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PEAT MARNICK MITCHELL AND CO SAN FRANCISCO CALIF
SAN FRANCISCO INTERNATIONAL AIRPORT DATA PACKAGE NUMBER 2, AIRP-ETC(U)
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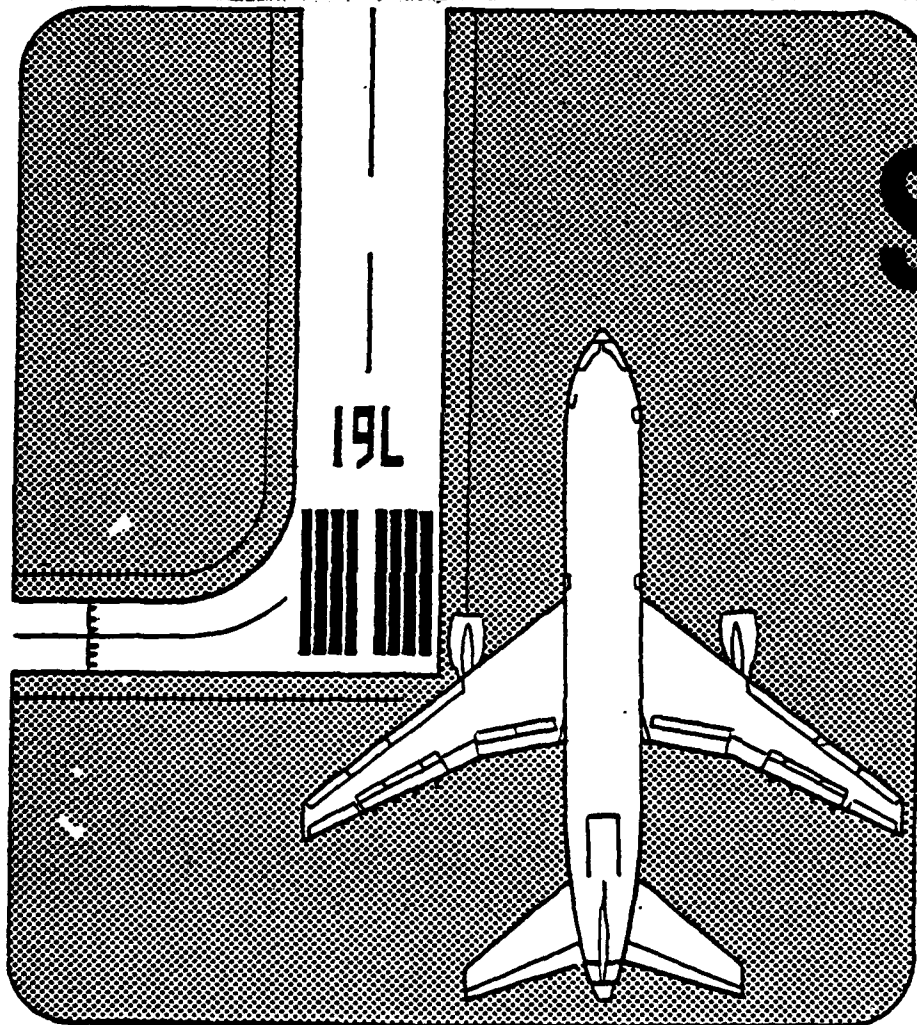
SAN FRANCISCO INTERNATIONAL AIRPORT

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DATA PACKAGE ^{NUMBER} NO. 2 LEVEL III

AIRPORT IMPROVEMENT
TASK FORCE DELAY STUDIES

AD A099952



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PEAT, MARWICK, MITCHELL & Co.

P. O. BOX 8007

SAN FRANCISCO INTERNATIONAL AIRPORT

SAN FRANCISCO, CALIFORNIA 94128

Telephone: (415) 347-9521

September 8, 1978

Mr. Ray Fowler, AEM-100
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

Re: Input Data for San Francisco Simulation Model
Stage 1 Delay Experiments

Dear Ray:

Enclosed are the results of the SFO calibration and the
input data package for San Francisco Stage 1 delay experi-
ments.

The enclosures contain information that should be reviewed,
revised, and approved by the San Francisco Task Force prior
to use in model runs.

Sincerely,



Stephen L. M. Hockaday
Manager

SLMH/nlm
Enclosure

cc: Mr. J. R. Dupree (ALG-312) (w/encl)
Mr. B. Chambers (AWE-4) (w/encl)
Mr. R. Mink (AWE-4) (w/encl)

Attachment A

SFO CALIBRATION RESULTS

SAN FRANCISCO INTERNATIONAL AIRPORT

Airport Improvement Task Force Delay Studies

Peat, Marwick, Mitchell & Co.
San Francisco, California

September 8, 1978

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San Francisco International Airport

CALIBRATION RESULTS

I. Arrival Flow Rates

<u>Runway</u>	<u>Time Interval*</u>	<u>Field Data</u>	<u>Calibrated Model</u>
1R	2400-0100	1	1
28R	2400-0100	14	15
28L	2400-0100	17	15
1R	0100-0200	1	1
28R	0100-0200	20	20
28L	0100-0200	23	22

II. Departure Flow Rates

<u>Runway</u>	<u>Time Interval</u>	<u>Field Data</u>	<u>Calibrated Model</u>
1R	2400-0100	11	11
1L	2400-0100	9	9
28R	2400-0100	6	6
28L	2400-0100	2	2
1R	0100-0200	2	3
1L	0100-0200	15	15
28R	0100-0200	5	5
28L	0100-0200	1	1

III. Weighted Average Fix-to-Threshold Arrival Travel Times (Minutes)

<u>Time Interval</u>	<u>Field Data</u>	<u>Calibrated Model</u>
2400-0100	12.4	11.5
0100-0200	12.8	11.7

IV. Weighted Average Fix-to-Threshold Arrival Delays (Minutes)

<u>Time Interval</u>	<u>Field Data</u>	<u>Calibrated Model</u>
2400-0100	1.6	1.6
0100-0200	2.4	1.7

*GMT.

V. Weighted Average Gate-to-Roll Departure Travel Times (Minutes)

<u>Time Interval</u>	<u>Field Data</u>	<u>Calibrated Model</u>
2400-0100	4.6	5.1
0100-0200	6.4	6.3

Attachment B

STAGE 1 EXPERIMENTS: INPUT DATA PACKAGE

SAN FRANCISCO INTERNATIONAL AIRPORT

Airport Improvement Task Force Delay Studies

Peat, Marwick, Mitchell & Co.
San Francisco, California

September 1978

STAGE 1 EXPERIMENTS

Experiment Number	Model	Arrival Runways	Departure Runways	Weather	Demand	ATC Scenario	Near-Term Improvements
1	ASM	28L, 28R, 1L	1L, 1R, 28L	VFR 1	1977	Today	None
2	ASM	28L, 28R, 1L	1L, 1R, 28L	VFR 2	1977	Today	None
3	ASM	28R	1L, 1R, 28L	IFR 1	1977	Today	None
4	ASM	28L, 28R	28L, 28R	VFR 1	1977	Today	None
5	ASM	28R	28L	IFR 1	1977	Today	None
6	ASM	19L, 19R	10L, 10R, 19R	VFR 1	1977	Today	None
7	ASM	19L	10L, 10R	IFR 1	1977	Today	None
8	ASM	19L, 19R	19L, 19R	VFR 2	1977	Today	None
9	ASM	19L	19L, 19R	IFR 2	1977	Today	None
10	ASM	19L	19L, 19R	IFR 2	1977	Today	Extend Taxiways L and V
11	ASM	19L, 19R	10L, 10R, 19R	VFR 1	1977	Today	Extend 1L/19R, VASI on 19R
12	ASM	19L, 19R	10L, 10R, 19R	VFR 1	1977	Today	Extend Taxiway K; 10L/10R departs
13	ASM	28L, 28R	1L, 1R	VFR 1	1977	Today	Utility runway on Taxiway L
14	ASM	28L, 28R	1L, 28L	VFR 1	1977	Today	None
15	ASM	28L	1L, 1R	IFR 1	1977	Today	None
16	ADM	n.a.	n.a.	n.a.	1977	Today	None
17	ADM	n.a.	n.a.	n.a.	1977	Today	None

INPUT DATA FOR EXPERIMENT NUMBER 1

A. LOGISTICS

1. Title: San Francisco International Airport Airfield
Simulation Model Calibration Run
2. Random Number Seeds: 2017, 3069, 4235, 5873, 6981,
7137, 8099, 9355, 0123, 1985.
3. Start and Finish Times: To be provided by Task Force.
4. Print Options: Summary run for ten random number seeds.
5. Airline Names:

<u>Name</u>	<u>Code</u>
Air California	OC
Air Taxi/Commuter	AT
American	AA
Continental	CO
Delta	DL
Flying Tiger	FT
Hughes Airwest	RW
International	IN
National	NA
Northwest	NW
Pacific Southwest	PS
Trans World	TW
United	UA
Western	WA
6. Processing Options: First run to check model input.
Other runs in COMPUTE mode.
7. Truncation Limits: ± 3 standard deviations.
8. Time Switch: Not applicable.

B. AIRFIELD PHYSICAL CHARACTERISTICS

9. Airfield Network: See Figure 1.
10. Number of Runways: 4.
11. Runway Identification: 1L, 1R, 28L and 28R.

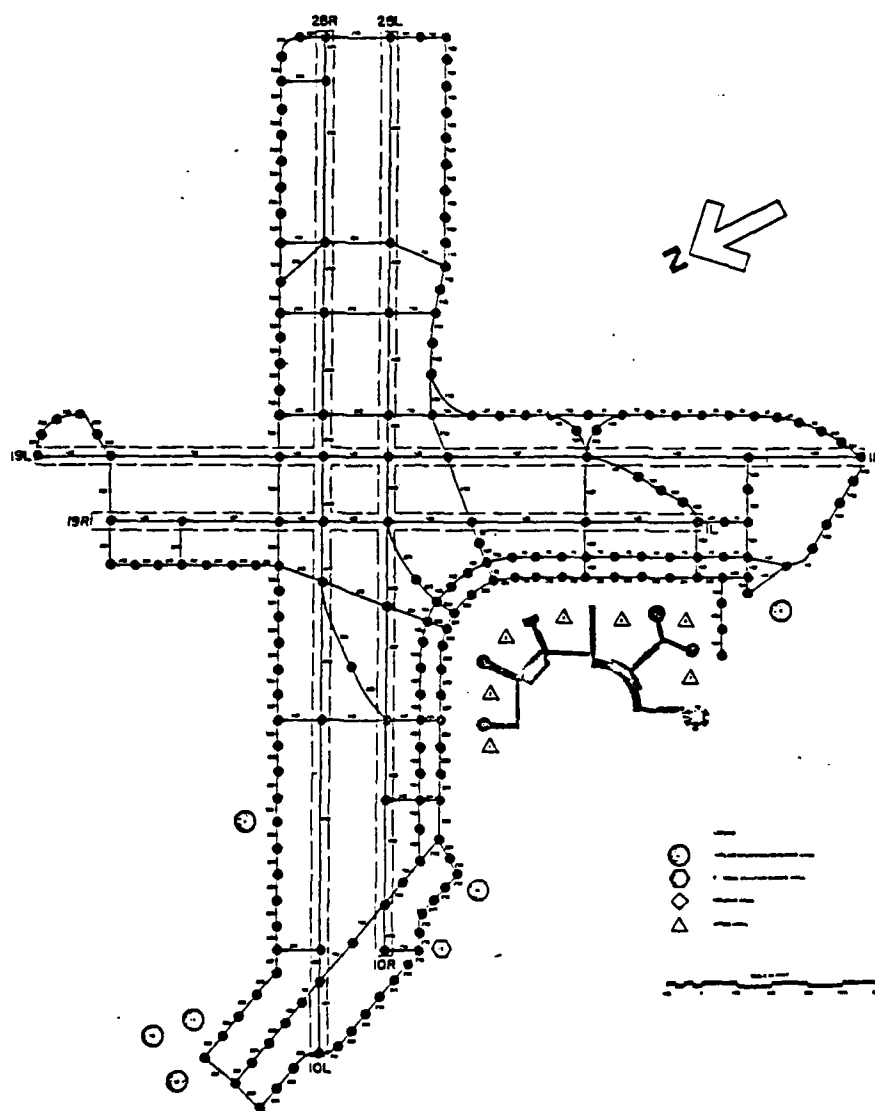


Figure 1

AIRFIELD NETWORK
SAN FRANCISCO INTERNATIONAL AIRPORT

12. Departure Runway End Links: 401, 429, 436
13. Runway Crossing Links: 252, 248, 322, 168, 167,
120, 119
14. Exit Taxiway Location:

<u>Runway</u>	<u>Taxiway</u>	<u>Link</u>	<u>Distance from Threshold (feet)</u>
28L	J	271	5,800
	E	251	6,600
	D	247	7,900
	R	214	10,500
28R	E	252	6,300
	T	321	6,500
	D	248	8,000
	U	281	10,600
1L	F	120	2,600

15. Holding Areas: Not applicable.

16. Airline Gates:

<u>Airline</u>	<u>Airline Gate Area</u>
Air California	5
Air Taxi/Commuter	4,5
American	4,5
Continental	4
Delta	4
Flying Tiger	10
Hughes Airwest	3
International	7
National	4
Northwest	4
Pacific Southwest	3,4
Trans World	5,6
United	1,2,3
Western	7

17. General Aviation Basing Areas: Butler Aviation. (Area 13)

C. ATC PROCEDURES

18. Aircraft Separations: These values are based on Report No. FAA-EM-78-8A.

Arrival-Arrival Separation (n.m.)

<u>VFR</u>		<u>Trail Aircraft Class</u>			
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Lead Aircraft Class	A	2.7	2.9	3.0	3.1
	B	2.7	2.9	3.0	3.1
	C	3.5	3.7	3.0	3.1
	D	5.3	5.5	4.7	3.9

<u>IFR</u>		<u>Trail Aircraft Class</u>			
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Lead Aircraft Class	A	3.8	4.0	4.1	4.2
	B	3.8	4.0	4.1	4.2
	C	4.8	5.0	4.1	4.2
	D	6.8	7.0	6.1	5.2

Departure-Departure Separations (seconds)

<u>VFR</u>		<u>Trail Aircraft Class</u>			
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Lead Aircraft Class	A	35	35	45	50
	B	35	35	45	50
	C	50	50	60	60
	D	120	120	120	90

Same Runway

<u>IFR</u>		<u>Trail Aircraft Class</u>			
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Lead Aircraft Class	A	60	60	60	60
	B	60	60	60	60
	C	60	60	60	60
	D	120	120	120	90

Same Runway

<u>Lead Departure Runway</u>	<u>Trail Departure Runway</u>	<u>VFR Separation</u>
1L	28L, 28R	15
1R	28L, 28R	20
28L, 28R	1L	25
28L, 28R	1R	20

Departure-Arrival Separation (n.m.):

		Trail Aircraft Class				
		A	B	C	D	
Lead	A	0.9	1.1	1.2	1.3	<u>Same Runway</u>
Aircraft	B	0.9	1.1	1.2	1.3	
Class	C	1.0	1.3	1.4	1.5	
	D	1.0	1.3	1.4	1.5	
<u>Lead</u>	<u>Trail</u>					
<u>Departure</u>	<u>Departure</u>					
<u>Runway</u>	<u>Runway</u>					<u>VFR</u>
						<u>Separation</u>
1L	28L, 28R					1.5
1R	28L, 28R					1.5

Arrival-Departure Separations (minutes)

<u>Arrivals</u>	<u>Departures</u>
<u>Runways 28L, 28R</u>	<u>Runways 1L, 1R</u>
<u>Class</u>	<u>Separation</u>
A	0.4
B	0.6
C	0.8
D	0.8

19. Route Data: See Figure 2.
20. Two-Way Path Data: Two-way flows occur on connectors between Taxiways A and B.
21. Common Approach Paths:

<u>Arrival</u>	<u>Aircraft</u>	<u>Length of Common</u>
<u>Runway</u>	<u>Class</u>	<u>Approach Path</u>
28L	A	2.0
	B	2.0
	C	5.0
	D	5.0
28R	A	2.0
	B	2.0
	C	5.0
	D	5.0
1L	A	2.0
	B	2.0

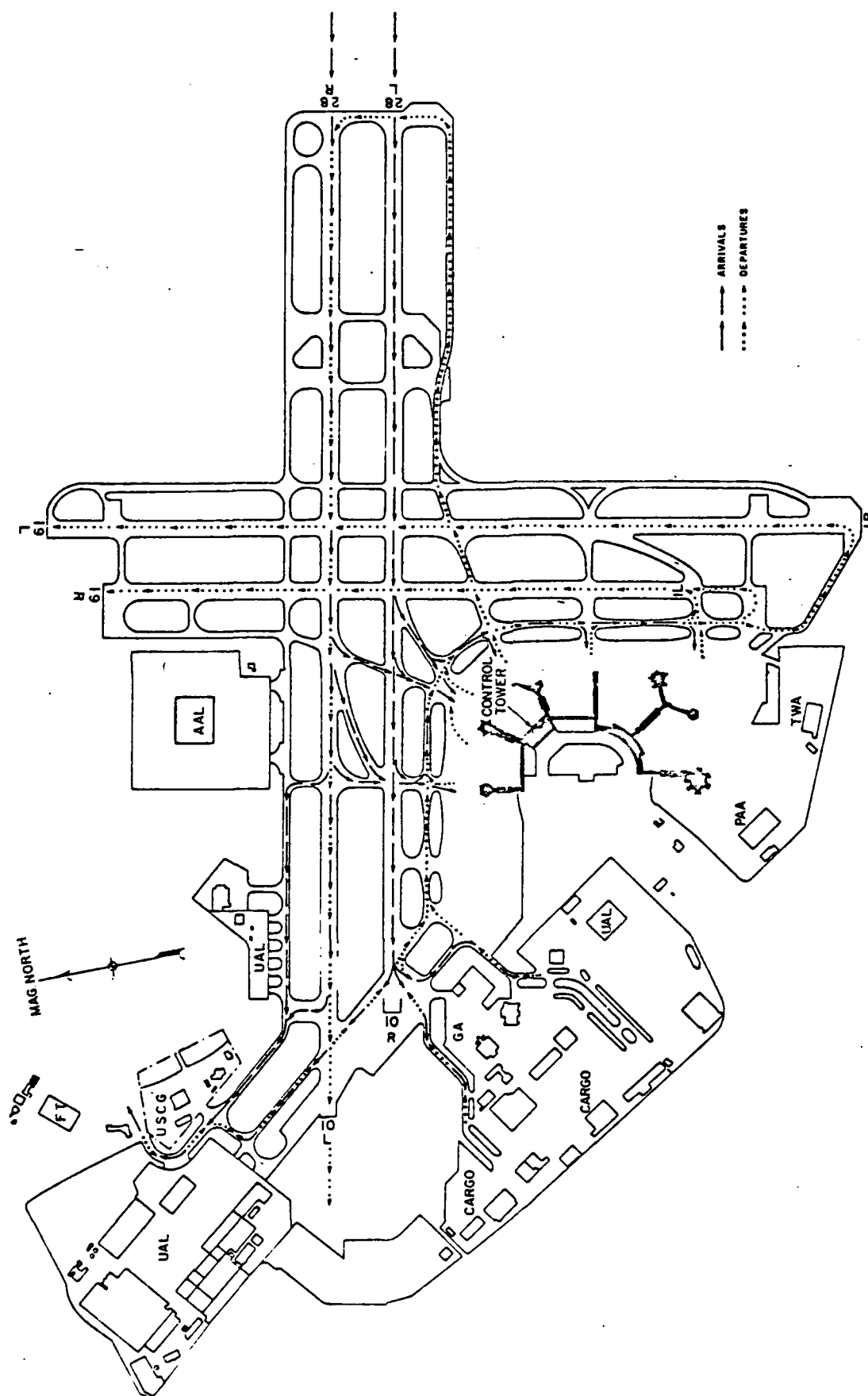


Figure 2. ARRIVAL/DEPARTURE TAXI ROUTES

22. Vectoring Delays:

This input allocates delays among vectoring and holding. Model input values will be used that hold arrival aircraft if delays to arrival aircraft exceed 10 minutes.

23. Departure Runway Queue Control:

Aircraft are assigned departure runways to preclude airspace crossovers, not to balance departure queues.

24. Gate Hold Control:

Aircraft are held at gates when departure queue at runway is 10 or more, except when gate holds would cause gate congestion.

25. Departure Airspace Constraints:

Aircraft are not held at gates due to departure airspace constraints.

26. Inter-Arrival Gap:

With this runway use, arrival aircraft are delayed in the arrival airspace when departure delays exceed 15 minutes.

27. Runway Crossing Delay Control:

Arrival and departure runway operations are only interrupted for a taxiing aircraft to cross an active runway when the taxiing aircraft is delayed by 10 minutes or more.

D. AIRCRAFT OPERATIONAL CHARACTERISTICS

28. Exit Taxiway Utilization:

		Exit Utilization (percent)			
		A/C			
	Class	E	T	D	U
Runway 28R	A		15		85
	B	15			85
	C	63	27	3	7
	D	23	77		

Exit Utilization (percent)

A/C					
Class		J	E	D	R
Runway 28L	A				100
	B	100			
	C	88	5	5	2
	D	88		12	

Exit Utilization (percent)

A/C					
Class		F			
Runway 1L	A				100
	B				100

29. Arrival Runway Occupancy Times:Runway Occupancy Time (seconds)

A/C					
Class		E	T	D	U
Runway 28R	A		80		95
	B	64			102
	C	55	60	92	105
	D	54	54		

A/C					
Class		J	E	D	R

Runway 28L	A				75
	B	56			
	C	46	54	63	102
	D	47		75	

A/C					
Class		F			

Runway 1L	A				40
	B				34

30. Touch & Go Occupancy Times: Not applicable.31. Departure Runway Occupancy Times:

Aircraft Class	Runway Occupancy Time (seconds)	
	Mean	Standard Deviation
A	34	4
B	34	4
C	39	4
D	39	4

32. Taxi Speeds: To be based on reduced field data.

33. Approach Speeds:

<u>Aircraft Class</u>	<u>Approach Speed (knots)</u>	
	<u>Mean</u>	<u>Standard Deviation</u>
A	95	10
B	120	10
C	130	10
D	140	10

34. Gate Service Times: Not applicable.

35. Airspace Travel Times: See Table 1.

36. Runway Crossing Times:

<u>Aircraft Class</u>	<u>Runway Crossing Time (seconds)</u>
A	12
B	14
C	17
D	20

37. Lateness Distribution: See Table 2.

38. Demand: To be provided by Task Force.

Table 1
 AIRSPACE TRAVEL TIMES^a
 (minutes)
 San Francisco International Airport
 Stage 1 Experiments: Input Data

<u>Fix</u>	<u>Aircraft Class</u>	<u>Travel Time To Runway</u>	
Cedes (1)	1,2	8.5	8.5
	3	10.0	8.5
	4	10.5	8.5
Santa Cruz (2)	1,2	9.5	9.5
	3	11.0	11.0
	4	11.0	11.5
Briny (3)	1,2	10.0	10.0
	3	11.0	11.0
	4	12.0	12.0
Point Reyes (4)	1,2	8.5	11.5
	3	8.5	12.5
	4	8.5	12.5

a. Nominal (undelayed) travel times.

Table 2

ARRIVAL AIRCRAFT LATENESS DISTRIBUTION
(Average deviation from schedule, excluding
delays due to destination airport)

<u>Amount of time</u> <u>late or early</u>	<u>Percent of flights</u> <u>late or early (5)</u>
More than 15 min. early	0
less than 15 min. early	3
On time	21
less than 5 minutes late	34
5 to 10 minutes late	16
10 to 15 minutes late	9
15 to 30 minutes late	9
30 to 45 minutes late	3
45 to 60 minutes late	5
more than 60 minutes late	0

Source: Peat, Marwick, Mitchell & Co. analysis of
data provided by San Francisco Task Force.

Experiment Number: 2 (Input changes from experiment number 1)

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
a. Logistics	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
b. Airfield Physical Characteristics	
9 Airfield network	
10 Number of runways	
11 Runway identification	
12 Departure runway end links	
13 Runway crossing links	
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
c. ATC Procedures	
18 Aircraft separations	Use VFR 2 Separations, i.e., no visual approaches
19 Route data	
20 Two-way path data	
21 Common approach paths	
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
d. Aircraft Operational Characteristics	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	

Experiment Number: 3 (Input changes from experiment number 1)

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
a. <u>Logistics</u>	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
b. <u>Airfield Physical Characteristics</u>	
9 Airfield network	
10 Number of runways	
11 Runway identification	
12 Departure runway end links	
13 Runway crossing links	
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
c. <u>ATC Procedures</u>	
18 Aircraft separations	Use IFR 1 separations
19 Route data	
20 Two-way path data	
21 Common approach paths	All aircraft fly same common approach
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
d. <u>Aircraft Operational Characteristics</u>	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	IFR runway occupancy times
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	

Experiment Number: 4 (Input changes from experiment number 1)

15

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
<u>a. Logistics</u>	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
<u>b. Airfield Physical Characteristics</u>	
9 Airfield network	
10 Number of runways	
11 Runway identification	
12 Departure runway end links	
13 Runway crossing links	
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
<u>c. ATC Procedures</u>	
18 Aircraft separations	
19 Route data	Additional routes
20 Two-way path data	
21 Common approach paths	
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
<u>d. Aircraft Operational Characteristics</u>	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	Reassign all operations to 28L, 28R

Experiment Number: 5 (Input changes from experiment number 3)

16

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
a. <u>Logistics</u>	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
b. <u>Airfield Physical Characteristics</u>	
9 Airfield network	
10 Number of runways	
11 Runway identification	
12 Departure runway end links	
13 Runway crossing links	
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
c. <u>ATC Procedures</u>	
18 Aircraft separations	
19 Route data	
20 Two-way path data	
21 Common approach paths	
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
d. <u>Aircraft Operational Characteristics</u>	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	Reassign all departures to 28L

Experiment Number: 13 (Input changes from experiment number 1)

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
a. Logistics	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
b. Airfield Physical Characteristics	
9 Airfield network	Utility runway on Taxiway L
10 Number of runways	Additional runway
11 Runway identification	2-20
12 Departure runway end links	Additional departure runway end link
13 Runway crossing links	
14 Exit taxiway location	Additional data for new runway
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
c. ATC Procedures	
18 Aircraft separations	Additional separations
19 Route data	Additional routes
20 Two-way path data	
21 Common approach paths	Additional common approach path
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
d. Aircraft Operational Characteristics	
28 Exit taxiway utilization	Additional data for new runway
29 Arrival runway occupancy times	
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	Additional airspace travel times
36 Runway crossing times	
37 Lateness distribution	
38 Demand	Assign some aircraft to new runway

Experiment Number: 14 (Input changes from experiment number 1)

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
a. <u>Logistics</u>	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
b. <u>Airfield Physical Characteristics</u>	
9 Airfield network	
10 Number of runways	
11 Runway identification	
12 Departure runway end links	
13 Runway crossing links	
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
c. <u>ATC Procedures</u>	
18 Aircraft separations	
19 Route data	
20 Two-way path data	
21 Common approach paths	
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
d. <u>Aircraft Operational Characteristics</u>	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	Reassign arrival and departure runways

Experiment Number: 15 (Input changes from experiment number 3)

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
a. <u>Logistics</u>	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
b. <u>Airfield Physical Characteristics</u>	
9 Airfield network	
10 Number of runways	
11 Runway identification	
12 Departure runway end links	
13 Runway crossing links	
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
c. <u>ATC Procedures</u>	
18 Aircraft separations	
19 Route data	
20 Two-way path data	
21 Common approach paths	
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
d. <u>Aircraft Operational Characteristics</u>	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	Reassign arrival and departure runways

INPUT DATA FOR EXPERIMENT NUMBER 6

A. LOGISTICS

1. Title: San Francisco International Airport Airfield
Simulation Model Calibration Run
2. Random Number Seeds: 2017, 3069, 4235, 5873, 6981,
7137, 8099, 9355, 0123, 1985.
3. Start and Finish Times: To be provided by Task Force.
4. Print Options: Summary run for ten random number seeds.
5. Airline Names:

<u>Name</u>	<u>Code</u>
Air California	OC
Air Taxi/Commuter	AT
American	AA
Continental	CO
Delta	DL
Flying Tiger	FT
Hughes Airwest	RW
International	IN
National	NA
Northwest	NW
Pacific Southwest	PS
Trans World	TW
United	UA
Western	WA
6. Processing Options: First run to check model input.
Other runs in COMPUTE mode.
7. Truncation Limits: ± 3 standard deviations.
8. Time Switch: Not applicable.

B. AIRFIELD PHYSICAL CHARACTERISTICS

9. Airfield Network: See Figure 1.
10. Number of Runways: 4.
11. Runway Identification: 10L, 10R, 19L and 19R.

12. Departure Runway End Links: 410, 421, 422, 430.

13. Runway Crossing Links: 119, 159, 167, 195, 251,
252.

14. Exit Taxiway Location:

<u>Runway</u>	<u>Taxiway</u>	<u>Link</u>	<u>Distance from Threshold (feet)</u>
19L	F	119	4,700
	G	167	6,300
	H	162	6,400
	M	149	8,000
	B	142	9,500
19R	F	120	4,400
	G	168	5,700
	H	158	7,000

15. Holding Areas: Not applicable.

16. Airline Gates:

<u>Airline</u>	<u>Airline Gate Area</u>
Air California	5
Air Taxi/Commuter	4,5
American	4,5
Continental	4
Delta	4
Flying Tiger	10
Hughes Airwest	3
International	7
National	4
Northwest	4
Pacific Southwest	3,4
Trans World	5,6
United	1,2,3
Western	7

17. General Aviation Basing Areas: Butler Aviation. (Area 13)

C. ATC PROCEDURES

18. Aircraft Separations: These values are based on Report No. FAA-EM-78-8A.

Arrival-Arrival Separation (n.m.)

<u>VFR</u>		<u>Trail Aircraft Class</u>			
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Lead Aircraft Class	A	2.7	2.9	3.0	3.1
	B	2.7	2.9	3.0	3.1
	C	3.5	3.7	3.0	3.1
	D	5.3	5.5	4.7	3.9

<u>IFR</u>		<u>Trail Aircraft Class</u>			
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Lead Aircraft Class	A	3.8	4.0	4.1	4.2
	B	3.8	4.0	4.1	4.2
	C	4.8	5.0	4.1	4.2
	D	6.8	7.0	6.1	5.2

Departure-Departure Separations (seconds)

<u>VFR</u>		<u>Trail Aircraft Class</u>			
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Lead Aircraft Class	A	35	35	45	50
	B	35	35	45	50
	C	50	50	60	60
	D	120	120	120	90

Same Runway

<u>IFR</u>		<u>Trail Aircraft Class</u>			
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Lead Aircraft Class	A	60	60	60	60
	B	60	60	60	60
	C	60	60	60	60
	D	120	120	120	90

Same Runway

<u>Lead Departure Runway</u>	<u>Trail Departure Runway</u>	<u>VFR Separation</u>
19R	10L, 10R	10
10L, 10R	19R	35

Departure-Arrival Separation (n.m.):

		Trail Aircraft Class				
		A	B	C	D	
Lead	A	0.9	1.1	1.2	1.3	<u>Same Runway</u>
Aircraft	B	0.9	1.1	1.2	1.3	
Class	C	1.0	1.3	1.4	1.5	
	D	1.0	1.3	1.4	1.5	

<u>Departure</u> <u>Runway</u>	<u>Arrival</u> <u>Runway</u>	<u>VFR</u> <u>Separation</u>
10L, 10R	19L, 19R	3.0

Arrival-Departure Separations (minutes)

<u>Arrivals</u> <u>Runways 19L, 19R</u>	<u>Departures</u> <u>Runways 10L, 10R</u>
<u>Class</u>	<u>Separation</u>
A	0.4
B	0.3
C	0.3
D	0.3

19. Route Data: See Figure 2.
20. Two-Way Path Data: Two-way flows occur on connectors between Taxiways A and B.
21. Common Approach Paths:

<u>Arrival</u> <u>Runway</u>	<u>Aircraft</u> <u>Class</u>	<u>Length of Common</u> <u>Approach Path</u>
19L	A	2.0
	B	2.0
	C	5.0
	D	5.0
19R	A	2.0
	B	2.0
	C	5.0
	D	5.0

22. Vectoring Delays:

This input allocates delays among vectoring and holding. Model input values will be used that hold arrival aircraft if delays to arrival aircraft exceed 10 minutes.

23. Departure Runway Queue Control:

Aircraft are assigned departure runways to preclude airspace crossovers, not to balance departure queues.

24. Gate Hold Control:

Aircraft are held at gates when departure queue at runway is 10 or more, except when gate holds would cause gate congestion.

25. Departure Airspace Constraints:

Aircraft are not held at gates due to departure airspace constraints.

26. Inter-Arrival Gap:

With this runway use, arrival aircraft are delayed in the arrival airspace when departure delays exceed 15 minutes.

27. Runway Crossing Delay Control:

Arrival and departure runway operations are only interrupted for a taxiing aircraft to cross an active runway when the taxiing aircraft is delayed by 10 minutes or more.

D. AIRCRAFT OPERATIONAL CHARACTERISTICS

28. Exit Taxiway Utilization:

		<u>Exit Utilization (percent)</u>			
		<u>A/C</u>			
		<u>Class</u>	<u>F</u>	<u>G</u>	<u>H</u>
Runway 19L	A	100			
	B	100			
	C	30	30	40	
	D	0	10	90	

Exit Utilization (percent)

<u>A/C</u>					
<u>Class</u>		<u>F</u>	<u>G</u>	<u>H</u>	
Runway 19R	A	100			
	B	100			
	C	20	65	15	
	D			100	

29. Arrival Runway Occupancy Times:Runway Occupancy Time (seconds)

<u>A/C</u>					
<u>Class</u>		<u>F</u>	<u>G</u>	<u>H</u>	
Runway 19L	A	63			
	B	53			
	C	44	55	55	
	D		55	55	

<u>A/C</u>					
<u>Class</u>		<u>F</u>	<u>G</u>	<u>H</u>	
Runway 19R	A	58			
	B	50			
	C	42	53	65	
	D			65	

30. Touch & Go Occupancy Times: Not applicable.31. Departure Runway Occupancy Times:

<u>Aircraft</u> <u>Class</u>	<u>Runway Occupancy Time (seconds)</u>	
	<u>Mean</u>	<u>Standard Deviation</u>
A	34	4
B	34	4
C	39	4
D	39	4

32. Taxi Speeds: To be based on reduced field data.33. Approach Speeds:

<u>Aircraft</u> <u>Class</u>	<u>Approach Speed (knots)</u>	
	<u>Mean</u>	<u>Standard Deviation</u>
A	95	10
B	120	10
C	130	10
D	140	10

34. Gate Service Times: Not applicable.

35. Airspace Travel Times: See Table 1.

36. Runway Crossing Times:

<u>Aircraft Class</u>	<u>Runway Crossing Time (seconds)</u>
A	12
B	14
C	17
D	20

37. Lateness Distribution: See Table 2.

38. Demand: To be provided by Task Force.

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
a. <u>Logistics</u>	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
b. <u>Airfield Physical Characteristics</u>	
9 Airfield network	
10 Number of runways	
11 Runway identification	
12 Departure runway end links	
13 Runway crossing links	
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
c. <u>ATC Procedures</u>	
18 Aircraft separations	IFR 1 Separations
19 Route data	
20 Two-way path data	
21 Common approach paths	All aircraft fly same common approach
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
d. <u>Aircraft Operational Characteristics</u>	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	IFR runway occupancy times
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	Reassign arrival and departure runways

Experiment Number: 8 (Input changes from experiment number 6)

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
a. <u>Logistics</u>	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
b. <u>Airfield Physical Characteristics</u>	
9 Airfield network	
10 Number of runways	
11 Runway identification	
12 Departure runway end links	
13 Runway crossing links	
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
c. <u>ATC Procedures</u>	
18 Aircraft separations	
19 Route data	VFR 2 separations
20 Two-way path data	Additional routes
21 Common approach paths	
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
d. <u>Aircraft Operational Characteristics</u>	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	Reassign departure runways

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
<u>a. Logistics</u>	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
<u>b. Airfield Physical Characteristics</u>	
9 Airfield network	
10 Number of runways	
11 Runway identification	
12 Departure runway end links	
13 Runway crossing links	
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
<u>c. ATC Procedures</u>	
18 Aircraft separations	IFR 2 Separations
19 Route data	
20 Two-way path data	
21 Common approach paths	All aircraft fly same common approach
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
<u>d. Aircraft Operational Characteristics</u>	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	IFR runway occupancy times
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	Reassign arrival runways

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
<u>a. Logistics</u>	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
<u>b. Airfield Physical Characteristics</u>	
9 Airfield network	Extend Taxiways L and V
10 Number of runways	
11 Runway identification	
12 Departure runway end links	
13 Runway crossing links	New crossing links
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
<u>c. ATC Procedures</u>	
18 Aircraft separations	
19 Route data	Additional routes
20 Two-way path data	
21 Common approach paths	
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
<u>d. Aircraft Operational Characteristics</u>	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	

Experiment Number: 11 (Input changes from experiment number 6)

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
<u>a. Logistics</u>	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
<u>b. Airfield Physical Characteristics</u>	
9 Airfield network	Extend 1L/19R
10 Number of runways	
11 Runway identification	
12 Departure runway and links	
13 Runway crossing links	
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
<u>c. ATC Procedures</u>	
18 Aircraft separations	
19 Route data	
20 Two-way path data	
21 Common approach paths	
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
<u>d. Aircraft Operational Characteristics</u>	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	Reassign runways

SIMULATION MODEL INPUT	DESCRIPTION OF INPUT CHANGE
<u>a. Logistics</u>	
1 Title	
2 Random number seeds	
3 Start and finish times	
4 Print options	
5 Airline names	
6 Processing options	
7 Truncation limits	
8 Time switch	
<u>b. Airfield Physical Characteristics</u>	
9 Airfield network	Extend Taxiway K
10 Number of runways	
11 Runway identification	
12 Departure runway end links	
13 Runway crossing links	
14 Exit taxiway location	
15 Holding areas	
16 Airline gates	
17 General aviation basing areas	
<u>c. ATC Procedures</u>	
18 Aircraft separations	Reflect simultaneous IOL/IOR departures
19 Route data	Additional routes
20 Two-way path data	
21 Common approach paths	
22 Vectoring delays	
23 Departure runway queue control	
24 Gate hold control	
25 Departure airspace constraints	
26 Departure queue	
27 Runway crossing delay control	
<u>d. Aircraft Operational Characteristics</u>	
28 Exit taxiway utilization	
29 Arrival runway occupancy times	
30 Touch-and-go runway occupancy times	
31 Departure runway occupancy times	
32 Taxi speeds	
33 Approach speeds	
34 Gate service times	
35 Airspace travel times	
36 Runway crossing times	
37 Lateness distribution	
38 Demand	Reassign runways

INPUT DATA FOR EXPERIMENT NUMBER 16

1. Annual Demand: 349,011 (1977)

2. Group Specification:

3 day groups : High, Average, Low
 12 week groups : 12 months, January through December
 4 weather groups: VFR1, VFR2, IFR1, IFR2

7 runway uses :	Arrivals Runway	Departures Runway
1.	28 L/R	1 L/R
2.	28 L or R	1 L/R
3.	28 L/R	1 L or R
4.	28 L/R	28 L/R
5.	19 L/R	10 L/R
6.	19 L/R	19 L/R
7.	Other*	Other*

3,4. Traffic Distribution:

Week Group	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
% of annual in one week	1.79	1.79	1.90	1.91	1.86	1.97	2.02	2.05	1.99	1.95	1.93	1.84
Number of weeks in month	4.43	4.00	4.43	4.29	4.43	4.29	4.43	4.43	4.29	4.43	4.29	4.43
% of annual in month	7.90	7.14	8.40	8.15	8.21	8.42	8.92	9.05	8.80	8.62	8.26	8.13

5,6. Daily Traffic Distribution:

Day Group	<u>High</u>	<u>Avg</u>	<u>Low</u>
% of weekly in one day	15.1	14.1	12.3
Number of days	3	3	1
% of weekly traffic in day group	45.3	42.4	12.3

*Includes Land 10 L/R, Depart 10 L/R and Land 1 L/R,
 Depart 1 L/R.

7. Weather Occurrences:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% VFR1	76	83	80	89	80	80	80	72	76	84	84	69
% VFR2	16	10	18	8	15	15	13	15	15	12	11	14
% IFR1	3	1	1	2	2	3	3	5	3	1	1	4
% IFR2	5	6	1	1	3	2	4	8	6	3	4	13

8. Hourly Runway Capacity Parameters:

Runway Use	Hourly Capacity ^(a) (Operations/hour)			
	VFR1	VFR2	IFR1	IFR2
1	111	89	53	(b)
2	(b)	(b)	(b)	(b)
3	(b)	(b)	(b)	(b)
4	98	96	63	(b)
5	97	97	63	(b)
6	(b)	64	48	36
7	(b)	(b)	(b)	(b)

9. Runway Use/Weather Group Demand Factors:

For all runway uses:

	Weather			
	VFR1	VFR2	IFR1	IFR2
	1.0	1.0	0.98	0.81

10. Runway Use Occurrences:^(c)

Runway Use	Percent Occurrence				All Weather
	VFR1	VFR2	IFR1	IFR2	
1					67 ^(d)
2					
3					
4			(c)		25
5					6
6					1
7					1
All Runways	79.2	13.4	2.7	4.7	100

(a) Federal Aviation Administration, San Francisco International Airport Staff-ATA-Airlines serving San Francisco-San Francisco International Airport Operations Improvement Program-Interim Report-September 1977.

(b) To be estimated by Task Force with PMM&Co. assistance.

(c) To be estimated by Task Force.

(d) Includes % for cases 2 and 3 which are to be estimated by Task Force.

11. Hourly Traffic:

<u>Hour</u>	<u>% Daily Traffic</u>	<u>Hour</u>	<u>% Daily Traffic</u>	<u>Hour</u>	<u>% Daily Traffic</u>	<u>Hour</u>	<u>% Daily Traffic</u>
00-01	2.6	06-07	1.6	12-13	7.1	18-19	5.5
01-02	1.6	07-08	4.6	13-14	6.6	19-20	6.2
02-03	0.9	08-09	6.1	14-15	6.4	20-21	5.1
03-04	0.7	09-10	6.2	15-16	5.2	21-22	3.8
04-05	0.4	10-11	5.7	16-17	5.0	22-23	3.9
05-06	1.0	11-12	6.0	17-18	5.2	23-24	2.6

12,13. Delay Curve Specification: To be determined after
airfield simulation runs.

14. Percent Arrivals:

<u>Hour</u>	<u>% Arrivals</u>	<u>Hour</u>	<u>% Arrivals</u>	<u>Hour</u>	<u>% Arrivals</u>	<u>Hour</u>	<u>% Arrivals</u>
00-01	44	06-07	34	12-13	49	18-19	59
01-02	43	07-08	43	13-14	46	19-20	57
02-03	60	08-09	40	14-15	49	20-21	62
03-04	67	09-10	40	15-16	49	21-22	57
04-05	65	10-11	51	16-17	52	22-23	44
05-06	50	11-12	61	17-18	46	23-24	65

15. Cancellation Diversion Specification: To be provided by
Task Force.

16. User-Specified Title: SFO ANNUAL BASELINE.

INPUT DATA FOR EXPERIMENT NUMBER 17

As for Experiment Number 16 except that runway capacities and runway uses will be revised to reflect the absence of operational constraints due to noise abatement procedures.