Phase

2

❖ BAY AREA ECONOMIC FORUM ❖

A Baseline Economic Impact Report on
Bay Area International Airports and
Their Relation to Jobs, the Economy and Global Competitiveness

Air Transport and the Bay Area Economy

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A BASELINE ECONOMIC IMPACT REPORT ON BAY AREA INTERNATIONAL AIRPORTS AND THEIR RELATION TO JOBS, THE ECONOMY AND GLOBAL COMPETITIVENESS

Air Transport and the Bay Area Economy

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EXECUTIVE SUMMARY

PHASE ONE

In January 2000, the Bay Area Economic Forum released the first phase of its study analyzing the contribution that the three major passenger/cargo airports – San Francisco International (SFO), Oakland International (OAK) and San Jose International (SJC) – make to the San Francisco Bay region's economy.

The goal of the Economic Forum, a public-private partnership sponsored by the Bay Area Council and the Association of Bay Area Governments, is to both understand the regional economic contribution made by airports and, equally important, the implications of congestion and constrained airport capacity on the Bay Area's economic future.

The Economic Forum's Phase One study utilized an economic model developed by Martin Associates. The model involved 100 percent direct surveys of airports and their tenants and vendors, plus large sample surveys of foreign and domestic travelers using the three airports.

PHASE ONE FINDINGS

Counting both direct impacts and indirect "ripple effects" in tourism and other sectors, the three airports together generated $37.7 billion in business revenues in 1998-99; supported 470,000 jobs representing $13.2 billion in personal income; accounted for $8.7 billion in federal, state and local taxes. Approximately one-seventh of the Bay Area's gross regional product of $234 billion is directly or indirectly linked to the activities of its three airports.

Cargo and passenger flows through Bay Area airports have grown dramatically in recent years, as 1) the region has become a focal point for new technologies and industries driving the global economy; 2) deregulation has added service and lowered fares; 3) convention, small conference and visitor activity have rebounded since the early 1990s; 4) international trade, particularly with Asia, has expanded through the Bay Area gateway; 5) corporate e-commerce and supply chain strategies favor time-definite shipment of high-value, time-sensitive products by air; and 6) mergers, strategic partnering and networking necessitates increased business travel.

Hub airports such as SFO experience the heaviest congestion problems and most are approaching saturation. As these airports near their optimal capacity levels, airline and flight schedules tend to become more condensed. Thus when bad weather strikes, or the volume of flights exceeds an airport's capacity, flights are typically delayed. Delays then increase exponentially: An airport growing from 80 to 90% of capacity, for example, will see the number of delays greater than 15 minutes more than double from 15 to 35 flights per 1,000 flight operations. SFO alone experienced 48 delays greater than 15 minutes per 1,000 operations – a total of 24,270 delays – in 1998, mainly due to weather conditions, and accounts for 5.7% of weather related delays nationwide, according to the Federal Aviation Administration.

Airport expansion in densely populated urban areas involves increasingly difficult sets of policy choices. Public concerns over noise, traffic congestion and environmental impacts (including filling in San Francisco Bay) are well-known at this stage of the public process. Less well-known are the economic impacts of capacity constraints as business growth and demographic changes exert demand pressures on the airports to expand their capacity.

Phase Two

The purpose of the Bay Area Economic Forum Phase One report was to provide Bay Area decision makers with baseline economic impact information to fully understand the public policy tradeoffs they will be required to make in considering various regional airport expansion proposals.

Phase Two builds on Phase One data by examining:

> How business travelers, air freight shippers and the airlines themselves use and rely upon the region's major airports;
>
> How flight delays and cancellations may translate into higher costs and lost opportunities for these constituencies; and
>
> What the broad implications are for the Bay Area economy over time if airport capacity is constrained relative to demand.

In undertaking its Phase Two analysis, the Economic Forum drew on new data. These include new MTC data on future aviation demand growth; economic modeling that uses Census Bureau data to measure the dollar value and contribution to the regional economy of air freight moving through the Bay Area; FAA 1998-99 flight operations and delay data, and updated FAA and ATA hourly delay cost formulas; a sample survey of 140 business travelers conducted in cooperation with the Bay Area Business Travel Association; and interviews with Bay Area firms in key industry clusters, with air freight forwarders, and with business site location specialists, about their own and their clients' reliance on regional airports.

Phase Two Findings

Current and Future Demand

In 1998, the three Bay Area airports together served 56.6 million passengers. Passenger demand at SFO, OAK and SJC is forecast to grow to 82.3 million passengers by 2010, and double to 111.1 million passengers by 2020.

By 2020, the Three Bay Area Airports Will Handle 111.1 Million Annual Passengers

Type/Area		1998	2010	2020
Total Domestic Passengers		39,740,840	55,713,806	70,394,227
International				
Transborder		1,725,572	2,820,576	4,210,551
Transatlantic		2,454,454	3,236,870	4,907,973
Transpacific		2,548,308	5,609,115	10,252,340
The Americas		61,463	116,496	178,172
Total International Gateway		6,789,797	11,783,057	19,549,036
Connecting	**Domestic**	6,649,670	8,565,998	10,823,112
	International	3,393,460	6,245,020	10,360,989
Total Connecting		10,043,130	14,811,018	21,184,101
Total Passengers		56,573,767	82,307,880	111,127,364
Enplanements		28,286,883	41,156,940	55,563,682
Annual Growth			3.2%	3.1%
Total Growth			45.0%	96.4%

Source: MTC

Barring infrastructure or other constraints, overall passenger traffic is forecast to increase by an average 3.1% annually; international passenger demand will grow by 4.9% a year. Markets are redistributing air service among the region's three major airports. SFO will remain the region's dominant air transport facility, particularly in international flights, but its share of the Bay Area passenger market will decline as OAK and SJC's service networks expand.

Source: MTC

About 1.75 million tons of air cargo (freight and mail) moved through the three airports in 1998. That figure should increase to 3.2 million tons in 2005, and is expected to triple to 5.5 million tons in 2020 – an average growth rate of 6.2% annually. Key growth segments in the air cargo market are international shipments, particularly to and from Asia; and time-sensitive, two or three-day package express shipments of all sizes.

SFO will benefit from increased international cargo business, but is expected to see slower domestic air cargo growth. OAK and SJC are expected to see across-the-board growth in international, integrator (mainly FedEx and UPS) and mail traffic.

Who uses the region's airports in conducting their business? How do they use it? And to what extent are they, in fact, reliant on commercial air services? This report analyzed three major catagories of airport activity—air cargo, business travel and airline service—that relate directly to the regional economy.

Cargo

U.S. Census Bureau figures show 859,000 tons of air freight (excluding express packages and mail) moving through the airports in 1999, with a total shipment value of $109 billion.

Key outbound commodities loaded at the airports included: computer and data processing equipment; electrical components and circuitry; toys; video and audio equipment; apparel and footwear; medical equipment; and fresh fruits. Key inbound commodities discharged at the airports included: computer and data processing equipment; fresh fruits and vegetables; plant seeds; electrical, measuring and audio equipment.

At SFO, 46% of air cargo handled is international (nearly three-fourths of that is to and from Asia); 58% of air cargo moves in the bellies of passenger jets.

By contrast, 90% of OAK's cargo business, and 80% of SJC's, originates with the hub operations of integrators providing combined air-truck, door-to-door delivery, particularly Federal Express and United Parcel Service. Most is domestic cargo and moves on narrowbody jet freighters. OAK has the largest share of air cargo operations among Bay Area airports—some 70% of domestic air freight and one-fourth of domestic mail.

In 1998, mail accounted for about 15 percent – or 264,000 tons – of the total cargo shipped through SFO, OAK and SJC.

Freight forwarders surveyed tend to route the majority of their freight through SFO, on all-cargo flights and in the bellies of passenger jets, depending on shipment size and schedule requirements. Some cargo is consolidated into full trailer loads in Northern California and trucked to Los Angeles, to take advantage of volume discounts and wider schedule choices.

Business Travel

About 30% of the total arriving, departing and connecting passengers at Bay Area airports in 1998 – some 17 million passengers – were business travelers. SFO is the dominant airport for business travel. In 1999, 16.1 million passengers (41% of total domestic travelers and 36% of total international travelers) passed through SFO on business.

Businesses surveyed for this report indicate that they tend to use, in order of preference, SFO, OAK and SJC when traveling on business. They like SFO for its accessibility from home or office, but some say they have begun to use OAK because of flight delays at SFO. Many use all three airports at various times depending on route and schedule requirements.

Priorities listed by business travelers surveyed include:

- Availability and frequency of both domestic and international service
- Non-stop domestic and international flights
- Concentration of flights to and from particular markets during peak hours
- Ease of rush hour commute to and from the airport
- Lower relative ticket costs

Most firms factor delays into trip planning (booking earlier flights, booking at airports with multiple departing and arriving flights around the same time, etc.).

Conventions, and smaller corporate and industry meetings held at hotels and conference centers throughout the Bay Area represent an important segment of the business travel market. Corporate event planners consider accessibility – choice of airlines and flights into and out of a city, availability of non-stop flights – in choosing a convention or conference site. Accessibility can also influence attendance, as executives and their travel planners consider the timing and convenience of arrangements.

Conventions that involve product exhibition additionally require adequate cargo connections, so that trade show booths, displays and products arrive and depart on schedule to meet setup and break down deadlines.

Airlines

In determining service levels to and from a particular city, commercial airlines consider not only market demand and competitive factors, but also the potential financial and operational effects of a new route on the carrier's entire network.

Passenger airlines are always striking a balance between the widest possible selection of flight options, and an on-time operation that doesn't spread aircraft, personnel and resources too thinly at any one time. Airlines also try to coordinate scheduling for connecting flights across their networks, including hub connections and through flights offered in cooperation with alliance partners.

Connections between international and domestic flights can feed additional demand into an airport and generate added domestic flights. Similarly, scheduling a stopoff at a gateway airport can improve a carrier's utilization on a longer flight by picking up additional passengers for a domestic shorthaul leg. For example, United Airlines reports that 60% of its total United Shuttle passengers – on short flights within the western U.S. – are connecting international or transcontinental passengers through the SFO hub.

This "feed" concept of closely interconnected routes and schedules makes it difficult for an airline to simply shift individual flights between airports to alleviate congestion, since each route segment is interdependent with the larger network and even small changes in service have systemwide impacts.

Airport Delays

Airport congestion, and delayed or cancelled flights, are a national phenomenon. Some 640 million airline passengers will board 7.4 million domestic flights alone in 2000, according to the FAA – twice the number traveling in 1980.

The bulk of airline flights are concentrated in peak periods of the morning and afternoon, and air traffic control systems are strained. Research at George Mason University indicates that many hub airports – Las Vegas, Minneapolis/St. Paul, Newark, La Guardia, San Francisco and others – are approaching saturation levels. Airport delays grew nationwide from 26,000 flight operations in July 1998 to 44,000 in July 1999.

Among Bay Area airports, SFO's runway capacity is strained, and the airport is operating at or over capacity with respect to arriving flights in bad weather. The U.S. Department of Transportation ranks SFO worst among Western U.S. airports in terms of delays which originate from its own operations and facilities, with 40% of its flights delayed in the first five months of 2000. SFO's ontime record during the first half of 2000 was as low as 51.7% of arrivals and 63.7% of departures, well below the national averages of 74.2% and 77.7% respectively. SJC was ranked 10th in delays among the nation's 193 commercial airports, with 27% of its flights delayed during that period, and OAK ranked 19th, with 23-24% of flights delayed.

Where the FAA has determined an average acceptable delay of 4-5 minutes per commercial flight operation, SFO averaged 5.18 minutes per operation in 1999, while OAK averaged 2.41 minutes per operation and SJC averaged 3.04 minutes. For all three airports, average delays per operation, as calculated by FAA, increased during the first half of 2000 (6.22 minutes for SFO, 2.45 minutes for OAK and 3.81 for San Jose).

Flight Operations/Delay Data, by Airport, 1998-2000									
	OAK			SFO			SJC		
	1998	1999	* Jan-June 2000	1998	1999	* Jan-June 2000	1998	1999	* Jan-June 2000
Departures	75,276	74,745	38,322	175,654	177,852	86,248	66,126	68,804	35,402
Arrivals	74,899	74,467	38,191	176,625	178,790	87,469	66,430	68,984	35,535
	Average Delay in Minutes per Flight								
Total Outbound	2.69	2.64	2.54	5.7	5.73	6.87	3.22	3.82	4.57
Total Inbound	2.87	2.18	2.36	5.36	4.63	5.57	2.7	2.26	3.06
Total Operation	2.78	2.41	2.45	5.53	5.18	6.22	2.96	3.04	3.81

Source: Federal Aviation Administration

Multiplying these average delays per operation by the total number of *flight operations* provides aggregate delay totals for each airport: 30,790 hours in 1999 for SFO; 5,993 hours for OAK; and 6,981 hours for SJC. As a measure of lost productivity, approximately 4.4 million *passenger hours* were lost in 1999 in terminal waiting areas, taxiing on runways and airborne hold patterns. Travelers at SFO experienced approximately 3.2 million lost hours due to delays. Business travelers at SFO alone experienced approximately 1.4 million hours of lost productivity due to delays.

The FAA's most recently adjusted estimate for the average hourly cost incurred by *passengers* relating to airport delays is $26.70. The Air Transport Association places a similar delay-related hourly cost to *airlines* at $2,047. Using these numbers, the calculation of annual costs to airlines is approximately about $89.6 million at the three airports in 1999. Calculating passenger impacts suggests an annual cost to Bay Area passengers in 1999 of $118.5 million.

Airport Capacity and Projected Demand

Recent forecasts by the Metropolitan Transportation Commission suggest that SFO and OAK could approach unacceptable levels of delay sometime between 2010 and 2020 with no capacity expansion by either airport (see chapter 5).

Over the longer term, technological advances in radar and air traffic control positioning instrumentation, shifting to larger aircraft, the proposed development of high-speed rail service between Northern and Southern California, and moving of some cargo or regional air operations to smaller general aviation airports may help increase effective capacity.

None of these solutions, however, in and of themselves can sufficiently expand capacity to fully accomodate either near-term demand growth, or the full extent of demand forecast by 2020. Even factoring in capacity improvements from larger aircraft and better airfield utilization, without runway expansion the Bay Area can expect:

- An increase in total flight delays, including increases in delays over an hour;
- Increased costs to business travelers in lost productivity and opportunity;
- Higher costs for airlines, possibly redirecting new services to other airport gateways;
- Fewer air freight options, particularly for international shippers and shippers of large or heavy freight.

Several expansion scenarios are under consideration for Bay Area airports in the coming decade. All involve tradeoffs between: a) new runway construction; b) runway and flight path reconfigu0ration, plus air traffic management improvements; and c) accepting constraints on future growth. Each scenario has advantages as well as economic and social costs.

Economic Impacts of Demand/Capacity Scenarios

The Bay Area's three major airports currently support over $37 billion in Bay Area business revenues; nearly 500,000 jobs with more than $13.3 billion in salaries and wages; and account for almost $3 billion in state and local taxes. When the large economic impacts of tourism are excluded, airport-generated business activity by itself supports over $20 billion in business revenues; 94,000 jobs with over $4 billion in wage and salary income; and accounts for almost $600 million in state and local taxes.

Assuming that the region's airports are able to fully meet the demand projected by MTC, their combined economic contribution to the region could grow to more than $70 billion in business revenue; 800,000 jobs with nearly $22 billion in wage and salary income; and close to $4.9 billion in state and local taxes by 2020. Excluding tourism and focusing only on impacts generated more directly by airports, by 2020 their combined contribution to the region's economy could grow to almost $43 billion in business revenue; 147,000 jobs with over $5.5 billion in wage and salary income; and $810 thousand in state and local taxes (see table below).

Projected Airport Generated Economic Impacts (Exclusive of Tourism)

IMPACT CATEGORY	Baseline 1999	Total 2010	Incremental Change (1999-2010)	Total 2020	Incremental Change (1999-2020)
Jobs					
Direct and Induced *	79,906	96,350	16,444	118,003	38,097
Indirect *	14,706	19,929	5,223	28,515	13,809
Total	**94,612**	**116,279**	**21,667**	**146,518**	**51,906**
Wage and Salary Income ($thousands)					
Direct and Induced *	$3,649,292	$4,315,116	$665,824	$4,546,063	$896,771
Indirect *	$524,649	$711,264	$186,615	$1,017,730	$493,081
Total	**$4,173,941**	**$5,026,380**	**$852,439**	**$5,563,793**	**$1,389,852**
Business Revenue ($thousands)	**$20,651,458**	**$29,514,646**	**$8,863,188**	**$42,849,533**	**$22,198,075**
State and Local Taxes ($thousands)	**$581,410**	**$605,886**	**$24,476**	**$810,009**	**$228,599**
Projected Visitor and Tourism Industry Economic Impacts					
Jobs	**373,590**	**486,408**	**112,818**	**663,361**	**289,771**
Wage and Salary Income ($thousands)	**$9,148,581**	**$11,924,741**	**$2,776,150**	**$16,216,948**	**$7,068,357**
Business Revenue ($thousands)	**$17,082,776**	**$21,890,820**	**$4,808,045**	**$29,101,393**	**$12,018,618**
State and Local Taxes ($thousands)	**$2,295,771**	**$2,989,048**	**$693,277**	**$4,076,447**	**$1,780,676**
Total Impacts Airport and Visitor Combined					
Jobs	**468,202**	**602,687**	**134,485**	**809,879**	**$341,677**
Wage and Salary Income ($thousands)	**$13,322,522**	**$16,951,121**	**$3,628,589**	**$21,780,741**	**$8,458,209**
Business Revenue ($thousands)	**$37,734,234**	**$51,405,466**	**$13,671,233**	**$71,950,926**	**$34,216,693**
State and Local Taxes ($thousands)	**$2,877,181**	**$3,594,934**	**$717,753**	**$4,886,456**	**$2,009,275**

* Direct - jobs and revenue directly generated by airport activities

Source: Martin Associates

* Induced - jobs and revenue generated through expenditures by individuals directly employed in airport activities

* Indirect - jobs and revenue generated due to the purchas of goods by firms dependent on airport activity

Constraints on future capacity can be expected to reduce these economic and employment benefits, while at the same time raising delay-related costs to passengers, freight shippers and airlines.

With no significant expansion to meet forecast demand, analysis by Martin Associates suggests that Bay Area airports may be unable to accommodate some 5.2 million expected passengers (6.4% of total passenger forecast) in 2010, or as many as 14.7 million passengers (13.2% of total passengers forecast) in 2020. This could cost the region as many as 92,000 jobs, nearly $7.5 billion in business revenue; $2.4 billion in wage and salary income; and nearly $570 million in state and local taxes by 2020. Excluding tourism and focusing only on impacts generated more directly by airports, the potential cost to the region is $4.3 billion in business revenue; 10,000 jobs with $470 million in wage and salary income; and $65 million in state and local taxes.

This estimate of costs does not include delay-induced losses in productivity to Bay Area businesses, or other opportunity costs to business resulting from worsening congestion.

While demand under these constrained capacity conditions would continue to be served, though under increasingly frustrating and costly conditions, it is clear that a threshold will soon be crossed—particularly at SFO and OAK— where capacity limitations will result in reduced airline service and/or lost business revenue and opportunity.

To the extent that incremental improvements in airport capacity are implemented, these gross impacts can be mitigated. The coming capacity crunch can also be eased in part by using larger aircraft to reduce the total number of flight operations, and by improved marketing, reservation and schedule coordination. Absent an expansion of the region's runway infrastructure, however, no combination of technology and flight management appears adequate to meet the region's growing air service needs.

Beyond their direct contributions to the region's economy, Bay Area airports serve an indispensable support function for businesses. Worsening airport congestion, when added to constrained mobility on the region's highways, bridges and streets, can seriously affect public perceptions of the Bay Area's quality of life, business climate, and its competitive position in attracting and retaining business.

The Bay Area is also a global leader in technology and trade, and highly dependent on its global connections. Airports play a key role in linking the Bay Area with national and worldwide markets, and with the people – engineers, scientists, entrepreneurs and financiers – who make this a uniquely productive, diverse and innovative region.

Failure to provide Bay Area airport infrastructure sufficient to meet future demand carries significant potential economic costs to the region. Among the likely results are: reduced travel choices for Bay Area residents, businesses and visitors, and diminished economic competitiveness and opportunity. These economic impacts must be weighed in the balance as the region confronts key policy decisions regarding environmental protection, quality of life and the expansion of airport infrastructure.

INTRODUCTION

THE PRICE OF AIRPORT CONGESTION: AN ECONOMIC ANALYSIS

This report represents the second phase of a study which examines how the region's major airports contribute to the Bay Area economy. This analysis is intended to assist regional decisionmakers in assessing policy options related to future expansion of the Bay Area's regional airport infrastructure.

The Bay Area's three international airports – San Francisco (SFO), Oakland (OAK) and San Jose (SJC) – enter the 21st century facing gridlock in a variety of forms.

In the next 20 years, passenger traffic has the potential to double, and cargo volumes to triple. Several trends account for much of this potential growth:

- The Bay Area's emergence as a center for new technologies driving the global economy, attracting buyers, investors and workers from around the world;
- Expanded domestic and international airline services, and lower fares, resulting from competition, deregulation and favorable aircraft purchase and lease terms;
- Increased business travel linked to trade, industry consolidation, strategic alliances and globalization, as face-to-face relationships remain critical to commerce;
- A revitalized visitor, small conference and convention market in the Bay Area since the mid-1990s, particularly in San Francisco, Silicon Valley, the North Bay and the I-680 corridor;
- A dramatic increase in the region's international trade, including a 42% increase in manufactured exports from 1993-98, to $42.8 billion, that has diversified and continued to grow even with the recent Asian economic crisis;
- Greater reliance by manufacturers, wholesalers and retailers on agile manufacturing and supply chain integration strategies that involve "made-to-order" production without inventory. Such strategies rely heavily on fast, time-definite air and truck transportation to lower costs and respond quickly to market changes.

The growth experienced in recent years, and the growth forecast by the MTC – to 111.1 million passengers and 5.5 million tons of cargo moving through Bay Area airports by the year 2020 – represent a regional success story. But there are significant differences within the region over how future growth can be accommodated.

How should airports scale their facilities and operations to manage future growth efficiently? What are the optimum tradeoffs between airport expansion and "quality of life" issues such as noise, traffic congestion and environmental impacts? To what extent might new technologies, new transportation alternatives, and regional service allocation schemes alleviate demand pressures in combination with runway and terminal expansion?

OBJECTIVES

The Bay Area Economic Forum, a partnership of civic leaders supported by the Bay Area Council and the Association of Bay Area Governments, set out to build on the extensive work already being done by MTC, the Bay Conservation Development Commission (BCDC), the Federal Aviation Administration (FAA), and the airports themselves, by:

- Examining how business constituencies (executives traveling on business; businesses participating in conventions and exhibitions; and businesses that are frequent, high-volume shippers of air freight) use Bay Area airports;

- Understanding the extent to which delayed or canceled flights already impact business users, and how capacity constraints and increased congestion might affect their future operations and decisionmaking;

- Assessing the dollar and other less tangible costs of current and future delay-related impacts to the Bay Area economy, as travelers, air freight shippers and commercial airlines adapt to constrained airport conditions.

We hope that the findings that follow will be useful in developing policies regarding airport infrastructure expansion and configuration that adequately balance the key public interests of economic vitality, environmental protection, quality of life and convenient, affordable travel.

CHAPTER 1

A GLOBAL LIFELINE FOR BUSINESS

In Phase One of this report, we examined the direct and indirect economic contribution that Bay Area airports make to the regional economy, measured in the ripple effect of expenditures by and at the airports, and by the impacts of airport-dependent tourism.

That contribution is significant. If we count the indirect economic benefits of tourism, the benefit added up to $37.7 billion in business revenues in 1998-99; 470,000 jobs representing $13.3 billion in personal income; and $2.9 billion paid in state and local taxes.

Approximately one seventh of the Bay Area's gross regional product of $235 billion is directly or indirectly linked to the activities of its three airports.

Even subtracting indirect, visitor-related economic impacts, combined passenger and cargo activities at Bay Area airports now support nearly $20.7 billion in business revenues; 95,000 direct and indirect jobs; $4.2 billion in direct and indirect wage and salary income; and $491 million in state and local taxes.

Applying the projected growth at the airports to the Phase One baseline regional airport impact figures, we find that excluding tourism the regional airports' combined economic contribution to the region could grow to 116,000 jobs, $5 billion in wages and salaries, $29.5 billion in business revenues and $606 million in tax revenues in 2010; and to 146,500 jobs, $5.5 billion in wages and salaries, $42.8 billion in revenues and $810 million in tax revenues in 2020[1] (see chart page 18).

By 2020, the Three Bay Area Airports Will Handle 111.1 Million Annual Passengers

Type/Area		1998	2010	2020
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Source: MTC

[1] Martin Associates. *Economic Impact Analysis of Bay Area Airports.* San Francisco, CA: Bay Area Economic Forum, August 2000. "Unconstrained Projected Airport Generated Economic Impacts."

The Bay Area airports' combined economic contribution to the region could grow to 800,000 jobs, $21.8 billion in wages and salaries, $72 billion in business revenues, and $4.8 billion in state and local taxes by 2020; excluding tourism, airport-generated economic impacts could reach 146,000 jobs, $5.5 billion in wages, $42.8 billion in business revenue, and $800 million in state and local taxes.

Projected Airport Generated Economic Impacts (Exclusive of Tourism)					
IMPACT CATEGORY	**Baseline 1999**	**Total 2010**	**Incremental Change (1999-2010)**	**Total 2020**	**Incremental Change (1999-2020)**
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Jobs	**468,202**	**602,687**	**134,485**	**809,879**	**$341,677**
Wage and Salary Income ($thousands)	**$13,322,522**	**$16,951,121**	**$3,628,589**	**$21,780,741**	**$8,458,209**
Business Revenue ($thousands)	**$37,734,234**	**$51,405,466**	**$13,671,233**	**$71,950,926**	**$34,216,693**
State and Local Taxes ($thousands)	**$2,877,181**	**$3,594,934**	**$717,753**	**$4,886,456**	**$2,009,275**

* Direct - jobs and revenue directly generated by airport activities

Source: Martin Associates

* Induced - jobs and revenue generated through expenditures by individuals directly employed in airport activities

* Indirect - jobs and revenue generated due to the purchas of goods by firms dependent on airport activity

The above figures assume that future aviation demand reaches the levels forecast by MTC for 2010 and 2020; that no significant changes take place in key transportation market segments (high-speed rail within California, for example) or in underlying economic conditions; and that airport capacity expands to meet forecasted demand.

This kind of pure, dollars and cents calculation does not tell the full story, however.

An efficient, user-friendly air transportation infrastructure – with vigorous carrier competition, a wide range of route and schedule choices, on-time arrivals and departures, low fares and cargo rates, convenient highway connections and full support services – adds value for a region's businesses well beyond its direct economic contribution.

Current Air Transport Trends

A February 2000 report on "San Francisco Bay Area Aviation Demand Forecasts (1998-2020)," as part of the 2000 Regional Airport System Plan Update for the Bay Area, prepared under supervision of MTC, outlines a number of growth trends for the regional airports.

Passenger

Total passenger traffic moving through SFO, OAK and SJC, is expected to grow from 57 million annually today, to 82 million in 2010 and 111 million in 2020, an average growth rate of 3.1% annually.

An efficient, user–friendly air transportaion infra-structure–with vigorous carrier competition, a wide range of route and schedule choices, on-time arrivals and departures, low fares and cargo rates, convenient highway con-nections and full support services–adds value for a region's businesses, well beyond its direct economic contribution.

Key growth segments of the Bay Area passenger market for the future include international flights; connecting flights via both hub and point-to-point operations; and flights to and from the East Coast and within the Western U.S. Most of the increase in traffic by 2020 is expected to come from: 1) a 25% increase in United hub flights through SFO; 2) a doubling of operations by Southwest at OAK, plus the addition of OAK as a city served via other airline hubs nationwide; and 3) a doubling of departures at SJC by a merged American Airlines/Reno Air, 27 new daily Southwest departures, and 19 new daily departures to and from other hub cities.

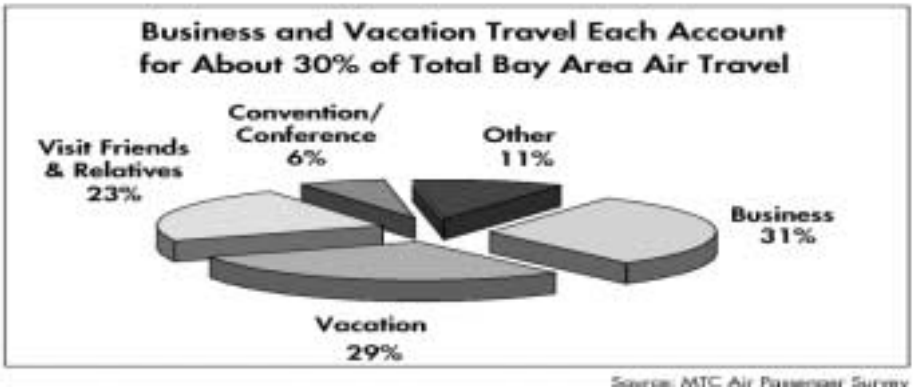
Market forces are already segmenting services and reallocating market shares among the three airports. By 2020, SFO's share of the Bay Area air passenger market is forecast to decline from 62% today to 53.8%, while OAK's share will grow from 16% to 22.8%, and SJC's will increase from 18% to 23.4%. OAK is expected to add service to 22 new cities by that time, while SJC adds service to 13 new cities and SFO adds service to 5.

Increase in Flight Operations/changes in market share by airport, 1998 vs. 2020

Airports	1998 Passengers Operations	2020 Passengers Operations	1998-2020 % Increase in Operations	1998 Market Share %	2020 Market Share %
Oakland International	113,396	217,331	92%	16%	22.8%
San Francisco International	394,886	512,981	30%	62%	53.8%
San Jose International	130,964	223,380	71%	18%	23.4%

Source: MTC

SFO will retain its lead in international passenger service, because of its name, its ability to accommodate larger aircraft in larger numbers, and its expanded international terminal capacity. OAK and SJC will have more than half of the market in domestic flights by 2020, up from 45% today.



A 1995 MTC air passenger survey showed that business travel accounted for some 31% of total passengers into and out of the Bay Area, with convention/conference travelers accounting for another 6%.[2] While all travel into and out of the Bay Area has increased sharply since 1995, interviews with convention and visitors' bureaus throughout the region suggest that the convention/conference share is now larger and may continue to grow at a faster pace in future.

CARGO.

Total cargo through the three airport gateways is likely to increase from about 1.75 million tons currently to 3.2 million tons in 2005, and to 5.5 million tons in 2020 – an average growth rate of 6.2% annually.

SFO is the main airport in the Bay Area for international cargo, including freight carried in the holds of widebody passenger jets, and jet freighter service operated by international airlines to augment their overall cargo service. It also accounts for all international mail and more than two-thirds of domestic mail moving via air into and out of the Bay Area. Most perishable products moving by air—agricultural products, biomedicines and some chemicals—move through SFO because of its non-stop service to 57 cities and its frequent schedules.

Air cargo moving through OAK grew 40% from 1994-98. OAK now has the largest share of air cargo operations among Bay Area Airports: some 70% of Bay Area domestic freight, and more than a fourth of domestic mail. Nearly 70% of its cargo business comes from FedEx, which uses OAK as a West Coast hub. UPS accounts for another 20%.

More than 80% of SJC's cargo comes from FedEx, UPS and other integrators. Its relatively small share of international traffic is derived mainly from a direct Tokyo passenger flight that also carries cargo.

[2] MTC Air Passenger Survey. "Reasons for Passenger Travel to/from the SF Bay Area's Airports." 1995.

Throughout the region, cargo volume is projected to grow at an average 6.2% annually, and mail volumes are expected to grow an average 2.3% a year. Domestic freight will grow from 1.1 million tons in 1998 to nearly 2.8 million tons in 2020. International freight will grow from 414,000 to 2.5 million tons. Mail volume will increase from 264,000 to more than 626,000 tons.

Bottom Line Trends for Bay Area Airports:

- **Passenger traffic should double, and cargo traffic should triple, by 2020.**
- **International flights, especially to and from Asia, and new domestic connecting flights will together account for most passenger growth.**
- **International passenger and cargo growth will focus on SFO; greater domestic passenger and cargo growth should increase OAK and SJC market shares.**
- **OAK and SJC will add significant passenger services to and from the East Coast and in the Western U.S.; the California market will mature.**
- **Asia will account for 80% of international cargo traffic.**
- **Domestic cargo growth will focus on 2-3 day integrator services, including larger, heavier shipments.**

CHAPTER 2

TIME REALLY IS MONEY

The needs of passengers, freight shippers and airlines themselves are changing, and schedule reliability now tops the list of critical service factors.

PASSENGER HOURS

No commercial airline customer, passenger or freight, finds airport delays a pleasant experience. We put up with them to a certain point, and when we have experienced enough of them, we begin to look for alternatives: a competing carrier, a different route or schedule, a different form of transportation, or traveling less.

Vacation flyers often take limited time off from work, and make hotel and other reservations that cannot be canceled on short notice without penalties. To lose a vacation day due to missed connections is bad; to pay for it regardless is worse. Sometimes a trip is connected to a once in a lifetime event – a wedding, anniversary celebration, or funeral – and a late or canceled flight means a lost milestone in one's life.

For business travelers, time is of the essence. A late or missed meeting can throw business to a competitor, or start negotiations off on the wrong foot. A missed reception or conference panel can mean lost critical information or networking opportunities for an audience participant, and a ruined event if the traveler is the honored guest or speaker.

And there are delay-related costs for business travelers, from lost productive time equivalent to hours of pay, to an extra night's hotel, meals, car rental and other charges.

Schedules are tighter than ever in business today. Companies demand of their employees that the benefits of a trip clearly warrant the cost. Businesses and individuals rely on airlines to provide the fastest, most reliable scheduled transportation between cities, domestically and internationally. A reasonable customer expectation is that published schedules will be met.

Currently, the FAA estimates the average hourly cost of delays to an airline passenger, for statistical purposes, at $26.70. This average takes into account a higher hourly cost for business travelers who are on company time while waiting in airport terminals, in holding patterns and on runways waiting for clearance to take off. A survey of *business* travelers conducted for this study (see Chapter 3) revealed an average salary of just under $87,000, or a direct labor cost of $42 per hour.

Using the average FAA cost for calculation purposes, it is possible to assign an overall cost total for delays at the three airports, factoring in average minutes of delay per flight operation at each airport. According to the FAA's Consolidated Operations and Delay Analysis System (CODAS), SFO averaged delays of 5.18 minutes per operation in 1999, while OAK averaged 2.41 minutes per operation and SJC averaged 3.04 minutes.

Multiplying these average delays per operation by the total number of *flight operations* provides aggregate delay totals for each airport: 30,790 hours in 1999 for SFO; 5,993 hours for OAK; and 6,981 hours for SJC.[3] As a measure of lost productivity, approximately some 4.4 million *passenger hours* were lost in terminal in 1999 in waiting areas, taxiing on runways and airborne holding patterns. Travelers at SFO experienced approximately 3.2 million lost hours due to delays. Based on the average 5.18 minutes of delay in 1999 and the total 16.1 million business travelers moving through the airport, business travelers at SFO alone experienced approximately 1.4 million hours of lost productivity due to delays.

As a measure of lost productivity, 4.4 million passenger hours were lost in 1999 in terminal waiting areas, taxiing on runways and airborne in holding patterns.

Applying the Air Transport Association's estimated hourly delay-related cost to airlines of $2,047, the calculation of annual airline costs is about $89.6 million at the three airports in 1999.

Calculating passenger impacts is somewhat more involved, taking into account numbers of passengers per airport in 1999 (9.9 million at OAK, 11.6 million at SJC, 40 million at SFO), average delays per operation for each airport, and other factors. Using the FAA's hourly per passenger cost figure of $26.70 suggests an annual total cost to Bay Area passengers in 1999 of $118.5 million. For all three airports, average delays per operation, as calculated by FAA, have increased during the first five months of 2000.

Changing Cargo Requirements

On the cargo side, several converging business trends focus on schedule reliability, specifically for time-definite delivery of freight:

Time to market. Getting product to the consumer or end user as quickly as possible is crucial for many businesses today. Software, video game, toy, fashion apparel, pharmaceutical and other manufacturers have only a very limited time to get new ideas into production and onto store shelves, before copycat products surface and begin to erode market share.

[3] It should be pointed out that these aggregate hours of delay apply to flight operations of all types, and can be attributed to multiple factors, not all of them related to bad weather or other causes of airport congestion that are the subject of this discussion (mechanical malfunctions, for example). The CODAS data is, however, the best data source for calculating delay-related costs, especially since research done for this study reveals no significant complaints about all-cargo flight delays, and bad weather delays make up a substantial and growing share of total flight delays and cancellations.

Committed release dates. A marketing strategy used by more and more companies is to announce in advance the release of a new product or line, usually at a trade show or press event, and commit to a specific release date, when the product will be available. Missed release dates happen for many reasons, but can have serious implications in how customers and investors view the company's overall reliability.

Reduced cycle time. Manufacturers struggle to lower costs, improve the bottom line and deliver better customer service by shortening the order cycle – the total transaction time from placement of an order by the customer, to final delivery and payment. This re-engineering process requires, in part, close tracking and control of the materials and components going into a product, as well as shipment and distribution of finished product.

Supply chain integration. Businesses also lower carrying costs by minimizing or even eliminating inventory altogether through a supply chain strategy. This takes the reduced cycle time approach a step further by integrating all steps of the manufacturing process in a continuous flow of materials, components, subassemblies and finished product moving on a "just-in-time" basis.

Airport delays cost Bay Area passengers an estimated $118.5 million in 1999.

This strategy, first applied on a large scale by auto manufacturers in the 1980s, is now standard procedure for companies ranging from Land's End to Amazon.com to Dell Computer. Savings are enormous – in some cases 15-20% of overhead. But the risk is great, too. Toyota's Georgetown, Kentucky plant, for example, measures its "inventory" for various parts and subassemblies in hours, and in some cases minutes. That requires extreme precision in shipment tracking and planning, since small parts delivery delay can shut down an entire production line.

A significant portion of time-sensitive supply chain traffic – including e-commerce retail shipments – moves by a combination of air and truck, particularly air express, which now accounts for 60% of the U.S. air cargo market and is growing at a rate of 25% annually, according to John D. Kasarda, Director of the Kenan Institute of Private Enterprise of the University of North Carolina, Chapel Hill, which focuses on urban development, logistics and competitiveness research.[4]

For the remainder, which moves efficiently via surface transportation (provided shipments are scheduled earlier and staggered for continuous delivery), air freight is the fall-back in case something goes wrong. Again, it is less important whether next-day, two-day or three-day service is used, than that delivery is time-definite and on time.

Flexible service is also important for just-in-time shippers. For example, it may be necessary for the customer to use a peak-hour widebody passenger jet, and send an employee as a passenger to take control of the shipment at the airport.

Perishables. Shipments of fresh produce, fresh cut flowers, meat and seafood, pharmaceuticals, photochemicals and other products requiring either simple refrigeration or sophisticated temperature controls have always been somewhat time-sensitive. A day lost in

[4] Kasarda, John D. *Time-Based Competition & Industrial Location in the Fast Century*, Real Estate Issues, Winter 1998/1999, P. 24.

transit is a day lost in shelf life at destination. But delays also incur costs, as these sensitive cargoes have to be monitored continuously to ensure that refrigeration, temperature, air circulation and other factors are consistent with the unique handling requirements for each commodity.

If fast, reliable air/highway connections are essential to agile manufacturing and supply chain operations, Kasarda points out, airports that are able to meet the requirements of these new industrial strategies find themselves emerging as economic development magnets. Some examples:[5]

> FedEx's Memphis hub has attracted manufacturing and distribution centers for Nike, Apple Computer and Disney Stores, plus 130 foreign-owned firms from 22 countries employing 17,000 workers.
>
> In the 10 years after Atlanta initiated international air service, 813 foreign firms invested $33 billion in facilities, generating 54,000 manufacturing and distribution-related jobs.
>
> Alliance Industrial Airport, outside Ft. Worth, TX, attracted $3.6 billion in new investment during the 1990s from 50 companies, among them Intel Corp., Nokia, Nestle Distribution, BFGoodrich Aerospace and Zenith Electronics.

A significant portion of time-sensitive supply chain traffic – including e-commerce retail shipments – moves by a combination of air and truck, particularly air express, which now accounts for 60% of the U.S. air cargo market and is growing at a rate of 25% annually.

Similarly, a 1998 study by Kenneth Button and Roger Stough of George Mason University's Institute of Public Policy concluded that metropolitan statistical areas with hub air cargo operations generate an average 12,000 more high-tech jobs than those without hubs.[6] A 1992 Ernst & Young analysis identified six U.S. metropolitan areas likely to exhibit the most growth in facilities and jobs. Five of those – Atlanta, Dallas, Raleigh, Charlotte and Houston – had hub airports.

Business has become more time-sensitive:

- **As travel budgets are restricted, results must justify expenditures.**
- **Schedules are tight and business is more competitive; missed meetings often mean lost opportunities.**
- **Conferences and conventions are highly dependent on timely arrival to make presentations, obtain valuable business intelligence and make key contacts.**
- **Time to market is short, often involving announced release dates and delivery commitments tied to product marketing.**
- **Catalog and e-commerce retailing has made time-definite delivery a basic customer expectation.**
- **Programs to cut cycle time and manage supply chains require schedule precision.**

[5] Ibid, P.28.

[6] Button, Kenneth and Roger Stough. *The Benefits of Being a Hub Airport City: Convenient Travel and High-Tech Job Growth.* Fairfax, VA: Institute of Public Policy, George Mason University, November 1998.

CHAPTER 3

BUSINESS USER CONCERNS

In a series of surveys and interviews, businesses that rely on Bay Area airports — both as travelers and as air freight shippers – seem able to live with congestion today, but share concern for the future.[7]

The primary objective of this study is to analyze the airports' economic impacts on the regional economy – that is, on residents and businesses in the Bay Area. It is important to note, in this context, that a sizable share of cargo moving through SFO, OAK and SJC does not necessarily originate or terminate in the Bay Area, but is instead channeled through the airport as a gateway to and from other California, U.S. or global locations.

Also, a company may be headquartered in the Bay Area while its manufacturing, sourcing and distribution are global. One cannot assume, for example, that Levi-Strauss & Co. or Hewlett-Packard necessarily ship more product through the region simply because their corporate operations are centered here.

Similarly, we focus our analysis on individual business travelers, or firms with extensive business travel activity, that are domiciled in the Bay Area, recognizing that a large share of business travel through the airport may be connecting passengers.

The Bay Area Economic Forum, through its consultants Martin Associates, interviewed businesses in several key regional industry clusters identified by the Economic Forum, the Bay Area Council and McKinsey & Co. in their September 1999 report, "*The Bay Area: Winning in the New Global Economy.*"

These sectors included computers and electronics; telecommunications; multimedia; and bioscience. Clusters were chosen based on the likelihood that businesses in them would be substantially engaged in both business travel and shipment of high value goods by air. Also interviewed were a number of Bay Area freight forwarding firms, who make domestic and international air freight shipment arrangements on behalf of clients.

Certain strong Bay Area industry sectors outside this basic profile, such as financial services, were contacted through a separate, three-month online survey of business travelers conducted by Martin Associates over March-May 2000 for this report. This survey was prepared in cooperation with the Bay Area Business Travelers' Association, a regional trade association of corporate travel planners. Some 140 executives and travel planners responded to questions regarding their experiences with airport delays.

[7] Martin Associates, op cit.

The vast majority of businesses surveyed were mainly concerned with the potential impacts of increased airport congestion in connection with business travel. While they have encountered occasional flight delays, most see it as a short to medium-term, industrywide problem that they work around as best they can (booking earlier flights, allowing more time to get to the airport, etc.). At the same time, they say that if congestion were to worsen over time, serious problems could arise.

While airport congestion raises significant business issues in its own right, when added to other regional congestion on roads and bridges it has the potential to seriously aggravate business concerns over the region's economic competitiveness and quality of life.

Business Travel

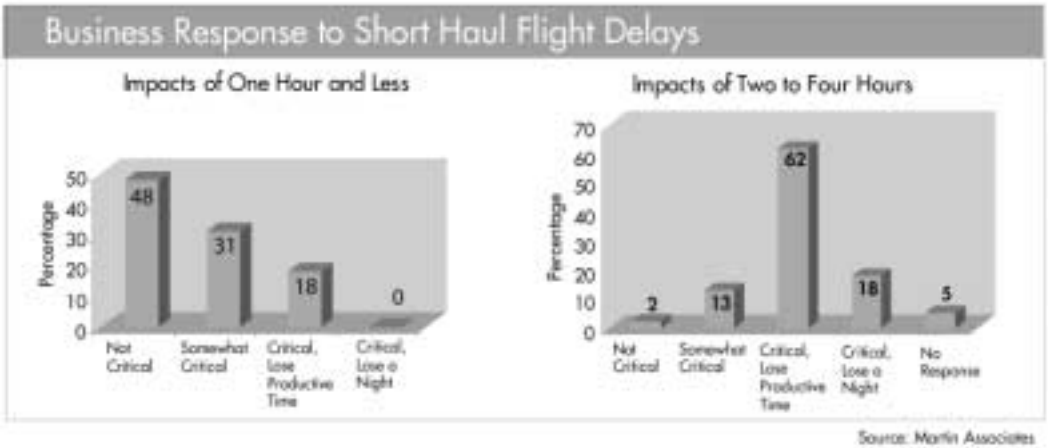
Nearly all of the firms interviewed, from key industry clusters and among the fastest growing firms, said their employees travel frequently on business.

Many company travel policies now require junior-level employees to fly for the cheapest fare, typically via connecting flights. It is these employees who are most impacted by delays, to the extent that they miss their connections.

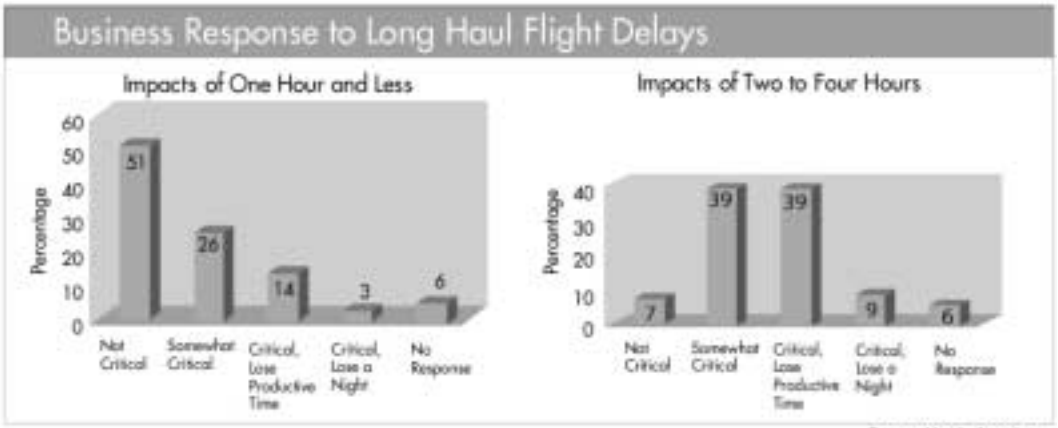
Most tended to favor flying out of SFO, OAK and SJC in that order of preference, the main reason being a perception of lower fares and availability of more non-stop international and domestic flights at SFO. At times, flight availability throughout the day determines the airport used. For example, an executive may want to fly overnight for a morning meeting, or fly in the morning for same-day arrival.

As a general trend, businesses said they tend to locate offices in the Bay Area a short distance from where most of their employees were living or wanting to live. Interview findings suggest that Bay Area business travelers tend to leave for the airport from home more often than from the office. Many choose the airport closest to home, unless they can't arrange a flight they need.

While senior-level employees most often fly on short notice, paying full fare and traveling non-stop, many company travel policies now require junior-level employees to fly for the cheapest fare, typically via connecting flights. It is these employees who are most impacted by delays, to the extent that they miss their connections. This in turn complicates the job of travel planners in choosing an airline. They must in turn calculate which carrier's hub or other connecting city has the most connection options in the event of a missed flight.



Source: Martin Associates



To the extent they have experienced delays, businesses complained of missed meetings and a loss of productive business time, despite the availability of lounges and business centers between flights.

Some 140 business travelers responded to the online Martin Associates/BABTA survey. The majority, 54%, were in the financial services industry, while 16% were in business services, 12% worked for information technology firms and 3% were in the biotech field. Another 14% were in other sectors of the regional economy. As mentioned earlier, the average salary for the employees surveyed was just under $87,000 a year, suggesting a high cost to these travelers of lost days due to flight delays or cancellations.

While it is likely that the survey results are somewhat skewed toward business travelers who have experienced delays, a fact which encouraged them to respond, the information provides insight into the relationships between length of delays and the resulting economic cost to the traveler.

On shorthaul flights, nearly half of those surveyed stated that a delay of less than an hour had little or no impact, while 21% believed it had some impact and 18% believed it created a real loss of productive time. By contrast, 62% of respondents saw a delay of two hours or more as critical, with another 18% suggesting it would cost them an extra night in travel time. A four-hour delay or more meant a wasted extra day for almost half of the travelers.

Travelers taking longhaul transcontinental or international flights were evenly divided, at 39% each, on whether a delay of two hours or more was "somewhat critical" (highly disruptive but salvageable) or "a lost day." By four hours, however, 74% thought a day of business was wasted.

As mentioned earlier (*See pages 23-24*), passengers at Bay Area airports experienced an estimated 4.4 million lost hours due to delays of all kinds in 1999, travelers at SFO lost 3.2 million hours due to delays and business travelers at SFO eperienced approximately 1. 4 million lost hours of productivity due to delay in 1999.

If the average $42 per hour employee cost revealed in the business travel survey were applied to these lost hours, rather than the $26.70 per hour FAA average (which assumes a higher cost for business vs. leisure travel anyway) the opportunity cost to businesses would have totaled $58.8 million for SFO alone.

Airline consulting firm, the Airline Planning Group(APG) further calculated the overall delay-related costs to SFO passengers in a different way, based on its share of total national delays (5.7%), with comparable results, given SFO's passenger share.

1999 Air Traffic Delay Costs Nationwide and SFO

	Aircraft Operating Costs/Minute	Delay Minutes (Millions)	Delay Cost ($ Millions)
Nationwide			
Gate	$24.30	5.155	$125.27
Taxi Out	$30.47	34.648	$1,055.72
Airborne	$47.64	16.155	$767.70
Taxi In	$29.81	9.642	$287.43
Total Aircraft Operating			$2,236.12
Added Ground Costs*			$850.00
Value of Passenger Time			$2,100.00
Total Delay Cost			$5,186.12
San Francisco Airport			
% of National Delays at SFO			5.7%
Value of Passenger Time at SFO			$119.70
Total Delay Cost for SFO			$295.61

*Air Transport Association Estimate

Source: Airline Planning Group/Air Transport Association and FAA

CARGO

A relatively small number of Bay Area businesses surveyed said they were heavily dependent upon air freight transportation services in and out of the Bay Area. While it is clear that considerable manufacturing is done in the San Francisco Bay region, several factors combine to skew the survey results.

So far, forwarders say they generally have not had problems making delivery deadlines due to airport delays, although they have begun to experience occasional delays when moving freight on passenger flights during the day.

First, a greater share of the region's economy is service-based (banking, legal, construction and engineering, research, tourism, etc.), than in other metropolitan areas. Secondly, more traditional manufactured goods, including farm and forest products, machinery, chemicals and so on, move by lower-cost surface transport – ship, rail and truck. Thirdly, many large Bay Area firms may be headquartered here while their manufacturing is global, or is located in other lower cost, less regulated areas of the U.S.

Also, while retailing and wholesaling are important local industry clusters, high land costs and taxes tend to discourage large-scale warehousing. The result is that goods arrive by air at regional distribution centers outside the Bay Area and are trucked to stores and small warehouses here.

Finally, small and mid-sized growth companies in technology-based or e-commerce industries, including makers of computers and peripherals, tend to use either cargo integrators or freight

forwarders to arrange door-to-door transportation at lower rates. All of the companies surveyed who said they were somewhat dependent on freight transportation fell into this latter category.

Freight forwarders and customs brokers are essentially intermediaries that provide trade and transportation services. Historically, forwarders have handled domestic and export shipments, while customs brokers have specialized in documentation, tax and other services related to importing. Major intermediaries today typically operate as both.

Most forwarders surveyed list SFO as their first choice for international cargo, given the wide choice of schedules and the option of using passenger jet bellies or jet freighters depending on shipment size. Since intermediaries deal in larger, regular shipments and make their living in part by arranging "intermodal" air/truck transit on behalf of customers, they tend to view integrators as competitors. That, plus the relative scarcity of widebody passenger flights through OAK and SJC tend to favor SFO.

So far, forwarders say they generally have not had problems making delivery deadlines due to airport delays, although they have begun to experience occasional delays when moving freight on passenger flights during the day. Some 80-90% of their outbound freight originates in the Bay Area. Cargo moving on pure jet freighters flies out and arrives in the late hours of the night, experiencing few delays. Import cargo from Asia, an important component of their business, typically comes in through SFO and arrives on weekends in off-peak hours, allowing flexibility for Monday delivery.

The larger forwarders frequently use Los Angeles International Airport(LAX) as their gateway for the West Coast, with Portland or Seattle as fallback airports. Under this scenario, trucks leave the Bay Area between midnight and 2:00 a.m., arriving in Los Angeles by 10:00 a.m., with cargo loaded onto an aircraft for mid-afternoon departure. Forwarders surveyed cited two benefits to this approach: LAX has a wider choice of services and schedules, and by consolidating Northern California loads with Southern California cargo, they can negotiate more favorable volume rates with carriers. However, shipping Bay Area air cargo to LAX by truck also adds to ground traffic congestion.

A business 'wish list' for Bay Area airports:

- **A wide choice of competitive carriers and flights should be available throughout the day.**
- **A choice of non-stop domestic and international flights is critical, with greater availability of widebody passenger/cargo options.**
- **Competition on popular routes should be encouraged to lower fares.**
- **Travel times from home or office should be short, with ease of access to terminals and gates.**
- **Airline schedules must be realistic and reliable, with minimal delays and cancellations.**

CHAPTER 4

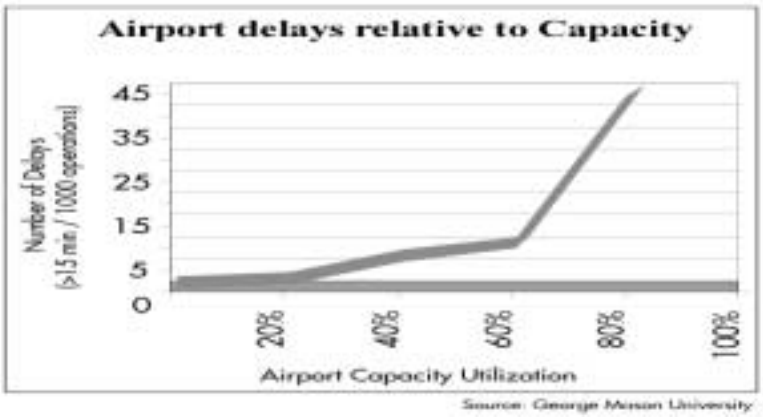
AIRLINES COPE WITH CONGESTION

Commercial airlines may be the hardest hit from an economic perspective when airports approach capacity. The Airline Planning Group, an Arlington, VA-based airline industry consulting firm, provided the Bay Area Economic Forum with analytical support in examining airline impacts in the Bay Area, with special focus where appropriate on SFO.[8]

Airlines face increased operating costs when they fly into congested airports. As a March 2000 Air Transport Association (ATA) study points out, considerable fuel is expended circling in holding patterns or taxiing around tarmacs. Flight crews are paid while waiting in the air or on the ground. More gate agents and customer service representatives are needed to assist delayed customers. Reaccommodating passengers who miss their connections often means either transferring revenue to a competing carrier, or paying for a hotel room.

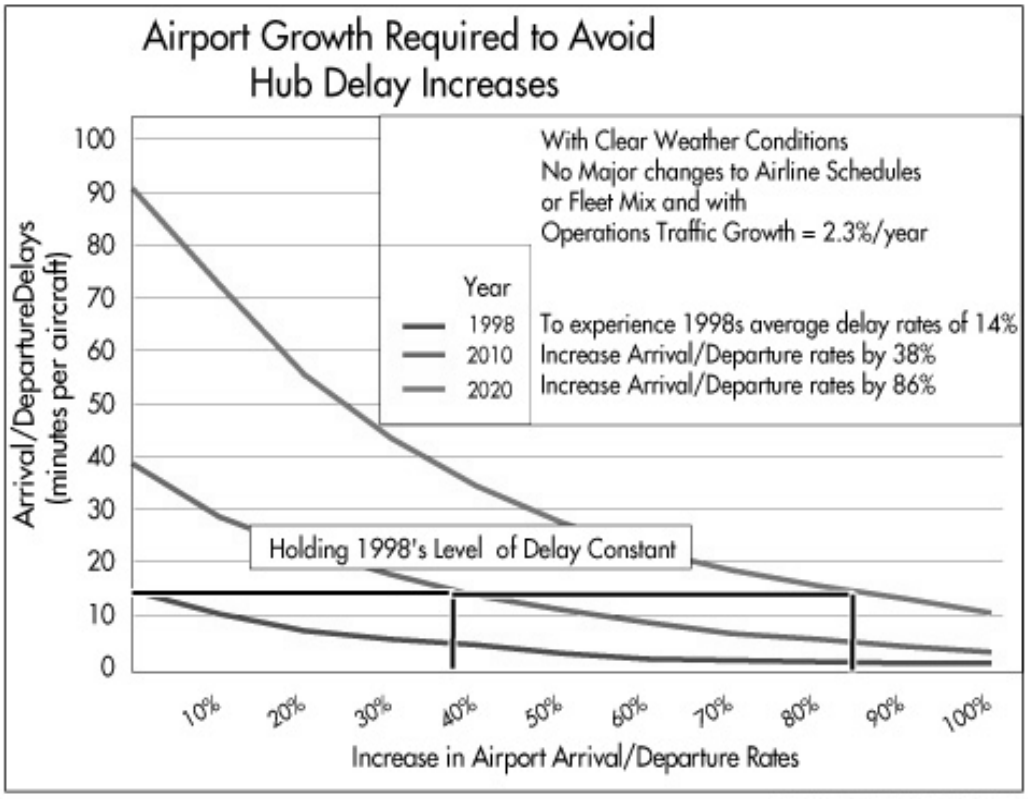
Airport congestion is a national problem, stemming from several causes, among them sharply increased passenger and cargo demand (an estimated 640 million people will board 7.4 million domestic flights alone in 2000); airline scheduling practices; an antiquated air traffic control system; limited space for airports to expand; and bad weather, accounting for 70% of all delays.[9] Hub airports, including SFO, experience a higher level of delays and most are approaching saturation.

Delays increase exponentially, according to Dr. George L. Donahue of George Mason University: An airport growing from 80-90% capacity, for example, will see the number of delays greater than 15 minutes more than double from 15 to 35 per 1,000 flight operations.[10] In 1998, SFO experienced 48 delays greater than 15 minutes per 1,000 operations – a total of 24,270 – mainly due to bad weather. As stated earlier, SFO accounts for 5.7% of weather-related delays nationwide, according to the Federal Aviation Administration (See Chapter 5).



[8] Airline Planning Group, *Potential Airline Impacts and Response to Bay Area Airport Congestion.* San Francisco, CA: Bay Area Economic Forum, June 2000.
[9] Sharkey, Joe. *Adding Hours on the Ground to Hours in the Sky.* New York Times, August 13, 2000, Week in Review, P.5.
[10] Donahue, D. George L. *21st Century Transportation: Limits to Growth?* Remarks presented at the Future Flight Central NASA Ames Research Facility dedication, December 13, 1999.

Assuming a 2.3% growth in demand nationwide, hub airports looking to avoid delays beyond current levels will need to provide capacity to accomodate 40% growth in arriving and departing flights by 2010. This figure rises to 86% by 2020. If capacity constraints limit of airport arrivals and departures, delay rates nationwide could increase from 15 minutes currently to 40 minutes in 2010 and 90 minutes in 2020.



Source: George Mason University

Among Bay Area airports, SFO is approaching its runway capacity in good weather and has exceeded capacity in bad weather. The U.S. Department of Transportation ranks SFO first among Western U.S. airports in terms of delays which originate with its own operations and facilities, with 40% of its flights delayed in the first five months of 2000. SFO's overall ontime record during the first half of 2000 is 51.7% of arrivals and 63.7% of departures, well below the national average of 74.2% for arrivals and 77.7% for departures. SJC is ranked 10th in delays among the nation's 193 commercial airports, with 27% of its flights delayed. OAK ranks 19th, with 23-24% of flights delayed.

Where the FAA has determined an average acceptable delay of 4 minutes per commercial flight operation, SFO averaged 5.18 minutes per operation in 1999, while OAK averaged 2.41 minutes per operation and SJC averaged 3.04 minutes.[11] For all three airports, average delays per operation, as calculated by FAA, have increased during the first half of 2000 (6.21 minutes for SFO, 2.45 minutes for OAK and 3.81 for San Jose).

[11] Federal Aviation Administration. CODAS 1999 Detail Reports on delays, by U.S. airport

Multiplying the average 1999 delays per operation by the total number of flight operations provides aggregate delay totals for each airport: 30,792 hours of aircraft delay in 1999 for SFO; 5,988 hours for OAK; and 6,984 hours for SJC.

Flight delays at Bay Area Airports cost airlines an estimated $89.6 million in 1999.

In total, airlines lose an average of $2,047 per hour of delay based on Air Transport Association statistics, although other estimates place the figure as high as $3,865 per hour depending on how costs are counted. Given the total flight operations and hours of delay at Bay Area airports, and using the ATA formula, estimated airline costs approached $94.1 million in 1998 and $89.6 million in 1999. FAA figures for the first five months of 2000 suggest an upward trend, both in the number of flight operations and the length of delays.

Delaying an aircraft affects not only that aircraft but also other aircraft vying for gate and runway space. Passengers and crews are forced to wait for a gate opening if the number of runway operations is limited and aircraft are not able to take-off in the amount of time originally allotted by the airline. One delayed flight at a gate can cause a cascade of delays throughout the day.

From an airline planning perspective, the impact of delays at Bay Area airports is felt far beyond the Bay Area. Because of the network effect, an hour delay at SFO, for example, may lead to an hour delay for passengers in Denver, Dallas, Indianapolis or any number of downline stations. Moreover, planes may be delayed waiting for people who are connecting from delayed flights originating from SFO. Consequently, a passenger connecting via Chicago from Madison, WI to Hartford, CT may experience delays as a result of a delayed San Francisco to Chicago flight.

Potential Airline Responses to Congestion

As an airport reaches its capacity limitations, airlines begin to rethink expansion plans and, if congestion worsens, will look for routes and schedules that can most easily be cut or rerouted to a less congested airport. Of the three Bay Area airports, SFO is most likely to encounter such a response to the increased congestion and delay in the near term.

Airlines consider a variety of issues when determining service levels to a particular city. Certainly, the size of the local market and the presence of competition are two of the most important issues; however, planners are also cognizant of the extent to which the new route would complement the existing network, both financially and operationally.

Considering the network effect of delays, airline planners are reluctant to introduce service into congested airports for fear of negatively impacting other customers within their networks. Moreover, airline planners must balance the level of service with the constraints of the airport capacity. Absent constraints, airlines would schedule nearly limitless departures between 7:30 a.m. and 9:00 a.m. as well as from 4:30 p.m. to 6:30 p.m., the peak hours for business travel.

However, even if airlines possessed the fleet for such operations, the passenger experience would suffer because of the congestion at the airport. Although it may not be obvious to most travelers, airlines do space out the schedule in order to make the most efficient use of airline staff and to maintain acceptable on-time departure and arrival percentages.

Balancing the consumers' demand for a robust schedule with the need to run an on-time operation is especially difficult at airports such as SFO, which have limited take-off and departure capacity during poor weather conditions due to its closely spaced runways. Consumers tend to avoid airlines that are regularly delayed or do not offer enough service. Consequently, airlines may be willing to work collectively to reduce service at a given airport, but no single airline is likely to take the first step unilaterally, for fear of losing revenue and passenger share.

Airlines also face the constraint of scheduling for internal and interline connections. In many instances, connecting traffic feeds domestic flights that might not otherwise have enough demand to support the level of service that could be provided with connecting traffic. For example, the local market between San Francisco and Albuquerque may only be large enough to support two roundtrips per day. With the feed from those domestic and international cities beyond San Francisco, the Albuquerque to San Francisco market may be able to support an additional roundtrip, which would benefit Albuquerque to San Francisco travelers in the form of a more robust schedule.

It is the concept of feed that prevents carriers from relieving congestion at SFO by splitting service among the Bay Area airports. Although one proposed response to the congestion problems at SFO would be to simply shift flights from SFO to Oakland, such a shift would be difficult on a large scale. Having intra-west service flying into Oakland with transcontinental service flying out of San Francisco would prohibit passengers from easily connecting from an intra-west flight to a transcontinental or international flight or vice-versa. Consequently, shifting flights at San Francisco to Oakland or San Jose does not appear to be a feasible stand-alone solution.

Potential Impacts to Airports and Consumers

One of the most obvious solutions to congestion is to limit the number of operations into and out of an airport. However, while a reduction in service or a zero-growth policy may help to ease airport congestion, there are negative economic consequences.

The most direct effect of service reduction on consumers would be the reduction in competition on routes currently flown. For many years, the Bay Area has enjoyed fairly healthy competition among the airlines. According to MTC estimates, consumers have had a choice of which carrier to fly, and airfares in the Bay Area have historically averaged 15% less than those in other major metropolitan areas. Reductions in service would lead to less robust schedules for the traveler and could also lead to increased fares.

A reduction in service offerings could also reduce the number of cities served nonstop, thereby reducing the traffic and economic benefits generated by nonstop service. Convention traffic is perhaps the most sensitive to the level of service from a potential convention city simply because organizers generally strive to minimize travel for convention participants.

Because the economies of San Francisco, Oakland and San Jose all receive a boost from visiting conventions, if direct service were to be curtailed they are at risk of becoming less attractive as convention cities.

Leisure travelers are also sensitive to changes in air service patterns to destination cities. Many tourists seek out vacation destinations reached easily from their point of origin, which has generally worked in favor of San Francisco given the number of destinations served. However, if SFO did not accommodate as many flights, San Francisco would be vulnerable to a dip in tourism; the same concern applies to the other regional airports.

In the longer term, service levels also affect business travel. Even in the age of the Internet, availability of transportation is one of the most important criteria in the decision of where to locate a business or a branch of an existing business. Although the region certainly has much to offer a startup company, it could experience slower growth if service levels to the area were reduced or if congestion at the airports became overwhelming. Foreign companies reliant on international air service linking satellite offices to corporate headquarters may choose to open their U.S. office in other cities if travel to the Bay Area were burdensome.

Losing traffic to other West Coast cities should be a significant concern. Foreign and U.S. based international carriers could decide that operating transpacific flights to Los Angeles or Seattle would be less operationally taxing to their networks than would service to SFO. In that instance, the Bay Area economy would almost certainly be negatively impacted.

Potential Hub Airlines Response

United Airlines is the only carrier with a true hub operation in the Bay Area, located at SFO. Its response to congestion is instructive, both in terms of the resources a large carrier can bring to bear in addressing the problem, and in terms of the unique impacts congestion has on a hub configuration.

With 61% of all departures from SFO and 53% of departing seats, United is the largest carrier at San Francisco. It has established a hub at SFO and, including express flights, flies 324 departures to 48 destinations domestically and 18 departures to 15 destinations internationally. As the largest carrier, United is extremely important to the Bay Area economy, but it is also a factor in the current congestion at SFO.

United has outlined several steps to reduce congestion. These include: dual-end boarding, standby flight crews, "closed-loop flying," development of a new radar system, the use of larger aircraft and limited flight reductions. The most promising of these initiatives for SFO is the new radar system, called the Simultaneous Offset Instrument Approaches (SOIA). The system has the potential to improve takeoff and landing capacity in poor weather by 10-15 percent during weather conditions that occur about 7% of the time and is projected to be operational in mid 2001.

[12] Interview with Frank Kent, Managing Director for Northern California, United Airlines, September 2000

United's proposed "closed-loop flying," whereby an aircraft and its crew are assigned to fly the same route all day, will only mitigate the potential cascade of system delays throughout the day if flights outside of the loop are not held to accommodate connecting passengers from delayed flights. And in terms of flight reductions, United has maintained the same number of departures internationally, but has reduced daily domestic departures from 298 to 230 from May 1998 to May 2000. It has maintained the same number of total seats, however, using wider body planes.

Airfares in the Bay Area have historically averaged 15% less than those in other major metropolitan areas. Reductions in service would lead to less robust schedules for the traveler and could also lead to increased fares.

Finally, United announced in June 2000 that it would make schedule refinements requested by SFO, which would achieve a projected one-third reduction in bad weather delays. In return, the airport withdrew its petition for an FAA rulemaking requiring United to fly larger aircraft on heavily traveled routes.

If congestion continues to worsen, however, United could possibly shift the focus of its West Coast growth from San Francisco to the Los Angeles area. The carrier has already developed a hub at Los Angeles World Airport (LAX), with 368 flights a day to 48 destinations domestically and 13 flights per day to 11 destinations internationally. Furthermore, the carrier has added 50 daily departures at LAX from May of 1998 to May of 2000.

United maintains that, if capacity at SFO were completely unconstrained, demand would justify 430 departures a day from SFO. UAL officials add that the LAX and SFO hubs are distinct, serving different customer bases and connecting flight patterns based on demand in the Southern California and Northern California markets. Thus, while United would not shift hub resources elsewhere for purely operational reasons – demand would have to justify such a move – it could find, in the future, a need to place greater emphasis on LAX as an international gateway.[12]

This could result in reduced direct domestic and international service through SFO, as domestic routes feed and sustain the international routes. United points out, for example, that 60% of total United Shuttle passengers are connecting passengers with international or transcontinental flights on United or one of its alliance partners.

The Bay Area will pay a significant economic cost if the problem of congestion and delays at its airports, and at SFO in particular, is not alleviated. Consumers stand to lose time, money and convenience. Airlines will face higher operating costs and ultimately consumers could pay higher fares as a result. If the problem becomes more severe the economy of the Bay Area would also feel greater impacts as a result of reduced service.

Comparison of Western U.S. Airports			
Airport	Departures/Day	Departing Seats/Day	Length of Haul
LAS (Las Vegas)	445	63,944	791
LAX (Los Angeles)	872	107,486	850
PHX (Phoenix)	642	80,084	762
SAN (San Diego)	253	32,030	742
SEA (Seattle)	527	55,165	741
SFO (San Francisco)	503	66,990	977
SJC (San Jose)	195	26,350	746
SLC (Salt Lake City)	326	37,281	644

Source: OAG Data for May 2000

Potential airline impacts from future capacity constraints:

- **Delays will increase, at costs to airlines of more than $2,000 per hour per flight.**
- **Schedule disruptions and missed connections will ripple throughout domestic and international airline networks.**
- **Carriers will experience increased difficulty maintaining robust schedules throughout the day, and will be reluctant to expand existing services or add new ones.**
- **At worst, they will begin to shift existing or new hub flights to other gateways, and/or reduce non-stop flights and/or cities served.**
- **Reduced competition and higher costs will raise overall airfares.**
- **Ultimately, the Bay Area's competitiveness for business growth, capital and jobs could be jeopardized.**

CHAPTER 5

NEW CAPACITY SCENARIOS

New MTC forecasts examine how various airport expansion proposals match capacity to future demand.

Of the three Bay Area airports, SFO faces the most immediate and significant capacity problems, especially in bad weather. Built 60 years ago, with two runways spaced only 750 feet apart, it can accommodate up to 60 arrivals per hour in good weather, as opposed to 100 or more at most major hub airports.

When fog or cloud cover limits visibility at the airport, the FAA requires a 4,300-foot horizontal separation between runway center lines. Under these conditions the two runways cannot be used simultaneously and effective capacity is reduced to as low as 30 arrivals per hour.

SFO currently ranks first among Western U.S. airports in terms of delays which originate with its own operations and facilities. SFO's ontime record is only 51.7% for arrivals and 63.7% for departures, largely due to bad weather delays.[13] These delays are primarily the result of the airport's inability to use dual runways in inclement conditions, because of inadequate runway separation.

In the past two years, jet departures at SFO have increased 0.2%, and departures at OAK have increased 0.6%, while they have increased by 13.8% at Los Angeles, 11.2% at Seattle and 3.5% at Portland.[14]

OAK and SJC experience delays (OAK's on-time record is 76% for arrivals, 79% for departures; SJC's is 74% and 79% respectively), but not on a routine basis or to the same degree as SFO. However, as passenger and cargo traffic through the Bay Area continue to grow, delays at both are likely to increase as current capacity is strained.

With no significant expansion of capacity to meet forecast demand, analysis by Martin Associates suggests that Bay Area airports will be unable to accommodate some 5.2 million passengers (6.4% of total passenger forecast) in 2010, or as many as 14.7 million passengers (13.2% of total passengers forecast) in 2020. This could cost the region as many as 92,000 jobs, nearly $7.5 billion in business revenue; $2.4 billion in wage and salary income; and $570 million in state and local taxes. Excluding tourism and focusing only on airport-generated economic impacts, the potential cost to the region is $4.3 billion in business revenue; 10,000 jobs with $470 million in wage and salary income; and $65 million in state and local taxes.[15]

While demand under these circumstances would most likely continue to be served albeit under increasingly frustrating and costly conditions, it is also clear that at some point a threshold would be crossed—particularly at SFO and OAK— where capacity limitations will result in reduced airline service and/or lost business opportunity.

[13] Mays, Jon. *Airport Mulls Runway Expansion, High-Tech Tools to Solve Delay Woes,* San Francisco Independent, June 13, 2000
[14] APG, *op cit.*
[15] Martin Associates, *op cit.*

Runway capacity will continue to determine overall airport capacity, irrespective of new terminals. If runway capacity remains constrained as is the case today, it will be difficult to achieve the utilization levels and efficiencies on which the new terminals depend.

Potential Airport-Generated and Visitor Industry Opportunity Costs if no Regional Expansion Takes Place

IMPACT CATEGORY	Unconstrained 2010	Constrained 2010	Opportunity Cost	Unconstrained 2020	Constrained 2020	Opportunity Cost
Airport-Generated Jobs						
Jobs						
Direct and Induced *	96,350	93,149	(3,201)	118,003	110,677	(7,326)
Indirect *	19,929	18,775	(1,154)	28,515	25,231	(3,284)
Total	**116,279**	**111,924**	**(4,355)**	**146,518**	**135,908**	**(10,610)**
Wage and Salary Income ($thousands)						
Direct and Induced *	$4,315,116	$4,153,494	($161,622)	$4,546,063	$4,192,608	($353,455)
Indirect *	$711,264	$670,219	($41,045)	$1,017,730	$900,845	($116,885)
Total	**$5,026,380**	**$4,823,713**	**($202,667)**	**$5,563,793**	**$5,093,453**	**($470,340)**
Business Revenue ($thousands)	**$29,514,646**	**$27,988,177**	**($1,526,469)**	**$42,849,533**	**$38,502,644**	**($4,346,889)**
State and Local Taxes ($thousands)	**$605,886**	**$579,124**	**($26,762)**	**$810,009**	**$744,805**	**($65,204)**
Visitor Industry Impacts						
Jobs	**486,408**	**457,787**	**(28,621)**	**663,361**	**581,554**	**(81,807)**
Wage and Salary Income ($thousands)	**$11,924,741**	**$11,251,238**	**($673,503)**	**$16,218,948**	**$14,285,425**	**($1,933,523)**
Business Revenue ($thousands)	**$21,890,820**	**$20,775,061**	**($1,115,759)**	**$29,101,393**	**$25,973,843**	**($3,127,550)**
State and Local Taxes ($thousands)	**$2,989,048**	**$2,813,160**	**($175,888)**	**$4,076,447**	**$3,573,720**	**($502,727)**
Total Impact Airport and Visitor combined						
Jobs	**602,687**	**569,711**	**(32,976)**	**809,879**	**717,462**	**(92,417)**
Wage and Salary Income ($thousands)	**$16,951,121**	**$16,074,951**	**($876,170)**	**$21,782,741**	**$19,378,878**	**($2,403,863)**
Business Revenue ($thousands)	**$51,405,466**	**$48,763,238**	**($2,642,228)**	**$71,950,926**	**$64,476,487**	**($7,474,439)**
State and Local Taxes ($thousands)	**$3,594,934**	**$3,392,284**	**($202,650)**	**$4,886,456**	**$4,318,525**	**($567,931)**

* Direct - jobs and revenue directly generated by airport activities

* Induced - jobs and revenue generated through expenditures by individuals directly employed in airport activities

* Indirect - jobs and revenue generated due to the purchase of goods by firms dependent on airport activity

Source: Martin Associates

These negative impacts can be mitigated to the extent that capacity constraints are partly or fully addressed. It should also be noted, however, that these estimated costs do not include financial or opportunity costs to Bay Area busineses caused by worsening airport delays or service curtaiment.

SFO and OAK are in the midst of capital programs to modernize terminal gates, from ticket processing to baggage handling to security and waiting areas. Modernization has necessarily included expansion, as airports anticipate future demand growth. SFO's new $1 billion, 2.5 million square foot International terminal, for example, is expected to fully open in January 2001. It will feature 24 gates, up from the current 10, and is designed to process 5,000 passengers an hour, more than four times the current capacity.

To a large extent, however, runway capacity will continue to determine overall airport capacity, irrespective of new terminals. If runway capacity remains constrained as is the case today, it will be difficult to achieve the utilization levels and efficiencies on which the new terminals depend. Alternatively, if airlines do continue to expand flights and bookings through the expanded terminals, added pressure will be placed on airports runway and traffic control systems, presumably adding to the number and average length of delays.

The coming capacity crunch can be eased in part by a reduction in the number of flights due to the advent of larger aircraft, and improved marketing, reservation and schedule coordination to fill those flights. Proposals have also been made to shift certain cargo, small commuter

aircraft, private jet and other general aviation operations from the three major airports to new facilities at converted military air fields, to help free up capacity for scheduled commercial airline service. However, these changes by themselves, apart from generating the same controversies over noise and environmental impacts in the communities where the cargo and general aviation activities would be relocated, will still not fully address the capacity crunch, according to MTC.

It will take some combination of new technologies, facilities expansion and possibly demand management to bring about the kind of capacity-demand equilibrium that will preserve competition, service choice and low fares.

Strategies for the Future

It is worth examining for a moment the various solutions proposed for increasing effective capacity at Bay Area airports in the coming decade:

San Francisco International Airport

Projections developed by the Metropolitan Transportation Commission for the Regional Airport Planning Committee (RAPC)[16] suggest that maximum capacity at SFO with its existing runways is 107 flight operations (arrivals and departures) in good weather and 77 in bad (*See table*). By 2010, the unconstrained demand forecast will require an estimated 99 operations in a peak hour and 270 averaged over a typical three-hour period. By 2020 demand is expected to grow to 123 operations in a peak hour and 339 over a typical three-hour period. Thus by 2010 demand will approach good weather capacity and will exceed bad weather capacity.

A failure by the region to accommodate forecast demand could cost the Bay Area nearly $7.5 billion in business revenue, 92,000 jobs, 2.4 billion in wage and salary income, and nearly $570 million in State and local taxes by 2020.

A number of technological innovations are being considered for SFO to expand effective capacity. One option is a combination of the Simultaneous Offset Instrumentation Approach (SOIA) radar system and the Precision Runway Monitor (PRM) system. SOIA enables traffic controllers to more precisely stagger landing approaches. PRM would extend the lead time and procedures available to pilots to pull out of an approach in the event of a problem. [17]

The SOIA/PRM combination applies to landings in bad weather only, and could increase SFO's bad weather capacity from 30 to 38 landings per hour, thus bringing the total bad weather capacity to 85 operations from 77,* and leaving good weather operations at 107. PRM is currently available only on runways separated by at least 2,500 feet. A more sophisticated version, available in 2010, could accommodate runways separated by 1,000 feet – still wider than the current 750 foot separation at SFO, leaving open the question of whether PRM could ever be a significant option at SFO with its existing runway configuration.[18]

In addition, the airport is working with NASA's Aviation Systems Division at Ames Research Center in Mountainview, CA on several new air traffic control tools: Final Approach Spacing Tools (FAST) and Transit Manager Advisor (TMA), to help pilots and controllers land more

[16] Martin Associates, *op cit.*
[17] Mays, Jon. *Op cit.*
* MTC estimate based on FAA data; United Airlines estimates an increase to 45 landings, bringing bad weather capacity to 92 landings per hour.
[18] Edwards, Dr. Tom, NASA Aviation Systems Division. *Presentation to Regional Airport Planning Committee Public Workshop,* San Francisco, CA June 3, 2000.

aircraft spaced closely together; and Airborne Information for Lateral Spacing (AILS), which would modify aircraft instrument displays to track other planes around them more effectively in low visibility weather.

Airport demand could exceed capacity by as many as 5.2 million passengers in 2010 (6.4% of the total), and 14.7 million in 2020 (13.2% of the total).

TMA is currently being used at Dallas-Fort Worth and will be deployed at SFO in 2001. The other tools are currently in development. If and when they are deployed later in this decade, these tools, in combination with certain "demand management" steps – consolidation of commute flights to Southern California, schedule adjustments, and shifting private planes out of SFO, all measures requiring FAA approval – could increase capacity by 10-12%, to 120 good weather operations and 87 bad weather operations per hour, according to MTC projections.

United Airlines has recently made a commitment to reduce flight delays at SFO by a third, through modifications to its hub operations, but as this report goes to press neither the details nor a timetable for this plan are available.

Finally, SFO has three alternative runway expansion proposals, – termed Refined BX, F2, and A3 – which would add significantly more capacity for the future:[19]

ALTERNATIVE REFINED BX

Extension of one existing runway by 7,500 feet, and development of two new 9,000-foot runways, each separated from an existing parallel runway by 3,400 to 4,300 feet, permitting two simultaneous landings during bad weather.

ALTERNATIVE F2

Extension of one existing runway by 5,000 feet and build two new parallel runways separated by 4,300 feet on either side, to land two planes simultaneously in bad weather.

ALTERNATIVE A3

Construction of one new 11,500-foot runway parallel to an existing runway with a separation of 4,300 to permit two simultaneous landings during bad weather..

All of the above expansion scenarios involve expansion into San Francisco Bay. Both the Refined BX and F2 alternatives would result in 136 hourly flight capacities in good weather, with refined BX accommodating 119 operations in bad weather and F2 handling 111. Alternative A3 involving less bay fill, would increase bad weather capacity to 107 operations, the same as in good weather.

[19] Neuwirth, Donald B., San Francisco Bay Conservation Development Commission. *Bay Resources Impact Scorecard, presentation at RAPC Public Workshop,* San Francisco, CA, June 3, 2000.

Oakland International Airport

Existing runway capacity at OAK is 56 operations in good weather and 54 in bad weather. By 2010, MTC forecasts demand of 47 operations in a peak hour and 112 in a representative three-hour period. By 2020 demand could reach 62 peak hour operations and 160 in a three-hour period. Thus, sometime in the 2010-2015 period demand will exceed capacity absent any improvements.[20]

Oakland has proposed construction of two parallel runways, one inland or one constructed in the Bay, expanding overall capacity. The "inboard" runway would raise capacity to 90 good weather and 64 bad weather operations. The "outboard" runway in the Bay would raise total capacity to 108 good weather and 79 bad weather operations.

Other improvements will also include consolidation of Terminals 1 and 2, adding 12 new gates; reconfiguration and expansion of roadways; a 5,000-space multi-level garage and interim parking lots; widening of taxiways; expanded facilities for FedEx and the U.S. Postal Service; new north field cargo facilities; and expanded ground support and aircraft provisioning facilities.[21]

A theoretical proposal to install air traffic control improvements and shift some aircraft operations from OAK's south field to the north field would permit 63 good weather and 61 bad weather operations. It should be noted, however, that many of those same operations were earlier moved away from the north field to address community noise abatement concerns, and MTC acknowledges that moving them back is both problematic and unlikely.[22]

San Jose International Airport

SJC has obtained the necessary permits for a runway expansion program under its current master plan. Two 11,000-foot runways would be constructed 700 feet apart. Neither runway involves Bay fill, and SJC's landlocked location effectively prevents further expansion or wider runway separation in the foreseeable future.[23]

With no other modifications, SJCs capacity will increase from 56 operations to 80 in good weather, but bad weather capacity will remain at 43 operations per hour, even after the new runways are completed. MTCs demand forecast for 2010 is 42 operations per peak hour and 110 in a three-hour period. For 2020 it would be 63 operations in a peak hour and 156 in a three-hour period.

By moving general aviation aircraft out of SJC to smaller airports, and adding new air traffic control innovations, capacity would increase to 88 good weather and 47 bad weather operations per hour.

[20] Ibid.
[21] Oakland International Airport. *Airport Development Program Overview.*
[22] Telephone interview with MTC staff, August 2000.
[23] Ibid.

Delay Impact Forecasts

MTC has assessed the delay impacts of various scenarios(see bar graphs page 47). At SFO, the current average of just over 15 minutes' annual delay per flight would increase to more than 25 minutes in 2010 with new technologies in place and no expansion, but would decline under most other runway reconfiguration scenarios. Delays could also continue through 2020 depending on the combined expansions at SFO and OAK. (Note: MTC uses an airport and airspace simulation model approved by FAA to calculate delay against published schedules for each airport over a year's time. This is different from the more commonly reported CODAS delay statistics, which compare actual aircraft and departure times to published airline schedules, and produce the lower monthly average delay figures per flight given earlier).

It will take some combination of new technologies, facilities expansion and possibly demand management to bring about the kind of capacity-demand equilibrium that will preserve competition, service choice and low fares.

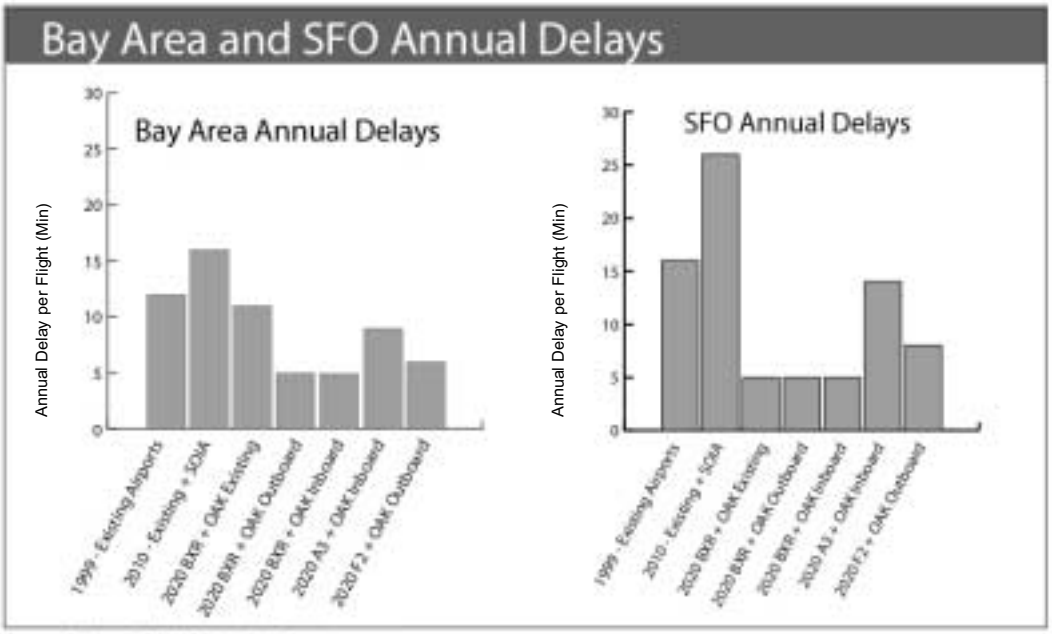
Planning Values for Demand/Capacity Assessment

AIRPORT	Capacity (Hourly Arrivals and Departures) VFR (Good Weather)	IFR (Bad Weather)	Demand Pk Hour 2010	3 Hour 2010	Pk Hour 2020	3 Hour 2020
SFO			**99**	**270**	**123**	**339**
Existing Runways-(Today)	107	77				
Existing Runways + SOIA/PRM	107	85				
Refined BX	136	119				
F2	136	111				
A3	107	107				
Existing Runways + Demand Management	120	87	**77**	**206**	**101**	**278**
OAK			**47**	**112**	**62**	**160**
Existing Runways-(Today)	56	54				
New Inboard Runway	90	64				
New Ourboard Runway	108	79				
Existing Runways + Demand Management	63	61			**49**	**126**
SJC			**42**	**110**	**63**	**156**
Master Plan Runways-(Today)	80	43				
Master Plan + Demand Management	88	47			**58**	**144**

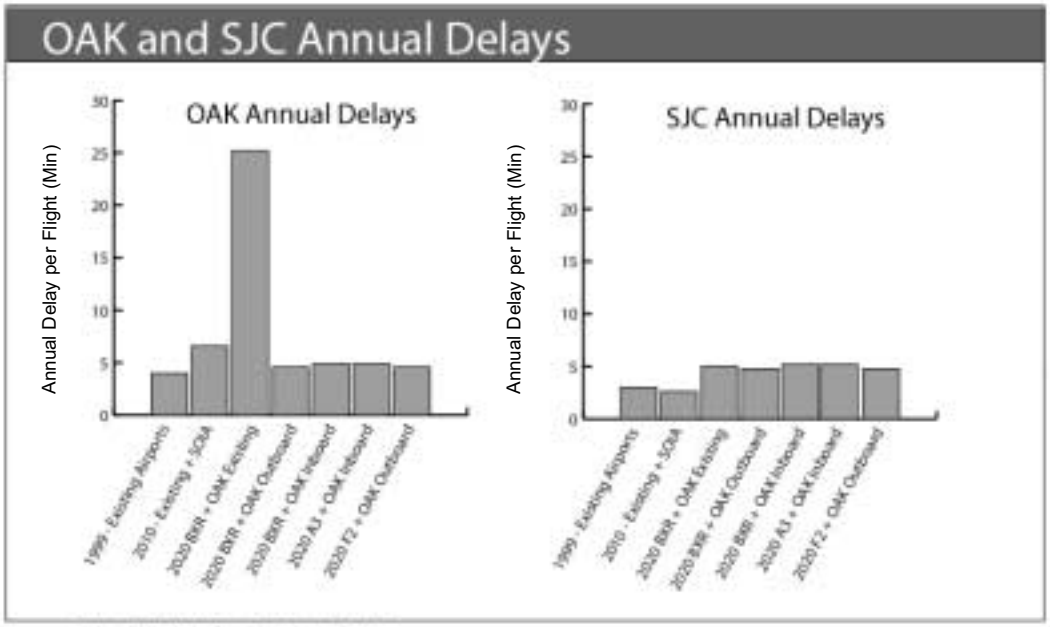
*SOIA/PRM - Simultaneous Offset Instrument Approach/Precision Runway Monitor

Source: Air Transport Association and FAA

At OAK, current average annual delays of about 4 minutes per flight would increase to only about 7 minutes in 2010 with no further expansion. A worst-case scenario would bring delays up to 25 minutes in 2020 if OAK does not build a second runway. SJC's master plan expansion will adequately meet demand, with only slight increases in delays delays in 2020 due to SFO and OAK expansion.



Source: Bechtel's SIMMOD Analysis Sept. 8, 2000



Source: Bechtel's SIMMOD Analysis Sept. 8, 2000

Viewed on a regional basis, MTC forecasts that Bay Area airports will see the greatest delays if SFO does not undertake any runway expansion by 2010, or if OAK does not expand its runways by 2020.

At OAK, the existing runway configuration approaches unacceptable delay levels after year 2010. By 2020, both the existing configuration and inboard runway plan are at or near unacceptable levels. At SJC, existing capacity adequately meets good weather demand through 2020, but approaches unacceptable bad weather levels in 2010. Even with demand management, SJC will have marginal levels of delay during bad weather by 2020.

Demand management can improve the overall capacity situation by 10-12%. If all radar, traffic control and instrumentation advances are fully deployed; all demand management strategies are approved by the FAA and implemented; and larger planes and improved load factors work to slow the growth in demand, the only clear alternative to runway expansion and reconfiguration is still a cap on air passenger and cargo growth, particularly in the period between 2008 and 2015, according to FAA district officials.

Such restrictions will negatively impact the Bay Area's economy, its domestic and international competitiveness, and its quality of life through restricted travel service choices and higher costs.

How airport expansion plans match up with demand:

- **With no new expansion of capacity,as many as 5.2 million passengers in 2010 (6.4% of the total), and 14.7 million in 2020 (13.2% of the total) may not be accommodated by Bay Area airports.**
- **With no improvements, demand will exceed bad weather capacity and approach good weather capacity at SFO by 2010, and at OAK after 2010.**
- **SOIA/PRM systems deal only with landings, and PRM deployment relies on wider runway separation than currently exists at SFO.**
- **NASA final approach spacing tools are still in early development stages.**
- **Route cancellations, schedule changes and removal of private planes from airports require FAA approval, which no airport has yet received.**
- **Large scale reallocation of airline operations among airports requires lengthy FAA review and approval, could have highly disruptive network effects for scheduled airlines, and would likely encounter opposition from surrounding communities.**
- **With no runway expansion, congestion problems are likely to significantly worsen between 2010 and 2020, at all three airports.**

CHAPTER 6

CONCLUSION

There is no easy answer to the capacity problems facing Bay Area airports (and, by implication, the Bay Area economy) over the next 20 years. What is clear is that demand from leisure and business travelers, from conventions, from air cargo shippers and forwarders, domestic and international, continues to grow, and that the choices in planning for the future cannot wait.

Bay Area airports make an essential contribution to the region's economy – in jobs, revenues and taxes generated. Beyond that direct contribution, the region's airports, like its highways and harbors, provide a circulatory system for the movement of people and goods that connects us to the world through business, cultural and personal exchanges. They are a key component of our rich diversity and our economic vibrancy.

Noise, increased traffic congestion, air quality and encroachment on San Francisco Bay are each important considerations, and legitimate points of concern among those directly affected. At the same time, Bay Area residents have experienced the freedom of travel, the importance of face-to-face connections across great distances in their work, and the frustration of missed appointments, lost family time or business opportunities caused by airpor delays. This study concludes that a failure by the region to upgrade its airport infrastructure and management systems to levels that will accommodate future demand, will impose significant financial, productivity and opportunity costs on the regional economy.

These elements frame the regional discussion about how the region's airports should meet the growing demands of a dynamic economy and changing social fabric. Decisions must be made, the appropriate balances must be struck, and work must begin now to ensure that the Bay Area controls its future by balancing economic growth, environmental protection and quality of life concerns in decisions regarding its future airport infrastructure.

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