing	State & local government
Data processing	Marketing research	Transportation support services
Distribution	Miscellaneous manufacturing	Vehicle parts manufacturing
Electric power	Office administrative services	Wholesale trade
Entertainment	Offices of physicians	Wireless telecommunications
Environmental services		

Source: EDR Group using the 2017 IMPLAN economic model

Visitor Spending. As described earlier, visitor spending data comes from surveys of airport visitors, both those arriving via commercial service and GA aircraft. **Table 2.6** displays the sectors used to categorize the visitor spending. Visitor spending includes six primary sectors made up of 47 separate industries. The heavy use of aggregation is because a visitor at an airport cannot be realistically asked to divide food expenditures among different types of food and beverage establishments, let alone parse out spending of different types of retail or entertainment. Categories need to be general in order to present visitors with surveys that they can and are willing to quickly answer.

Table 2.6. Industries and Sectors Modeled for Visitor Spending Classifications

Visitor Spending Categories	Industry Sector
Accommodations	Hotels & motels, including casino hotels
	Other accommodations
Car Rental engaged off airport	Automotive equipment rental & leasing
Entertainment	Performing arts companies
	Commercial sports except racing
	Racing & track operation
	Independent artists, writers, & performers
	Museums, historical sites, zoos, & parks
	Amusement parks & arcades
	Gambling industries (except casino hotels)
	Other amusement & recreation industries (including skiing)
	Fitness & recreational sports centers
	Bowling centers
Food & Beverage	Full-service restaurants
	Limited-service restaurants
	All other food & drinking places
Ground Transportation, other than car rental	Retail - Gasoline stores
	Transit & ground passenger transportation
	Transportation support activities
Retail	Retail - Electronics & appliance stores
	Retail - Food & beverage stores
	Retail - Health & personal care stores
	Retail - Clothing & clothing accessories stores
	Retail - Sporting goods, musical instruments, & books
	Retail - General merchandise stores
	Retail - Miscellaneous store retailers

Source: EDR Group using the 2017 IMPLAN economic model