TO: JUDY ROSS, ASSISTANT DIRECTOR, MINETA SAN JOSÉ INTERNATIONAL AIRPORT
FROM: LANDRUM & BROWN, INC.
DATE: FEBRUARY 19, 2019
RE: DOWNTOWN AIRSPACE AND DEVELOPMENT CAPACITY STUDY (PROJECT DADCS)
EXISTING CONDITIONS ASSESSMENT MEMORADUM

DRAFT WORK PRODUCT

Introduction

A focus of the Downtown Airspace and Development Capacity Study (Project DADCS) is understanding the impacts to airline/aircraft operations in Southeast Flow (Runway 12L/12R) as impacts to departures are greater due to the existing obstacle environment south of the Airport. This memorandum provides a summary of an assessment of airport runway configurations, historical weather trends and airline operations/fleet mix at San José International Airport (SJC). Understanding the aircraft fleet mix, times of day when these aircraft operate and the destinations served from SJC is an integral component in evaluating potential impacts to domestic, international and transoceanic operations as it applies to proposed high-rise developments south of the Airport and the potential for modifications to protected airspace protection surrounding the Airport.

The second part of this memorandum compiles an assessment of the existing air service operations at SJC, regional competition with San Francisco International Airport (SFO) and Oakland International Airport (OAK), and economic influence of the air service area. The following topics are described in detail:

- Bay Area Airport Service Area
- Economic Base of Air Travel
- Benefits of SJC, SFO and OAK
- Bay Area Airports Air Service
- Bay Area Market Share
- Airline Operations
- Costs of Doing Business
- Advantages and Disadvantages of the Bay Area Airports
- Regional Competition

Table of Contents

Section 1: SJC Airport Operations

Section 1A. Airport Runway Operating Configurations

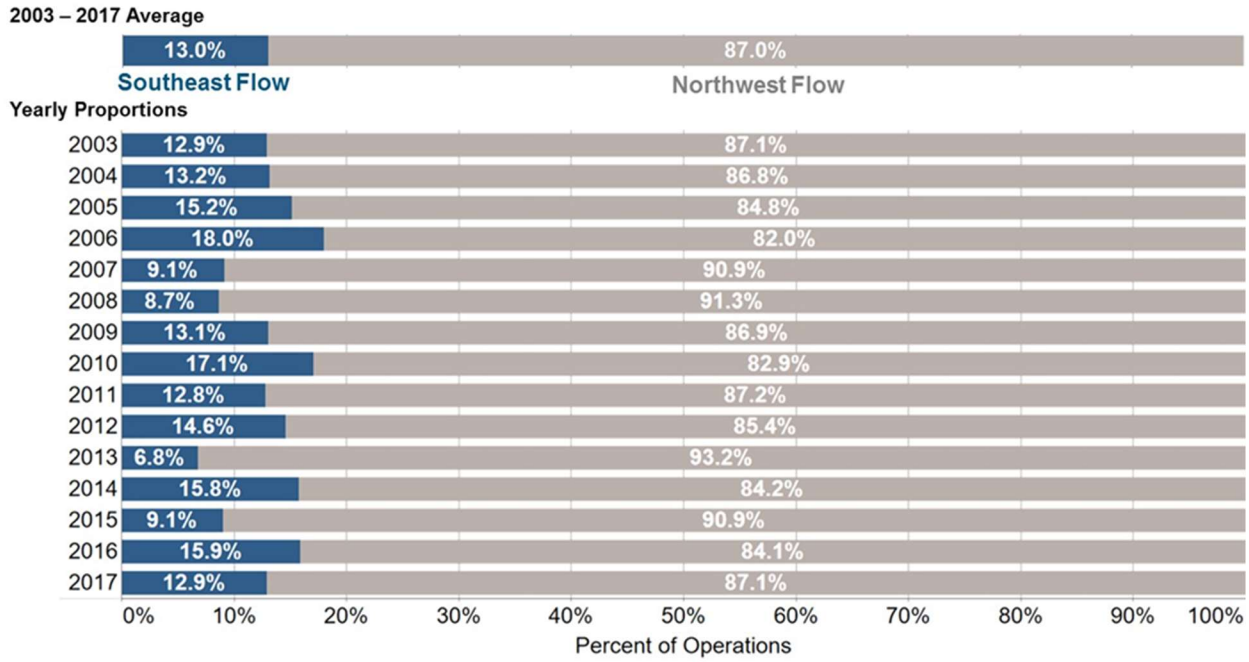
The primary operating configuration at SJC is the Northwest Flow (landing and departing on Runways 30L and 30R). Arrivals on final approach descend over Downtown San José. Departures initially take off over Santa Clara, away from Downtown San Jose. During Southeast Flow conditions, aircraft land and depart on Runways 12L and 12R, with departures over Downtown San José as depicted in **Figure 1**.

Figure 1: Runway 12L Departure View of Downtown San José Hi-Rise Buildings

Source: Kimley Horn

As presented in **Figure 2**, operations data collected from the SJC Airport Noise and Operations Monitoring System (ANOMS) from 2003-2017 show that the Airport operates in the Northwest Flow approximately 87 percent of the time annually while operations in the Southeast Flow (arriving and departing Runways 12L and 12R) occur 13 percent of the time annually.

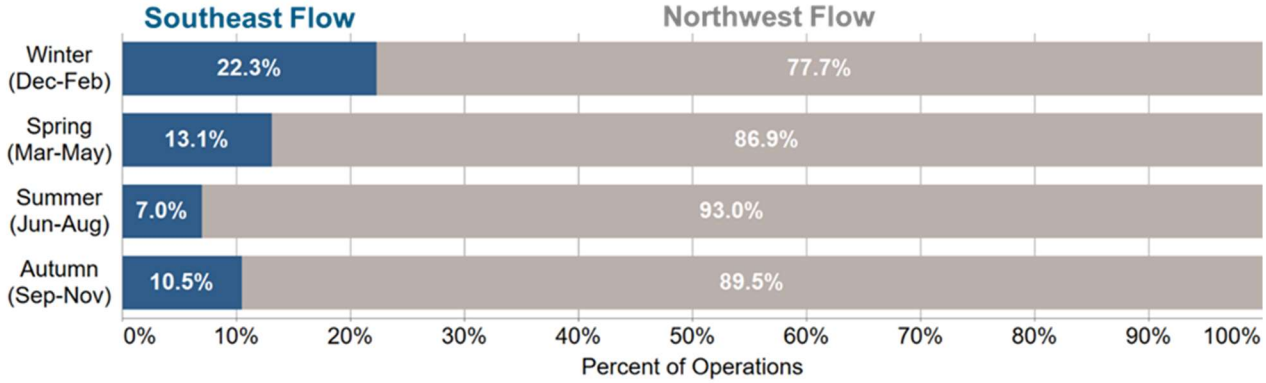
Figure 2: 2003 – 2017 Historical Airport Runway Configurations at SJC



Source: Data: ANOMS (2003 – 2017), Figure: Landrum & Brown

Figure 3 provides a summary of the historical runway configurations by season. It is important to note that operations in the Southeast Flow primarily occur in the winter months between December and February.

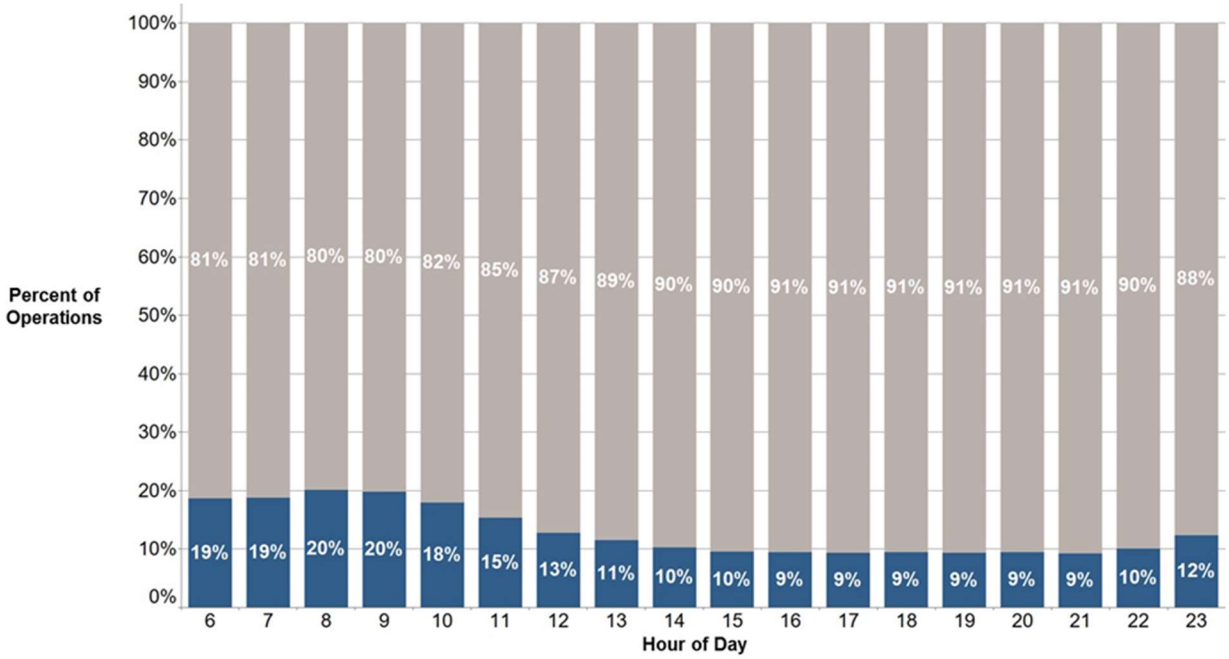
Figure 3: 2003 – 2017 Seasonal Historical Airport Runway Configurations at SJC



Source: Data: ANOMS (2003 – 2017), Figure: Landrum & Brown

With respect to time of day, the morning hours average approximately 80 percent of the time in the Northwest Flow. As depicted in **Figure 4**, that average increases to approximately 91 percent in the afternoon hours.

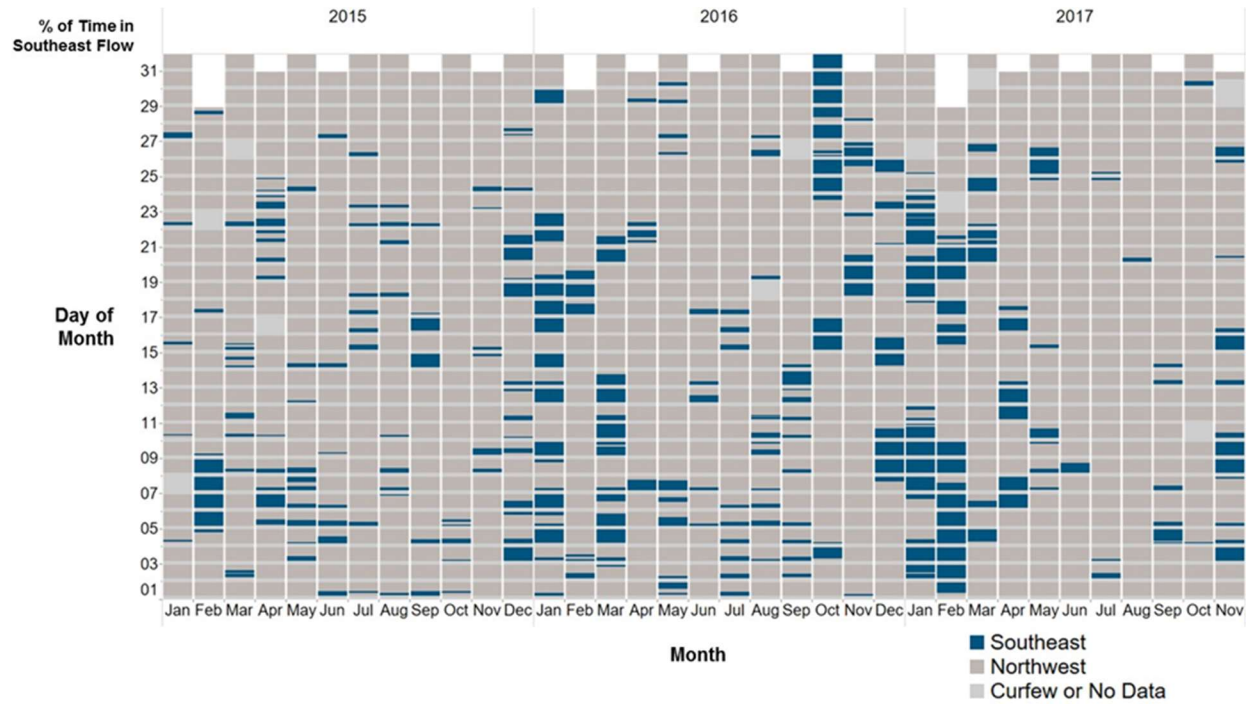
Figure 4: Southeast Flow by Hour of Day



Source: Data: ANOMS (2003 – 2017), Figure: Landrum & Brown

The Southeast Flow is usually associated with inclement weather that typically occurs in the winter months. That trend is reflected in **Figure 5**, which shows greater use of the Southeast Flow from October through April (although these monthly trends vary by year). Conversely, the Southeast Flow is not as frequently used in/near the summer months (May through September).

Figure 5: Flow by Calendar Hour



Source: Data: FAA ASPM (2015 – 2017), Figure: Landrum & Brown

As depicted in **Table 1**, there are typically 100 days each year when the Southeast Flow is in use, and during the winter months, the Southeast Flow may operate for several consecutive days.

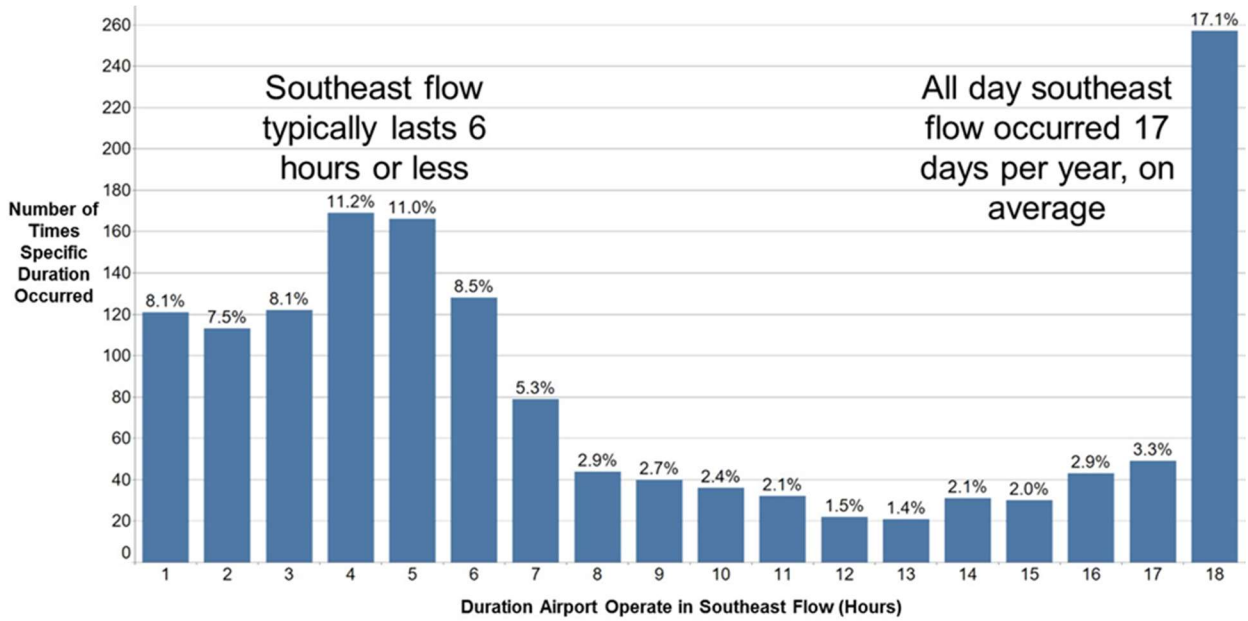
Table 1: Southeast Flow by Number of Days Annually

Year	Number of Days When Southeast Flow Occurred	Year	Number of Days When Southeast Flow Occurred
2003*	37	2011	110
2004	101	2012	110
2005	112	2013	66
2006	129	2014	119
2007	89	2015	98
2008	72	2016	119
2009	100	2017**	87
2010	127		

* 2003 only includes data for August – December
** 2017 only includes data for January – November
Source: Data: FAA ASPM (2003 – 2017), Table: Landrum & Brown

Although the Southeast Flow occurs during an average of 100 days per year, that flow typically occurs for six hours or less during each instance. As depicted in **Figure 6**, all-day Southeast Flow occurs an average of 17 days per year.

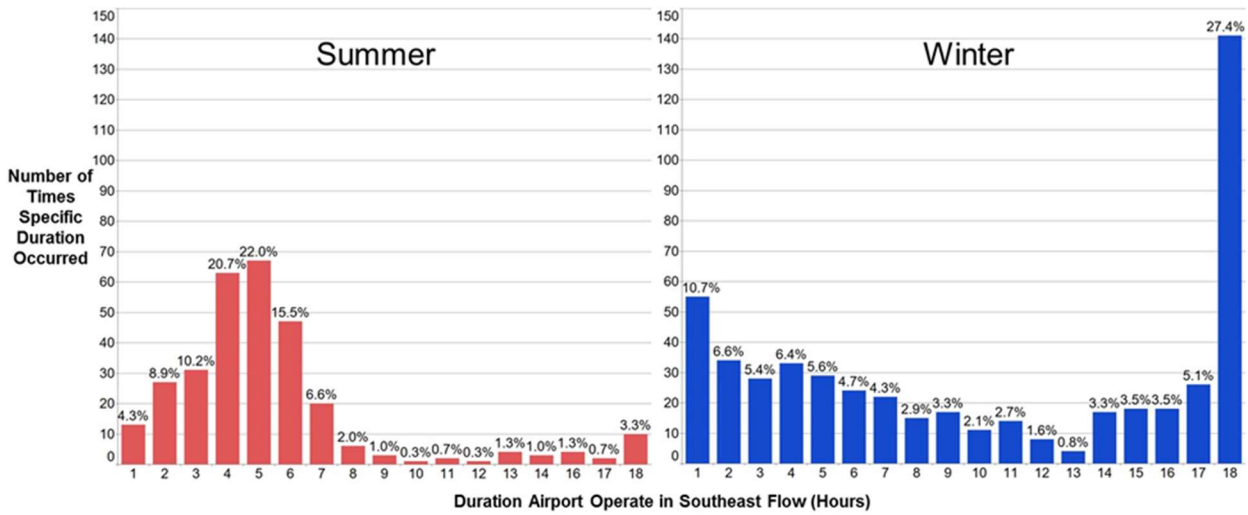
Figure 6: Average Duration of Southeast Flow



Source: Data: FAA ASPM (2003 – 2017), Figure: Landrum & Brown

Consistent with other observations, there are typically shorter durations while operating in the Southeast Flow during the summer months and longer durations during the winter months. These trends are reflected in **Figure 7**.All-day Southeast Flow rarely occurs in the summer months but occurs more frequently in the winter months.

Figure 7: Seasonal Duration of Southeast Flow



Source: Data: FAA ASPM (2003 – 2017, June – August, December – February), Figure: Landrum & Brown

Section 1B. Historical Temperature Analysis

The FAA Aviation System Performance Metrics (ASPM) database provides hourly temperature data. This data was analyzed to identify average temperature trends with respect to hour, month, and flow configuration. For all hours (i.e., both the Northwest and Southeast Flows), the average temperature was 62 degrees Fahrenheit. Average temperatures by month varied from an average of 50 degrees in December to an average of 69 degrees in July, August, and September. Average temperatures by hour varied from an average of 54 degrees Fahrenheit in the 0500 and 0600 hours to an average of 71 degrees Fahrenheit in the 1400, 1500, and 1600 hours.

When the data was filtered to consider only temperatures during the Southeast Flow, the average temperature decreased to 59 degrees Fahrenheit. The meteorological patterns that typically cause the Southeast Flow often occur during the cooler winter months, and they also result in weather that is more temperate (i.e., narrower temperature ranges). Average temperatures by month varied from an average of 54 degrees Fahrenheit in January to an average of 66 degrees Fahrenheit in September. Similarly, the range narrowed of average temperatures by hour, from an average of 55 degrees in the 0400, 0500, and 0600 hours to an average of 63 degrees Fahrenheit in the 1200, 1300, 1400, 1500, and 1600 hours. **Table 2** provides a summary of the aforementioned temperatures assessment from 2015 to 2017.

Table 2: Historical Temperature Analysis

Temperature (F)	Both Flows	Southeast Flow only
Average (avg)	62	59
Lowest, avg month	50	54
Highest, avg month	69	66
Lowest, avg hour	54	55
Highest, avg hour	71	63

Source: Data: FAA ASPM (2015 – 2017), Table: Landrum & Brown

Section 1C. Aviation Fleet Mix and Markets Served

Table 3 provides a summary of the domestic and international airlines at the Airport as of July 2018

Table 3: Airlines Currently Service SJC (As of July 2018)

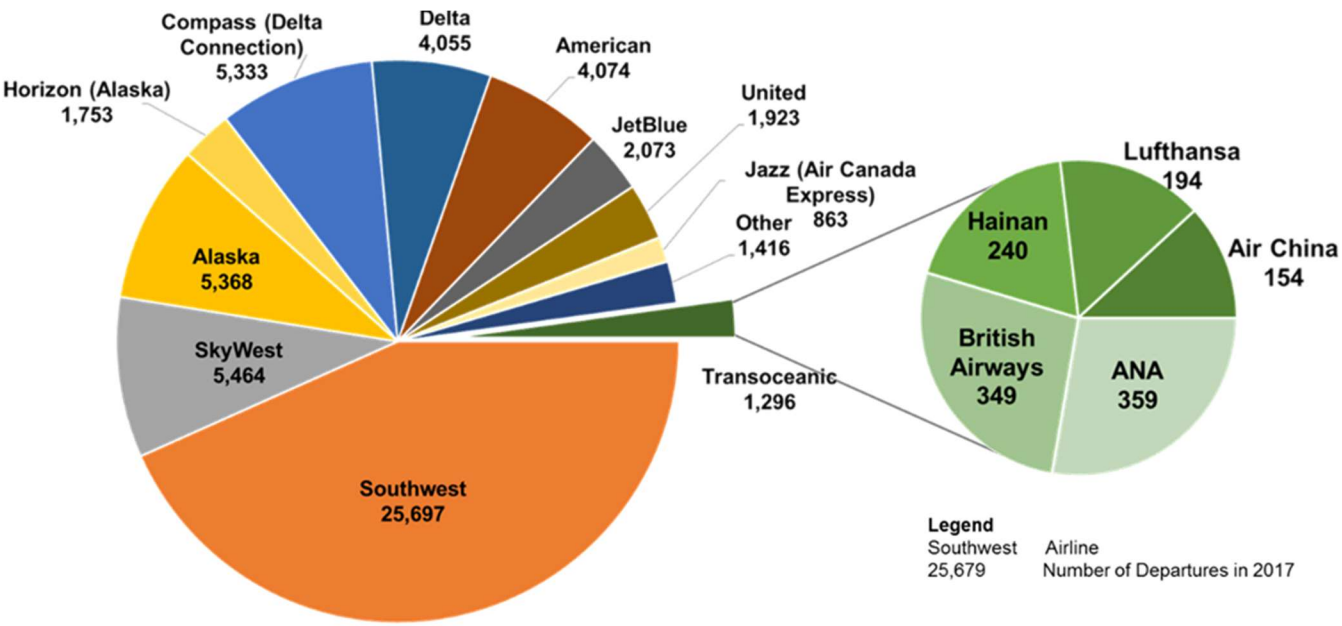
Airlines Currently Serving SJC	
Domestic Airlines	**International Airlines**
Alaska	Aeromexico
American	Air Canada
Delta	Air China
Frontier	ANA
Hawaiian	British Airways
JetBlue	Hainan
Southwest	Lufthansa
United	Volaris

Source: www.flysjc.com/airlines

To understand the fleet mix and markets at SJC, FAA ASPM data (2003 – 2017) was studied. Additionally, runway use data (2003 – 2017) was analyzed from the ANOMS.

As depicted in **Figure 8**, Southwest operated the largest number of flights in 2017. Other carriers with substantial operations included Alaska, American, and Delta. In addition, the competitive landscape at SJC changed between 2013 and 2017 as Delta (including Delta Connection) and JetBlue both increased their presence at the airport. It should be noted that SkyWest operated flights for Alaska, Delta, and United. SJC's transoceanic operations are comprised of five carriers: Air China, ANA, British Airways, Hainan, and Lufthansa.

Figure 8: Airline Market Share – Passenger

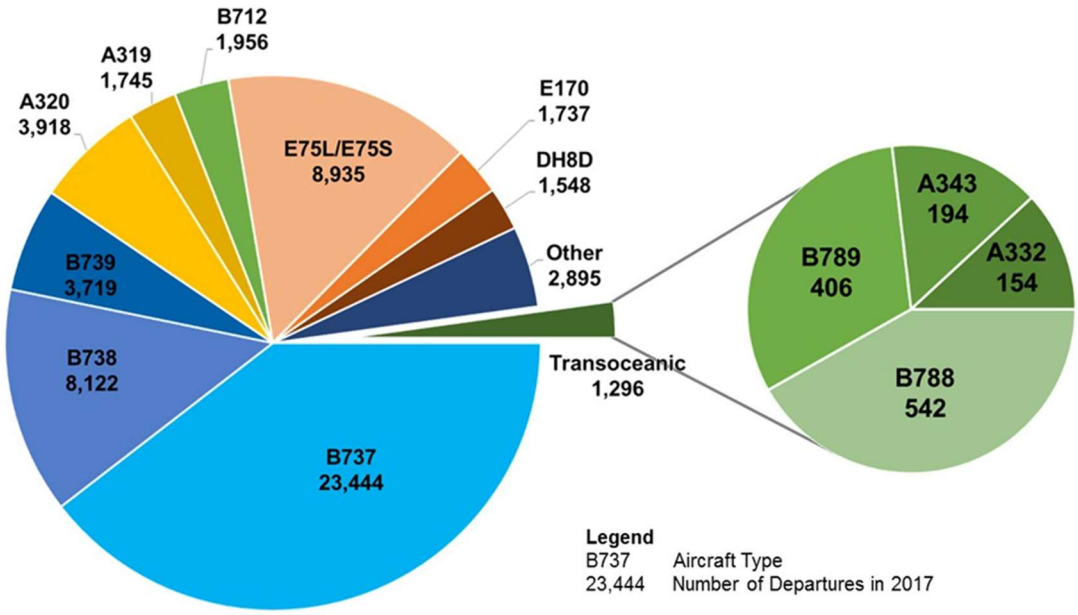


Source: Data: ANOMS (2017), Figure: Landrum & Brown

As depicted in **Figure 9**, the same ANOMS data was used to analyze aircraft types that operated at SJC in 2017. Consistent with Southwest's large presence, the Boeing 737-700 was the most commonly operated aircraft at the airport. Other popular types included the Boeing 737-800 and -900, the Airbus A319 and A320, and the Embraer 175. Some changes have occurred in the fleet mix at SJC including the retirement of the Boeing 737-300 by Southwest, and the removal of the Bombardier CRJ-200 by SkyWest. Other aircraft types have increased operations, such as the Embraer 175 and the Boeing 717-200 (operated by Delta). Transoceanic operations were comprised of four aircraft types:

- Airbus A330-200: Air China to PVG
- Airbus A340-300: Lufthansa to FRA
- Boeing 787-8: ANA to NRT, Hainan to PEK
- Boeing 787-9: British Airways to LHR, Hainan to PEK

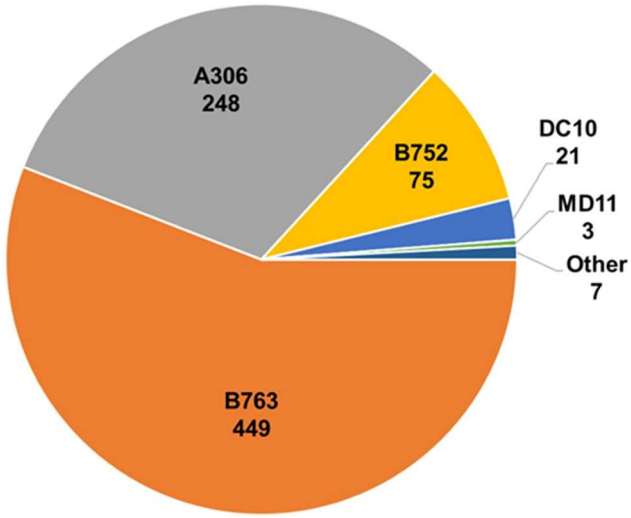
Figure 9: Aircraft Profile – Passenger



Source: Data: ANOMS (2017), Figure: Landrum & Brown

Cargo operations at SJC are comprised of a distinctly different fleet mix when compared with the passenger fleet mix. As depicted in **Figure 10**, the most commonly used cargo aircraft is the Boeing 767-300, which is operated by both FedEx and UPS. The Airbus A300-600 also has a substantial presence at SJC (used by FedEx and UPS).

Figure 10: Aircraft Profile – Cargo



Source: Data: ANOMS (2017), Figure: Landrum & Brown

The following analyses illustrate flight operations by stage length (the length of a flight as measured in statute miles). As depicted in **Table 4**, stage lengths are organized as follows:

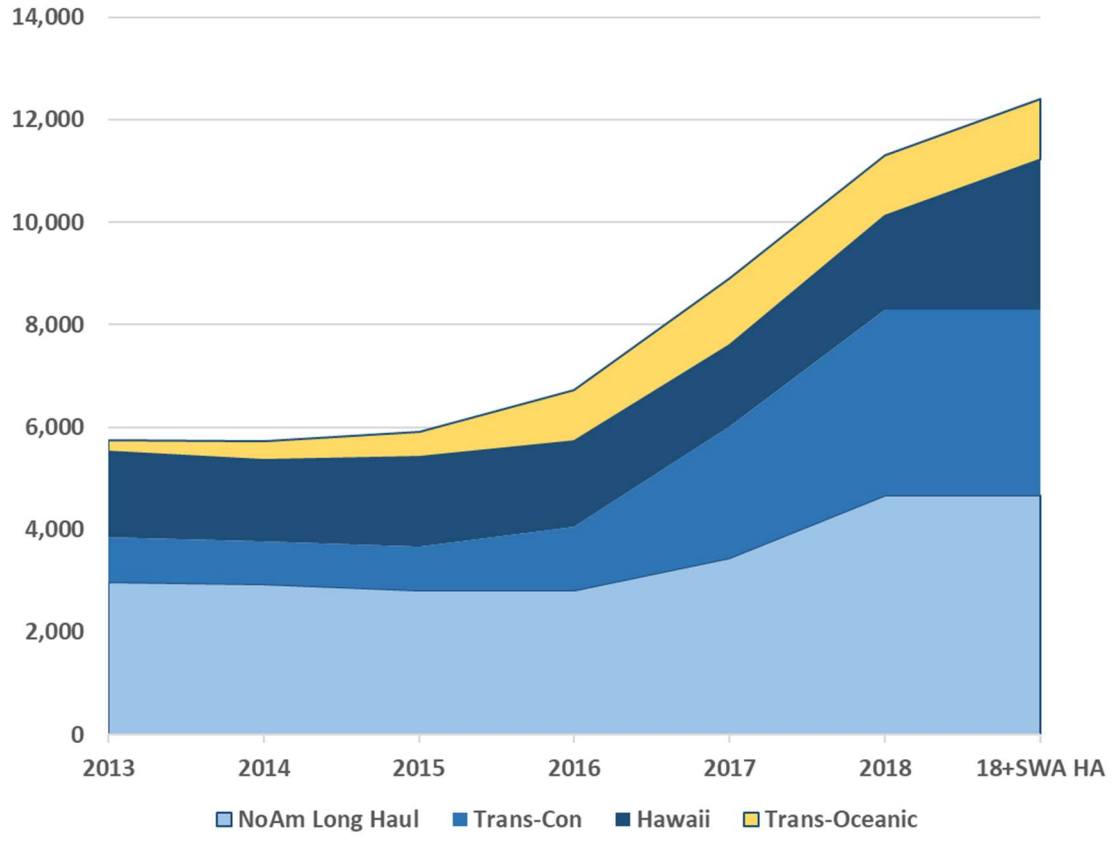
Table 4: Stage Length Categories

Distance (Miles)	Category	Examples
0 - 749	Short Haul	LAX, SEA, SAN, PHX
750 - 1,499	Mid-Range	AUS, DFW, SAT, SJD
1,500 - 1,999	NoAm Long Haul	HOU, MSP, MEX, STL
2,000 - 3,000	Trans-Con	BOS, BWI, JFK, MCO
2,000 - 3,000	Hawaii	HNL, OGG, LIH, KOA
3,000 +	Trans-Oceanic	LHR, PEK, FRA, NRT

Source: DIIO and Innovata Global Flight Schedules Calendar 2018

Since 2013, there has been a significant increase in the number of longer-haul flights (mid-continent, transcontinental, and transoceanic). This increase, which is particularly noticeable starting in 2016, is depicted in **Figure 12**.

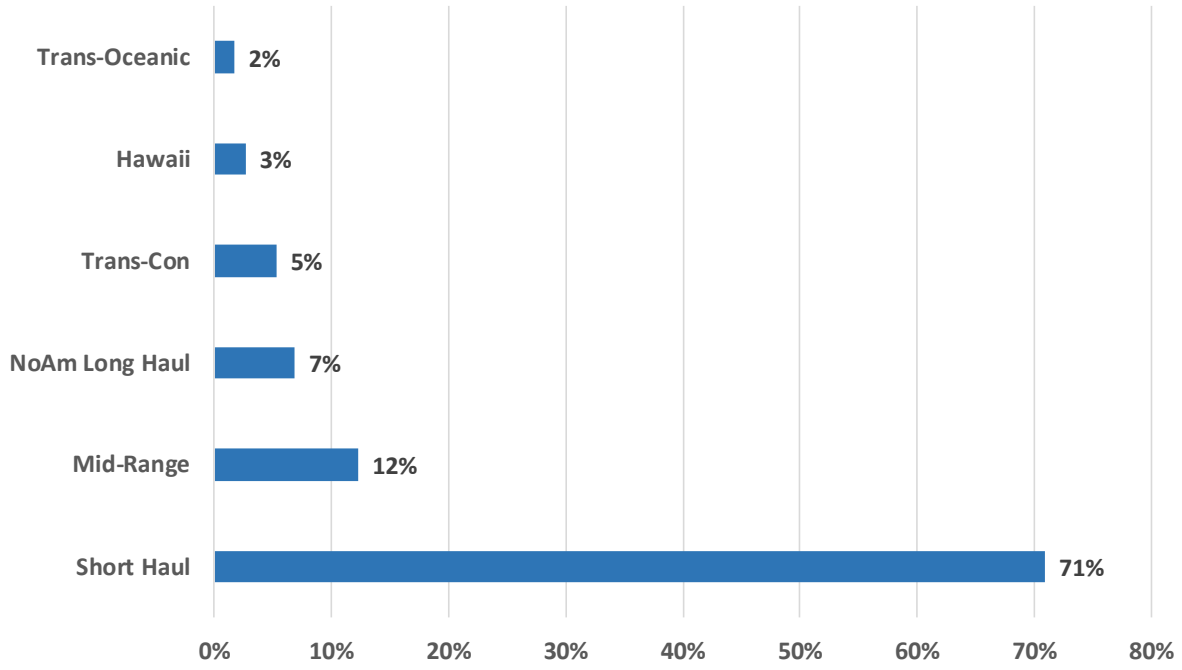
Figure 11: Long Haul Departure Trend



Source: DIIO and Innovata Global Flight Schedules, Departures of 1,500+ Miles

As depicted in **Figure 12**, an analysis of the passenger and cargo flights at SJC reveal that over 71 percent of the flights are classified as "shorter haul" and mid-range flights account for 12 percent of total operations. The remaining 10 percent of commercial operations include transcontinental, Hawaii and transoceanic flights.

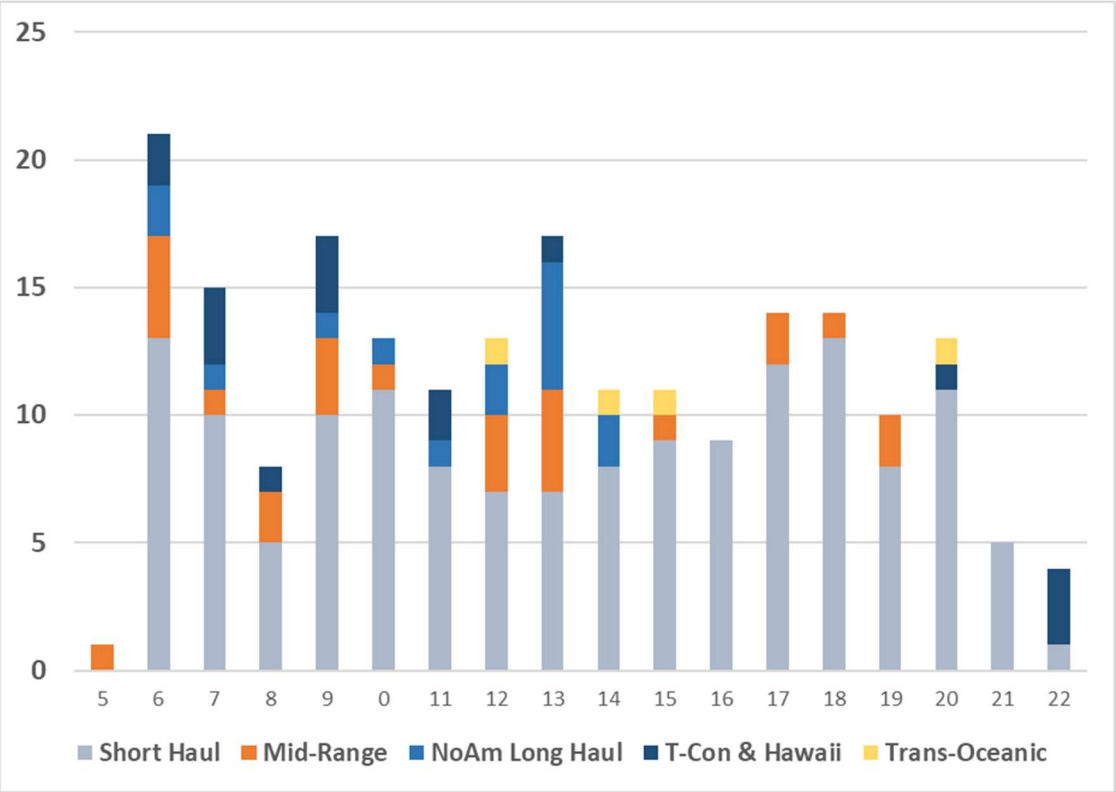
Figure 12: Departures by Stage Length (2018)



Source: DIIO and Innovata Global Flight Schedules Calendar 2018

As depicted in **Figure 13**, the largest portion of shorter-haul flights operate in the morning and early evening hours; however, traffic is fairly consistent throughout the day. Transoceanic flights to Asia typically operate in the late morning to mid-day hours while transoceanic flights to Europe operate in the afternoon and evening hours. Hawaii flights typically depart in the morning while mid-continent flights operate throughout the day.

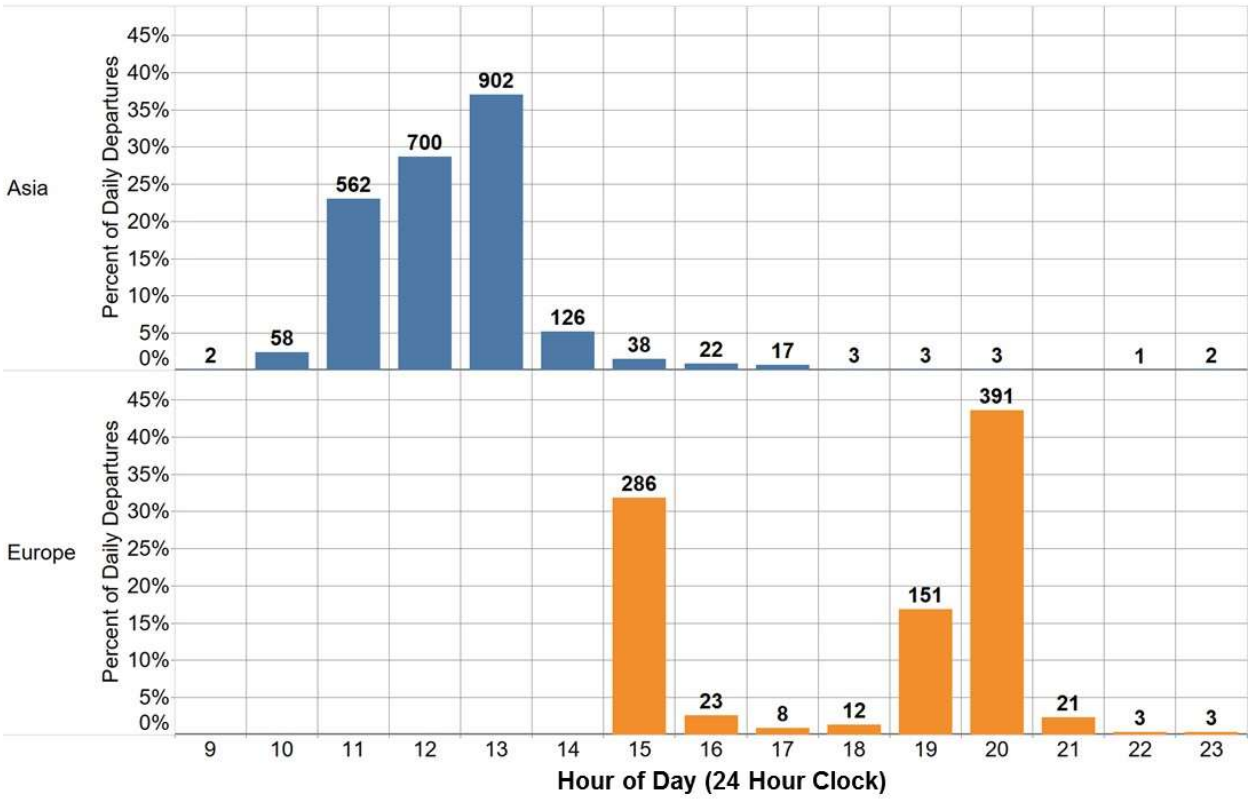
Figure 13: Hourly Departures by Stage Length (2013-2017)



Source: DIIO and Innovata Global Flight Schedules Calendar 2018

A more detailed analysis of transoceanic flights is depicted in **Figure 14**. Most Asia departures are concentrated in the 1100 to 1300 hours while Europe departures operate in the latter part of the day, starting in the 1500 hour with noticeable increases in the 1900 and 2000 hours.

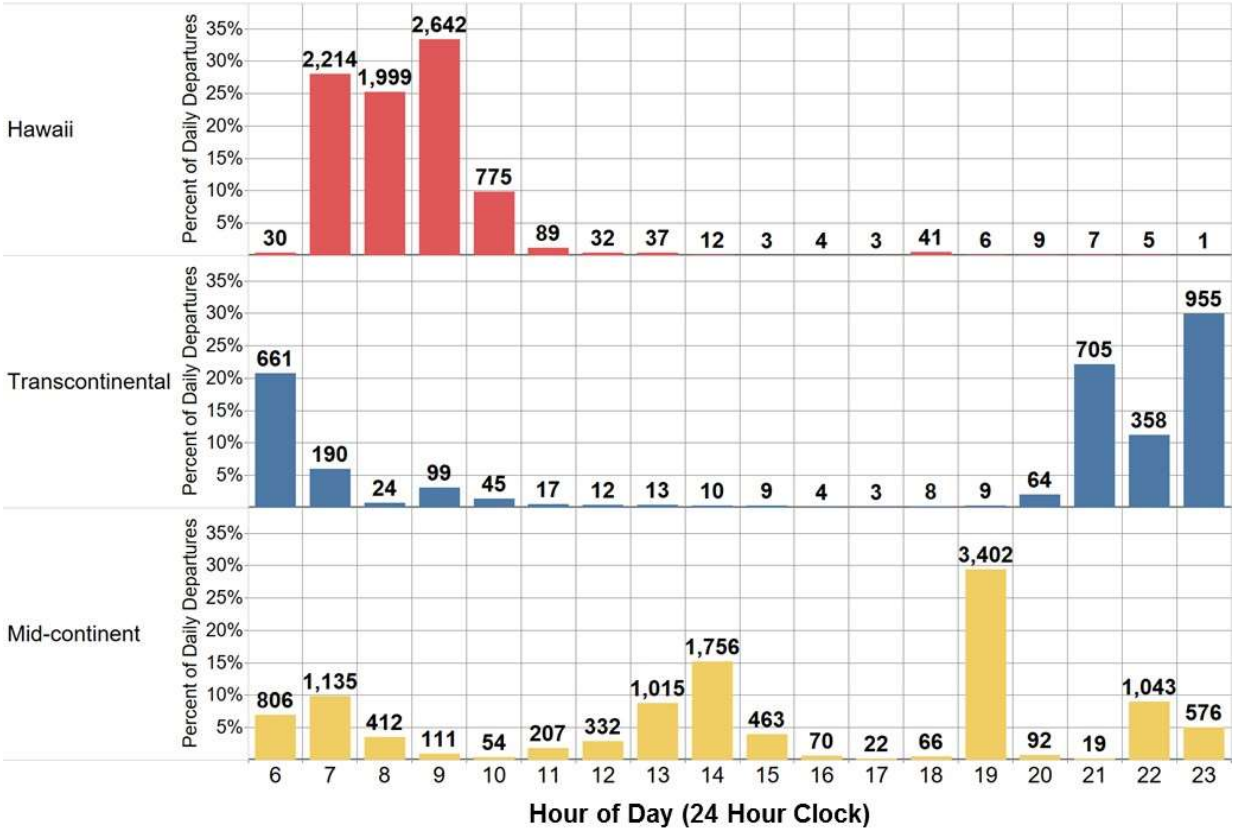
Figure 14: Departure Pattern by Stage Length



Source: Data: ANOMS (2013 – 2017), Figure: Landrum & Brown

Domestic departures also exhibit patterns based on the time of day. As depicted in **Figure 15**, Hawaii departures mostly depart between 0700 and 1000 hours, transcontinental departures mostly operate in the early morning or late evening (red-eye), and mid-continent departures operate with several peaks throughout the day. All flights are subject to the City of San Jose's airport curfew ordinance, which starts at 2330 and ends at 0630.

Figure 15: Departure Pattern by Stage Length



Source: Data: ANOMS (2013 – 2017), Figure: Landrum & Brown

Section 2: Bay Area Airport Service Area

The area served by SJC, including the City of San José and Santa Clara County, is a part of the San José-San Francisco-Oakland Combined Statistical Area (referred to herein as the Bay Area CSA). A CSA is the collection of two or more Metropolitan Statistical Areas. These metro or micro areas consist of one or more counties that have a high degree of social and economic integration. The Bay Area CSA, as defined by the U.S. Department of Commerce, Bureau of the Census, includes the 12 counties of Alameda, Contra Costa, Marin, Napa, San Benito, San Francisco, San Joaquin, San Mateo, Santa Clara, Santa Cruz, Solano, and Sonoma.

There are three international commercial passenger service airports located in the Bay Area CSA: SJC, SFO and OAK. SJC is located less than three miles from Downtown San José and conveniently located within Silicon Valley. SFO is located 13 miles south of downtown San Francisco. OAK is located across the Bay from SFO. SJC and OAK are medium-hub airports and provide primarily short-and medium-haul domestic service. SFO is a large-hub airport, international gateway, and dominates long-haul domestic service. Because of the proximity of SJC, OAK, and SFO, it is essential to understand local socioeconomic trends in the broader regional context. Economic growth and activity stimulate a significant portion of passenger demand at all three airports. **Figure 16, Bay Area CSA**, graphically depicts the Bay Area CSA and the international commercial service airports within.

Figure 16: Bay Area CSA

Source: Landrum & Brown

Section 3: Economic Base of Air Travel

Potential travelers make air travel decisions based primarily on the following three factors: (1) availability of air service, (2) price, and (3) distance of an airport from point of local trip origin/destination. Air travelers will typically select the closest airport if all other selection factors are equal. Conversely, a better set of air service options at more competitive prices will cause travelers to select airports which are not necessarily the closest to where their trip begins or ends. Catchment area "leakage" occurs when passengers use an airport other than the most convenient airport (usually closest) to their trip origin.

This is the case at SJC where a significant portion of the passengers who begin or end their journeys in Silicon Valley. Alternate airports such as SFO and OAK are available for air service needs if unmet at SJC. SJC appeals to high-yield business traffic, being the closest airport to many companies in Silicon Valley. SJC can leverage this convenient location to attract many high-yield business travelers in the technology

industry. However, if air service is not available, passengers may choose to utilize SFO and OAK for their travels. Likewise, if high-yield business travelers originate in or are destined for San Francisco, then SFO or OAK may be the easiest airport for those passengers. Additionally, SFO offers a high frequency of flights to key business markets, and OAK offers many low-cost alternatives.

It is attractive to high yield business travelers to have non-stop and long-haul flight opportunities. There are intrinsic links between the growth of aviation activity and economic growth. Growth in population, employment, personal income, and tourism typically lead to increased demand for air travel for both business and leisure purposes. An individual's demand for air travel is often referred to as "underlying demand" in that it cannot be realized without the presence of airline service at a price that results in the decision to fly rather than use other modes of transportation or not traveling. Because the Bay Area is densely populated and highly compensated, the demand for air travel is higher than the national average.

Future aviation activity at SJC and the Bay Area airports depend on a combination of trends in the airline industry, national and international economic conditions, and the socioeconomic conditions in the Bay Area. As the Bay Area is an influential global business location, as well as a vacation destination in the United States, changes in the broader U.S. economy and in the world economy have the potential to affect the number of passengers at SJC. An overview of the economic factors that generate underlying demand for air travel at SJC and within the Bay Area is provided below. Historical and forecast socioeconomic variables were obtained from Woods & Poole Economics, Inc., of Washington D.C. All economic variables are presented in constant dollars to eliminate any distortion in the data resulting from inflation.

Section 3A. Population

When the population base of an air service region increases, so does the passenger demand. The Bay Area CSA was ranked as the fifth most populated combined statistical area in the United States, and second most populated in California. The Bay Area CSA has shown steady population growth since 1990, at an average rate of 1.0% annually through 2017. In 2017, the Bay Area CSA had an estimated population of more than 8.8 million. The Bay Area CSA is expected to experience steady population growth over the planning horizon at a rate of 0.8% annually, on par with national expected growth, and slightly below expected growth in the State of California (see **Table 5, Population Trends**). Due to the positive population forecast in both the Bay Area and United States, it is expected demand will continue to be strong for the Bay Area Airports. Passengers will continue to make choices based on availability of air service, price, and distance from their origin/destination.

Table 5: Population Trends

POPULATION (IN THOUSANDS)			
YEAR	BAY AREA CSA	CALIFORNIA	UNITED STATES
1990	6,814	29,960	249,623
1995	7,168	31,697	266,278
2000	7,680	33,988	282,162
2005	7,781	35,828	295,517
2010	8,174	37,333	309,348
2015	8,686	38,994	320,899
2016	8,752	39,250	323,132
2017	8,827	39,619	325,888
2020	9,076	40,835	335,058
2025	9,503	42,930	350,937
2030	9,937	45,067	367,239
2035	10,349	47,125	382,998
2040	10,731	49,063	397,912
2045	11,090	50,911	412,256
2050	11,437	52,717	426,439
AAGR			
1990-2017	1.0%	1.0%	1.0%
2000-2017	0.8%	0.9%	0.9%
2017-2050	0.8%	0.9%	0.8%

Source: Woods & Poole 2018; Landrum & Brown

SJC serves a catchment population close to 4 million residents and thousands of Silicon Valley companies with global operations. Residents and visitors within this area can utilize SJC versus driving an hour or more to and from SFO or OAK Airports.

Section 3B. Employment

Growth in employment is an important indicator of the overall health of the local economy. Population changes and employment changes tend to be closely correlated as people migrate in and out of areas largely depending on their ability to find work in the local economy.

The San José area is home to some of the biggest tech giants in the world including Apple, Adobe, Cisco, Facebook, Google, Intel, Netflix, Hewlett Packard, and eBay. There are 105 companies within 18 miles of SJC worth $39.3 billion in capital expenditures, with $628 billion in global sales. As time savings is often correlated with money, businesses travelers often prefer non-stop routes, convenient flight schedules, and long-haul flight opportunities to capitalize on work productivity and personal life balance. SJC can leverage its convenient location to attract many high-yield business travelers in the technology industry. However, if long-haul/trans-oceanic direct routes are unavailable or discontinued, SJC catchment area passengers may decide to travel to SFO or OAK for these preferred routes, even though they may drive past SJC to get there.

Employment in the Bay Area CSA grew at the same rate as the State of California from 1990 through 2017, at an average annual growth rate (AAGR) of 1.3% (see **Table 6, Employment Trends**). Bay Area CSA employment is forecast to increase at an AAGR of 1.1% from 2017 through 2050, which is on par with expected growth for the United States, and slightly slower than the State of California.

Table 6: Employment Trends

EMPLOYMENT (IN THOUSANDS OF JOBS)			
YEAR	**BAY AREA CSA**	**CALIFORNIA**	**UNITED STATES**
1990	4,192	16,835	138,332
1995	4,296	16,940	147,917
2000	4,962	19,228	165,372
2005	4,772	20,147	172,557
2010	4,721	19,654	173,035
2015	5,598	22,701	190,423
2016	5,759	23,265	193,668
2017	5,921	24,019	198,990
2020	6,195	25,239	208,570
2025	6,651	27,180	223,254
2030	7,110	29,118	237,848
2035	7,536	30,915	251,572
2040	7,920	32,541	264,330
2045	8,275	34,066	276,751
2050	8,617	35,554	289,232
AAGR			
1990-2017	1.3%	1.3%	1.4%
2000-2017	1.0%	1.3%	1.1%
2017-2050	1.1%	1.2%	1.1%

Source: Woods & Poole 2018; Landrum & Brown

Section 3C. Personal Income

Income statistics are broad indicators of the relative earning power and wealth of the region and inferences can be made related to a resident's ability to purchase air travel. PCPI (per capita personal income) corresponds to the average income per inhabitant (total personal income divided by total population). As personal income increases, air travel becomes more affordable and can be used more frequently.

The Bay Area CSA PCPI is much higher than the United States and State of California. Between 1990 and 2017, PCPI for the Bay Area CSA area had increased at an average annual rate of 2.4%, significantly higher than the State of California and the United States. The Bay Area CSA is expected to increase 0.8% annually from 2017-2050 in line with the State of California expected growth, and slightly below the United States. **Table 7, Personal Income Per Capita Trends**, displays the historical and forecast PCPI

trends. It is expected that air carriers will continue to increase markets and air service operations to the Bay Area, as the local and national economies continues to flourish.

Table 7: Personal Income Per Capita Trends

PCPI (IN 2009 DOLLARS)			
YEAR	**BAY AREA CSA**	**CALIFORNIA**	**UNITED STATES**
1990	36,894	31,872	29,050
1995	39,561	32,211	30,867
2000	55,395	39,811	36,812
2005	54,993	42,836	38,916
2010	54,469	42,612	39,622
2015	67,562	49,979	44,255
2016	69,490	50,884	44,450
2017	70,273	51,737	45,335
2020	72,914	53,853	47,348
2025	76,781	56,849	50,233
2030	80,447	59,574	52,882
2035	83,583	61,732	55,039
2040	86,409	63,556	56,946
2045	89,106	65,272	58,828
2050	92,064	67,223	61,015
AAGR			
1990-2017	2.4%	1.8%	1.7%
2000-2017	1.4%	1.6%	1.2%
2017-2050	0.8%	0.8%	0.9%

Source: Woods & Poole 2018; Landrum & Brown

Section 3D. Tourism

SJC is a gateway to some of California's leading tourist destinations, including Big Sur, Carmel, Monterey, Pebble Beach, Santa Cruz, and Yosemite National Park. Many cultural, entertainment, and site seeing opportunities are also available in the Bay Area. Visitors to the region likely make their air travel decisions similar to the local catchment area passengers, basing airport choice on availability of air service, price, and distance from their origin/destination.

Section 4: Benefits of SJC, SFO and OAK

Section 4A. Benefits of SJC

Based on a 2013-14 Economic Impact Study at SJC: 57% of SJC passengers were visitors (41% for business vs. 59% leisure), while the remaining 43% of passengers were residents (38% for business vs. 62% leisure). If traveling within Silicon Valley or the San José region, flying to SJC is most convenient. SJC is assessible by various rail and transit networks and has an easily navigated airport layout. SJC has also had historically less flight delays than SFO and OAK.

SJC has been actively adding new air service. In San José, city officials spent years courting a direct flight to Asia, something Silicon Valley businesses had been highly desired. They worked with business leaders to assure airlines that there was pent up demand for new routes. All Nippon Airways launched a direct flight to Japan in 2013 on the new 787 Dreamliner. A wave of other flights quickly followed, including other trans-pacific flights and other trans-oceanic flights to Europe (Frankfurt and London), opening flight connections across both the Pacific and Atlantic Oceans.

In five years, SJC went from 29 domestic and 2 international destinations in 2012 to 42 domestic and 11 international destinations including long-haul markets to Asia (Tokyo, Beijing, and Shanghai), European markets (Frankfurt and London), and Transborder (Los Cabos, Guadalajara, Zacatecas, Morelia, Mexico City. Leon, Los Cabos, and Vancouver) in 2018. Passengers are expected to increase over 15% from 2017 to 2018. During this period, many new markets have been added at the Airport. In 2018, Delta and Alaska Airlines added transcontinental service to New York, John F Kennedy Airport, in addition to JetBlue. Low-cost Frontier Airlines, which started flying out of SJC last fall with new service to Denver and Las Vegas, has targeted the airport for expansion this year, including service to the east including Cincinnati, Austin, San Antonio, Atlanta, and Tulsa. Southwest has been actively adding flights in 2018, with the addition of 80 more flights per week since 2017, including new non-stop service to eight cities and more frequencies on existing routes, and its first-ever international service from the airport (Cabo San Lucas, Mexico). Southwest has also had an aggressive expansion to Hawaii from SJC, developing a significant market share in leisure markets to Honolulu, Kahului, Kona, and Lihue.

Section 4B. Benefits of SFO and OAK

Residents and visitors traveling to/from downtown San Francisco and Oakland have closer proximity to SFO/OAK than SJC. It is sensible to assume that passengers traveling from counties north of San Francisco and Oakland, including Sonoma, Napa, and Solano would utilize SFO or OAK instead of passing the airport and heading south to SJC.

SFO is an international gateway airport and is the only airport in the Bay Area CSA and Northern California with substantial international service (48 international destinations) and connecting traffic, as well as domestic non-stop service to 83 destinations. SFO has the most international service compared to the other Bay Area airports. Due to United's hub at SFO, there is much more high-yield business traffic with many flight frequencies. United has increased its capacity at SFO in recent years versus capacity reductions at its other hub airports such as Newark and Chicago.

In July 2018, OAK had non-stop direct service to 54 domestic and 14 international destinations. OAK added a significant amount of international traffic over the past few years including transatlantic service to Barcelona, Copenhagen, London-Gatwick, Azores, Paris, Oslo, Stockholm and Rome, as well as

transborder flights to Mexico including Mexico City, Guanajuato, Guadalajara, Morelia, Los Cabos, and Puerto Vallarta. OAK also has significant Southwest Airlines domestic connectivity to 34 markets in 2018, including recent additional daily service added to five highly sought destinations from the East Bay: Newark, San Antonio, Orlando, Minneapolis, and Indianapolis.

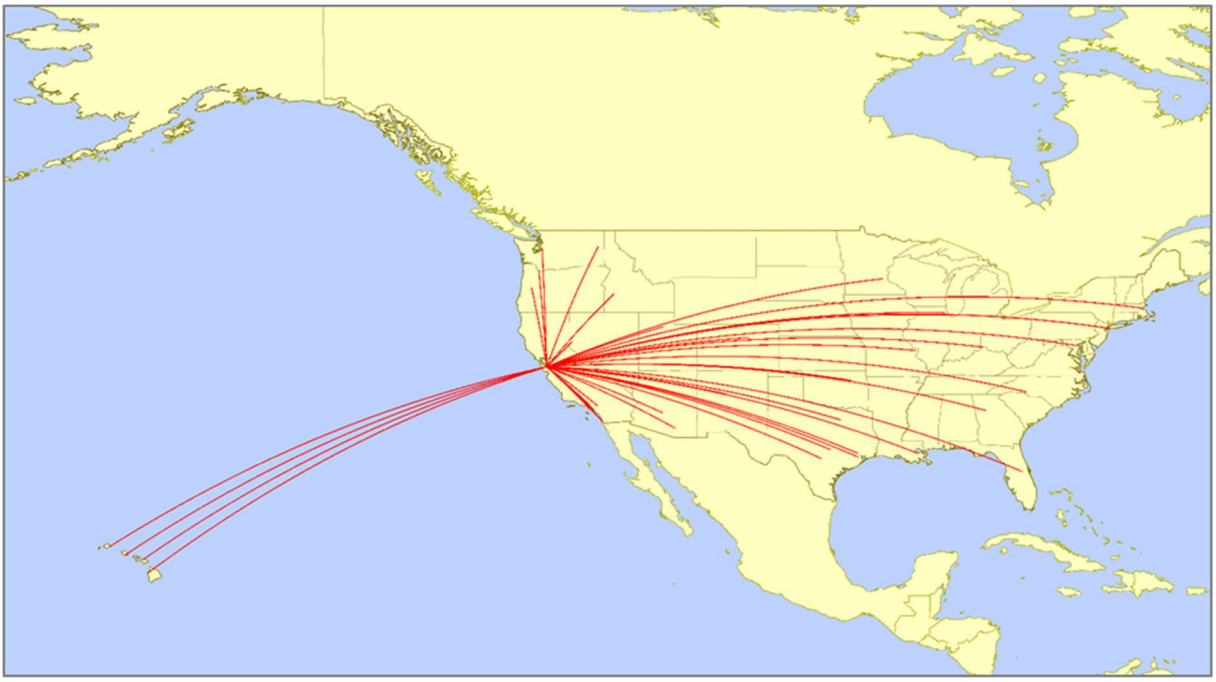
Section 5: Bay Area Airports Air Service

Section 5A. SJC Air Service

In 2017, SJC served approximately 12.5 million passengers, of which 11.6 million were domestic and 900 thousand were international. During this time, 93% of total activity was origin & destination (O&D) passengers with the remaining 7% as connecting passengers. As of July 2018, it is the second busiest airport in the bay area.

In July 2018, SJC provided service to 42 domestic destinations (see **Figure 17, SJC Domestic Routes (July 2018)**) with 182 average daily domestic departures, with an average distance of 702 nm. It also provided service to 11 international destinations including long-haul markets to Asia (Tokyo, Beijing, and Shanghai), European markets (Frankfurt and London), and Transborder (Los Cabos, Guadalajara, Zacatecas, Morelia, Mexico City, Leon, and Vancouver) (see **Figure 18, SJC International Routes (July 2018)**) with 12 average daily international departures (includes Asia, Mexico, and Europe), which had an average distance of 2,241 nm.

Figure 17: SJC Domestic Routes (July 2018)



Source: Official Airline Guide; Landrum & Brown

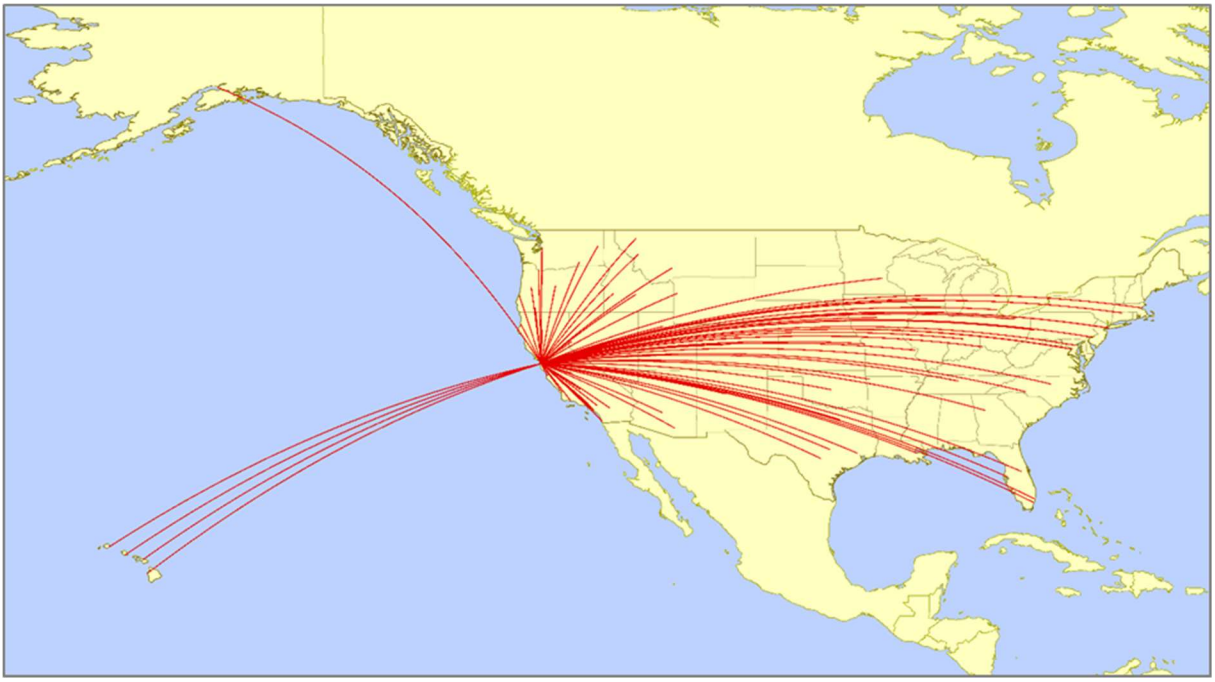
Figure 18: SJC International Routes (July 2018)

Source: Official Airline Guide; Landrum & Brown

Section 5B. SFO Air Service

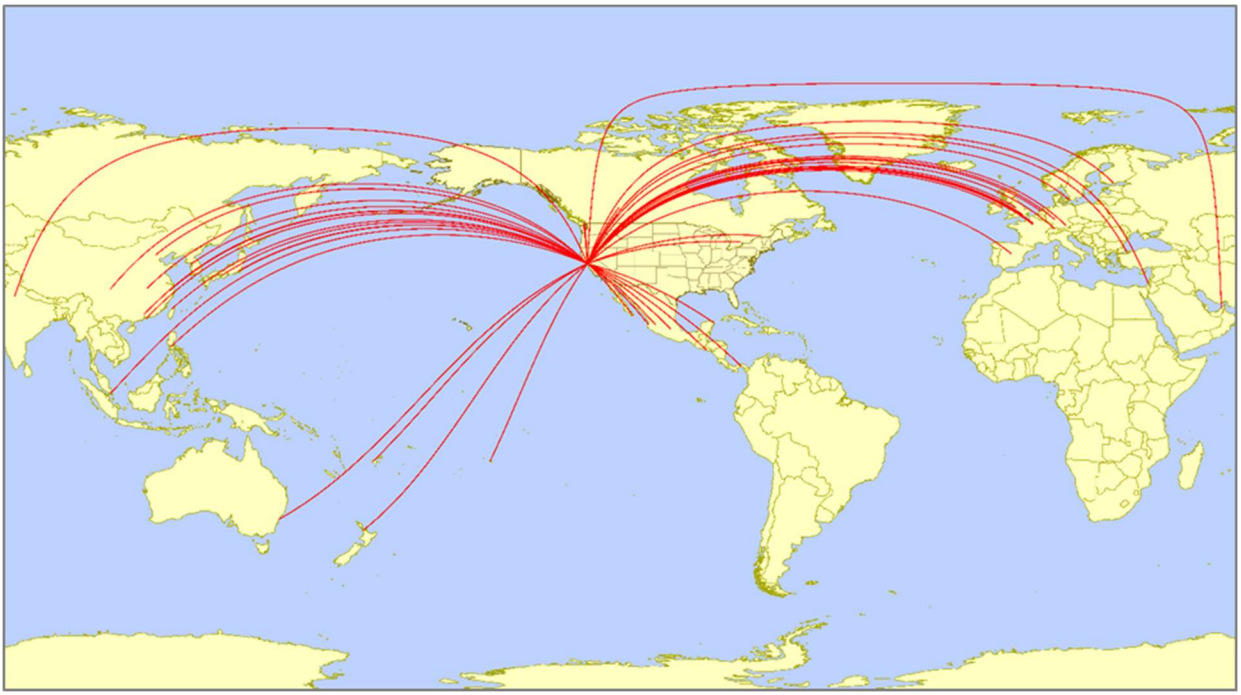
In 2017, SFO served approximately 55.8 million passengers, of which 42.4 million were domestic and 13.4 million were international. During this time, 75% of total activity was O&D passengers. In July 2018, SFO provided service to 83 domestic destinations (see **Figure 19, SFO Domestic Routes (July 2018)**) with 527 average daily domestic departures, with an average distance of 1.060 nm. It also provided service to 48 international destinations (see **Figure 20, SFO International Routes (July 2018)**) with 107 average daily international departures (as an international gateway), which had an average distance of 3.643 nm.

Figure 19: SFO Domestic Routes (July 2018)



Source: Official Airline Guide; Landrum & Brown

Figure 20: SFO International Routes (July 2018)

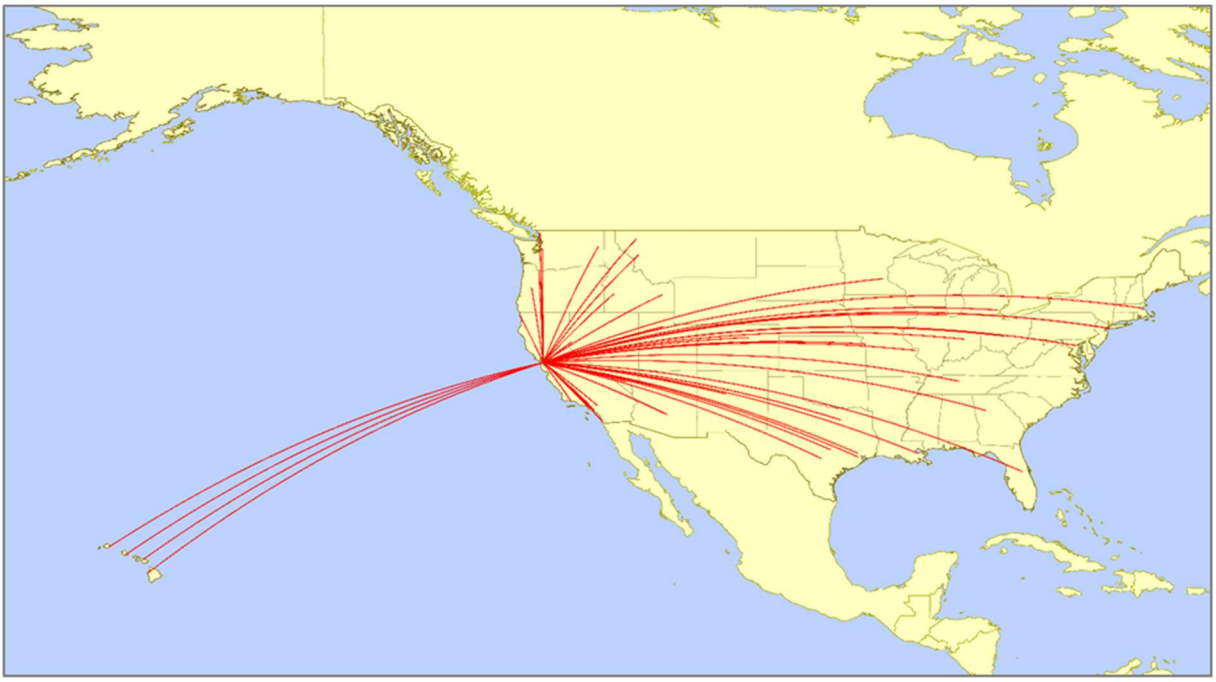


Source: Official Airline Guide; Landrum & Brown

Section 5C. OAK Air Service

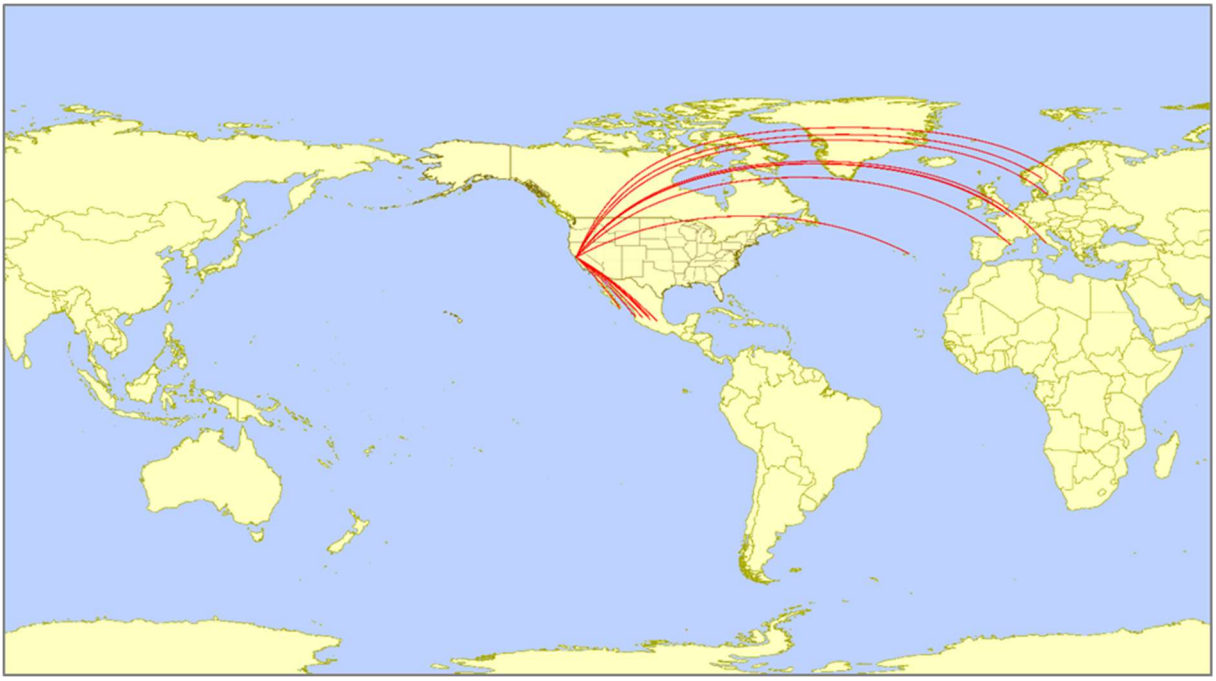
In 2017, OAK served approximately 13.0 million passengers, of which 12.3 million were domestic and 700 thousand were international (almost double from the previous year, 400 thousand). During this time, 89% of total activity was O&D passengers. In July 2018, OAK provided service to 54 domestic destinations (see **Figure 21, OAK Domestic Routes (July 2018)**) with 171 average daily domestic departures, with an average distance of 687 nm. It also provided service to 14 international destinations (see **Figure 22, OAK International Routes (July 2018))** with 9 average daily international departures (focused on Mexico and Europe), which had an average distance of 3,020 nm. OAK has an easily navigated layout with less airline competition than SFO yet offers competitive travel costs.

Figure 21: OAK Domestic Routes (July 2018)



Source: Official Airline Guide; Landrum & Brown

Figure 22: OAK International Routes (July 2018)

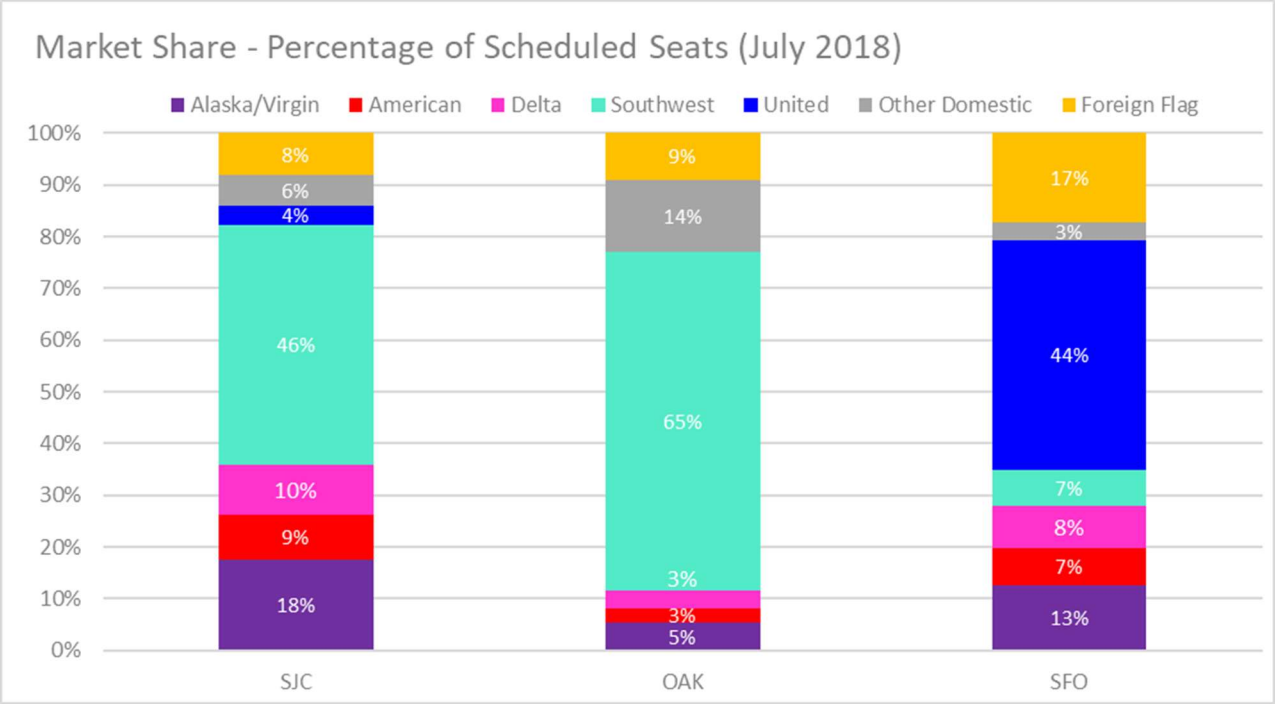


Source: Official Airline Guide; Landrum & Brown

Section 6: Bay Area Market Share

Figure 23, Bay Area – Percentage of Scheduled Seats (July 2018) displays the percentage of scheduled seats by carrier at each Bay Area airport. In July 2018, Southwest Airlines was the primary carrier at SJC (46% of total seats) with a steadily increasing Alaska Airlines market share (18%) and increasing foreign flag carrier presence (8%). United Airlines utilizes SFO as one of its hub airports and is the primary carrier at the airport (44% of total seats). This activity generates network connectivity and high yield business traffic. Alaska Airlines (13% of total seats) operates a mini-hub at SFO and foreign flag carriers have a large presence (17%) due to being an international gateway. OAK is a focus city for Southwest Airlines (65% of total seats in July 2018). OAK also had an increasing amount of foreign flag of seats (9%).

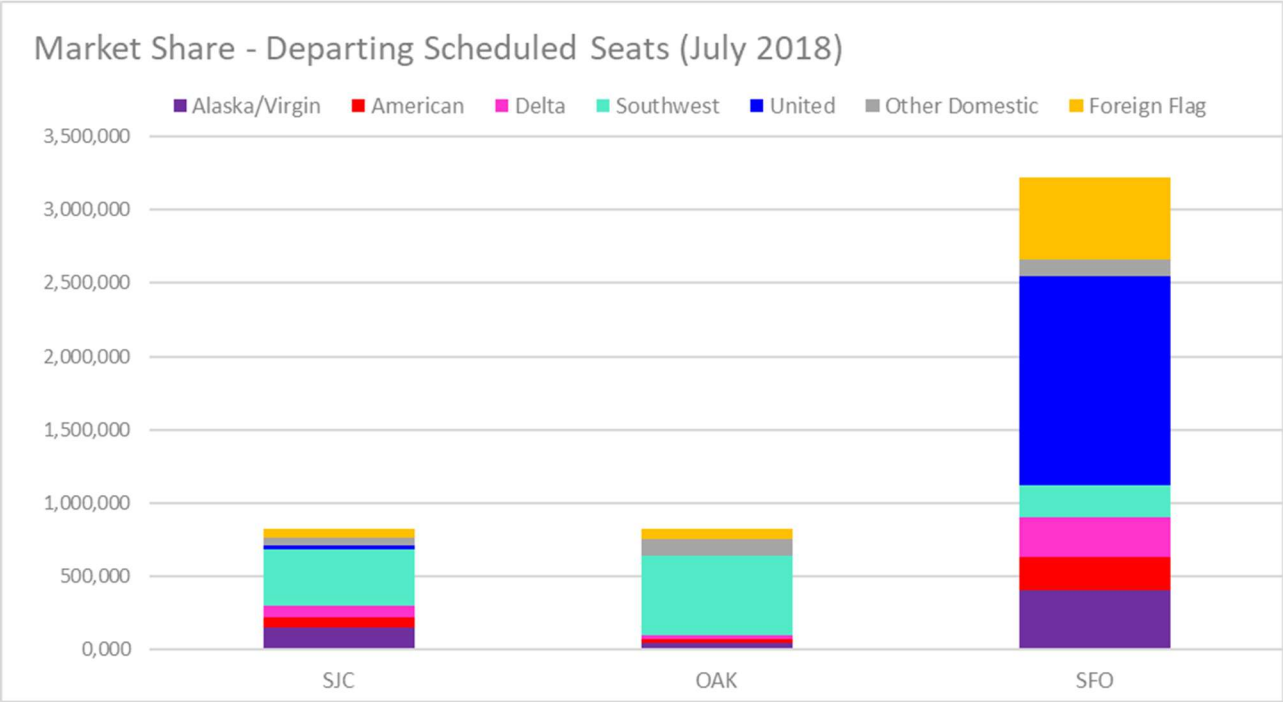
Figure 23: Bay Area – Percentage of Scheduled Seats (July 2018)



Source: Official Airline Guide; Landrum & Brown)

Figure 24, Bay Area – Departing Scheduled Seats (July 2018) displays total departing scheduled seats by carrier at each Bay Area airport. In July 2018, the primary carrier at SJC, Southwest, scheduled approximately 383,200 departing seats, followed by 145,500 departing seats scheduled by Alaska. SJC foreign flag scheduled departing seats in July 2018 were 68,000. United Airlines, the primary carrier at SFO had approximately 1,427,400 scheduled departing seats in July 2018, followed by Alaska, the second largest carrier, with approximately 407,300 scheduled departing seats. During the same period, foreign flag scheduled departing seats at SFO were approximately 560,700. Southwest, the primary carrier at OAK, had scheduled approximately 540,200 departing seats in July 2018. During the same period, foreign flag scheduled departing seats at OAK were 75,100.

Figure 24: Bay Area – Departing Scheduled Seats (July 2018)



Source: Official Airline Guide; Landrum & Brown

Section 7: Airline Operations

The Bay Area airports generally operate as a system with all airports predominantly operating in the west flow. However, each airport may individually transition to the southeast flow when winds dictate such a change. These southeast winds most often occur during the winter season, but they can appear at other times of year.

In addition to runway configurations, flight procedures at each airport are designed in such a manner to ensure vertical and lateral separation between traffic flows. These types of restrictions optimize use of the available airspace while allowing each airport to maximize throughput.

In irregular operations, the airports depend on each other to accommodate flight diversions. Among the Bay Area airports, SFO is most prone to weather-related delays, a result of its closely-spaced parallel runways. In these instances, arriving aircraft are often guided into hold patterns. Excessive delays in a hold pattern may necessitate a diversion to another airport for refueling, and these diverted flights often use SJC and OAK as their alternate airports.

In another example of this close relationship among Bay Area airports, it was recently reported that Alaska Airlines is experimenting with a new operational adjustment where SFO-bound flights could purposefully be re-routed to OAK or SJC to avoid lengthy delays. Instead of a delayed departure from another airport (bound for SFO), the flight could depart on-time but destined for OAK or SJC instead. Upon arrival in OAK or SJC, passengers would be transferred to SFO via pre-arranged ground transportation. Meanwhile, with the aircraft positioned at either OAK or SJC, the subsequent departure would also depart from either OAK or SJC and departing passengers would be transported from SFO to

either one of the other airports. This strategy demonstrates how airlines can leverage the proximity of each airport to manage operations and mitigate delays.

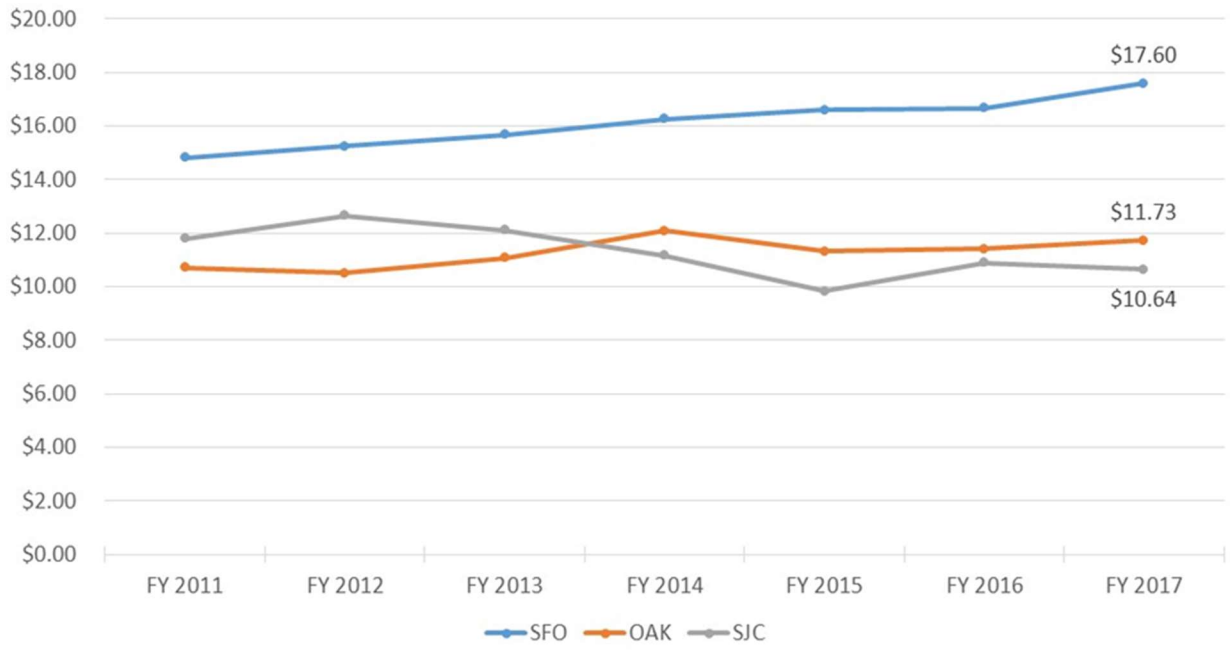
Section 8: Cost of Doing Business

To evaluate the cost of doing business at each Bay Area airport, it was necessary to study the cost per enplanement (CPE) for each airport. CPE is an industry standard in determining average costs for an airline to operate at a particular airport. Per the Certification Activity Tracking System (CATS) website of the Federal Aviation Administration (FAA), the following costs were summed and included in calculating CPE:

- Passenger airline landing fees
- Terminal arrival fees, rents, and utilities
- Terminal area apron charges/tiedowns
- Federal Inspection Fees
- Other passenger aeronautical fees

These costs, coupled with enplanement data, were used in determining CPE. Among the Bay Area airports, SFO has always had the highest CPE while OAK and SJC have had lower and fairly comparable CPEs. In the 2017 fiscal year, SJC had the lowest CPE of $10.64 (of all Bay Area airports). Meanwhile, SFO had the highest CPE of $17.60. **Figure 25, CPE Comparison** displays historical passenger airline CPE from FY 2011-2017 at the Bay Area airports.

Figure 25: CPE Comparison



Source: Compliance Activity Tracking System (CATS), Federal Aviation Administration, cats.airports.faa.gov; Landrum & Brown

Section 9: Advantage and Disadvantages of the Bay Area Airports

Each airport has unique characteristics that may be classified as advantages or disadvantages for passengers and airlines. These characteristics are diverse and include a variety of features such as airline competition, facilities, destinations served, congestion, and weather patterns.

SJC:

Advantages

- Lower operating costs: As discussed in the CPE comparison, SJC has the lowest costs among all Bay Area airports.
- Fewer airlines – less competition to many markets: Airlines at SJC often face less competition when compared to operating at busier airports such as SFO.
- Appeals to high-yield business traffic in Silicon Valley: SJC is the closest airport to many companies in Silicon Valley. The airport can leverage this convenient location to attract many high-yield business travelers in the technology industry.
- Few delays: Unlike SFO, SJC has a simple runway layout and favorable weather conditions that do not affect flight operations, thus resulting in few delays.
- Positive passenger experience with less traffic and simple airport layout: Compared to SFO, SJC offers a simple airport layout, less congestion, and easy curbside access.

Disadvantages

- Does not attract San Francisco travelers: Given SJC's location, which is 45 miles south of San Francisco, it is difficult for the airport to attract travelers who are originating in or destined for San Francisco. The airport's primary catchment area is the South Bay.
- Fewer destinations and flight frequencies as that of SFO: SJC has fewer flights and destinations when compared to SFO, especially with respect to international and transcontinental flights. Although SJC may be more conveniently located for some travelers, those travelers may choose SFO for long haul flights.
- Curfew restrictions: SJC observes a noise-based curfew program between the hours of 23:30 and 06:30. This curfew could affect international or transcontinental flights that would otherwise operate in the late night or early morning hours. In contrast, SFO has several international and transcontinental flights that operate around 01:00 and 06:00, respectively.

SFO:

Advantages

- Prestige of operating at the region's primary airport: SFO has the distinction of serving the region's largest market, San Francisco. Therefore, many airlines prioritize service to this airport over the region's smaller airports.
- Appeals to high-yield business traffic with proximity to SF and many flight frequencies: Many high-yield business travelers originate in or are destined for San Francisco, and SFO is the easiest gateway airport for those passengers. Additionally, the airport offers a high frequency of flights to key business markets.

- Robust facilities that accommodate all aircraft types and many passengers: SFO has a variety of facilities that can accommodate all types of aircraft and large volumes of passengers. In this regard, the airport is more capable than its Bay Area counterparts are.
- Connections to many destinations: SFO has flights to the most destinations of any Bay Area airport.
- CBP operating hours: CBP is staffed for most hours of the day at SFO, which enables international flights to operate at many hours. In contrast, SJC and OAK only have CBP staffing at specific hours, which may limit the addition of new international flights.

Disadvantages

- Higher operating costs: As discussed, SFO has the highest CPE of all Bay Area airports (by a wide margin).
- Competition from dominant United hub and smaller Alaska hub (previously Virgin America): New airlines that start service and existing airlines that want to add service at SFO face stiff competition from United's dominant hub and Alaska's smaller yet still significant hub. These two carriers provide significant challenges for other airlines.
- Prone to weather-related delays: Unlike SJC and OAK, SFO is susceptible to significant weather-related delays because of its closely spaced parallel runways and frequent low ceilings. These delays result in significant operational challenges that compromise airline schedule integrity.

<u>OAK:</u>

Advantages

- Lower operating costs: OAK's operating cost is significantly lower than that of SFO and comparable (albeit slightly higher) than that of SJC.
- Fewer airlines – less competition to many markets: With fewer airlines and flights compared to SFO, airlines at OAK generally face less competition on a given route. However, airlines often encounter competition from Southwest, which is the dominant carrier at OAK.
- Appeals to San Francisco travelers: Although OAK is located in the East Bay, it still attracts many travelers who are originating in or destined for San Francisco. Additionally, BART provides convenient public transportation to downtown San Francisco from OAK.
- Few delays: With one air carrier runway and a modest flight schedule, OAK rarely experiences delays.
- Positive passenger experience with less traffic and simple airport layout: OAK has a simple airport layout that is comprised of just two terminals and easy curbside access for passengers.

Disadvantages

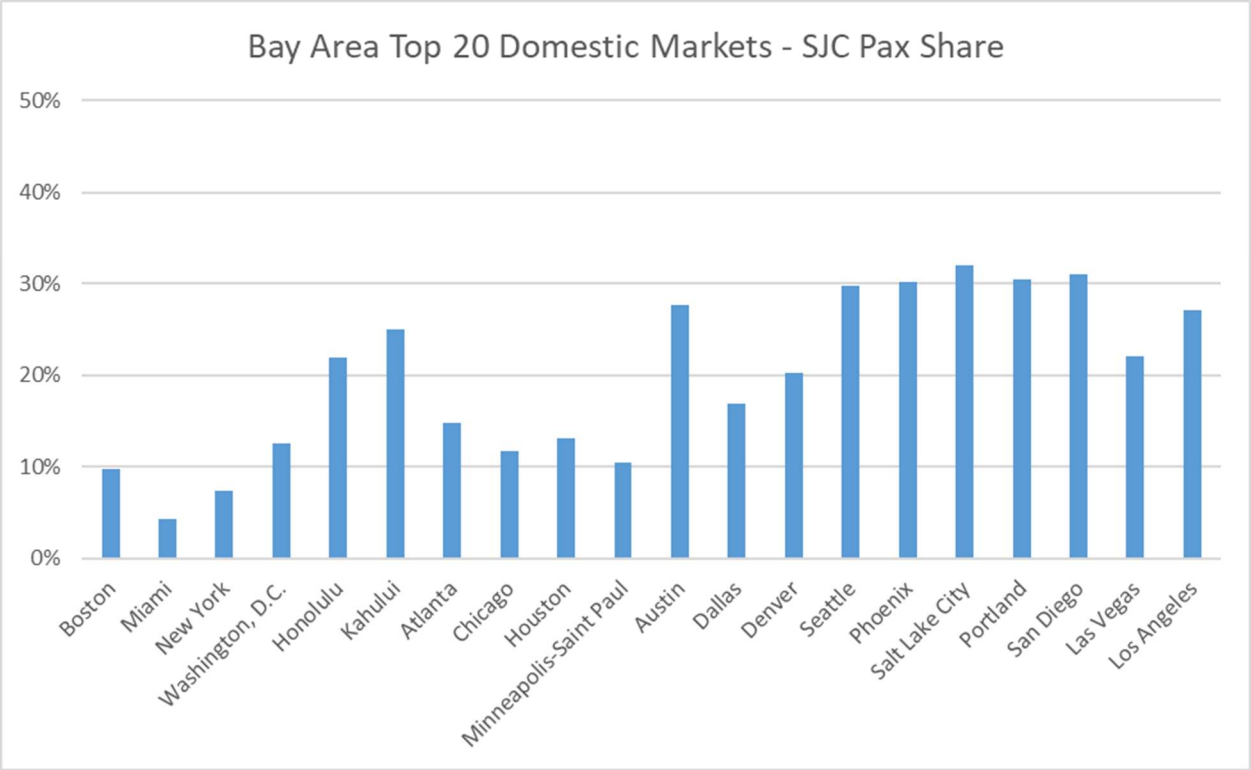
- Competition from dominant Southwest hub and sizable operations from other low-cost carriers: Carriers at OAK often face competition from Southwest's dominant hub. Depending on routes and services, Southwest can be a formidable opponent when establishing new routes for existing carriers or adding new carriers. There is also a significant presence of ultra-low-cost carriers with Allegiant and Spirit.
- Facilities: Unlike Terminal 2, Terminal 1 does not provide a competitive level of service.
- Fewer destinations and flight frequencies as that of SFO: When compared with SFO, OAK has fewer destinations and flights.

Section 10: Regional Competition

To study SJC's role among the Bay Area airports, it is important to evaluate the airport's passenger share among the Bay Area's busiest markets. The airport primarily serves shorter routes and accommodates an average of 27% of the Bay Area passengers on these routes. Example destinations include Los Angeles, Las Vegas, and San Diego. However, SJC's passenger share falls to an average of just 13% on longer domestic routes such as Chicago, New York, and Boston. While the airport does not have as much passenger share in domestic long-haul markets, it does have a significant market share in leisure markets to Hawaii (Honolulu and Kahului). In the Bay Area's top 20 international markets, SJC averages just 10% of the passenger share with the notable exception of Guadalajara, which has substantial service from SJC.

Figure 26, Top Bay Area O&D Domestic Markets displays SJC's passenger share in the top 20 Bay Area domestic O&D markets.

Figure 26: Top Bay Area Domestic O&D Markets



Miami: FLL, MIA; New York: EWR, JFK, LGA; Washington, D.C.: BWI, DCA, IAD; Chicago: MDW, ORD; Houston: HOU, IAH; Dallas: DAL, DFW; Los Angeles: BUR, LAX, LGB, ONT, SNA. Destinations sorted in descending order by distance from the Bay Area. "Shorter" Haul defined as destinations less than 1,500 miles from the Bay Area.
Sources: U.S. DOT, Air Passenger Origin-Destination Survey, 2017 data

Figure 27, Top Bay Area O&D International Markets displays SJC's passenger share in the top 20 Bay Area international O&D markets.

Figure 27: Top Bay Area O&D International Markets

London: LGW, LHR; Tokyo: HND, NRT.
Destinations sorted in descending order by distance from the Bay Area.
Sources: U.S. DOT, Air Passenger Origin-Destination Survey, 2017 data