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Development Challenges of Secondary and Small Airports in California, Research Report 11-21

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Development Challenges of Secondary and Small Airports in California

MTI Report 11-21

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REPORT 11-21

DEVELOPMENT CHALLENGES OF SECONDARY AND SMALL AIRPORTS IN CALIFORNIA

Senanu Ashiabor, Ph.D.
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16. Abstract

This study investigates the development of secondary and smaller airports in California. Low-Cost Carrier (LCC) business is growing at these airports because they offer reduced operating costs, and they have adequate capacity to help LCCs avoid battling with incumbent airlines at the large hubs for limited resources, such as gates.

However, increased LCC aircraft operations at the secondary airports have led to significant noise impacts on the surrounding communities and this has been a challenge for the secondary airport operators. They have imposed operational curfews to limit the noise impacts, but this approach constrains the resident airlines that want to increase their traffic. As a result, some LCCs have begun to initiate flights out of the large hubs.

Statistics from this study show that the LCCs have replaced the legacy airlines as the dominant air provider in the state. With their growing dominance, the LCCs will become more attractive to the large hub airports, and the secondary airports will face increased competition in retaining them. To retain those LCCs, the secondary airports must better understand how LCCs make investment decisions related to airport development. At the same time, they must better educate the LCCs about their airport needs.

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EXECUTIVE SUMMARY

This report looks at the development challenges facing airports in the state of California. After deregulation of the US aviation industry in 1978, the major airlines focused their efforts on building up operations at core hub airports, usually at the major or close-to-major economic centers of activity. They used commuter airlines with smaller planes to feed flights from smaller communities into these hubs, creating the hub-and-spoke system.

The hub-and-spoke system was efficient for the airlines that thrived, as they were able to consolidate their resources at a few major airports. However this led to traffic stagnating and declining at airports close to those hubs. These airports are usually referred to as secondary airports. Metropolitan planning agencies, managers of the secondary airports, and city and state officials have long advocated for a more even allocation of flights across airports in their regions to reduce and manage congestion at the primary airports. The legacy airlines, however, had invested heavily in developing infrastructure at the large hubs, and it did not make economic sense to invest in other airports.

The secondary airports were thus left with excess capacity as the primary hubs grew congested. Residents living close to these secondary airports frequently bypass them, driving long distances, to catch flights at hubs with more frequent flights and nonstop flights to more destinations.

The past ten years have seen the rapid growth of a new category of airline in the US market. The airlines in this new category are generically referred to as low-cost carriers (LCC). These airlines work very hard to keep their operating costs low so they can pass on the savings to passengers in the form of low fares. A key component of the cost-minimizing strategy of LCCs has been the use of secondary airports. Using secondary airports allows the LCCs to negotiate cheaper aeronautical fees with the airports, avoid the congestion at the hubs, and also avoid having to battle with the legacy airlines at hubs for limited resources, such as gates, among others. This has generated significant demand at the secondary airports, exactly what the planners, and local and state officials had longed for.

This report is a focused study of the airport system in the state of California, looking at how the operations of the LCCs are impacting the development of secondary airports in the state. Three of California's busier secondary airports (Oakland, Ontario, and Bob Hope airports) stated in interviews that noise impacts and expansion are their key challenges. Initiation of LCC operations has generated significant demand at these airports. Traffic at Long Beach airport more than doubled in less than a year once JetBlue initiated operations. Oakland, Ontario, Bob Hope, and airports where Southwest Airlines has initiated traffic have all seen significant traffic growth. The growth, however, has turned out to be a double-edged sword, leading to more noise and environmental pollution. The result has been complaints from residents in the surrounding communities.

The pushback from residents on noise from aircraft operations is now a key constraint in the ability of the LCCs to grow their traffic at these airports. Airport officials admit there is no easy fix to the noise pollution problem. At Bob Hope Airport they have moved proactively to engage with the community and implement curfews and rules of operations

so aircraft noise is kept to a minimum. At Long Beach the city initially imposed a very stringent noise ordinance but was forced to relax the restrictions after the airlines mounted a legal challenge.

The LCCs have begun to slowly initiate flights out of the large hubs. In the recent economic downturn some of them actually increased their flights at the large hubs and cut back on flights at the secondary airports. The secondary airports are now faced with the challenge of fighting to retain the LCCs at their ports while placating the neighboring residents and communities. If the current trend continues and the LCCs transition a large proportion of their flights to the large hubs, they could potentially reverse the gains in passenger traffic that the secondary airports have experienced during the growth of the LCCs.

This report also looks at smaller airports and the opportunity for them to use very light jets (VLJ) as an on-demand service. The authors estimate that the cost of on-demand jet service fares to travelers in smaller communities will be out of reach for even business travelers. The authors do believe it may be possible in select locations to utilize spare capacity of corporate aircraft to meet the needs of business travelers in some of the smaller communities.

I. INTRODUCTION

The past ten years have seen the rapid growth of a new category of airline in the US market. The airlines in this new category are generically referred to as low-cost carriers (LCC). They are so-named because a major component of their operating strategy has been to keep costs low and pass on the savings to customers in the form of low fares. Southwest Airlines is the pioneer and the most successful LCC airline in the US. Southwest has gained so much market share, in fact, that at the end of the first quarter of 2012, it was the largest US domestic carrier, excluding international passengers. A key component of the cost-minimizing strategy of LCC has been the use of secondary airports. This strategy allows them to negotiate cheaper aeronautical fees, avoid the congestion at hubs, and also avoid having to battle legacy airlines at the hubs for limited resources, such as gates, among others.

Until recently, the airlines operating hub-and-spoke networks (usually referred to as legacy airlines or carriers) have dominated the airline industry. These legacy airlines sought to gain competitive advantage by building large-scale hub-and-spoke networks with high departure frequencies and aggressive ticket pricing strategies. As far back as 1972, Fruhan[1] had empirically demonstrated that a passenger airline's regional market share has a strong correlation to the frequency of its flights. Hence, the modus operandi of the airlines has been to concentrate as many flights as possible (with high frequencies) at their hubs to ensure they capture the bulk of passenger traffic.

The majority of the hub airports are located close to the major metropolitan regions in the US, as they tend to be the centers of economic activity and generators of passenger traffic. The concentration of flights created by this competitive environment has resulted in cases in which secondary airports close to primary airports are left with excess capacity while the primary hub grows increasingly congested. Residents living close to these secondary airports frequently bypass them, driving up to two hours to catch flights at the primary hubs because they offer a larger number of destinations, cheaper fares and more frequent departures. Aviation literature typically refers to this phenomenon as "airport leakage."

Efforts by planners, airport operators and authorities to convince the legacy carriers to spread flights across regional airports have not been successful for a variety of reasons that will be discussed later in this report. The primary hub airports are experiencing constraints accommodating gradually increasing aircraft operations on their existing facilities (runways and taxiways). They, however, find it difficult to make capacity improvements, such as adding runways, due to limited financial resources, stringent environmental requirements and community opposition. The large hubs are slowly becoming a bottleneck in the national airspace system. Despite their current capacity limitations, it is worth noting that the NextGen program being rolled out by the FAA contains several elements aimed at improving capacity of the major commercial service airports to serve increased traffic while minimizing the impact of operations on neighboring communities.

Though LCCs operate through point-to-point networks, they still need to be close to high-density markets; therefore, they select only those secondary airports that are close to metropolitan areas. The LCCs' preference for secondary airports has implications for

small(er) airports that are outside major metropolitan areas. Those such as Monterey Airport in Northern California and McClellan-Palomar in Southern California continue to experience significant airport leakage as local residents bypass them to access primary and LLC-serviced secondary airports more than two hours' drive from their communities. Traffic has been so low at these smaller airports that some would be unable to maintain scheduled airline service without subsidies, such as the Essential Air Service Program.[2]

This report is a focused study of the airport system in the state of California, looking at how the operations of the legacy airlines and LCC impact the development of secondary airports in the state. The objective is to identify the key factors driving the dynamics of airport selection by airlines – especially the LCCs – and use this information to identify policies and measures that planners can use to guide the development of secondary airports. The review also looks at the smaller airports that are too far from the major metropolitan areas to be attractive to LCCs and examines their options for growing and sustaining traffic. The report is developed based on a review of literature and interviews with public officials at selected airports in California.

The next section is a broad overview of how low-cost carriers have become integrated and grown in the California airport system, followed by a review of secondary airports with low-cost carrier presence and a look at one secondary airport that has spare capacity. Some of the key airports were unable to grant interviews; so the authors relied heavily on published statistics. The report also includes the results of interviews with two relatively small airports experiencing airport leakage and discusses some opportunities they could explore to attract traffic. The information gathered from the interviews, publications and analyses are used to develop recommendations for steps the airports should be taking to improve and sustain airline traffic.

II. OVERVIEW OF THE CALIFORNIA AIRPORT SYSTEM

Three of California's major airports – Los Angeles International, San Francisco International and San Diego – consistently rank among the top 30 hub airports in the United States. As of 2012, there are 246 public-use airports, in California, of which 214 are privately owned. Air traffic in California is concentrated at a small number of the 246 airports. Table 1 shows that approximately 75 percent of the airline traffic is concentrated in the top five of the state's airports.

Table 2 was generated using enplanement data from the Bureau of Transportation Statistics T100 Domestic tables for the top 15 California airports. The data shows that almost 90 percent of the traffic is concentrated at the first seven airports. The high concentration of flights at these airports leads to high levels of congestion, especially during peak travel seasons. Any minor spike or disruption at those facilities during peak periods tends to cascade through the national air space system in the form of delays and cancelations.

Aviation administrators and planners have long sought to reduce this concentration of traffic with little success. A classic example occurred in 1992 when the US government established rules for flights out of Regan National limiting frequency and limiting destination distances to 1,000 miles to encourage airlines to shift traffic to Washington Dulles. Legacy airlines circumvented the rule by rerouting long-haul domestic flights through hubs that within that radius, and rerouting international flights through JFK in New York instead of nearby Washington Dulles.[3] The operating paradigm and structure of legacy airlines means they tend to favor large airports and plan to increase capacity at existing airports rather than moving operations to secondary airports.

Table 1. 2010 Passenger Enplanements at Primary US Airports (Adapted from FAA Website)

Rank	State	Airport Code	City	Airport Name	Y2010
1	GA	ATL	Atlanta	Hartsfield - Jackson Atlanta International	43,130,585
2	IL	ORD	Chicago	Chicago O'Hare International	32,171,831
3	CA	LAX	Los Angeles	Los Angeles International	28,857,755
4	TX	DFW	Fort Worth	Dallas/Fort Worth International	27,100,656
5	CO	DEN	Denver	Denver International	25,241,962
6	NY	JFK	New York	John F. Kennedy International	22,934,047
7	TX	IAH	Houston	George Bush Intercontinental/Houston	19,528,631
8	CA	SFO	San Francisco	San Francisco International	19,359,003
9	NV	LAS	Las Vegas	McCarran International	18,996,738
10	AZ	PHX	Phoenix	Phoenix Sky Harbor International	18,907,171
11	NC	CLT	Charlotte	Charlotte/Douglas International	18,629,181
12	FL	MIA	Miami	Miami International	17,017,654
13	FL	MCO	Orlando	Orlando International	17,017,491
14	NJ	EWR	Newark	Newark Liberty International	16,571,754
15	MI	DTW	Detroit	Detroit Metropolitan Wayne County	15,643,890
16	MN	MSP	Minneapolis	Minneapolis-St. Paul International/ Wold-Chamberlain	15,512,487

Rank	State	Airport Code	City	Airport Name	Y2010
17	WA	SEA	Seattle	Seattle-Tacoma International	15,406,243
18	PA	PHL	Philadelphia	Philadelphia International	14,951,254
19	MA	BOS	Boston	General Edward Lawrence Logan International	13,561,814
20	NY	LGA	New York	La Guardia	12,001,501
21	VA	IAD	Dulles	Washington Dulles International	11,276,481
22	MD	BWI	Glen Burnie	Baltimore/Washington International Thurgood Marshal	10,848,633
23	FL	FLL	Fort Lauderdale	Fort Lauderdale/Hollywood International	10,829,810
24	UT	SLC	Salt Lake City	Salt Lake City International	9,910,493
25	HI	HNL	Honolulu	Honolulu International	8,740,077
26	VA	DCA	Arlington	Ronald Reagan Washington National	8,736,804
27	IL	MDW	Chicago	Chicago Midway International	8,518,957
28	CA	SAN	San Diego	San Diego International	8,430,509
29	FL	TPA	Tampa	Tampa International	8,137,222
30	OR	PDX	Portland	Portland International	6,582,227
Total for All Commercial Service Airports					**712,025,632**
Total for Top 30 Airports					**504,552,861**

Table 2. Cumulative Flight Distribution Among Top 15 Airports in California (2010 Enplanements)

Airport	Airport ID	2010 (% Enplanements)	Cumulative (% Enplanements)
Los Angeles International	LAX	30%	30%
San Francisco International	SFO	22%	52%
San Diego International	SAN	12%	64%
Oakland International	OAK	7%	70%
Sacramento International	SMF	6%	77%
Orange County/John Wayne	SNA	6%	83%
San José International	SJC	6%	89%
Ontario International	ONT	3%	92%
Burbank/Glendale/Pasadena	BUR	3%	95%
Long Beach Municipal	LGB	2%	97%
Palm Springs Regional	PSP	1%	98%
Fresno Yosemite International	FAT	1%	99%
Santa Barbara Municipal	SBA	1%	100%
Monterey Peninsula	MRY	0%	100%
San Luis Obispo	SBP	0%	100%

III. LOW-COST CARRIERS AT CALIFORNIA AIRPORTS

LOW-COST CARRIER DOMINANCE AT SECONDARY AIRPORTS IN METROPOLITAN REGIONS

Part of the cost-minimizing strategy of the LCC has been to operate out of secondary airports close to urban areas instead of the existing major airports. In California, Southwest and JetBlue airlines have fueled growth at Oakland and Long Beach airport, respectively. The LCCs' share of passenger traffic has grown steadily from 7 percent in 1990 to 20 percent in 2000[4] and was estimated to be at 50 percent by 2005.[5] It is becoming clear that LCCs are likely to dominate air traffic in the future.

Tables 3 through 7 show the rank of the top five airlines at each of the 15 airports in California from 1990 to 2010 (at 5 year intervals). The data was processed from the T100 database.[6] (The airline codes for Southwest and JetBlue are WN and B6, respectively.)

Table 3. Ranking of Top 5 Airlines by Enplanements at Top 15 Airports in California in 1990

Airport Name	Airport ID	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Los Angeles International	LAX	UA	DL	AA	US	CO
San Francisco International	SFO	UA	US	AA	DL	CO
San Diego International	SAN	US	WN	AA	UA	HP
San José International	SJC	AA	US	UA	HP	DL
Oakland International	OAK	UA	WN	US	HP	AS
Ontario International	ONT	UA	AA	WN	HP	DL
Orange County/John Wayne	SNA	AA	US	HP	CO	NW
Sacramento International	SMF	UA	AA	US	DL	OE
Burbank/Glendale/Pasadena	BUR	US	WN	HP	UA	AA
Long Beach Municipal	LGB	AS	HP	AA	UA	DL
Fresno Yosemite International	FAT	OE	DL	UA	HP	US
Palm Springs Regional	PSP	AA	AS	OE	UA	HP
Santa Barbara Municipal	SBA	UA	AA	OE	HP	
Monterey Peninsula	MRY	OE	UA	US		
Bakersfield Meadows Field	BFL	AA	OE	HP		

Notes:

- In 1990, Southwest ranked only second and third out of five of the top fifteen airports in the state.
- Note: WN: Southwest Airlines, B6: JetBlue Airways (See legend for other airline codes below).

Airline Codes for Tables 3 through 7

AA – American Airlines	**G4 – Allegiant Air**	**UA – United Airlines**
AS – Alaska Airlines	**HA – Hawaiian Airlines**	**US – US Airways**
B6 – JetBlue Airways	**MQ – American Eagle**	**WN – Southwest Airlines**
CO – Continental Airlines	**OO – Skywest Airlines**	**YV – Mesa Airlines**
DL – Delta Airlines	**QX – Horizon Air**	**YX – Republic Airlines**

Table 4. Ranking of Top 5 Airlines by Enplanements at Top 15 Airports in California in 1995

Airport Name	Airport ID	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Los Angeles International	LAX	UA	WN	DL	AA	CO
San Francisco International	SFO	UA	AA	DL	CO	NW
San Diego International	SAN	WN	UA	AA	DL	HP
Oakland International	OAK	WN	UA	AS	HP	DL
San José International	SJC	WN	QQ	AA	AS	UA
Orange County/John Wayne	SNA	UA	HP	AA	WN	AS
Sacramento International	SMF	WN	UA	HP	AA	DL
Ontario International	ONT	WN	UA	HP	DL	AA
Burbank/Glendale/Pasadena	BUR	WN	UA	AS	HP	AA
Palm Springs Regional	PSP	AA	AS	UA		AX
Fresno Yosemite International	FAT	DL	AA	AX		YV
Long Beach Municipal	LGB	HP		AS		
Santa Barbara Municipal	SBA	UA	ZW		AX	MQ
Monterey Peninsula	MRY	UA	AX		YV	MQ
Bakersfield Meadows Field	BFL	AA		YV		

Note: Five years after previous measurement, Southwest was present at eight of the top fifteen airports in the state.

Table 5. Ranking of Top 5 Airlines by Enplanements at Top 15 Airports in California in 2000

Airport Name	Airport ID	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Los Angeles International	LAX	UA	AA	WN	DL	NW
San Francisco International	SFO	UA	AA	DL	NW	CO
San Diego International	SAN	WN	UA	AA	DL	HP
San José International	SJC	WN	AA	UA	AS	HP
Oakland International	OAK	WN	UA	AS	AA	HP
Sacramento International	SMF	WN	UA	HP	DL	AS
Orange County/John Wayne	SNA	AA	UA	HP	WN	AS
Ontario International	ONT	WN	UA	DL	HP	AS
Burbank/Glendale/Pasadena	BUR	WN	UA	AS	HP	AA
Palm Springs Regional	PSP	AS	AA	UA	MQ	NW
Long Beach Municipal	LGB	AA	HP	G4		
Santa Barbara Municipal	SBA	UA	MQ	ZW		XP
Fresno Yosemite International	FAT	MQ	QX	AA	G4	
Monterey Peninsula	MRY	MQ		UA		
San Luis Obispo	SBP	MQ				

Note: By 2000, Southwest t ranked first at six of the top fifteen California airports.

Table 6. Ranking of Top 5 Airlines by Enplanements at Top 15 Airports in California in 2005

Airport Name	Airport ID	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Los Angeles International	LAX	AA	UA	WN	DL	OO
San Francisco International	SFO	UA	AA	OO	DL	NW
San Diego International	SAN	WN	UA	AA	DL	HP
Oakland International	OAK	WN	B6	AS	UA	HP
Sacramento International	SJC	WN	AA	AS	UA	MQ
Orange County/John Wayne	SMF	WN	UA	HP	DL	AA
San José International	SNA	WN	AA	AS	UA	HP
Ontario International	ONT	WN	DL	HP	AA	UA
Burbank/Glendale/Pasadena	BUR	WN	OO	AA	AS	HP
Long Beach Municipal	LGB	B6	AA	AS	YV	
Palm Springs Regional	PSP	AS	OO	AA	YV	NW
Fresno Yosemite International	FAT	OO	YV	AA	QX	MQ
Santa Barbara Municipal	SBA	OO	YV	MQ	QX	
Monterey Peninsula	MRY	OO	YV	MQ		
San Luis Obispo	SBP	OO	YV	MQ		

Note: By 2005, Southwest dominance grows and JetBlue is first and second at Long Beach and Oakland.

Table 7. Ranking of Top 5 Airlines by Enplanements at Top 15 Airports in California in 2010

Airport Name	Airport ID	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Los Angeles International	LAX	AA	UA	WN	DL	OO
San Francisco International	SFO	UA	AA	WN	OO	DL
San Diego International	SAN	WN	DL	UA	AA	US
Oakland International	OAK	WN	B6	AS	US	HA
Sacramento International	SMF	WN	DL	UA	OO	US
Orange County/John Wayne	SNA	WN	AA	DL	UA	AS
San José International	SJC	WN	AS	AA	US	OO
Ontario International	ONT	WN	AA	US	OO	CO
Burbank/Glendale/Pasadena	BUR	WN	OO	AA	B6	AS
Long Beach Municipal	LGB	B6	OO	YV	QX	YX
Palm Springs Regional	PSP	OO	AS	AA	YV	G4
Fresno Yosemite International	FAT	OO	YV	AA	MQ	QX
Santa Barbara Municipal	SBA	OO	YV	AA	QX	YX
Monterey Peninsula	MRY	OO	MQ	AA	G4	
San Luis Obispo	SBP	OO	YV			

Note: By 2010, Southwest airlines ranks first at seven of the top fifteen airports, and JetBlue ranks first, second and fourth.

The information in Tables 3 through 7 illustrates how LLC Southwest airlines has gone from being the second- and third-ranked airline at four airports to the dominant airline at seven of California's top 15 airports.

JetBlue, another LLC, has also grown tremendously. It currently dominates Long Beach and is the number two airline in terms of domestic passengers at Oakland airport. Given the above trend it will not be surprising if five years from now Southwest airlines is in second place at either Los Angeles or San Francisco international airports. Even without dominating these two airports, Southwest airlines is the dominant carrier in the state (see Table 8).

Table 8. Summary of Enplanements of Top 10 California Airports in 2010

Airport Name	Airport ID	Rank 1		Rank 2		Rank 3		Rank 4		Rank 5	
		Enplanements	Airline	Enplanements	Airline	Enplanements	Airline	Enplanements	Airline	Enplanements	Airline
Los Angeles International	LAX	3966344	AA	3482252	UA	3416731	WN	3063547	DL	1539503	OO
San Francisco International	SFO	5208434	UA	1607194	AA	1447929	WN	1432134	OO	1409428	DL
San Diego International	SAN	3241026	WN	936326	DL	901010	UA	661311	AA	506724	US
Oakland International	OAK	3407631	WN	311535	B6	230419	AS	128434	US	109371	HA
Sacramento International	SMF	2317160	WN	308618	DL	283194	UA	238298	OO	222496	US
Orange County/John Wayne	SNA	1506018	WN	591814	AA	461641	DL	416525	UA	412251	AS
San José International	SJC	2137648	WN	352579	AS	349797	AA	184579	US	156105	OO
Ontario International	ONT	1269884	WN	210205	AA	175782	US	144918	OO	144281	CO
Burbank/Glendale/Pasadena	BUR	1474477	WN	156686	OO	156382	AA	153553	B6	127419	AS
Long Beach Municipal	LGB	1163333	B6	85793	OO	83446	YV	56662	QX	27776	YX

In summary, LCCs are currently the key drivers of growth of secondary airports, but in the near future they are poised to become the dominant carriers in the US. If LCCs become the dominant clients of airports in the future, then appropriate planning for secondary airports will require planners and airports to understand the needs and behavior of this new provider group.

One of the key ways secondary airports partner with LCC airlines has been negotiating terms of agreements for use of their facilities. This typically involves some form of reduced landing fees and passenger guarantees offered to the airline as an incentive. Once the initial agreement phase ends and the projected demand in the form of passenger traffic materialize both parties begin to focus on more permanent measures. The next major step usually involves an upgrade of the terminal the airline is operating from, or, in some cases, construction of a new terminal, usually financed by the airline. At Oakland airport, Southwest airlines invested in the development of Terminal B, and JetBlue recently completed Terminal 5 at JFK airport in New York.

A COST-SENSITIVE APPROACH TO INFRASTRUCTURE INVESTMENTS AT AIRPORTS

One of the areas where LCCs differ from legacy airlines is in how they invest in airport terminals. In contrast to the elaborate and sophisticated architectural designs at major hubs, LCCs place an emphasis on both utility and cost and tend to favor simple designs.

In a review of Gensler (architects) experience in building terminals for both Southwest and JetBlue at MacArthur-Islip, and JFK Terminal 5, the emphasis was on utility and keeping costs down.[7] Both airlines wanted to avoid the “grand ticketing hall” and opted to focus more on the post-security-check portion of the terminal. This was based on their perception that their passengers tend to arrive earlier, stay closer to their gates, spend more of their time in the post-security sections, and spend more money at concessions (since most LLCs offer reduced inflight services). This assumption is documented in recent airport studies that indicate that passengers are spending more at concessions for a variety of reasons, including airline cutbacks on inflight amenities, longer average trip lengths, and increased security measures.[8] In the drive to keep costs low, LCCs tend to limit the amount they will spend building up space for concessions; they provide only what is necessary to meet the needs of their passengers.[9]

The reduced spending leads to lower costs for the airlines, which they pass on to passengers as lower fares; however, the approach of focusing on post-security passengers leads to limited amenities and options for terminal users who are not traveling (for example, those waiting to pick up or drop off travelers). Airport managers and developers need to consider the potential loss of revenue from ignoring or paying less attention to this group of airport users.

The LCCs also opt for simpler gate layouts, as they usually have a uniform fleet with only one or two aircraft types. Their high-volume operations and low aircraft turnaround times also mean that passenger loads per gate can be as high as 600,000, compared to 300,000 for legacy airlines.[10] This implies a high demand on restrooms, furniture and facilities in

the gate area. LLCs therefore opt for more durable finishes. Accordingly, they also choose polished and hardened concrete flooring instead of terrazzo.

LCCs are examining all the minute details to minimize costs, even opting for no finishes under their baggage claim devices since passengers cannot see that surface. Cost is not their only criteria though; they are also concerned about passengers' experience. JetBlue insisted that restrooms at JFK Terminal 5 be designed in such a way that half of them could be taken out of service for cleaning while the other half remained open. Also, to accommodate the high volume of passengers, more restrooms were located on the right-hand side of arriving passengers to avoid oncoming traffic.

The type of infrastructure investments LCC are willing to make during their tenure at secondary airports should be proactively used by planners as they plan upgrades at existing airports.

EFFICIENT OPERATIONS AT AIRPORTS

Although minimizing costs has been the key competitive advantage of LCCs, this is not their only key strength. The legacy airlines learned this in a painful way as they attempted to compete with the LCCs by creating subsidiary low-cost clones (Ted, Song, etc.). Most of these subsidiaries failed miserably because they competed only on fares and ignored other key LCC strategies. In addition to keeping their costs down, low-cost airlines have aggressively managed various aspects of their operations for efficiency. For example, they have very short turnaround times at their gates, maintain high on-time reliability, have built strong collaborative relationships with their workers' unions, and implemented several structures to keep their employees motivated. Their location at secondary airports gives them various advantages, such as reduced congestion and fast turnaround times for their aircraft as well as the ability to negotiate low fees and charges with airport authorities eager to attract traffic.

RISKS OF FOCUSING ON LOW-COST CARRIERS

We do note that LCC airlines are not all the same. In the recent economic down turn two of the major low-cost airlines serving Oakland, ATA Airlines and Aloha Airlines failed. Around the same time Skybus Airlines that had recently begun service at Oakland also failed. Several of the legacy airlines also consolidated their operations by moving flights from Oakland to San Francisco. The net effect was a 30 percent loss in traffic to the Airport. In interviews with other airports in the Bay Area during this study, they had noted that low-cost carriers can be a double edged sword, as some legacy airlines could stop service if they decide it is not worth staying and competing with an expanding low-cost airline. The net effect is then a high frequency of flights to a few specific destinations (via the LCC) and a loss of connection to several destinations the legacy carrier used to provide.

Going forward, airports will need to become much smarter at evaluating airlines in order to match their markets to the right airline type. If they lack the capacity, airports should consider hiring experienced air service development consultants to assist with market analysis. The upfront cost of a quality assessment of the market and evaluating of potential

partner airlines is well worth the expense to prevent the situation of ending up with an upgraded or expensive terminal down the line with no airline to utilize it. For example, though an airline like Allegiant with a focus on providing access to tourist destinations may be attractive to a secondary airport, it may not be the best match for, say, San José if the airport authorities think their key priority should be serving the business travelers of Silicon Valley.

IV. SECONDARY AIRPORTS WITH SIGNIFICANT LOW-COST CARRIER PRESENCE

To get a better idea of the issues airports in the state are grappling with, we approached staff of airports for interviews. The airports were selected to give a good geographic coverage of the states, a broad mix of secondary and smaller airports, and airports with significant low-cost presence and those without. We initially contacted seven airports, Oakland, San José, Monterey, and Concord airports in northern California and Long Beach, Bob Hope, and McClellan-Palomar in southern California. We were able to interview five of them during the study, San José, Concord, Long Beach, Bob Hope, and McClellan-Palomar.

In addition to the airports, we also interviewed the aviation regional planners at the Metropolitan Transportation Commission (MTC) and the Southern California Association of Governments (SCAG), the two metropolitan planning agencies in both regions. In the following sections we present a summary of our findings on the challenges the airports are dealing with. We start with Long Beach and Bob Hope, two airports with significant low-cost carrier presence.

LONG BEACH AIRPORT: A FOCUS CITY AIRPORT FOR JETBLUE

Long Beach Airport is located in southern California and is about 17 miles southeast of Los Angeles International Airport. Owned by the City of Long Beach, the airport and currently provides both commercial and general aviation services to the community. Currently, scheduled commercial air service is provided by Alaska Airlines, Delta Airlines, JetBlue Airways, Frontier Airlines and US Airways. In addition to the scheduled airlines, the airport receives significant general aviation activity, with a little over 300 aircraft based on its field.

Growth and Expansion

Long Beach Airport provides an example of how low-cost airlines have impacted traffic at secondary airports over the past two decades. As illustrated in Figure 1, Long Beach airport has seen phenomenal traffic growth since JetBlue initiated operations in 2001. Prior to 2002, passenger traffic had been holding steady in the range of 700,000 annual enplanements. Once JetBlue began offering service in 2002, enplanements jumped from 708,686 to 1,401,039 within a year. In the FAA compiled rankings for passenger enplanements, Long Beach Airport moved from a rank of 93 to 72 in 2010.

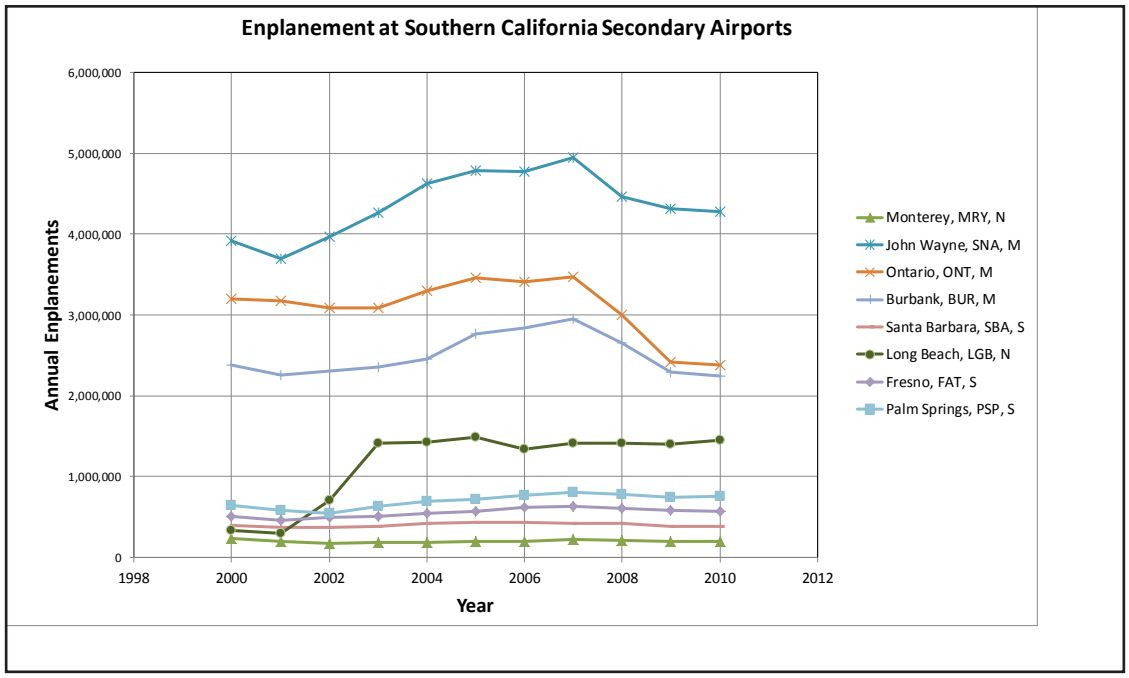

Figure 1. Enplanements Highlighting Impact of Southwest Entry at Long Beach Airport

Noise ordinances imposed by the city of Long Beach constrain each commercial carrier at Long Beach Airport to a maximum of 41 flights per day and commuter airlines to a maximum of 25 flights per day.[11] Airlines may exceed those flight caps if they can show noise from aircraft operations will not exceed the baseline CNEL* budget limits set in the baseline year in the ordinance (see Figure 2). The ordinance also restricts commercial flights to the hours between 10 p.m. and 7 a.m. The current noise ordinance is shown in Figure 2. The ordinance was passed as part of an out-of-court settlement between the city and the airlines after the city had initially tried to impose a limit of 15 flights per day in 1983.[12] The airlines challenged the city in court, and after multiple rulings and appeals, the dispute was settled out of court in 1995.

* Community Noise Equivalent Level (in decibels) is a noise metric developed in California that is based on hourly noise levels from three periods of the day; 0700-1900, 1900-2200 and 2200-0700 hours. The explicit formula is defined in the Caltrans State Noise Standards (http://www.dot.ca.gov/hq/planning/aeronaut/documents/statenoisestnds.pdf).

E. Air Carrier Flights

1. **Air Carriers shall be permitted to operate not less than forty-one flights per day, the number of flights authorized on November 5, 1990. Pending assessment of compliance with the CNEL budget applicable to Air Carriers, Flights by these users shall not be increased above the number permitted as of November 5, 1990.**

2. **In order to achieve applicable noise budgets, users within the Air Carrier category will be encouraged to operate at the lowest average noise level consistent with safety. This encouragement will be provided by permitting increases in the number of allowed Air Carrier Flights if the Air Carrier user group achieves compliance with the CNEL budget established pursuant to this Chapter, as determined on an annual basis.**

3. **Flights which are available for use, but which are unallocated at the time this Chapter becomes effective, shall be allocated on a first-come, first-served basis. Allocations of Flights which are sought by more than one user shall be determined by lottery.**

4. **The Airport Manager shall determine, at the end of the fourth calendar quarter following implementation of this Chapter, whether additional Flights may be allocated to Air Carriers based on the cumulative noise generated by Air Carrier Operations during the prior twelve month period. Additional Flights above those permitted under Subsection E.1 shall be awarded only to the extent the Airport Manager determines that initiation of service utilizing those Flights will not lead the Air Carriers, as a group, to exceed the level established pursuant to Section 16.43.050.C.**

5. **Flights allocated by the Airport Manager pursuant to Subsection E.4 shall be awarded for a period of one year. In the event the Airport Manager determines (a) that implementation of Flights awarded under Subsection E.4 has resulted in air carrier cumulative noise in excess of the Air Carrier noise budget and (b) that overall aircraft noise exceeds the level allowed by Section 16.43.050.A, the Airport Manager shall revoke such of the Flight awards granted under Subsection E.4 as the Airport Manager determines must be revoked in order to achieve compliance with the Air Carrier noise budget. In making this determination, the first Flights awarded under Subsection E.4 to be eliminated with be those of the operators with the highest average noise levels per Flight during the prior twelve months. In the event that equal priorities exist, the Airport Manager shall conduct a lottery to determine which Flights shall be eliminated. In order to minimize Air Carrier noise, all Air Carrier Operations shall be conducted by aircraft which comply with the standards of FAR Part 36 Stage 3 and all operations shall be scheduled between the hours of seven A.M. and ten P.M.**

Figure 2. City of Long Beach Municipal Noise Ordinance 1995

The airport has three runways. Runway 12/30 – the longest of the three at 10,000 feet – is the main runway for air carrier operations. It runs from the northwest to southeast end of the airport and intersects with parallel runways 7L-25R (6,192 ft.) and 7R-25L (5,423 ft.). Runways 34L/16R and 34R/16 run north-south and intersect the other three runways.

The airport is currently operating close to capacity and all available gates and departure slots have been taken up by operating airlines. Allegiant Air and Frontier Airlines served the airport until 2011. When they left, Allegiant Air slots were allotted to JetBlue, while Frontier's three slots were allocated to JetBlue, Delta and US Airways. Demand for air services at the airport remains robust, with all the major carriers showing load factors greater than 80 percent in 2011.[13]

The noise restrictions are the largest impediments to growth at the airport. As a result of this constraint, even though JetBlue has designated Long Beach a "focus city," it now operates several flights out of Los Angeles International airport since there is no room to expand operations at Long Beach.

During interviews, airport officials mentioned that curfews, noise restrictions and availability of slots were a key constraint on the expansion of services at the airport. They were, however, cognizant of the impact of aircraft operations on the community, and the airport was exploring various innovative techniques to mitigate the noise impact. One option being investigated is the Advanced Continuous Descent Approach, which, in addition to minimizing fuel consumption, reduces noise impacts. It involves keeping arriving aircraft at their cruise altitude for longer than conventional approaches, and then having them make a continuous descent to the runway at idle or near-idle thrust with no level flight segments.[14] The procedure was developed by researchers at the Massachusetts Institute of Technology and Georgia Tech in collaboration with FAA and NASA. The airport has an active noise abatement program that seeks to engage with the community.

BOB HOPE AIRPORT: SECONDARY AIRPORT CAPTIVE TO SELF-IMPOSED NOISE RESTRICTION

Bob Hope airport, usually referred to as Burbank Airport, is in fact jointly owned by the cities of Burbank, Glendale and Pasadena. Located in Southern California, the airport is in and is about 40 minutes' drive from Los Angeles International Airport when traffic is light.

In addition to scheduled commercial and general aviation operators, both FedEx and UPS operate air cargo flights out of the airport. Both of the airport's two runways – 15/33 at 6,885 feet and 8/26 at 5,802 feet – are used for scheduled airline operations.

Currently, scheduled commercial air service is provided by Alaska Airlines, JetBlue Airways, SkyWest, Southwest Airlines and US Airways. General aviation traffic at the airport is moderate, with 91 based aircraft. Forty-five percent of the aircraft operations at the airport are from scheduled commercial airlines.

In discussions with the authors of this report, the airport manager said that the airport has an anti-growth pact with the city of Burbank in which it has agreed not to expand the airport and is proactively engaging the community in all airport plans. The airport works collaboratively and proactively to ensure the noise impacts of aircraft operations on the community are minimized. Bob Hope airport has imposed its own noise curfews from 10 p.m. to 7 a.m. on aircraft used by scheduled airlines. Violation of the nighttime curfew carries a penalty of $3,953 per violation. The airport has a set of rules it expects aircraft operators to abide by. Unlike Long Beach, the rules resulted from a collaborative process between the airport and the towns rather than as a settlement arising out of litigation.

The airport is currently close to capacity and is dominated by Southwest Airlines which had close to 66 percent market share of the traffic in 2010. With JetBlue now serving Bob Hope, the airport becomes one of the few airports with two low-cost carriers. The airport is landlocked, and there is no space to expand on the airside. Also, residents in nearby communities have actively opposed measures to extend the runway and have been very vocal whenever additional aircraft operations are added.

The airport is in a similar situation to Long Beach and in the near future may lose some of the flights it has gained to Los Angeles International airport if the low-cost carriers want to

grow their market share. Like Long Beach, it is in a precarious position since the drive to LAX is not that far for Southern Californians accustomed to navigating the second-largest metropolitan area in the US. As documented in the study by Kanafani and Mahmoud, airports in the close vicinity of large hubs always find it hard to retain air service over the long term due to the ability of the large hub to offer a wider variety of destinations and competitive fares.

SUMMARY

The airports in the state that have been able to attract low-cost carriers have all experienced significant growth in traffic. The biggest challenge they face with the growth in demand is the noise impact of increased aircraft operations on residents in the surrounding areas. The city of Long Beach had an initial adversarial relationship with the tenant airlines, which resulted in litigation settled out of court. Bob Hope, on the other hand proactively agreed to self-imposed nighttime restrictions and flight curfews to maintain relationships with the community.

In the absence of new technology that will significantly reduce the noise from aircraft operations, engaging with the surrounding community is the best way to deal with noise impacts. Airports, such as Bob Hope, that adopt a proactive stance and engage with the community early on, are likely to face less developmental challenges and avoid the dollar and time cost of litigation. Airports interested in attracting low-cost carriers should consider both the environmental and noise impacts from increased service early on and incorporate this and the cost of the necessary mitigation measures into their business development plans.

V. SECONDARY AIRPORTS WITH LIMITED/NO LOW-COST CARRIER PRESENCE

The airport in San José, California, makes an interesting study because it is a classic case of a secondary airport located in a region with significant travel demand that nonetheless struggles to retain traffic because it is in the shadow of a large well-developed international airport – in this case, San Francisco International. The airport recently spent a significant sum to modernize and upgrade one of its terminals, but instead of the expected growth, it actually lost a key major airline, and passenger traffic remains low despite the presence of several high-profile technology companies in its core cities. The case study looks at how the master planning development approach has impacted the airport and what it is doing to attract traffic.

MINETA SAN JOSÉ INTERNATIONAL AIRPORT: AN AIRPORT WITH SPARE CAPACITY

Norman Y. Mineta San José International airport (SJC) in San José, California, is one of the three major airports in the Bay Area. The airport is located very close to downtown San José in the heart of Silicon Valley. It sits in the shadow of Oakland (OAK) and San Francisco (SFO) airports to the north, but its predominant leakage is to San Francisco, which offers cheaper fares and a wide selection of destinations with higher frequencies. Annual passenger enplanements in 2010 were four million, down from six million ten years ago. The landlocked nature of the airport and its close proximity to downtown, coupled with the path of its flight tracks, limit its future growth.

The airport recently completed expansion and modernization of one of its terminals, 'Terminal B,' at a cost of $1.3 billion and has been facing challenges attracting enough passenger traffic. Though Oakland airport may not impact SJC significantly, the presence of Southwest Airlines in Oakland ensures minimal leakage of traffic from the northern part of the East Bay to SJC. The airport has been hurt by the recent economic downturn. Conversations with officials indicate that they are concerned about the leakage issue and interested in conducting a leakage study to help quantify the extent of the leakage.

Attracting Air Service to the Airport

Going forward, SJC needs to work hard to attract traffic to justify the cost of investing in the terminal. The airport is actively exploring various markets where it can have a competitive edge. In line with this, it is actively engaged and partnering with business community leaders in Santa Clara and the local chamber of commerce to more clearly define their travel needs. In the process, it has conducted two rounds of surveys of businesses, which has helped identify key destinations the business community wants to access. As a result of the survey, the airport is working to attract air service to selected destinations in Asia (a core destination for Silicon Valley firms) and a few focus cities in Europe. Though this effort is laudable and a step in the right direction, strategically it should have expended more of its effort on business development prior to embarking on the extensive infrastructure upgrade instead of after the upgrade.

In several publications, de Neufville has warned about the risks of investing in major infrastructure development at airports with the assumption that traffic will grow to utilize the spare capacity created.[15,16,17] His key thesis has been that aviation forecasts used to make projections for terminal development projects have historically proven to be very unreliable. First, the demand for the aviation market is very susceptible (and correlated) to changes in the overall economy. Both nationwide events, such as a general economic slowdown, and location-specific events, such as shutdowns of local factories, could change the traffic that materializes at an airport. In addition, various factors, such as labor and fuel costs, mergers and regulations on aircraft type, influence the decisions of airlines on which airports to fly out of, and the number and type of aircraft operations they conduct at an airport.

The core underlying issue has been the master planning approach that sizes the terminal based on a single forecast that is assumed to be correct. Given the high level of uncertainty these factors impose on the validity of the forecasts, basing terminal development on the forecasts usually results in oversized and underutilized facilities that take a long time to reach their intended utilization projections.

De Neufville has advocated for a more flexible airport development approach. Where the terminal is sized based on a range of possible forecast scenarios (developed based on what-if analysis). The terminal(s) are then designed to be built-out in a phased manner in stages and the build-out plan is revisited and modified as the projected traffic does (or does not) materialize. In addition to this approach, a more critical point is the need to make sure that existing facilities are close to capacity before embarking on upgrades and construction of new facilities. In the case of San José (and, later, McClellan-Palomar), it appears the marketing to attract airlines to their facilities is being done after construction and not before. Given the substantial costs involved in upgrading terminals, airports need to closely examine this practice.

In various studies conducted by the Bay Area Metropolitan Transportation Commission, SJC has been considered as a candidate reliever should SFO get congested in the future, but its landlocked geography and challenges mentioned earlier will be a constraint.[18,19]

VI. SMALLER AIRPORTS IN THE CALIFORNIA AVIATION SYSTEM

In southern California there are several airports more than an hour's drive from Los Angeles International and San Diego airports. These airports still face challenges in retaining traffic in their region, despite the distance to a major airport. McClellan-Palomar is a classic example. The authors were able to interview its staff during this study.

MCCLELLAN-PALOMAR AIRPORT: SMALL AIRPORT STRUGGLING TO ATTRACT AIR SERVICE

McClellan-Palomar in Carlsbad, California, is a typical example of an airport that faces the challenge of airport leakage even though it is not near any large airport. Twelve percent of the population in the region lives within an hour's drive of the airport; however, most of this population still prefers to use airports outside the region.

An airport leakage analysis indicates more than 98 percent of potential travelers in Carlsbad do not use McClellan-Palomar for air travel. The study found that 76 percent of the population regularly drives to San Diego about 35 miles away, a trip that could take as long as an hour. Another 15 percent of the trips leak to Los Angeles Airport, which can be more than a two-hour drive in congested LA conditions. The key is that these airports are considerably larger and have more frequent flights and cheaper fares than McClellan-Palomar.

In addition to being in the shadow of these larger airports with cheaper fares, McClellan-Palomar's situation is compounded by steadily decreasing seat capacity. The only commercial service flight, operated by SkyWest on behalf of United Express, reduced its daily service to Los Angeles International airport from six flights to five in July 2010. The airport recently completed a modernization of its terminal at a cost of $24 million. The modernization effort included a new state-of-the-art terminal building with a customs station and new passenger bag screening facilities. A new restaurant has been constructed adjacent to the terminal building. Other improvements at the airport include a new storm water cleaning system, upgraded ramp storage space, public parking, and new firefighting truck and equipment. The airport has several fixed-base operators with on-site offices. The provision of the restaurant will serve both commercial travelers and other tenants and users of the airport.

Like San José, the airport invested in a terminal though it did not have a clearly identified and impending market of travelers. It now faces a similar challenge of attracting air service to justify the investment. In 2010 the airport applied for a Small Community Air Service Development Program (SCASDP) grant of $500,000 which it intended to match with local funds of $50,000 to provide incentives to Horizon Air to operate out of the airport. The SCASDP program is a pilot project established by Congress in 2000 to help small communities enhance their air service. The program was authorized as part of the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century and was re-authorized through 2008.[20] Horizon Air has indicated interest in initiating service from the airport to San José International. The entire $500,000 federal grant was to be used as a revenue

guarantee and to cover startup costs, while the $50,000 will be used for marketing and advertising. San José was chosen because the Bay Area is a major destination for travelers out of Carlsbad and because San José has attractive connections to various key markets in the continental US and also to Hawaii. Initiation of this service, however, presents an interesting conundrum. If Horizon Air service is initially successful, it may grab some market share from SkyWest's service to LAX. The recent cutback in capacity by SkyWest is an indication that the route is not very profitable, and a further drop in demand could lead to United withdrawing from the airport entirely. The airport may still have improved the quality of destinations available, but it will now be at the mercy of a startup airline whose future is not guaranteed.

The airport did not win the grant in the 2010 round of the SCASDP. In a review of the SCASDP program the GAO has noted that the criteria used by the DOT is not clear and needs to be improved.[21] Currently, the probability of the service being initiated looks very slim. Small airports around the country routinely face this challenge of retaining the service of the incumbent airlines, usually legacy carriers when they try to bring in new airlines to broaden the range of destinations they serve. Even medium-hub airports have lost service from incumbent legacy airlines when they initiate service with low-cost airlines. McClellan-Palomar airport is still facing challenges in attracting service after upgrading its terminal facilities, and the possibility of attracting commercial air service looks slim in the near and medium term. The experiences of McClellan-Palomar and San José both highlight the risk involved in upgrading terminal facilities with the hope of attracting services.

Based on the airlines currently operating out of San José, service from McClellan-Palomar to the San José will provide Carlsbad passengers access to Seattle but not New York. Even with service to San José, the airport leakage problem is likely to persist because travelers to destinations such as New York may prefer to drive to LAX for a direct flight rather than take a connecting flight from San José or the Bay Area.

This report does not cover Concord Airport in detail, but the airport has taken an innovative approach that's worth mentioning: They lease out the surrounding land for various commercial developments. This has helped the airport to generate substantial revenue, which it has used to fund its operations. In this case, the airport is a general aviation airport in a populated city; hence it is a reasonable trade-off, as operational growth is limited by noise and environmental impacts on the community.

Discussion on Very Light Jets

Very Light Jets (VLJs) are a class of small aircraft created to fill a niche between first-class commercial aviation travel and corporate jet service. VLJs are usually defined as jets with a maximum takeoff weight less than 10,000 lbs. and are priced between $1 million and $5 million. VLJs should seat six to ten people and are designed to be flown by single pilots. The aim was to provide a level of service comparable to business jets (on-demand service with closer access to traveler's origin and destination) but at a cheaper cost than business jets.

Currently, the purchase of a business jet is practical only for high-net-worth individuals and business clients who place a high value on time. Typical business jet acquisition costs start in the $2 million range, with maintenance and operating costs on top of that, placing them beyond the reach of everyday travelers. At a proposed cost closer to $1 million and with seating for six to ten passengers, VLJs would be practical for on-demand air taxi operations.

NASA's and the Birth of VLJ Technology

The NASA Small Aircraft Transportation (SATS) program was instrumental in pushing the envelope on the technology needed to develop VLJs. Eclipse Aviation was an initial leader in development of VLJ aircraft with its Eclipse 500 model. It was anticipated during the (SATS) program that the Eclipse 500 would be an ideal aircraft that could be used to deploy a national air taxi system. Some of the features that made it attractive were its six-seat capacity, advertised price of less than $1 million and state-of-the-art avionics equipment that would allow it to be flown safely by a single pilot.

The Eclipse Aviation company went bankrupt in 2008 after delivering about 100 aircraft and was sold to Eclipse Aerospace. Eclipse Aerospace announced the official launch of their Eclipse 550 twin-engine jet which it plans to begin delivering in 2013. The new jets will be priced at a little over $2 million.

The ability of VLJ aircraft to fly out of smaller airports means they could potentially be used to provide service at these smaller airports. This section looks at both the potential and some of the issues that could affect viable VLJ operations at smaller airports.

As noted by Kananfani and Mahmoud,[22] though small communities within the shadow of large hubs (125 miles) struggle to retain scheduled commercial air service, they do experience significant growth in general aviation traffic. In their study, Kanafani and Mahmoud noted that most of this traffic is business related. They also note that a high percentage of those who drive long distances to the hub airports in these small communities are business travelers. Studies show business travelers place a premium on time, and hence value airports with a high frequency of departures, as this reduces the amount of schedule delay they experience when they plan trips.

UTILIZATION OF GENERAL AVIATION SERVICE AT SMALLER AIRPORTS

The VLJ aircraft will present a possible opportunity for small airports (such as McClellan-Palomar) to meet the travel needs of their business travelers using nonscheduled on-demand air transportation. The availability of on-demand transportation significantly reduces the schedule delay element for business travelers. If the aircraft acquisition, maintenance and operating costs can be brought low enough, VLJs may revolutionize the traffic demand at smaller airports the same way low-cost carriers have positively impacted secondary airports. Cost will be a significant factor in this process.

McClellan-Palomar airport has several business jets and general aviation aircraft stationed and operating out of the airport. There is also a fixed-bas operator (FBO) and several manufacturers based on the airport property. Obviously, the businesses maintain their jets for travel by their employees. An interesting question is whether airports like McClellan-Palomar could utilize VLJ-type, on-demand air taxi operations to meet demand in a cost-effective manner.

Figures 3 and 4 present the cost profile of a typical jet and turboprop business aircraft (developed by researchers at Virginia during NASA's Small Aircraft Transportation Program). First, a comparison of the two figures shows that the cost per seat-mile to operate a business jet is significant compared to that of a turboprop aircraft. Several business jets were in the Virginia Tech model, but Figure 3 shows the cost range for jets less than 25,000 lbs. (close to weight range of a VLJ). Figure 3 shows that for any type of air taxi service with a jet to be feasible, both the annual hours of operation and the average stage length need to be very high. Even with those two factors coming together, the cost-per-seat-mile is still more than $1 (average annual hours of operation close 800 and average stage length greater than 500 miles).

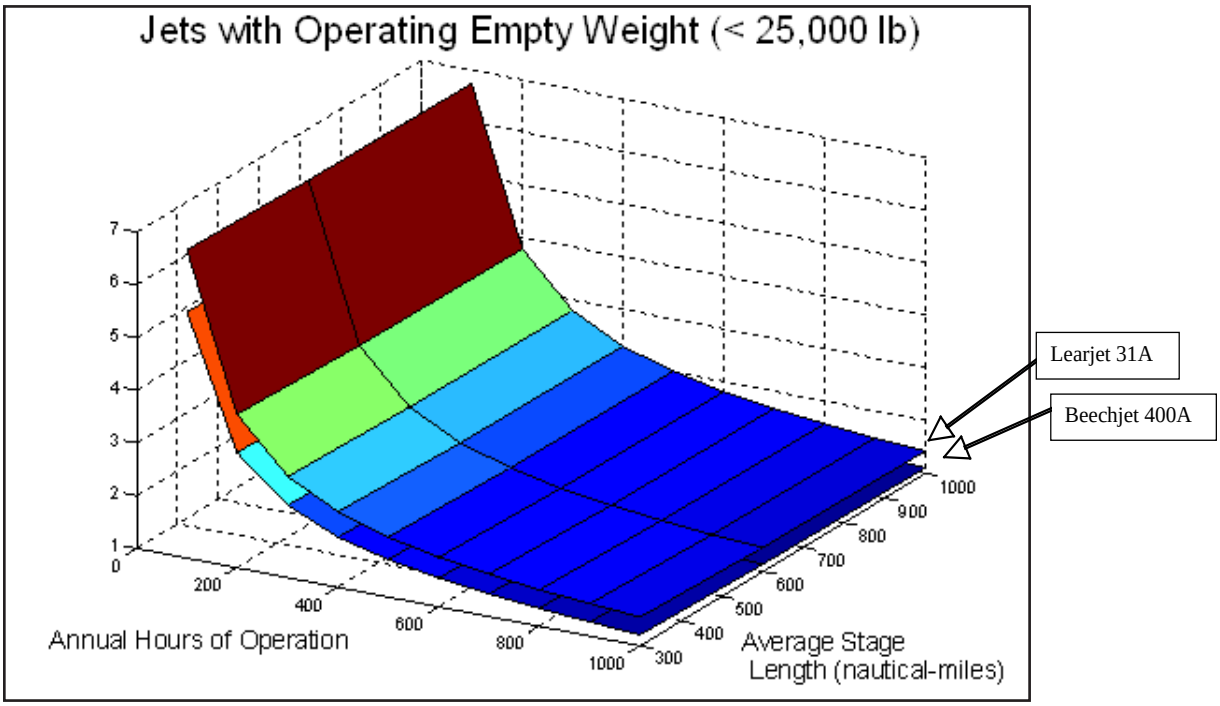

Figure 3. Cost per Mile of Business Jet Aircraft Over Stage Length and Annual Utilization (8 Passenger Learjet 31A and 7-9 Passenger Beechjet 400A)

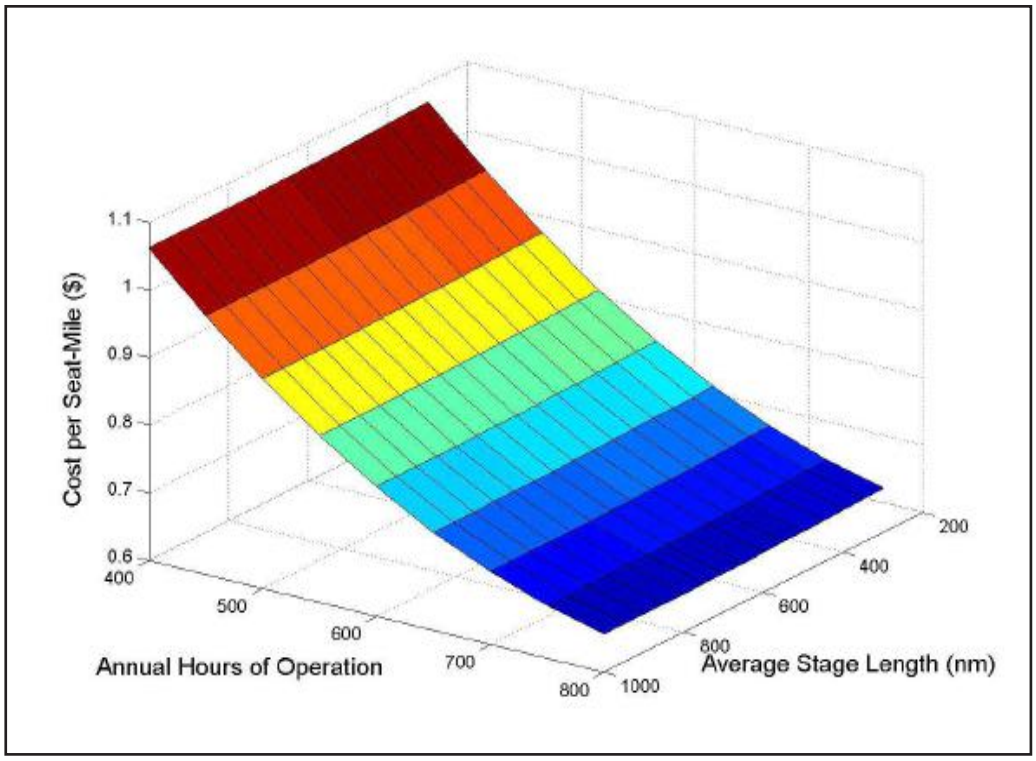

Figure 4. Cost-per-Seat-Mile of a Pilatus PC-12 Single Engine Turboprop Aircraft Over Stage Length and Annual Utilization

A $1 cost per seat-mile will be prohibitive to most business travelers. Travelers in small communities need to be extremely wealthy or have a very high-priority, critical mission that is time-sensitive enough to warrant the cost of the service. A pure VLJ on-demand air service will not be suitable for these small airports. In the same scenario the turboprop cost per seat-mile of 60 cents is still prohibitive but a more feasible operational price than that for jet service (or VLJ).

The McClellan-Palomar airport has a large number of business jet aircraft stationed at the general aviation portion of the airport. These aircraft belong to business and are used only a fraction of the time. The airport authority can explore the opportunity of having some of the aircraft used for on-demand air taxi service to select destinations that their business travelers frequent. Such a program will require some amount of planning and will require skilled consultants and experts to develop a feasible operating scheme. However it is neither infeasible nor farfetched from the fractional ownership model where several business team up to use/share a single aircraft. The final decision to participate in such a program will be made by the businesses that own the private jets, but the airport could fund studies to investigate the feasibility of such a program.

This could also be an opportunity a private entrepreneur could explore. The key fact is that increased service will lead to increased revenue for the airport. If the plan is well structured, the income from flights will reduce ownership costs for aircraft owners. If destinations are well selected (in the case of Palomar airport), such a program will meet the needs of some of the business travelers who are commuting up to two hours to access flights at Los Angeles and San Diego airports.

SUSTAINING AIR SERVICE THROUGH THE ESSENTIAL AIR SERVICE PROGRAM

The Essential Air Service program (EAS) is another alternative source to which some smaller airports in the state have turned in order to sustain air traffic. The program was included and initialized in 1978 Airline Deregulation Act[23] in response to concerns that airlines would withdraw service from small communities once the act took effect. Under the EAS program, the federal government through the FAA provided subsidies to airline carriers to provide air services to small communities. The program was initially authorized for ten years but was extended for ten more years in 1987 under the Airport and Airway Safety and Capacity Expansion Act.[24] The program was further extended under the Rural Air Service Act[25] in 1996. The 1996 act more than doubled the program's funding from $24 million to $50 million. According to the latest GAO report on the program, the funding level is now at $109.4 million.[26] Eligibility criteria for participating in the program have been refined with each act, and by 1989 the key criteria were:

- The community must be more than 70 highway miles from the nearest medium or large hub
- The community must be 55 highway miles or more from the nearest small hub airport or at least 45 miles from the nearest non-hub airport which enplanes a minimum of 100 passengers per day
- The subsidy per passenger cannot exceed $200 unless the community is more than 210 miles from a large- or medium-hub airport
- The communities must have been receiving scheduled air service prior to October 24, 1978 when the Deregulation Act was passed[27,28]

Though the EAS criteria are defined by community, and the program is aimed at providing air service to the community, the actual subsidy is disbursed to an airline servicing an airport in the community. It is also worth noting that when the program refers to "hubs" they are usually referring to the community.

The airline, not the community, applies for participation in the program. The DOT reimburses the airline the difference between revenues from fares and operation costs, with a 5 percent markup allowed for profits. The markup value is based on the language in the 1996 Act that provides for a reasonable rate of return on investment to the carrier.

There is debate about whether the EAS program has been useful. In an early review of the program, Williamson et al., proposed that it would be more efficient if states and local agencies rather that the federal government funded the program.[29] In another review, Cunningham[30] found that the program did increase service level at the communities that were served. He found some evidence indicating the program was effective in keeping fares down but concluded that program was not essential or critical, as the subsidy was only supporting a small section of the population (25,000) and mainly benefited the airlines participating in the program.

In a review by the Government Accountability Office in 2000, it was found that the program had generally met its objective of ensuring that smaller communities continue to receive scheduled air service.[31] The report noted that Congress had tightened the eligibility criteria used to determine which communities qualified for the EAS program. The report said that although funding levels had increased substantially in 1996, most of that increase had been absorbed by the increasing cost of providing the subsidized service.

Essential Air Service at California Airports

Currently only four communities in California receive service through the EAS program. Merced and Visalia are provided with twice-a-day round-trip direct flights by Great Lakes Airlines from Merced Regional and Visalia Municipal airports, respectively. Great Lakes Airlines operates out of both airports using a Beechcraft 1900D aircraft that seats 19 passengers. According to publicly available application of the airline, the subsidy for the Merced-Las Vegas operation was set at $1,367 per flight. The airline estimated approximately 9.5 passengers per flight so this subsidy covers the 10 empty seats and translates to approximately $146 per seat. At that rate, the subsidy is about 56 percent of the total cost of the flight. For the Visalia-Los Angeles operation, the subsidy is $1,218 per flight with an estimated 7.2 passengers per flight. The subsidy translates to 63 percent of the cost of operations. The airline provides service seven days a week at each of the airports.

Service at Crescent City and El Centro is provided by SkyWest Airlines under United Express, a subsidiary of United Airlines. At Crescent City, the airline's application requested two round trips per day, seven days a week, in a 30-seat Embraer-Brasilia aircraft. The airline operates out of Crescent City/Jack McNamara airport. At El Centro, SkyWest is providing one round-trip per day for only six days. The airline operates out of Imperial Airport and had earlier requested to cease operations to the community but the request was declined by the DOT based on comments received from the community. According to the latest EAS applications of the airlines, the subsidies at Crescent City and El Centro operations are at 46 percent and 32 percent, respectively. It is obvious why SkyWest wanted to withdraw.

A summary of the cost of operation, revenue and subsidy from the EAS program at the four California airports is shown in Table 9. The table shows that the subsidies at the four air service communities in California are very high, with ticket subsidies ranging 30 percent to 63 percent.

Table 9. Subsidy Rates for California Essential Air Service Airports

Community	Community/Airport	OD Pair	Airline	Aircraft Size	Annual Passengers	Pass./ Flight	Passenger Fare	Pass. Rev./ Flight	Subsidy/ Flight	Total Flight Cost	Percent Subsidy
Merced	Merced/Merced Regional	MCE-LAS	Great Lakes	19	14,000	9.6	$110	$1,062	$1,368	$2,429	56%
Visalia	Visalia/Visalia Municipal	VIS-LAX	Great Lakes	19	10,500	7.2	$98	$703	$1,218	$1,921	63%
Cresent City	Cresent City/Jack McNamara	CEC-SFO	SkyWest	30	22,000	15.1	$99	$1,494	$1,249	$2,743	46%
El Centro	El Centro/Imperial County	IPL-LAX	SkyWest	30	17,000	27.2	$95	$2,588	$1,240	$3,828	32%

In general, the EAS program has not been very successful in providing convenient air travel for small communities, especially when they are close to larger airports. This is typified by the low level of utilization of these flights, with most of the flights half-empty (see passengers per flight and aircraft size in Table 9). Studies have been conducted that indicate some of these communities may be better served by bus service.[32] Though the current four communities that have the service might want to keep it, given high percent subsidies in the case of California, the program looks like an expensive use of taxpayer dollars. In conclusion, we find that EAS is not a sustainable or efficient way to provide service to these communities.

VII. SUMMARY AND CONCLUSIONS

Until recently, the hub-and-spoke operating paradigm of the legacy airlines concentrated most of the traffic at the two major airports in California, Los Angeles International and San Francisco airports. Airport managers and planners had long argued for a wider distribution of the traffic among airports, citing congestion at the hubs and the cascading gridlock on the national airspace systems as these hub airports experienced a surge in demand. In the deregulated environment, the legacy airlines are focused on maximizing their profits; it is not a priority for them to ensure that available capacity in the national airport system or airspace is equitably utilized.

As low-cost airlines like Southwest, JetBlue and Allegiant entered the California market they opted to initiate service mainly out of the secondary airports like Oakland, Bob Hope, Long Beach and Ontario airports, among others. Currently the low-cost airlines are the major carriers at seven of the top 15 airports in the state, and Southwest Airlines is the dominant airline by passenger enplanements. The success of these airlines and their growth has generated significant traffic at the secondary airports from which they operate. The secondary airports welcome these air carriers and have even put in incentive schemes in some cases to attract and retain them. Though not the intent, the low-cost carriers' preference for secondary airports has thus led to a more even distribution of traffic among airports in the state.

The low-cost airlines tend to favor the secondary airports for a variety of reasons, including the opportunity to negotiate low facility usage fees, reduced congestion at these airports on the airside, and lack of competition from entrenched legacy airlines for facilities and gates, among others. Access to these underutilized airports has enabled them to operate efficiently and at low costs.

Two of the most pronounced impacts of LC airlines at secondary airports in California have been JetBlue's service at Long Beach Airport and Southwest's service at Oakland International. Long Beach jumped from a rank of 143 in 2001 to 93 in 2002 in the FAA airport enplanements rankings. The airport has continued to attract passengers and is currently (in 2012) ranked 75 in the latest published FAA rankings. From 1990 to 1995 to 2000, enplanements at Oakland airport went from 2.6 to 4.7 to 5.1 million as Southwest airlines transitioned from the second to the dominant carrier at the airport. The low-cost airlines are increasingly gaining market share from the legacy airlines.

The increased operations, however, have meant more noise impacts on surrounding communities at these airports, and, according to airport staff interviewed, engaging with the communities and mitigating the noise impacts have been their most prominent challenges. As traffic has grown, the LCCs have found the noise restrictions to be problematic. JetBlue began to schedule flights out of Los Angeles International as they used up their available slots at Long Beach airport. Southwest is running up against noise restrictions in Burbank.

Even when low-cost airlines operate out of secondary airports, they still face competitive pressures from carriers at the primary airport as they draw from the same market. An illustrative example is that when Virgin America announced plans to initiate service at

SFO, several of the airlines, including Southwest Airlines, increased their flights at SFO. Southwest Airlines transferred some of its flights from OAK to SFO. This shows that the low-cost carriers do not necessarily dislike primary hub airports; they will use them as and when they fit into their strategic plan.

The key implication for the secondary airports is that they cannot rest on their laurels and assume that the low-cost carriers are permanent tenants. They need to address the issues that are constraining the operations of the LCCs if they want to retain them as tenants.

Despite the attractive prospect they offer, low-cost airlines have brought their own risks to secondary airports. The most critical has been their financial stability. As mentioned earlier, Oakland lost 30 percent of its traffic when multiple low-cost airlines failed financially in 2010. This threw a big wrench into development plans and halted several terminal expansion plans.

For the smaller airports in the state, their biggest challenge has been “airport leakage.” This occurs when passengers drive past their local airports to larger airports in order to access cheaper fares and a wider selection of destinations. One of our case study airports, McClellan-Palomar, was a classic example, where residents drive almost two hours to fly out of Los Angeles International and an hour to fly out of San Diego airport. The key reason for such behavior is well documented in the literature: Travelers select departure airports that have lower fares and a high frequency of departing flights to their destination. The number of departing flights is especially critical for business travelers as it allow more flexibility in scheduling departure time. Non-business travelers are more sensitive to cost than flight frequency. Our study found that small airports (and even secondary airports, such as San José) face a steep challenge in dealing with airport leakage. Both McClellan-Palomar and San José made significant upgrades to their infrastructure (terminal and runways) without putting the requisite upfront effort in marketing their airports. Both ended up with expensive facilities that they now have to spend considerable time and effort to market to prospective airlines.

Given the growing dominance of the LC airlines, they stand to transform the aviation market space dramatically. The current secondary airports need to work hard to retain their services. The LCCs also have a very different approach to airport investment, to which airports must adjust. The key differences are a focus on cost minimization and an emphasis on utility vs. grand architecture in terminal design.

VIII. RECOMMENDATIONS

RECOMMENDATIONS FOR SECONDARY AIRPORTS

Secondary airports need to address the following issues:

Realize the emerging role of LCCs: LCCs are currently the key drivers of growth at secondary airports, and if the current trend continues there is the possibility they will become the dominant domestic carriers in the US. Appropriate planning for secondary airports will require understanding the needs and behaviors of this group.

Also, based on the experience of JetBlue building up flights at Los Angeles International, and Southwest shifting flights from Oakland to San Francisco, secondary airports need to realize that they do not have a monopoly on the LCCs. In fact, the current advantage they enjoy may be in jeopardy as the LCCs become larger and gain enough clout to negotiate attractive agreements with primary airports.

Use discernment when selecting LCCs: When working to attract LCCs, airports need to carefully consider the needs of their core communities. San José has decided that an LCC that provides cheap flights to tourist destinations will not serve the needs of their core business market, information technology industries. In addition, the bankruptcies of several LCCs should serve as a reminder that substantial due diligence is needed when choosing an LCC to partner with, since the presence of the LCC has long-term implications for the airport.

Understand the LCC approach to airport development: LCCs initially partner with secondary airports through negotiated terms of agreements for use of their facilities. In the past, these agreements have usually included some form of reduced landing fees and passenger guarantees as an incentive for the airline to initiate operations from the airport. At this stage, most LCCs do not make any substantial investment in the airport.

Once the initial phase of the incentive program expires and the projected passenger traffic materializes, both parties begin to transition in and negotiate more permanent terms. It is usually at this stage that the LCC will begin to consider substantial investment in airport infrastructure. At Oakland Airport, Southwest Airlines invested in the development of Terminal B, and JetBlue recently completed Terminal 5 at JFK airport in New York.

As mentioned earlier, LCCs take a very utilitarian and cost-sensitive approach to development of terminal buildings. Airport authorities need to familiarize themselves with the priorities of this new type of client if they want to retain them. Insights like this on the type of infrastructure investments LCCs are willing to make during their tenure should be proactively used by planners as they decide which facilities to upgrade, and what types of upgrades to make.

Educate LCCs on their airport needs: LLCs are cost sensitive and focus on ticketed air travelers, and this may not always align with the interests of airport owners. The

LCCs prefer to set up concessions post-security, but this this may deprive airport users who do not pass through security, such as those picking up and dropping off passenger. At airports where there is substantial pick-up and drop-off, this group of non-passenger airport users might represent a missed-income opportunity. It is up to airport managers to negotiate with and educate the LCC to adopt a broader perspective.

Adopt a more strategic airport infrastructure investment approach: Much has been written on the need to transition away from making massive one-time investments in airport infrastructure; however it appears this is practice is still occurring, as illustrated by San José airport. It is not clear whether the size of the newly remodeled San José terminal was based on a single forecast, but the fact that the airport is now actively trying to engage prospective tenants makes it appear to be a case of putting the cart before the horse.

Partner with the community: This is an area where secondary airports are beginning to get it right. Burbank airport's example of proactively engaging with the community on noise compliance, and San José's example of teaming with the local business community to develop and identify prospective air service destinations are, excellent examples of the benefits of such an approach. The core issue is that airports must realize their immediate neighbors are the ones most impacted by their operations, and they should be treated as key stakeholders in developing and operating the airport.

RECOMMENDATIONS FOR SMALL AIRPORTS

The smaller airports in the state are the most challenged in terms of attracting passengers and generating revenue to sustain their operations. They have very limited options, as several of them, such as McClellan-Palomar, are within driving distance of either primary or secondary airports. In such cases, it is inefficient even for LCCs to initiate service to these airports, as this would spread their limited resources too thin and increase their operating costs. With increasing competition from the LCCs, legacy airlines are consolidating their operations and actually cutting service to these smaller airports. Yet, despite these obstacles, there are still a few options these airports can explore:

Proactively create an air service development plan: Given their size and the level of airport leakage they experience, smaller airports that want to attract traffic need to invest in an air service development study. The study should identify the key destinations the community needs to reach (usually through a survey) and quantitatively estimate the demand to see if it is high enough to warrant commercial air service. Most communities will need to hire a consultant to conduct the study, as these smaller airports usually have limited staff whose expertise rarely includes research. However, airport staff need to be involved as well. The most critical part of the process is engaging with the community to learn their needs, and airport staff are typically the most knowledgeable in this area.

Realistically size airport development to passenger demand: In the case of McClellan-Palomar the level of investment seems high considering the level of

passenger demand. In discussions, the airport staff said that traffic had been growing steadily when the terminal construction was planned. However, as mentioned earlier, traffic trends in the aviation world change very quickly due to the wide range of factors that impact airline costs and, hence, would-be passenger decisions. It would have been more effective if, prior to terminal development, funds had been dedicated to building traffic to absorb some of the additional capacity that was going to come online from the project. Airports need to move toward a policy of adding capacity only when they are close to reaching capacity, and, even then, in a staggered manner. This is especially crucial for smaller airports that exist in the shadow of bigger ones.

Compete for available funds: Most airports in California do not qualify for EAS, however, there are federal funding sources, such as the SCASDP grant McClellan-Palomar applied for, that airports are allowed to use toward air service developments. The amount of money in the SCASDP is limited, but for those airports that find enough demand to justify bringing commercial air service to their community, it is an option they should compete for.

Consider innovative approaches: As mentioned earlier, a pure on-demand VLJ service is probably too expensive for business travelers in most small communities. Though the air taxi system envisaged by NASA and the developers of the Eclipse 500 aircraft has not yet materialized (due to bankruptcy of the manufacturer and the inability of the leading purchaser of the Eclipse, DayJet, headquartered in Florida, to maintain operations, leading to DayJet's bankruptcy in 2008), there is still potential to use the concept to serve some constrained communities.

Some small communities have underutilized corporate aircraft that are parked at the airport. If creatively scheduled, these could be used to serve business travelers in the community willing to pay a premium for the reduced travel time and shorter schedule delay offered by such a system. The scheduling, pricing, insurance and legal hurdles required to set up such a system are not trivial but also not insurmountable. Much of the fundamental research needed for the operations side of such a system has been developed under the FAA- and NASA-sponsored Small Aircraft Transportation System program.[33,34,35,36,37] Implementing such a program, however, would involve some complexity (as noted in a National Research Council Report[38]). A pilot program may be the most cost-effective approach to test if such a service will work.

MANAGING THE AIRPORTS AS A SYSTEM

Though this study focuses on the secondary airports, one major recommendation is that the state get engaged in the development of airports in the long term. Existing legislative framework limits the states' ability to do that – the mandate to operate and manage public use airports currently belongs to local authorities, such as cities and counties in whose jurisdiction the airport resides. The state as an entity does not need to manage the airports, but it could modify the legislation to give the metropolitan planning agencies, such as MTC and SCAG, more jurisdiction and control. It would be more efficient for the three major airports in the San Francisco Bay Area, for example, to be operated under a single authority, similar to the Metropolitan Washington Airports Authority that manages Baltimore,

Washington Dulles and Regan National airports. The airports in Northern California have some level of collaboration, but it is related only to traffic management.

APPENDIX A: VERY LIGHT JET COST MODEL

While working at Virginia Tech, Dr. Ashiabor developed an aircraft cost model that can be used to estimate the operating cost for using Very Light Jet aircraft.[39] The model was developed while conducting research to assist NASA in estimating the systems deployment cost of a conceptual small aircraft transportation system that was meant to operate as a national air taxi service over the continental US. The cost model is predicated on the assumption that aircraft in such a system will have costs between those of current general aviation and commercial airlines. A section of the cost model from the thesis is reproduced here.

Linear regression models were developed to predict the acquisition cost and various components of the fixed and variable costs. The aim of the regression analysis was to select as input independent variables that were easily obtainable from aircraft manufacturers and operators for both aircraft that are in production and those in the design stage. This would then make it easy to model the cost of VLJ vehicles in the future once these variables are estimated.

The regression models were developed using multivariate analysis and correlation analysis techniques to select the most appropriate variables. The data used to develop the model was from the Business & Commercial Aviation Purchasing and Planning Handbook and Operations and Planning Guide.

Twenty-five aircraft were used to derive realistic values in the jet model and eleven in the turboprop model.

Model Structure

Typically, airline accounts are classified into operating (items directly related to airlines services) and non-operating (items not directly related to the airlines services, such as gains or losses from retirement of property, interest on loans, foreign exchange transactions, etc.). The operating items may be costs or revenues. The costs are further classified into direct and indirect operating cost. Under ICAO's classification, direct costs include:

- Flight operations
- Maintenance and overhaul
- Depreciation and amortization

Indirect costs include:

- Station and ground expenses
- Passenger services
- Ticketing, sales and promotion

- General administrative
- Other operating costs

The model uses a similar structure but omits some of the costs, such as ticketing and sales that are not a significant part of current general aviation operating costs.

Model Input Variables

Input variables to the models can be grouped into two categories: those used to derive regression expressions and those used directly as input to the model. All data for these two models was derived from the 2001 Business and Commercial Aviation annual FBO and aircraft manufacturer surveys.

Variables used to derive regression equations are operating empty weight (lb.), fuel flow rate (lb./hour), engine power (horsepower), interior area/seat (sq. ft.), and purchase price of aircraft ($). Other variables used directly as input to the model include liability insurance ($), software maintenance costs ($), hangar costs ($), miscellaneous costs ($) and salaries. Where it was not possible to obtain good fit or reasonable regression expressions for variables, the average or actual costs in the Business and Commercial Aviation publication was used.

Acquisition Costs

The aircraft is assumed to be operated over a lifecycle of ten years. The independent variable used to estimate the acquisition cost was the “operating empty weight” and “area per seat” for the jets and “operating empty weight” for turboprop aircraft. The estimated costs are in dollars and represent the market value of the aircraft in 2001. The value used in computations is the depreciated value over ten years.

In order to depreciate the aircraft acquisition cost, salvage values had to be estimated. Business and Commercial Aviation contains data acquisition costs of aircraft when they were manufactured and their used prices in 2001. An analysis of the data shows that single-engine aircraft are losing only 10 percent of their value over a 10 year period with turboprops losing 50 percent and jets 15 percent. The salvage values used were 90 percent, 50 percent and 85 percent for single-engines multi-engines and jets, respectively.

The rapid drop in value of the multi-engine turboprops may be due to the steady drop in jet aircraft prices. Though single-engine aircraft prices seem to retain their value, it should be noted that they are relatively inexpensive relative to other aircraft types, with acquisition costs well below $1 million.

Turboprops range from $1 million to $4 million, while general aviation jets range from $2 million to $20 million, and above.

Variable Operating Costs

For the variable costs, the direct operating cost in seat-per-mile was estimated using "operating empty weight," "area per seat," and "power of the engine" as independent variables.

The direct operating cost in dollars per mile (dependent variable) obtained from the regression expression is then multiplied by the speed and hours flown per year to obtain the annual cost in dollars. The variable operation costs are those related to operating the aircraft and include maintenance, fuel, parts and trip-related expenses.

Fixed Operating Costs

The indirect operating cost is categorized as fixed costs, periodic maintenance costs, flight and crew costs, and facilities costs. The fixed costs were comprised of hull and liability insurance, maintenance and software costs, and miscellaneous service costs. The periodic costs included engine overhaul, midlife hot-section inspection, painting, interior refurbishment and modernization and upgrade costs.

The "Other Costs" categories include pilot and crew salaries, training, and salary costs, and the facilities cost (included hanger costs and other miscellaneous expenditure). Regression fits were derived for some of the dependent variables, but in most cases it was difficult to obtain a good fit and the values provided in the Business and Commercial Aviation database was used directly in the model.

Very Light Jet Cost Structure

The operation costs of aircraft are influenced by the number of hours the aircraft is operated and the stage length of the trips. The model developed is able to predict the total operating cost in dollars per seat-mile, given the annual number of hours the aircraft is operated and an average stage length.

The model estimates the annual acquisition cost, annual fixed operating costs and annual variable operating costs. The sum of these are then divided by the total number of miles the aircraft is flown per year to obtain the total operating cost per mile (number of miles flown per year is obtained by multiplying the average speed of the aircraft by the annual hours of operation). The current model output is for 400, 600 and 800 hours of operations per year, with average stage lengths of 300, 600 and 1,000 nautical miles for all aircraft except the ultra-long-range jets which have output for 1,000, 3,000 and 6,000 nautical miles.

The mode of operation of VLJs will greatly influence the number of hours flown annually and the aim of determining the operating cost for different annual hours of operation is to capture this variation in cost. The number of seats on the aircraft is multiplied by a load factor (currently this is input is set at 70 percent but can be easily changed to reflect different operating policies) and this is used to derive the cost per seat-mile of the class of

aircraft. The load factor adjusts for the fact that most of these aircraft are not operated at full capacity most of the time.

The cost per seat-mile for a single engine Pilatus PC-12 and a typical ultra-long-range business jet aircraft are shown for comparison. In addition to acquisition cost, the key to keeping costs low is being able to generate enough demand so the aircraft can be operated for longer hours.

As the VLJ aircraft transportation technology is deployed, it is likely that the initial travelers to switch to this mode would be full-fare-paying coach and first-class airline travelers. The attractiveness of the mode to travelers will be determined, to a large extent, by the cost of travel.

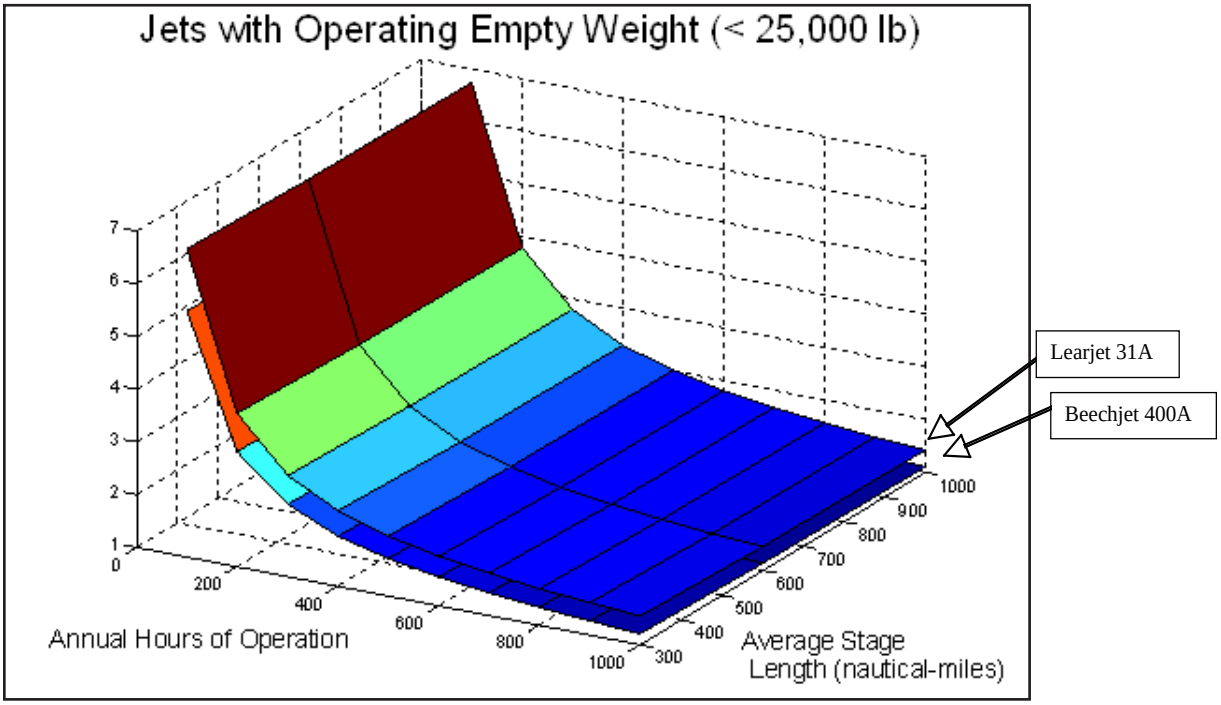

Figure 3 (repeated for reference): Cost per Mile of Business Jet Aircraft Over Stage Length and Annual Utilization (8 Passenger Learjet 31A and 7-9 Passenger Beechjet 400A)

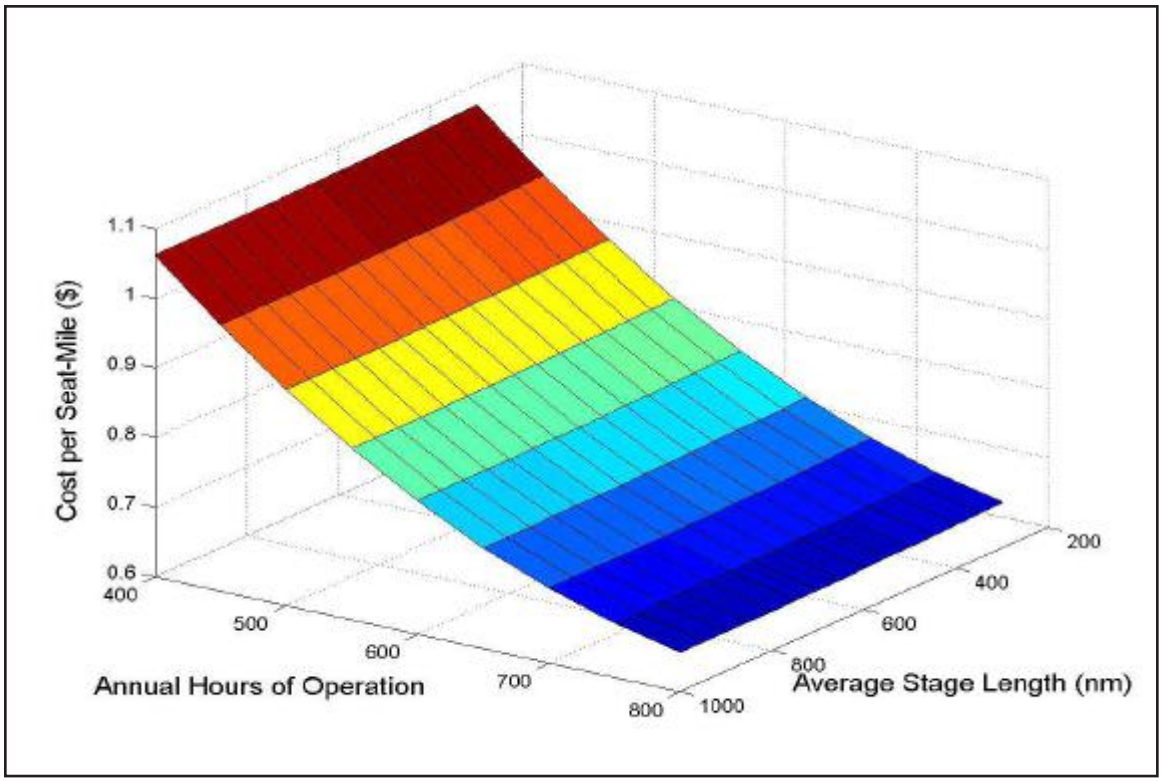

Figure 4 (repeated for reference): Cost-per-Seat-Mile of a Pilatus PC-12 Single Engine Turboprop Aircraft Over Stage Length and Annual Utilization

ENDNOTES

1. Fruhan. W., Jr., The Fight for Competitive Advantage: *A Study of the United States Domestic Trunk Carriers* (Boston, MA, Harvard University, 1972).

2. US DOT Office of Aviation Analysis, "What is Essential Air Service," (April, 2009), http://ostpxweb.dot.gov/aviation/rural/easwhat.pdf, (accessed March 20, 2012).

3. Richard de Neufville, *Planning Multi-airport Systems in Metropolitan Regions in the 1990s,* (Report DTFA01-92-p-01243 for FHWA, 2000).

4. Harumi Ito and Darin Lee, "Low Cost Carrier Growth in the U.S. Airline Industry," *Social Science Research Network* (2003).

5. Steven Morrison and Winston Clifford, *What's Wrong with the Airline Industry? Diagnosis and Possible Cures,* (Brookings Institute, 2005).

6. Research and Innovative Technology Administration (RITA) and Bureau of Transportation and Statistics (BTS), "Air Carrier Statistics Data," http://www.transtats.bts.gov/databases.asp?Mode_ID=1&Mode_Desc=Aviation&Subject_ID2=0 (accessed May 2012).

7. Bill Hooper, "Trend Setting: Designs for Economical Terminals for Low-Cost Carriers will Determine the Looks of many Facilities for the Next 20 Years," *Passenger Terminal World,* September 2005.

8. Michael Cassidy, Marymount University and Joseph Navarrete, *Airport Passenger-Related Processing Rates Guidebook,* (ACRP Report 223, 2009).

9. Richard de Neufville, *Low-Cost Airports for Low-Cost Airlines: Flexible Design to Manage the Risks,* Special Issue for Journal of Transportation Planning and Technology (Warren Walker and Vincent Marchau, Eds.), 2007.

10. Richard de Neufville, "Accommodating Low-Cost Airlines at Main Airports," Draft for Transportation Research Board Conference, 2006. http://ardent.mit.edu/airports/ASP_papers/Accommodating percent20Low percent20Cost percent20Carriers--percent20revised.pdf (accessed March 21, 2012).

11. Bon Terra Consulting, et. al., *Long Beach Airport Terminal Area Improvement Project: Draft Environmental Impact Report (EIR)* No. 37-03, prepared for the City of Long Beach, 2005.

12. City of Long Beach, *Long Beach California Municipal Code,* Title 16, Chapter 16.43 – Airport Noise Compatibility, 1995.

13. Long Beach Airport, *Capital Improvement Program – Status Report First Quarter 2012,* Long Beach Airport, 2012.

14. John-Paul Clarke, et. al., *Development, Design, and Flight Test Evaluation of A Continuous Descent Approach Procedure for Nighttime Operation At Louisville International Airport,* 2006.

15. Richard de Neufville, "Low-Cost Airports for Low-Cost Airlines: Flexible Design to Manage the Risks," *Journal of Transportation Planning and Technology* (special issue), 2007.

16. Richard de Neufville, "Amsterdam Multi-Airport System: Policy Guidelines, 1995," http://ardent.mit.edu/airports/ASP_papers/multi-airport percent20systems percent20policy percent20guidelines.PDF (accessed May 2012).

17. Richard de Neufville, *Planning Multi- Airport Systems in Metropolitan Regions in the 1990s,* (final draft feport for Federal Aviation Administration, 2000).

18. SH&E, Inc., *Regional Airport System Plan Update-Mid-point Screening Report,* (prepared for Regional Airport Planning Committee, July 2010).

19. SH&E, Inc., *Regional Airport System Planning Analysis – Volume 1: Final Report,* (prepared for Metropolitan Planning Commission, Bay Conservation and Development Commission and Association of Bay Area Government, 2011).

20. United States Congress, *Wendell H. Ford Aviation Investment and Reform Act for the 21st Century* (PL 106-181), Enacted by the Senate and House of Representatives of the Unites States of America in Congress, 2000.

21. United States General Accounting Office, *Commercial Aviation: Initial Small Community Air Service Development Projects have Achieved Mixed Results,* Report to Congressional Addressees, 2005.

22. Adib Kanafani and Abbas. M., Local Air Service and Economic Impact of Small Airports, *Journal of Transportation Engineering,* Vol. 113, Issue 1, 1987.

23. United States Congress, *Airline Deregulation Act of 1978* (PL 95-504), Enacted by the Senate and House of Representatives of the Unites States of America in Congress, 1978.

24. United States Congress, *Airport and Airway Safety and Capacity Expansion Act of 1987* (PL 100-223), Enacted by the Senate and House of Representatives of the United States of America in Congress, 1987.

25. United States Congress, *Rural Air Service Survival Act* (PL 104-264), Enacted by the Senate and House of Representatives of the Unites States of America in Congress, 1996.

26. Unites States General Accounting Office, *Commercial Aviation: Programs and Options for Providing Air Service to Small Communities,* Testimony before the Subcommittee

on Aviation, Committee on Transportation Infrastructure, House of Representatives, 2007.

27. Aisling Reynolds-Feighan, European and American Approaches to Air Transport Liberalisation: Some Implications for Small Communities, *Transportation Research A,* Vol. 29A, No. 6, (2000): pp. 467-483.

28. Unites States General Accounting Office, *Essential Air Service: Changes in Subsidy Levels, Air Carrier Costs and Passenger Traffic,* Report to the Chairman, Subcommittee on Aviation, Committee on Transportation Infrastructure, House of Representatives, 2000.

29. Kenneth Williamson, Lawrence Cunningham and Marc Singer, Scheduled Passenger Air Service to Small Communities: A Role for State and Local Governments, *Transportation Journal,* pp. 25-36, 1982.

30. Lawrence F. Cunningham and Eckard Woodrow, U.S. Small Community Air Services Subsidies: Essential or Superfluous, *Journal of Transport Economics and Policy,* 1987.

31. Unites States General Accounting Office, *Essential Air Service: Changes in Subsidy Levels, Air Carrier Costs and Passenger Traffic,* Report to the Chairman, Subcommittee on Aviation, Committee on Transportation Infrastructure, House of Representatives, 2000.

32. Dana Lowell, Tom Curry, Lily Hoffman-Andrews and Lea Reynolds, *Comparison of Essential Air Service Program to Alternative Coach Bus Service – Keeping Rural Communities Connected,* Report prepared by M. J. Bradley & Associates for American Bus Association, Natural Resources Defense Council, The Reason Foundation, and Taxpayers for Commonsense, September 2011.

33. Antonio Trani, Hojong Baik, Howard Swingle, Senanu Ashiabor, *Integrated Model for Studying the Small Aircraft Transportation System,* Transportation Research Record, Vol. 1850, 2003.

34. Terence Abbott, Kenneth Jones, Maria Consiglio, Daniel Williams, Catherine Adams, *Small Aircraft Transportation System, Higher Volume Operations Concept: Normal Operations,* NASA Langley Report NASA/TM-2004-213022, National Aeronautics and Space Administration, 2004.

35. Baik Hojong, Antonio Trani, Nicolas Hinze, Howard Swingle, Senanu Ashiabor, Anand Seshadri, *Forecasting Model for Air Taxi, Commercial Airline, and Automobile Demand in the United States,* Transportation Research Record, Vol. 2025, 2008.

36. Senanu Ashiabor, Antonio Trani, Hojong Baik, Nicholas Hinze, N., *Development of Intercity Mode Choice Models for New Aviation Technologies,* ASCE Conference Proceedings, Vol. 262, Issue 40938, 2007.

37. Senanu Ashiabor, Hojong Baik, Antonio Trani, *Logit Models to Forecast Nationwide Intercity Travel Demand in the United States,* Transportation Research Record, 2007.

38. National Research Council, *Future Flight: A Review of the Small Aircraft Transportation System, Special Report 263,* Transportation Research Board, 2002.

39. Senanu Ashiabor, *Development of an Airport Choice Model for General Aviation Operations,* MS Thesis, Virginia Tech, 2002.

ABBREVIATIONS AND ACRONYMS

EAS	Essential Air Service
FAA	Federal Aviation Administration
GAO	Government Accountability Office
LCC	Low-Cost Carriers
LC	Low Cost
MTC	Metropolitan Transportation Commission
VLJ	Very Light Jets
SCAG	Southern California Association of Governments

BIBLIOGRAPHY

Abbott, Terence, Jones Kenneth, Consiglio Maria, Williams Daniel and Adams Catherine. Small Aircraft Transportation System, Higher Volume Operations Concept: Normal Operations, NASA Langley Report NASA/TM-2004-213022, National Aeronautics and Airspace Administration, 2004.

Airport Information, http://www.airnav.com (accessed March 24, 2012).

Ashiabor, Senanu, Antonio Trani, Hojong Balk and Nicolas Hinze. *Development of Intercity Mode Choice Models for New Aviation Technologies.* ASCE Conference Proceedings, Vol. 262, Issue 40938, 2007.

Ashiabor, Senanu, Hojong Baik and Antonio Trani. *Logit Models to Forecast Nationwide Intercity Travel Demand in the United States.* Transportation Research Record, 2007, 2007.

Ashiabor, Senanu. *Development of an Airport Choice Model for General Aviation Operations.* MS Thesis, Virginia Tech, 2002.

Baik, Hojong, Antonio Trani, Nicolas Hinze, Howard Swingle, Senanu Ashiabor and Anand Seshadri. *Forecasting Model for Air Taxi, Commercial Airline, and Automobile Demand in the United States.* Transportation Research Record, Vol. 2025: 9-20, 2008.

Bennett, Randall, and James Craun. *The Airline Deregulation Evolution Continues: The Southwest Effect.* US DOT Office of Aviation Analysis,1993.

Bob Hope (Burbank) Airport, Airport Website. http://www.burbankairport.com/airportauthority/about-airport/airport-facts.html (accessed March 23, 2012).

Bonnefoy, Philippe and John Hansman. *Emergence of Secondary Airports and Dynamics of Regional Airport Systems in the United States.* MIT Center for Air Transportation, 2005.

Bon Terra Consulting, Mestre Greve Associates, CDM, Meyer Mohaddes Associates, Inc., Jones & Stokes and RBF Consulting. *Long Beach Airport Terminal Area Improvement Project: Draft Environmental Impact Report (EIR)*. No. 37-03, prepared for the City of Long Beach, 2005.

California Department of Transportation. *Capital Aviation System Plan: Capital Improvement Plan 2012~2021*. 2011.

Cassidy, Michael, Marymount University and Joseph Navarrete. Airport Passenger-Related Processing Rates Guidebook, ACRP Report 223, 2009.

City of Long Beach. *Long Beach California Municipal Code.* Title 16, Chapter 16.43 – Airport Noise Compatibility. 1995.

Clarke John-Paul, Dannie Bennett, Kevin Elmer, Jeffery Firth, Robert Hilb, Nhut Ho, Sarah Johnson, Stuart Lau, Liling Ren, David Senechal, Natalia Sizov, Robert Slattery, Kwok-On Tong, James Walton, Andrew Willgruber, David Williams. *Development, Design, and Flight Test Evaluation of A Continuous Descent Approach Procedure for Nighttime Operation At Louisville International Airport,* Final Report of the Partner CDA Team. Report No. PARTNER-COE-2006-002, 2006.

—. *Development, Design, and Flight Test Evaluation of a Continuous Descent Approach Procedure for Nighttime Operation at Louisville International Airport*. Partnership for Air Transportation Noise and Emissions Reduction Report, 2006.

Cunningham, Lawrence and Eckard Woodrow. “U.S. Small Community Air Services Subsidies: Essential or Superfluous.” *Journal of Transport Economics and Policy,* 1987.

de Neufville, Richard. “Low-Cost Airports for Low-Cost Airlines: Flexible Design to Manage the Risks.” Prepared for Special Issue of *Journal of Transportation Planning and Technology,* edited by Warren Walker and Vincent Marchau, 2007.

—. “Planning Airport Access in an Era of Low-Cost Airlines.” *Journal of the American Planning Association,* 72, 3, pg. 347, 2006.

—. “Accommodating Low-Cost Airlines at Main Airports.” Draft for Transportation Research Board Conference, 2006. http://ardent.mit.edu/airports/ASP_papers/Accommodating percent20Low percent20Cost percent20Carriers--percent20revised.pdf (accessed March 21, 2012).

—. *Airports of the Future: The Development of Airport Systems,* Presented at International Sysmposium and Exposition in Celebration of 100 years of Powered Flight in Dayton, Ohio, July 2003. http://ardent.mit.edu/airports/ASP_papers/Dayton percent20paper.pdf (accessed March 20, 2012).

—. *Planning Multi-airport Systems in Metropolitan Regions in the 1990s.* Report DTFA01-92-p-01243 for FHWA, 2000.

—. *Amsterdam Multi-Airport System: Policy Guidelines, 1995*. http://ardent.mit.edu/airports/ASP_papers/multi-airport percent20systems percent20policy percent20guidelines.PDF (accessed May 2012).

de Neufville, Richard and Amedeo Odoni. *Airport Systems Planning, Design and Management,* McGraw-Hill, 2003.

Fruhan, William, Jr., *The Fight for Competitive Advantage: A Study of the United States Domestic Trunk Air Carriers.* Boston, MA: Harvard University, 1972.

Fu, Xiaowen, Mark Lijesen and Tae Oum. “An Analysis of Airport Pricing and Regulation in the Presence of Competition Between Full Service Airlines and Low Cost Carriers.” *Journal of Transport Economics and Policy, Vol. 40 Part 3* (2006): 425-447.

Gillen, David, Andreas Knorr, Otto Meyer, Hans-Martin Niemeier, Peter Forsyth and David Starkie. *The Economic Regulation of Airports: Recent Developments in Australasia, North America and Europe,* Ashgate Pub Ltd, 2004.

Graham, Anne. *Managing Airports: An International Perspective.* Butterworth-Heinemann, 2008.

Graham, Brian, and Timothy Vowles. Carriers within Carriers: A Strategic Response to Low-Cost Airline Competition. *Transport Reviews,* Vol. 26, No. 1, (2006): 105-126.

Grothaus, James, Thomas Helms, Shaun Germolus, Dave Beaver, Kevin Carlson, Tim Callister, Robert Kunkel and Ann Johnson. *Guidebook for Managing Small Airports,* ACRP Report 16, Transportation Research Board, 2009.

Hansen, Mark, Geoffrey Gosling, Tarja Kettunen and Erik Wilkins. *The California Aviation System: Current Status and Recent Trends,* Institute of Transportation Studies, Research Reports, University of California, Berkeley, 2002.

—. *The California Aviation System: Current Status and Recent Trends,* Institute of Transportation Studies, Research Reports, University of California, Berkeley, 1998.

Hooper, Bill. *Trend Setting: Designs for Economical Terminals for Low-Cost Carriers will Determine the Looks of Many Facilities for the Next 20 Years,* Passenger Terminal World, 2005.

Ito Harumi and Lee Darin. Low Cost Carrier Growth in the U.S. Airline Industry, *Social Science Research Network,* 2003.

Kanafani, Adib and Mahmoud Abbas, Local Air Service and Economic Impact of Small Airports, Journal of Transportation Engineering, Vol. 113, Issue 1, 1987.

Knorr, Andreas and Andreas Arndt, *Most Low-Cost Airlines Fail(ed): Why Did Southwest Airlines Prosper? In – Competition Versus Predation in Aviation Markets: A Survey of Experience in North America, Europe and Asia,* Ashgate Publishing Limited, 2005.

Kramer, Lois, Peggy Fowler, Robert Hazel, Melissa Ureksoy and Gary Harig. *Marketing Guidebook for Small Airports,* ACRP Report 28, Transportation Research Board, 2010.

Kramer, Lois. *Airport Revenue Diversification,* ACRP Synthesis 19, Transportation Research Board, 2010.

Long Beach Airport, *Capital Improvement Program – Status Report,* First Quarter 2012, Long Beach Airport, 2012.

Lowell, Dana, Tom Curry, Lily Hoffman-Andrews and Lea Reynolds. Comparison of Essential Air Service Program to Alternative Coach Bus Service – Keeping Rural Communities Connected, Report prepared by M. J. Bradley & Associates for American Bus Association, Natural Resources Defense Council, The Reason Foundation, and Taxpayers for Commonsense, September 2011.

Morrison, Steven and Winston Clifford, *What's Wrong with the Airline Industry? Diagnosis and Possible Cures,* Brookings Ins 2005.

National Consortium for Aviation Mobility website, http://www.ncam-sats.org/ (accessed March 24, 2012).

National Research Council. Future Flight: A Review of the Small Aircraft Transportation System, Special Report 263, Transportation Research Board, 2002.

Research and Innovative Technology Administration (RITA) and Bureau of Transportation and Statistics (BTS) website, Air Carrier Statistics Data, (http://www.transtats.bts.gov/databases.asp?Mode_ID=1&Mode_Desc=Aviation&Subject_ID2=0) (accessed May 2012).

Resource Systems Group, Matthew Coogan, Mark Hansen, Megan Ryerson, Larry Kiernan, Joerg Last, Richard Marchi, and Robert Yatzeck. *Innovative Approaches to Addressing Aviation Capacity Issues in Coastal Mega-Regions,* ACRP Report 31, Transportation Research Board, 2010.

Reynolds-Feighan Aisling. European and American Approaches to Air Transport Liberalisation: Some Implications for Small Communities, *Transportation Research A,* Vol 29A, No. 6, pp 467-483.

Reynolds-Feighan Aisling. The US Airport Hierarchy and Implications for Small Communities, Urban Studies, Vol. 37, No. 3, pp 557-577, 2000.

Ricondo & Associates, Booz Allen Hamilton Inc., George Mason University, National Science Research. *Strategic Planning in the Airport Industry,* ACRP Report 20, Transportation Research Board, 2009.

SH&E Inc. *Regional Airport System Planning Analysis – Volume 1: Final Report,* Prepared for Metropolitan Planning Commission, Bay Conservation and Development Commission and Association of Bay Area Government, 2011.

SH&E Inc. *Regional Airport System Plan Update-Mid-point Screening Report,* Prepared for Regional Airport Planning Committee, July 2010.William Spitz, Richard Golaszewski, Susan Zellers, Stacy Pollert, Airports and the Next Generation of General Aviation Aircraft - Volume 2: Guidebook, ACRP Report 17, Transportation Research Board, 2009.

Spitz, William and Richard Golaszewski. *Airports and the Next Generation of General Aviation Aircraft - Volume 1: Forecast,* ACRP Report 17, Transportation Research Board, 2009.

Starkie, David. *Competition and Market Power in - Aviation Markets: Studies in Competition and Regulatory Reform.* Ashgate Publishing Limited, 2008.

Steven, Martin, Vesta Rae & Associates, Robin Lee Monroe & Associates, Wordsworth Communications. *Passenger Air Service Development Techniques,* ACRP Report 18, Transportation Research Board, 2009.

Trani, Antonio, Hojong Baik, Howard Swingle and Senanu Ashiabor. *Integrated Model for Studying the Small Aircraft Transportation System,* Transportation Research Record, Vol. 1850, pp 1-10, 2003.

United States Congress. *Wendell H Ford Aviation Investment and Reform Act for the 21st Century* (PL 106-181), Enacted by the Senate and House of Representatives of the Unites States of America in Congress, 2000.

United States Congress. *Rural Air Service Survival Act* (PL 104-264), Enacted by the Senate and House of Representatives of the Unites States of America in Congress, 1996.

United States Congress. *Airport and Airway Safety and Capacity Expansion Act of 1987* (PL 100-223), Enacted by the Senate and House of Representatives of the Unites States of America in Congress, 1987.

United States Congress. *Airline Deregulation Act of 1978* (PL 95-504), Enacted by the Senate and House of Representatives of the Unites States of America in Congress, 1978.

United States Department of Transportation - Office of Aviation Analysis. What is Essential Air Service, (April, 2009), http://ostpxweb.dot.gov/aviation/rural/easwhat.pdf (accessed March 20, 2012).

United States General Accounting Office. *Commercial Aviation: Programs and Options for Providing Air Service to Small Communities,* Testimony before the Subcommittee on Aviation, Committee on Transportation Infrastructure, House of Representatives, 2007.

—. *Commercial Aviation: Initial Small Community Air Service Development Projects Have Achieved Mixed Results,* Report to Congressional Addressees, November 2005.

—. *Commercial Aviation: Programs and Options for Providing Air Service to Small Communities,* Testimony before the Subcommittee on Aviation, Committee on Transportation Infrastructure, U.S. House of Representatives, 2000.

—. *Essential Air Service: Changes in Subsidy Levels, Air Carrier Costs and Passenger Traffic,* Report to the Chairman, Subcommittee on Aviation, Committee on Transportation Infrastructure, House of Representatives, 2000.

Williamson, Kenneth, Lawrence Cunningham and Marc Singer. Scheduled Passenger Air Service to Small Communities: A Role for State and Local Governments, *Transportation Journal,* Summer, pp 25-36, 1982.

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