

TRANSOLUTIONS

TRACS - Terminal, Roadway, and  
Curbside Simulation  
Airport Landside Analysis Tool

January 13, 2002

# Agenda

- Introduction & background
- TRACS
  - Input processor
  - Building models
  - Output analyzer
- Examples of airport modeling projects
- TRACS summary



# Introduction & Background



# TransSolutions' Capabilities

## Interdisciplinary staff

- Industrial engineers
- Operation researchers
- Scientists
- Mathematicians

## Areas of expertise

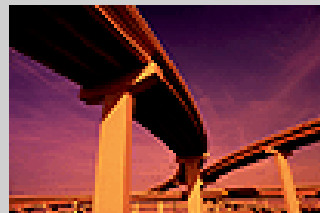
- Terminals
- Air field
- Baggage systems
- Security areas
- Roadways/parking

## Knowledge base

- Forecasting
- Logistics
- Mathematical programming
- Optimization
- Simulation
- Statistical analysis
- Stochastic processes

## Models

- TRACS, Arena, AutoMod
- SIMMOD
- CORSIM, VISSIM



# TransSolutions' Projects

✈ **TransSolutions**  
has worked  
at 24 of the 25  
largest airports  
in the world



# Modeling Approach

- Diverse set of tools are used based on project requirements
  - AutoMod - 3-D modeling, baggage systems
  - SIMMOD - Airfield and airspace modeling
  - ARENA - Initial modeling environment for most airport terminal models
  - CORSIM/VISSIM - Highway modeling
  - TRACS - Terminal, Roadway, and Curbside Simulation environment developed by TransSolutions for landside modeling and analysis
  
- Can model the total system of integrated airport components
  - Airport and airline operating environment
  - Interdependencies between functions
  
- Know what data is needed to accurately model various aspects of terminal operations



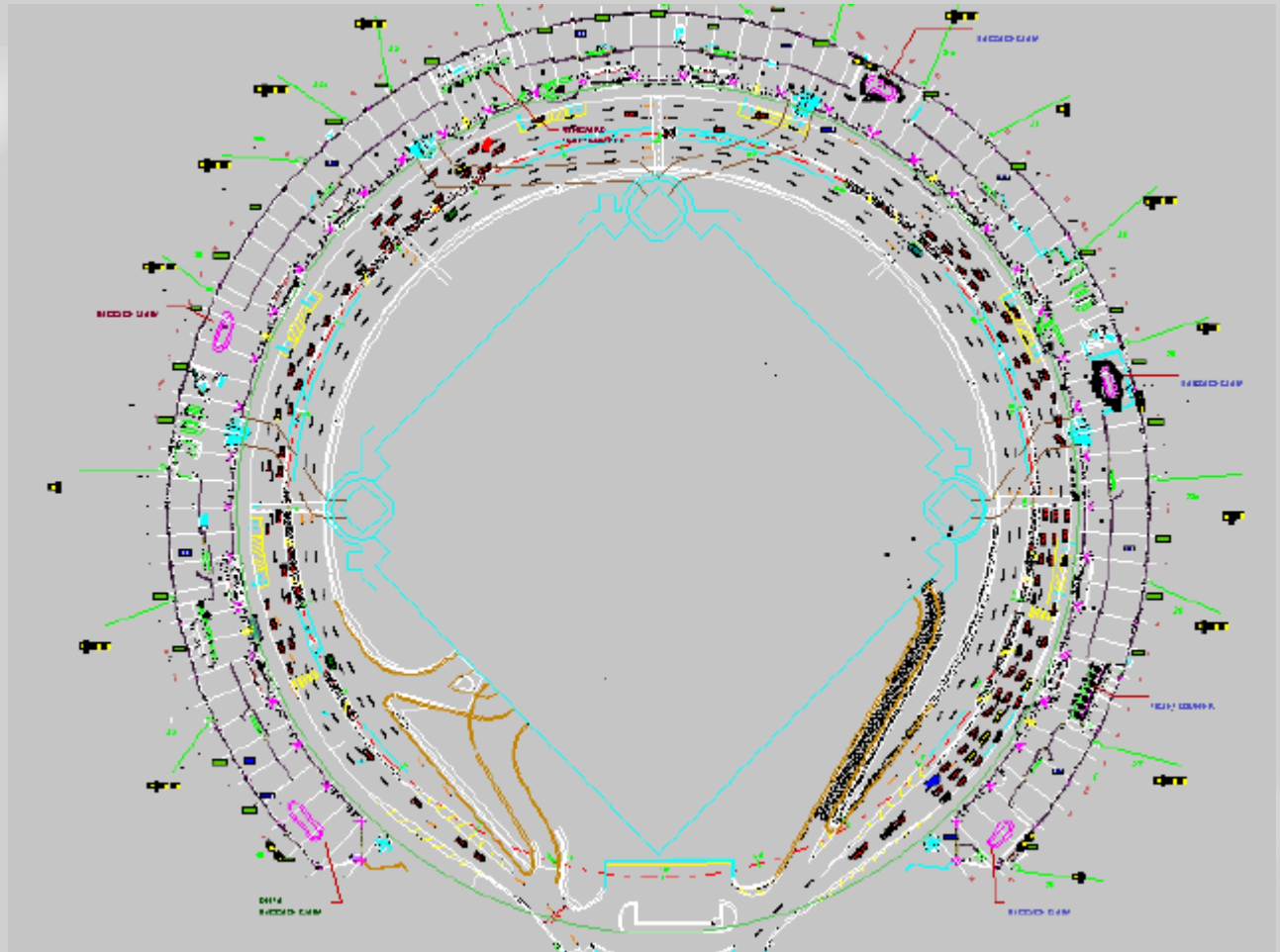
# Typical Areas of Airport Modeling

- Airport **a**ccess **r**oadway
- Terminal **c**urbside
- Parking **g**arage
- Ticketing
- Checked **b**ag **s**ecurity **p**rocessing (i.e., EDS)
- Security **c**heckpoints
- Concourse **p**assenger **m**ovements
- Automated **p**eople **m**over
- Outbound **b**aggage **s**ystem
- Bag **c**laim
- Federal **i**nspection **s**ervice (Immigration, Customs, etc.)
- Ramp **o**perations (**b**aggage **h**andling, catering, fueling, etc.)
- Aircraft **m**ovements



# MCI Integrated Simulation Model

- Objective
  - Compare options
- System components
  - Curbside roadway
  - ATO, security
  - Concessions, corridors
  - Gates, holdrooms
  - Inbound baggage
- Performance criteria
  - Roadway usage
  - Passenger processing
  - Level of service
  - Resource usage
  - Walking distances





# TRACS

## Terminal, Roadway, and Curbside Simulation

### One Framework

- Individual passengers
- Baggage
- Ground vehicles

### 24-hour day

- Customized output statistics
- Level of service standards

### Validated

- Over 200 studies
- 10 years of use
- Statistical validations to real-world data

### Seamless animation

- Vehicle arrival to curbside
- Passengers enter terminal
- Ticket counters
- Baggage check-in
- Security inspection
- Customs, immigrations
- Baggage claim

### Can be linked to:

- SIMMOD, TAAM, etc.
- CORSIM, VISSIM



# TRACS

Terminal, Roadway and Curbside Simulation

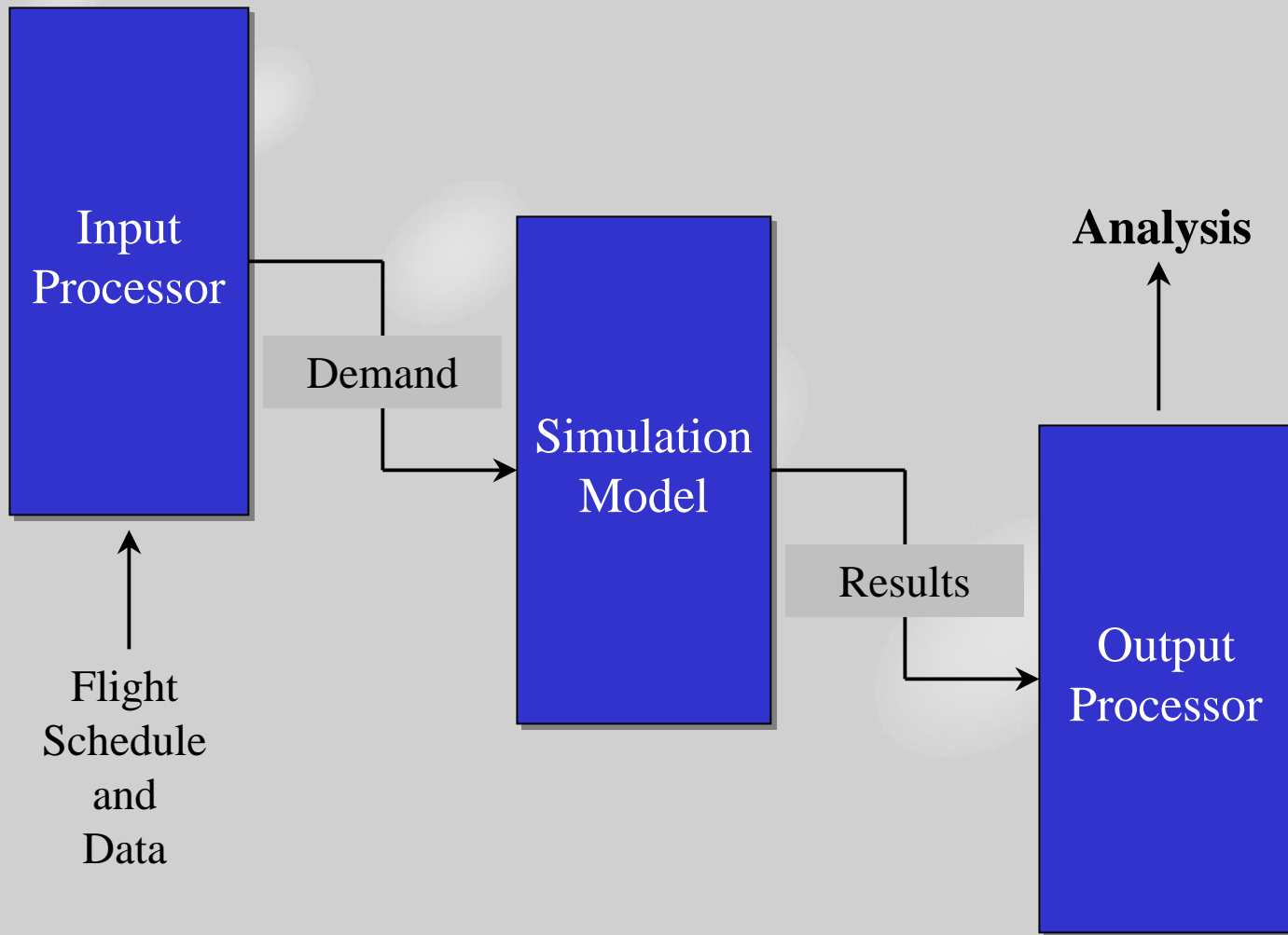


Start

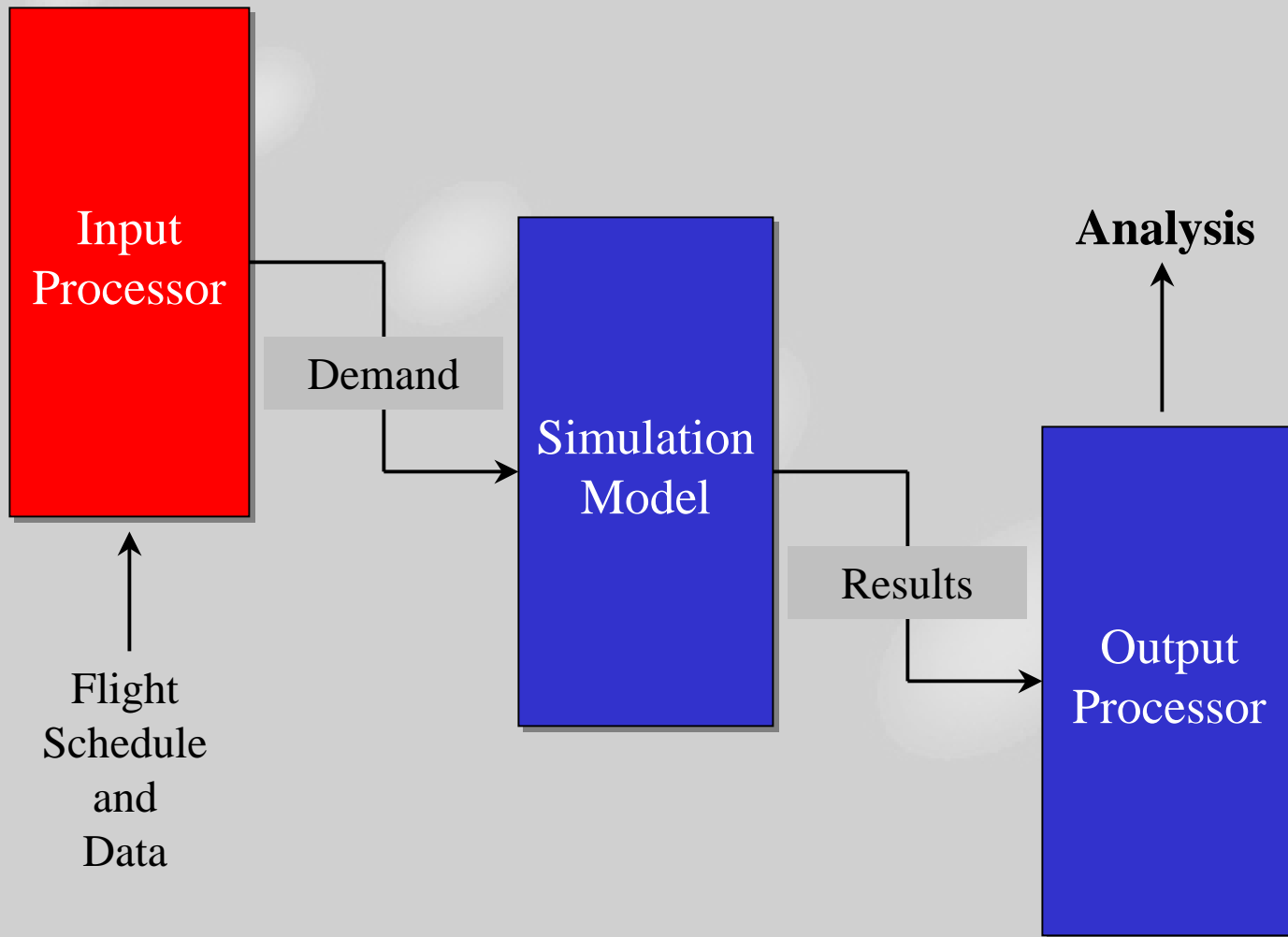


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# TRACS Process Design



# TRACS Process Design



# Input Processor

## Scenario Management

- Data input and organization
  - Flight schedule and related information
  - Passenger and operational characteristics
  
- Demand development for simulation model(s)

TRACS - Terminal, Runway and Outside Simulation

Scenario Management

Scenario Definition

- Create New
- Modify Previous
- Delete Scenario

Schedule Info

- Input from File
- Edit Schedule

Connections

Airline Information

- Edit Airline
- Edit Airline Group
- Assign Airline Group
- AC Type & Dash

Other Information

- Edit Market Group
- Assign Market Group
- Load Factors

Plan Simulation

Operational

Distribution

Scenario & Schedule

Edit the schedule for this scenario

Arrival/Altitude	Arrival/Altitude	Arrival/Altitude	ScheduledArrivalTime	ActualArrivalTime	AircraftType	ParkPos	Gate	DepartureAirline	Day
DL	28	ATL	08:50	08:50	B763	A1	A1	DL	15
DL	48	CNB	09:40	09:40	B763	A2	A2	DL	49
DL	86	CNB	12:58	12:58	B772	A3	A3	DL	87
AA	78	DFW	07:25	07:25	MD11	B1			
AA	84	ORD	08:35	08:35	B763	B2	B2	AA	88
AA	126	JFK	07:20	07:20	B763	B3			
AC	844	NYC	11:10	11:10	A346	C1	C1	AC	845
AC	874	FUL	07:50	07:50	A348	C1	C1	AC	875
AC	876	YYZ	08:55	08:55	A346	C2	C2	AC	877
TW	893	STL	04:20	04:20	B762	B3			
UA	933	SFO	05:05	05:05	B772	D1	D6	UA	934
UA	944	SEA	04:00	04:00	B744	D2	D2	UA	945
UA	978	MCO	11:25	11:25	B772	D1	D6	UA	979
US	192	CLT	04:30	04:30	B762	B3			
US	782	FIT	07:00	07:00	B762	B2			
US	894	PHL	09:45	09:45	A300	B1	B1	US	895
			00:00	00:00	B763	B3	AA	125	
			00:00	00:00	B762	B2	US	788	
			00:00	00:00	MD11	B1	AA	71	
			00:00	00:00	B762	B3	US	198	
			00:00	00:00	B762	B3	TW	99	

Update Cancel



# Input Processor

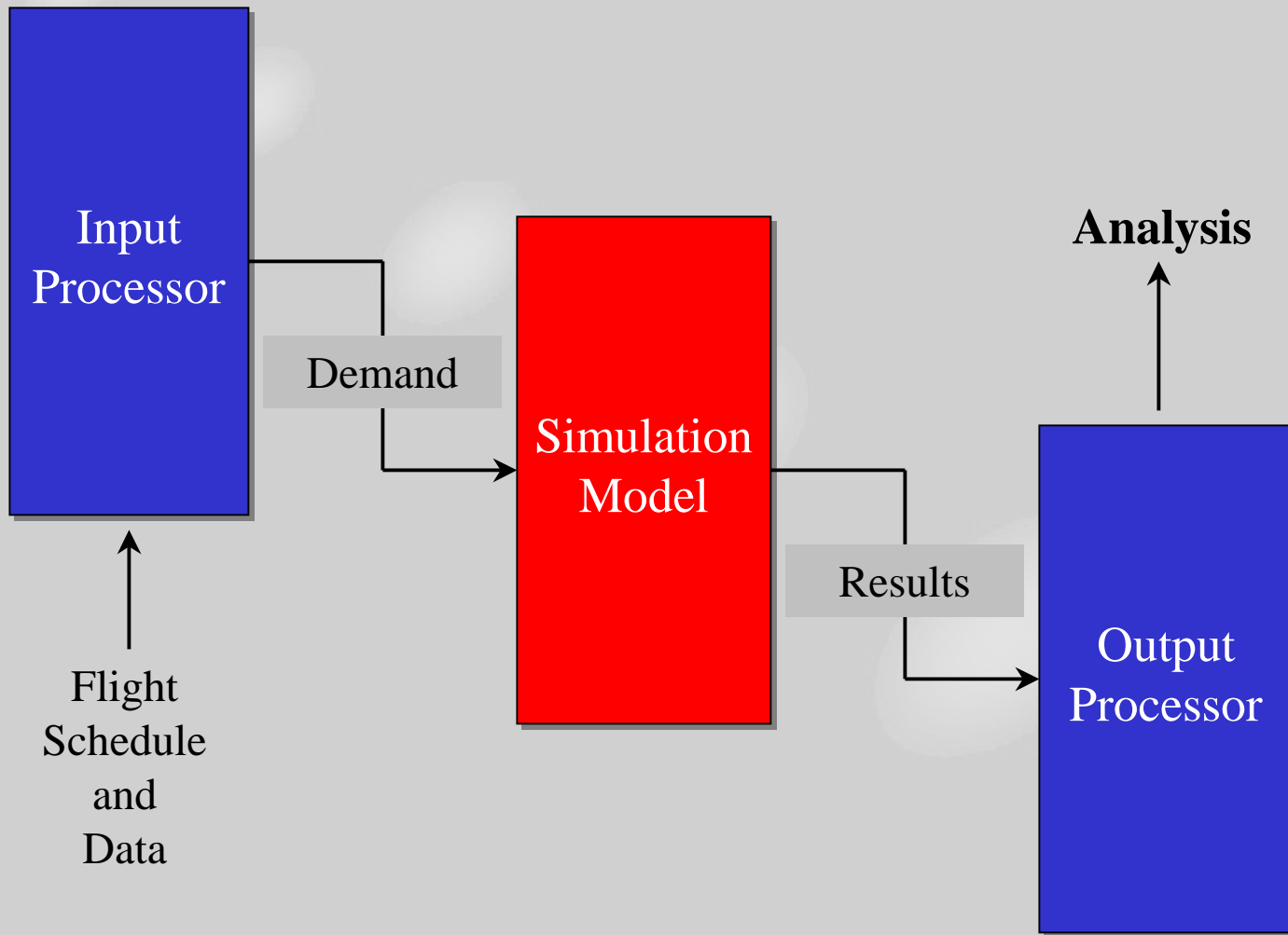
## Scenario Management

- Data input and organization
  - Flight schedule and related information
  - Passenger and operational characteristics
- Demand development for simulation model(s)

Market Group	Bag0	Bag1	Bag2	Bag3	Total
Domestic	2.00	65.00	29.00	4.00	1.00 00
Europe	2.00	61.00	33.00	4.00	1.00 00
Heavy	2.00	46.00	43.00	9.00	1.00 00
International	7.00	68.00	26.00	4.00	1.00 00
TLV	2.00	61.00	33.00	4.00	1.00 00
Toronto	8.00	72.00	39.00	2.00	1.00 00
US	5.00	56.00	30.00	7.00	1.00 00



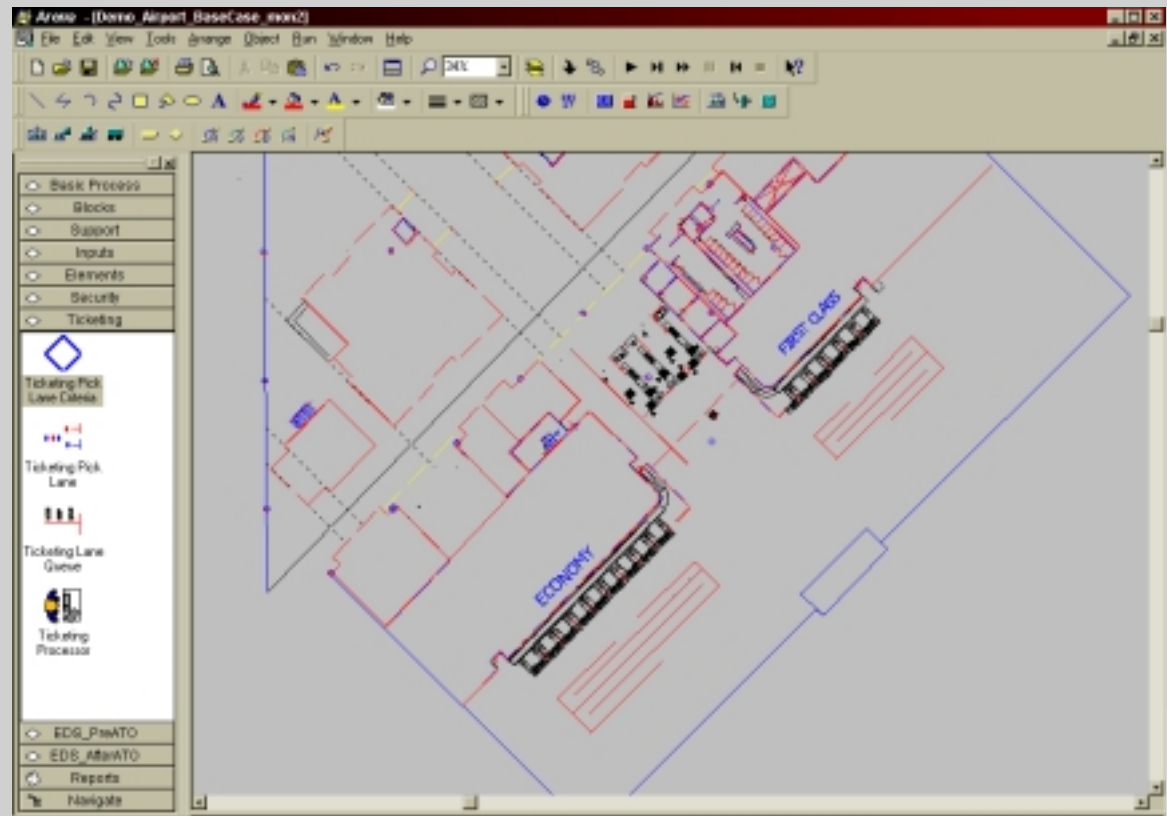
# TRACS Process Design



# Simulation Model

## → Airport-specific templates

- Quick insertion of components to model
- Customized input data
- Flexible, combined with Arena code

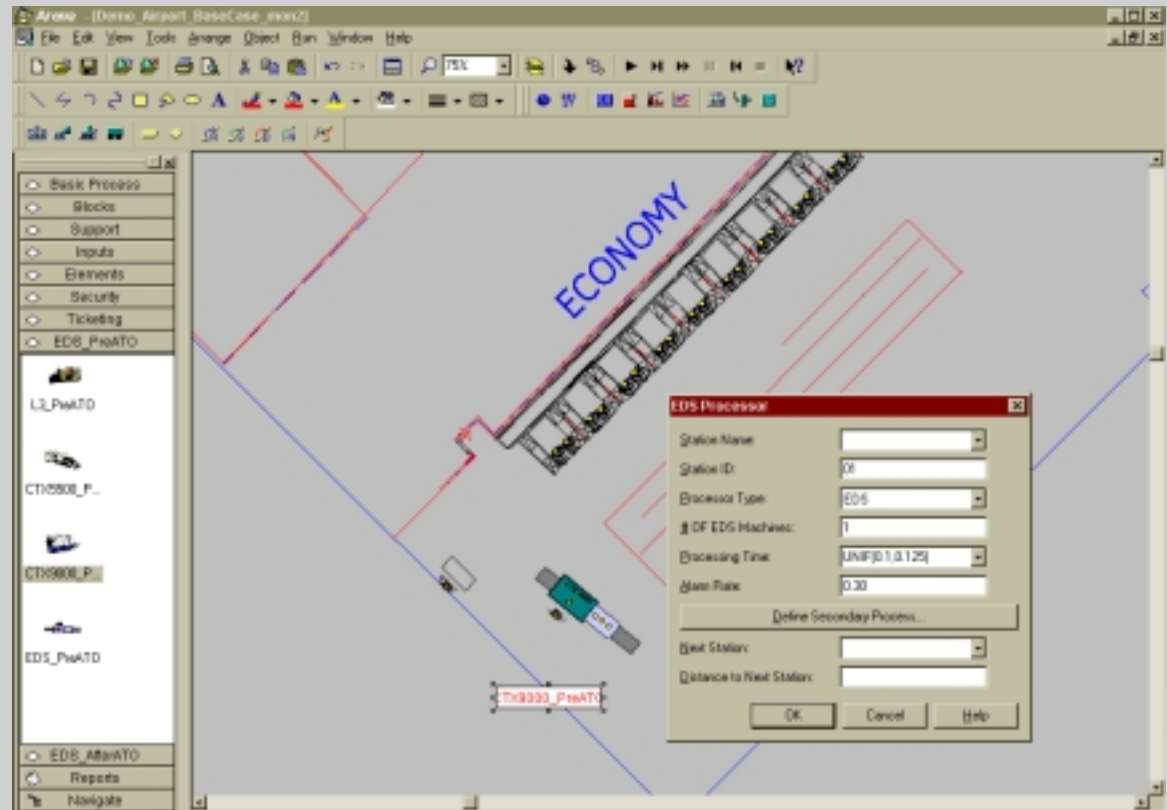




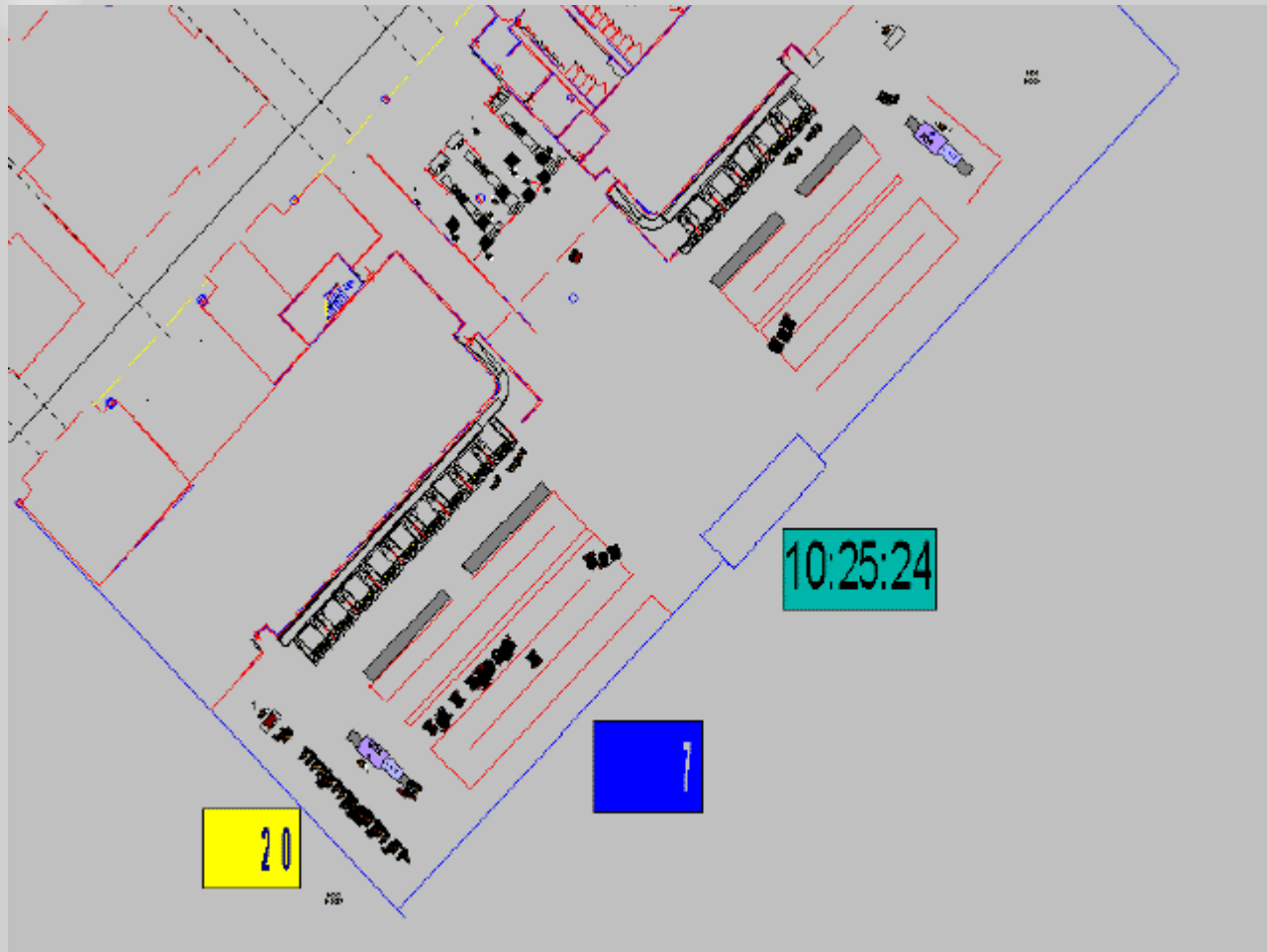
# Simulation Model

→ Airport-specific templates

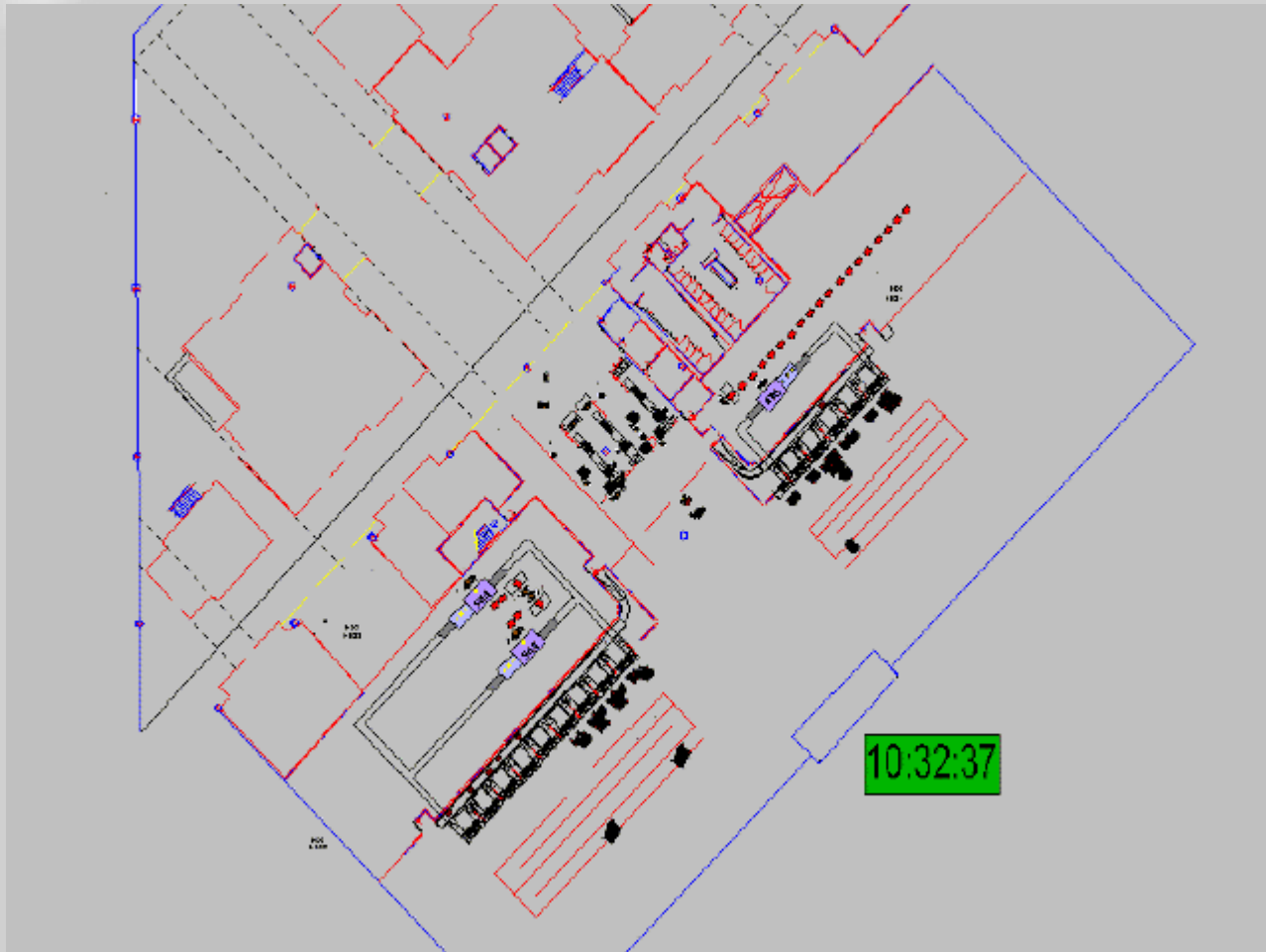
- Quick insertion of components to model
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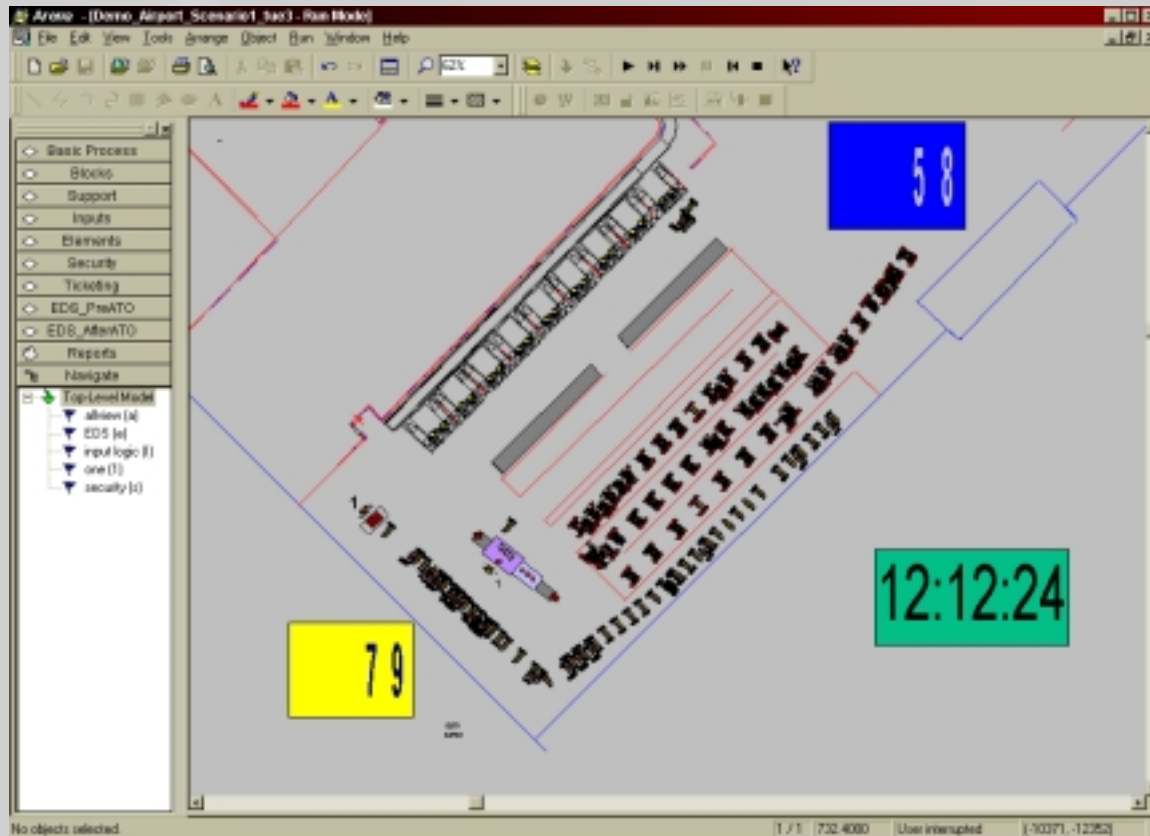
# Simulation Model



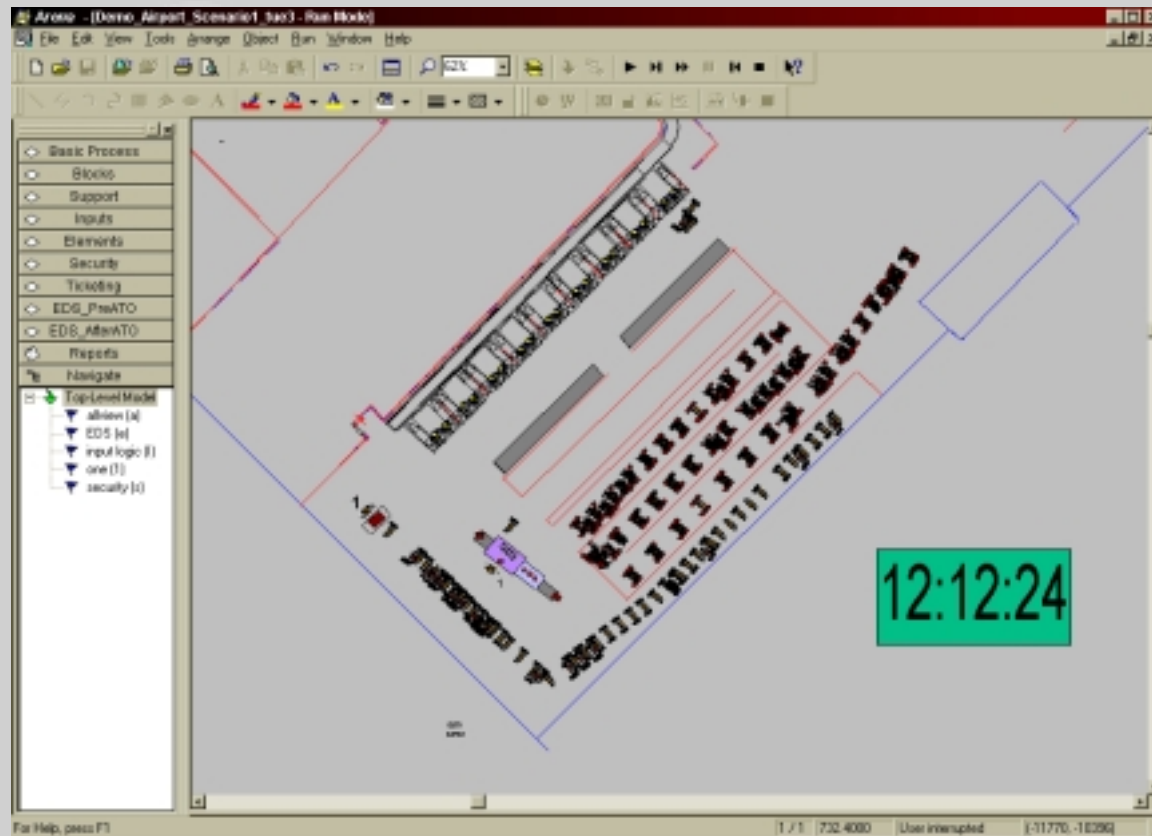
# Simulation Model



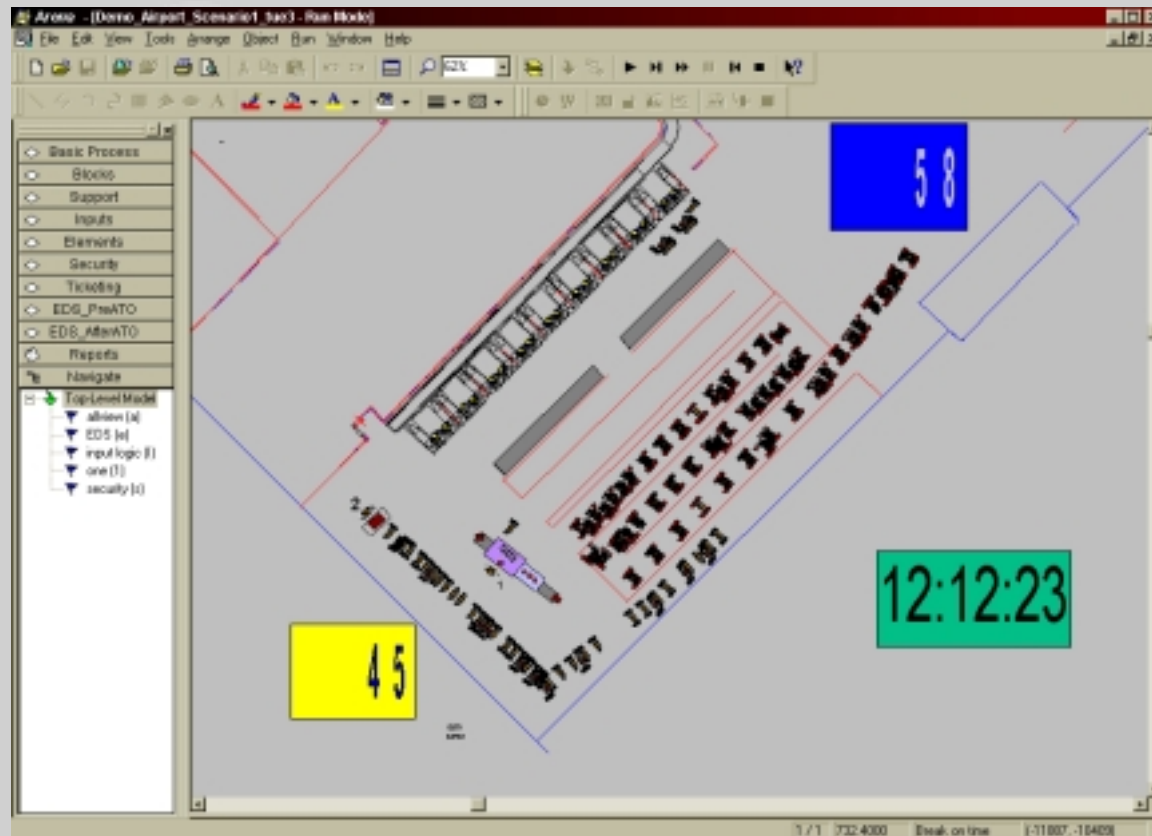
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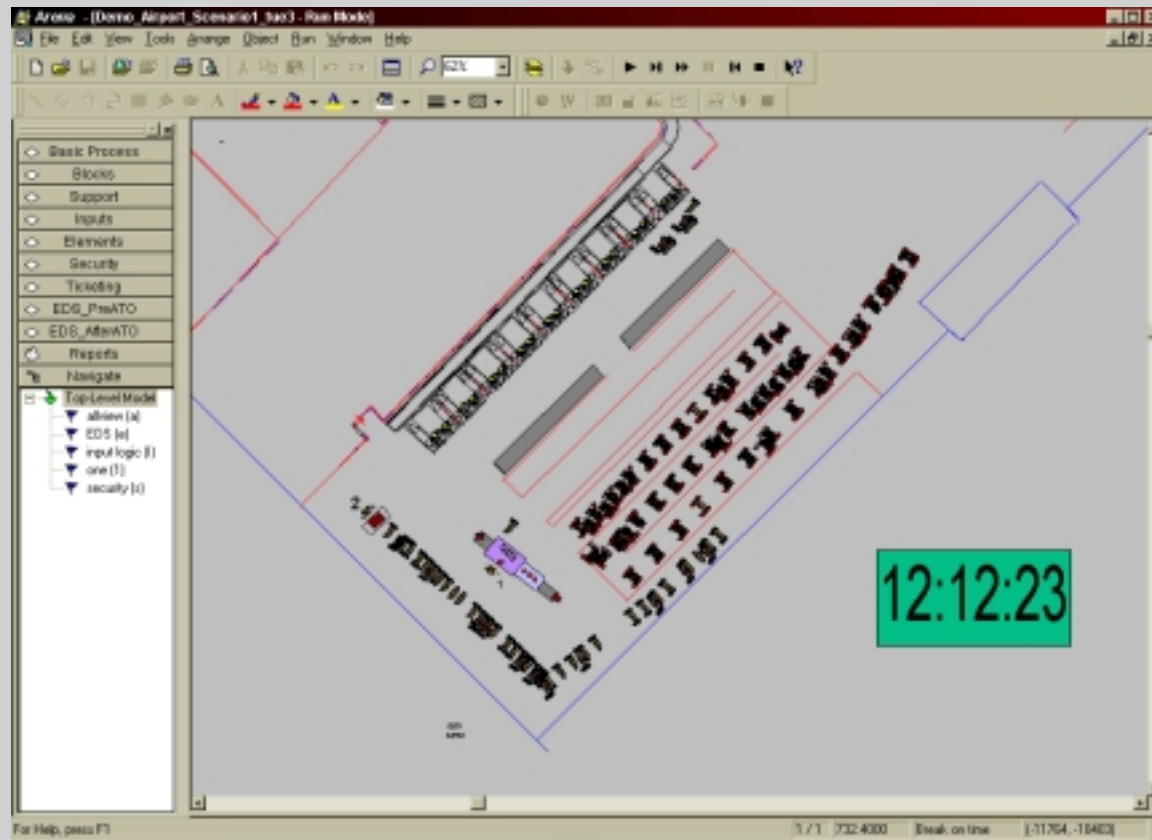
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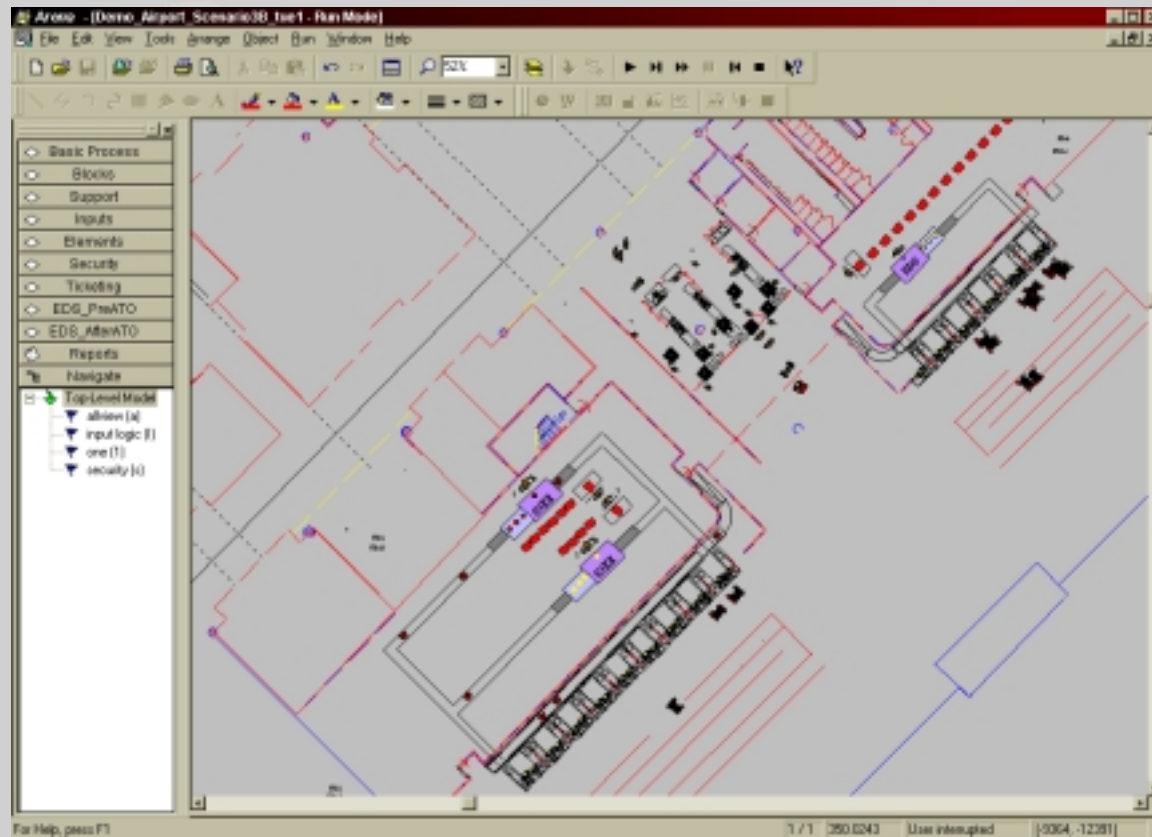
# Simulation Model



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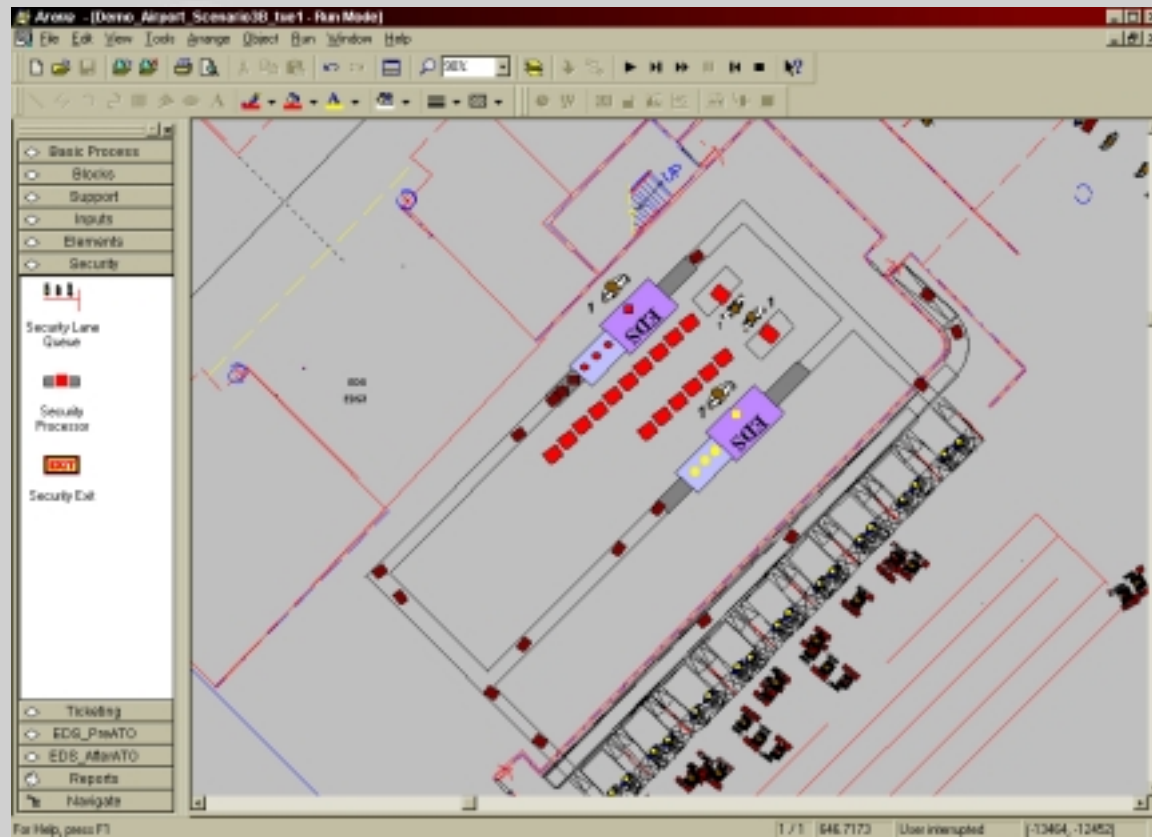


# Simulation Model

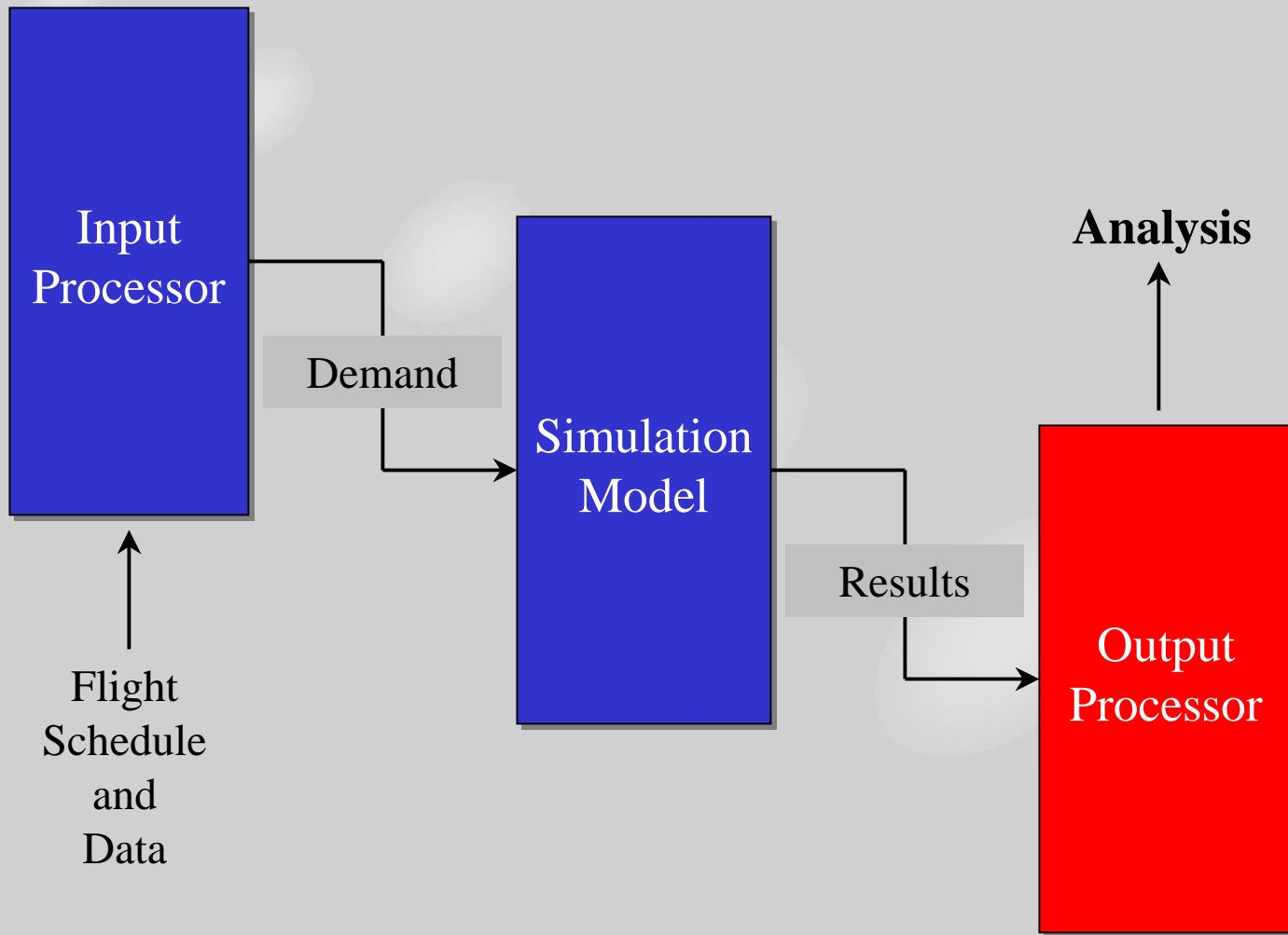




# Simulation Model

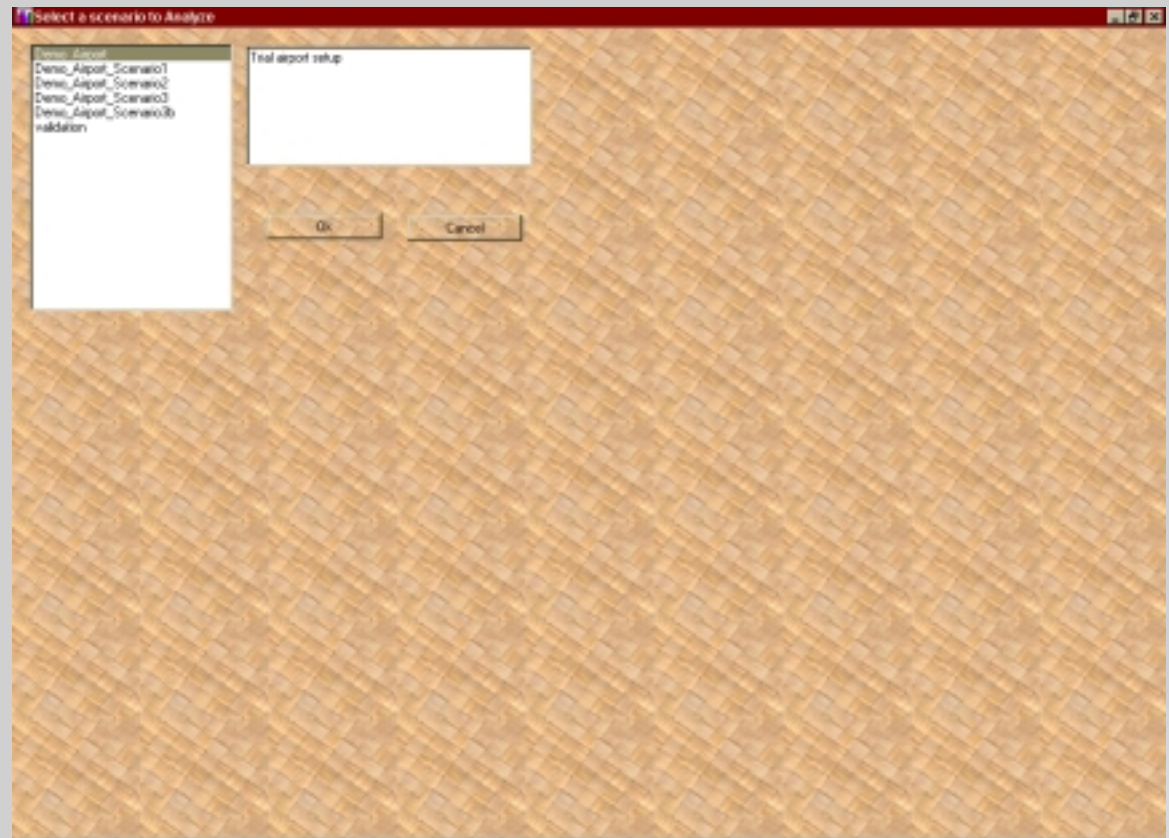


# TRACS Process Design



# Output Processor

- Collects and organizes results from model
  - **Output data management**
  - One step to produce charts
  - Flexible in chart characteristics
  - Easily export data to other presentations



# Output Processor

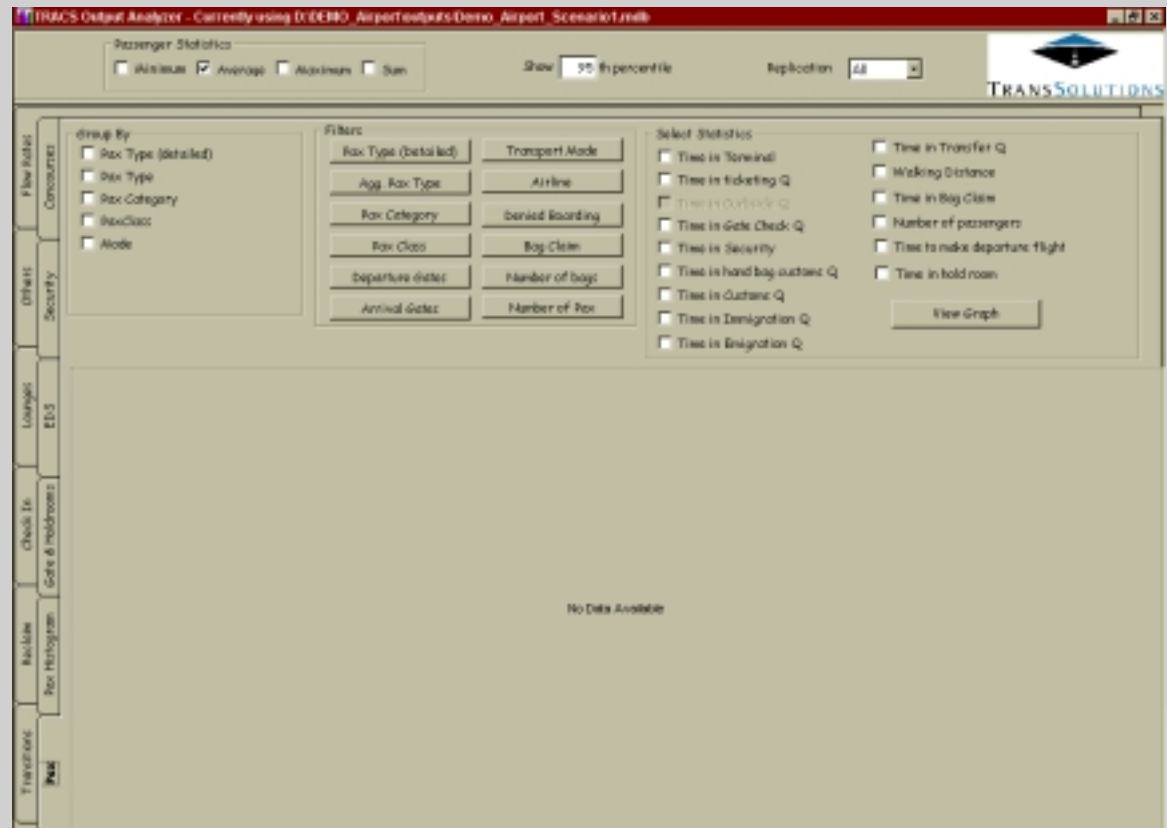
→ Collects and organizes results from model

→ **Output data management**

→ One step to produce charts

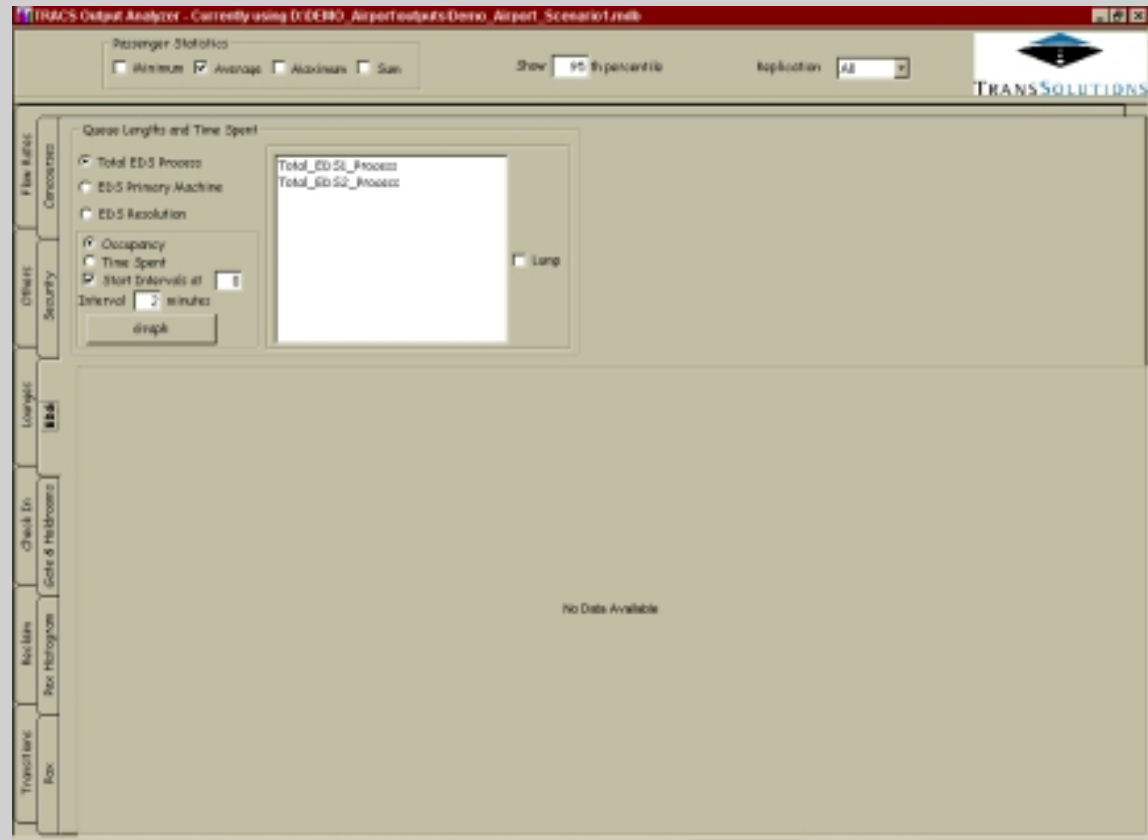
→ Flexible in chart characteristics

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# Output Processor

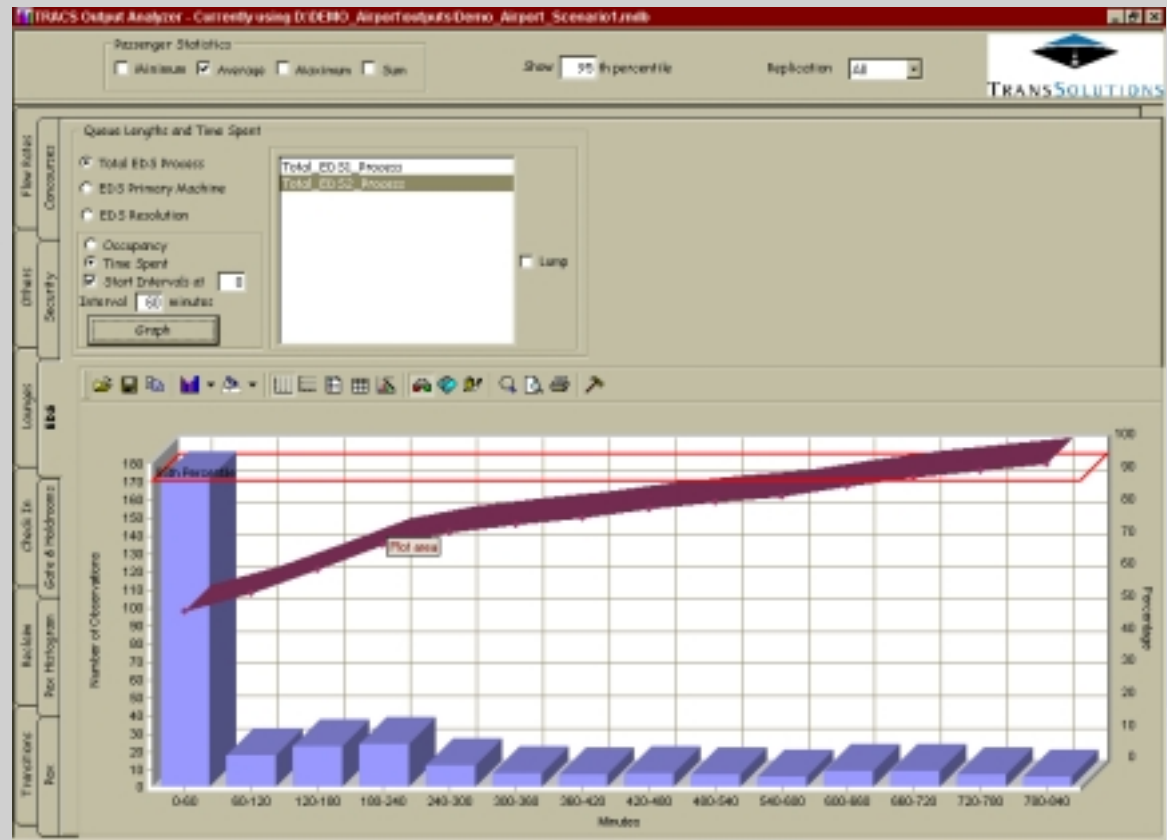
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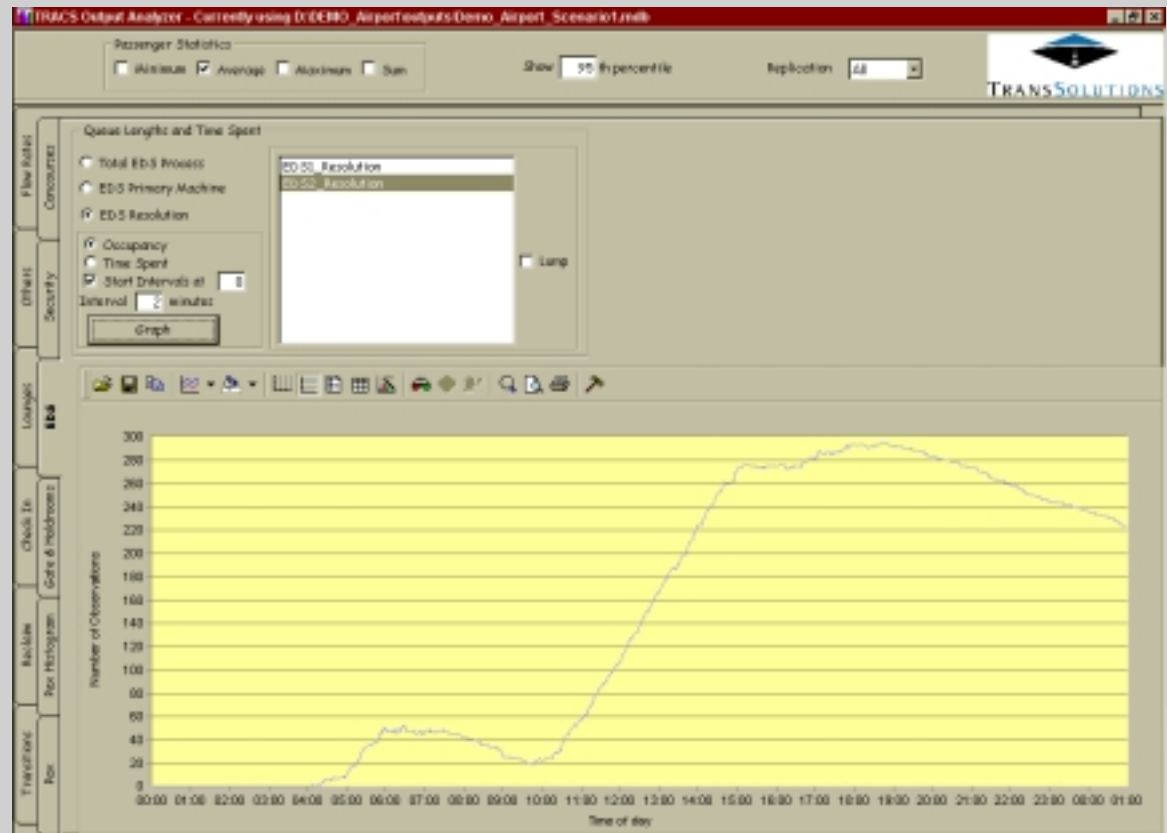
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# Output Processor

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- Output data management
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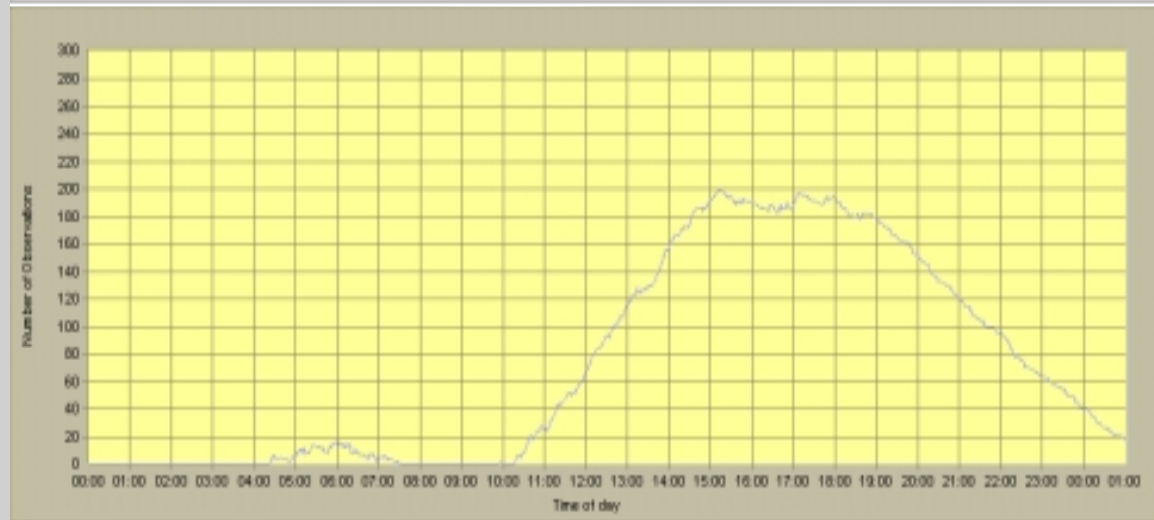


# Output Processor - Occupancy Comparison

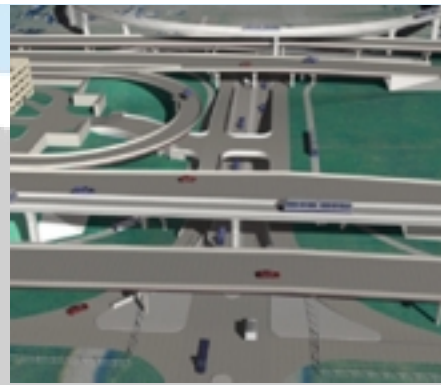
One  
resolution  
agent



Two  
resolution  
agents







# Examples of Airport Modeling Projects

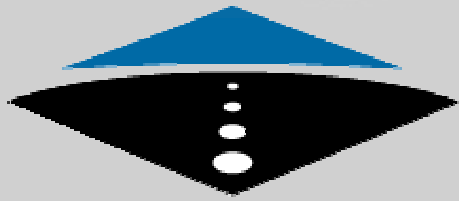


# Recent Project Work

	ATL	BOS	DFW	IAH	JFK	MIA	MCI	OAK	SJC	SFO
Airport Access Roadway			✓	✓						✓
Terminal Curbside		✓	✓	✓	✓		✓	✓	✓	✓
Parking Garage			✓	✓			✓	✓		
Ticketing	✓	✓	✓		✓	✓	✓	✓		✓
Checked Bag Security			✓		✓	✓				
Security Checkpoints	✓	✓	✓		✓	✓	✓	✓		✓
Concourse Passenger Flow		✓	✓		✓	✓	✓	✓		
Automated People Mover			✓			✓				✓
Outbound Baggage System			✓		✓	✓				
Bag Claim		✓	✓		✓	✓	✓	✓	✓	
Federal Inspection Service			✓	✓	✓	✓	✓	✓	✓	✓
Ramp Operations		✓	✓			✓	✓	✓		✓
Aircraft Movements		✓	✓	✓		✓				



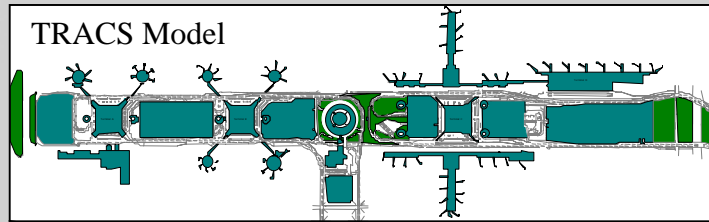
# George Bush Intercontinental Airport Houston (IAH) Roadway



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# IAH Roadway

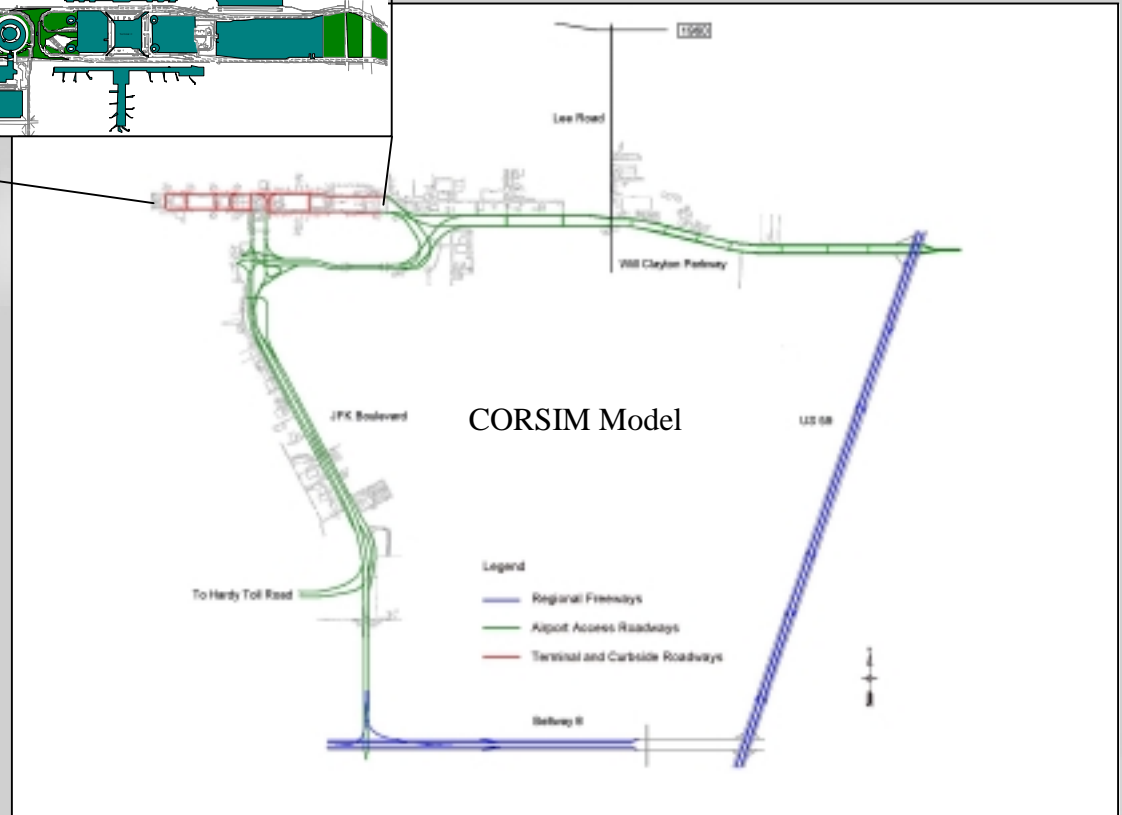


## → Objective

- Assess roadway and curbside capacity under various construction projects

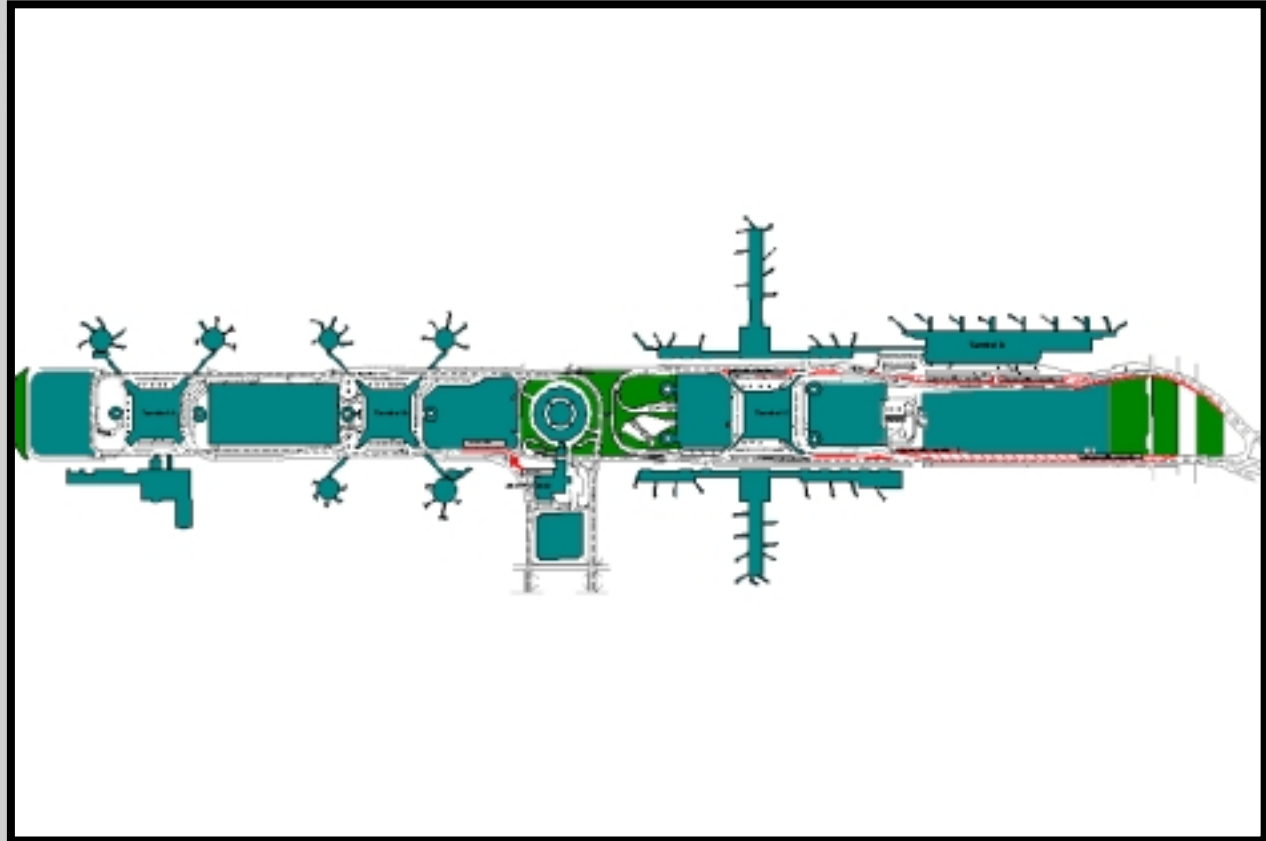
## → Performance criteria

- Roadway throughput
- Vehicle delays



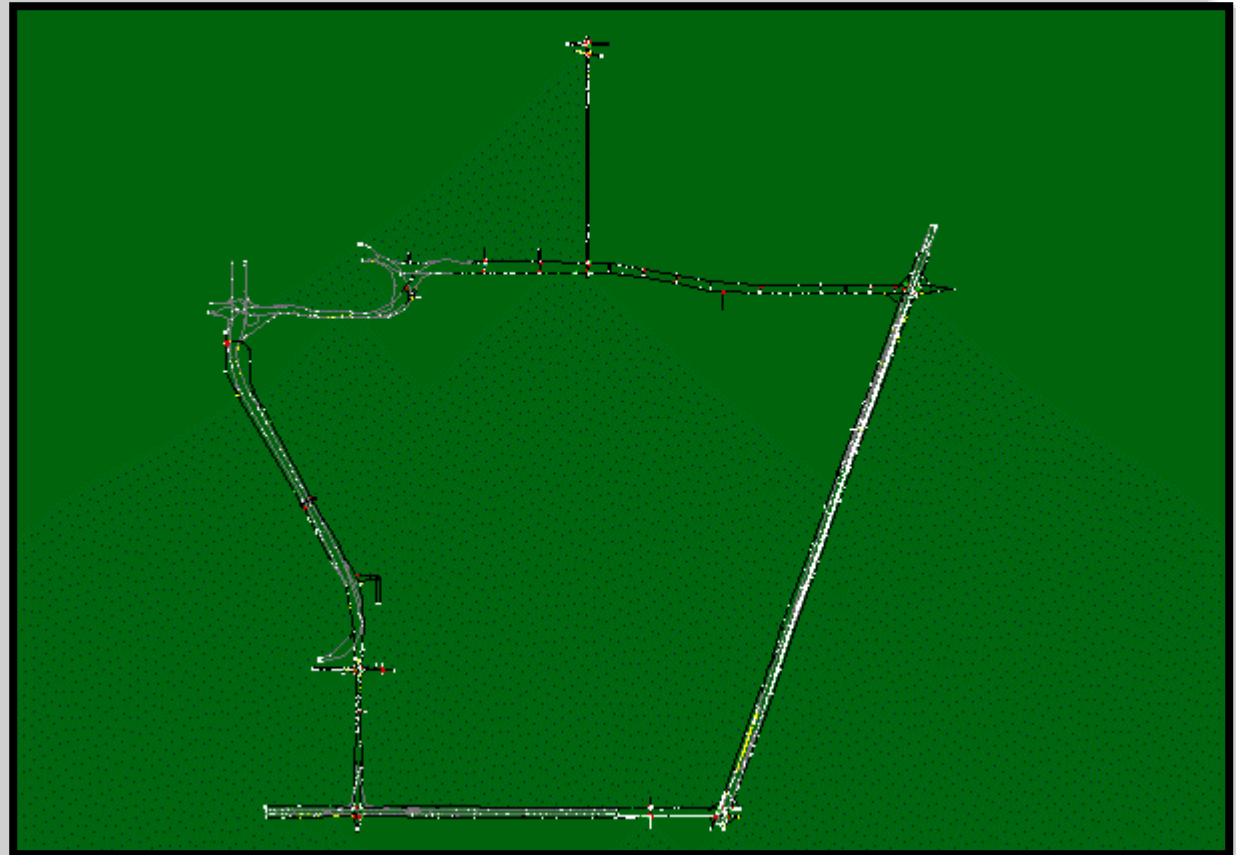
# IAH Roadway (TRACS)

- System components
  - Complete airport curbsides and circulation roadways
  - Access to and from parking facilities



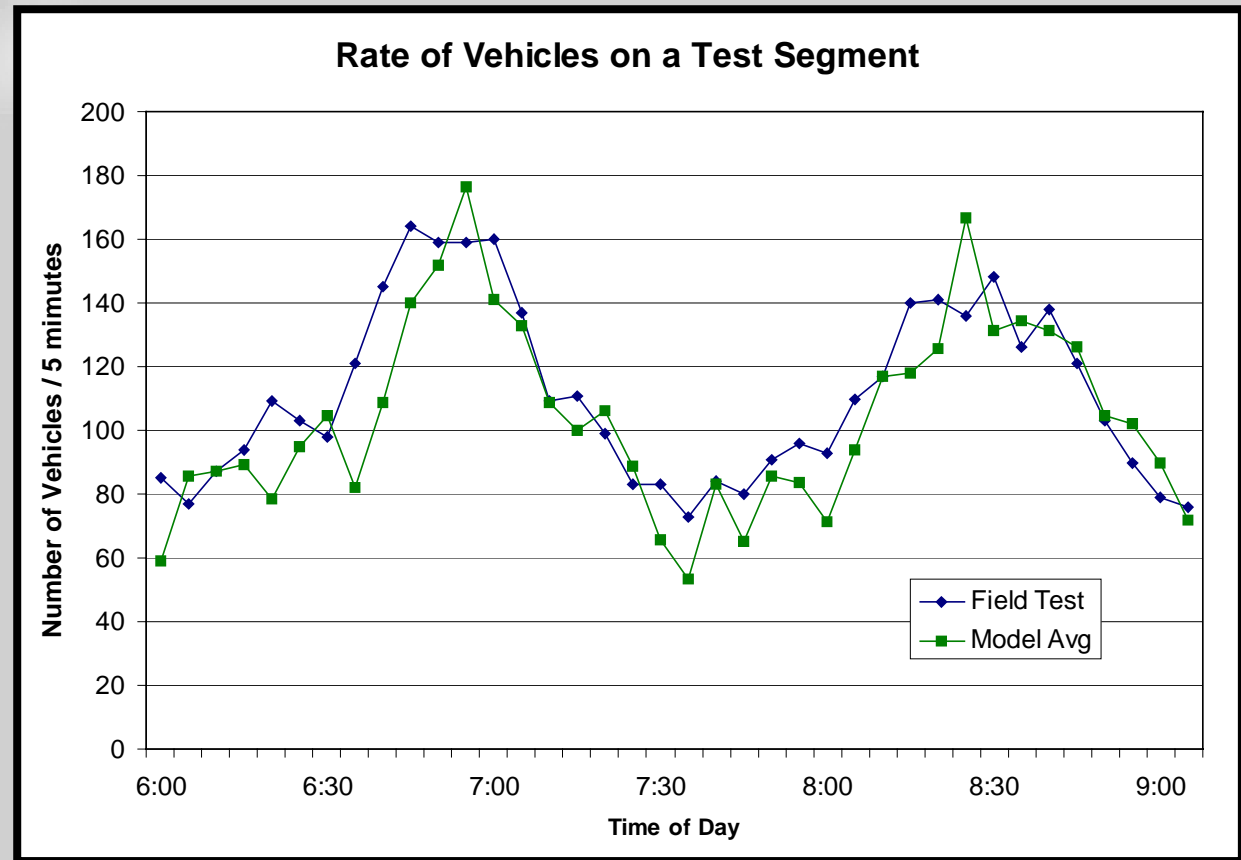
# IAH Roadway (CORSIM)

- System components
  - Regional freeways
    - Beltway 8
    - US 59
    - Hardy Toll Road connector
  - Airport access roadways
    - JFK Blvd
    - Will Clayton Pkwy



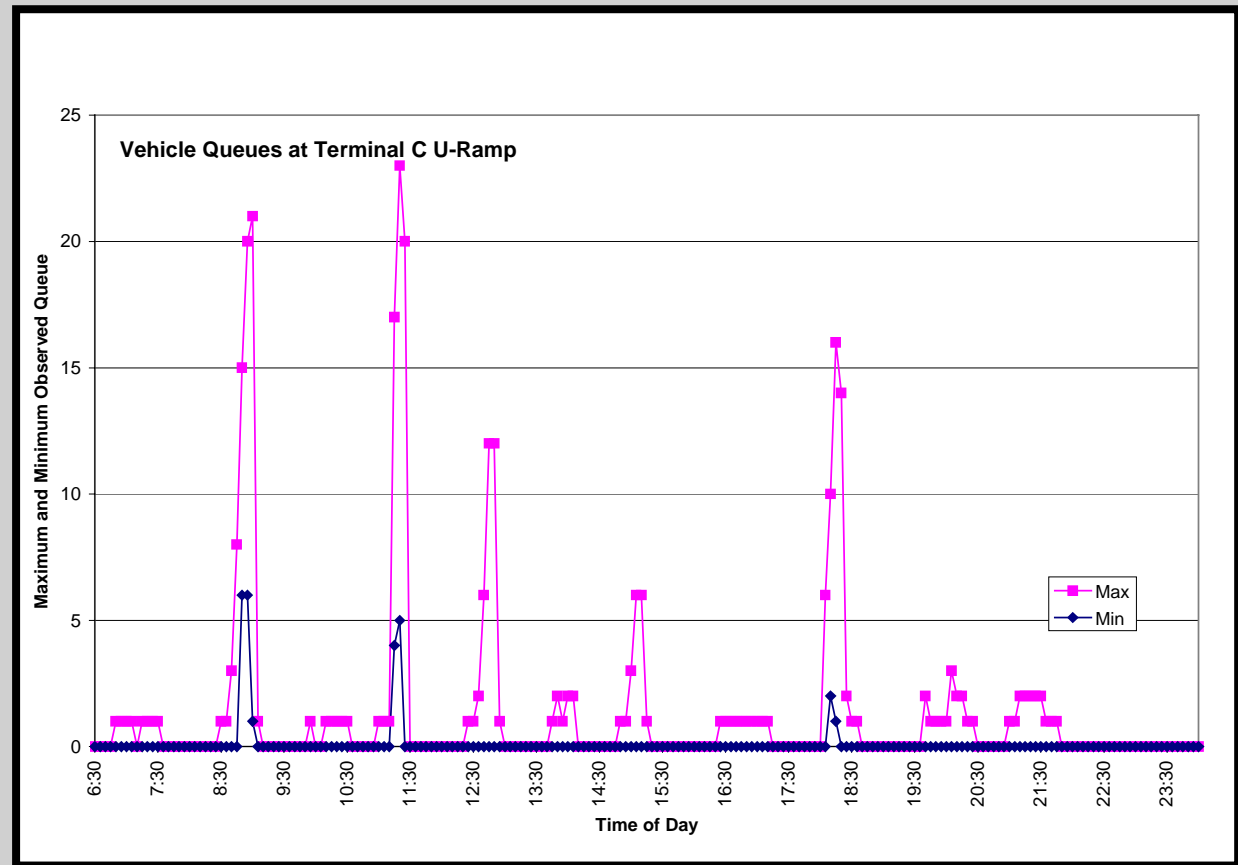
# IAH Simulation Model Results

## ➔ Model Validation Results



# IAH Simulation Model Results

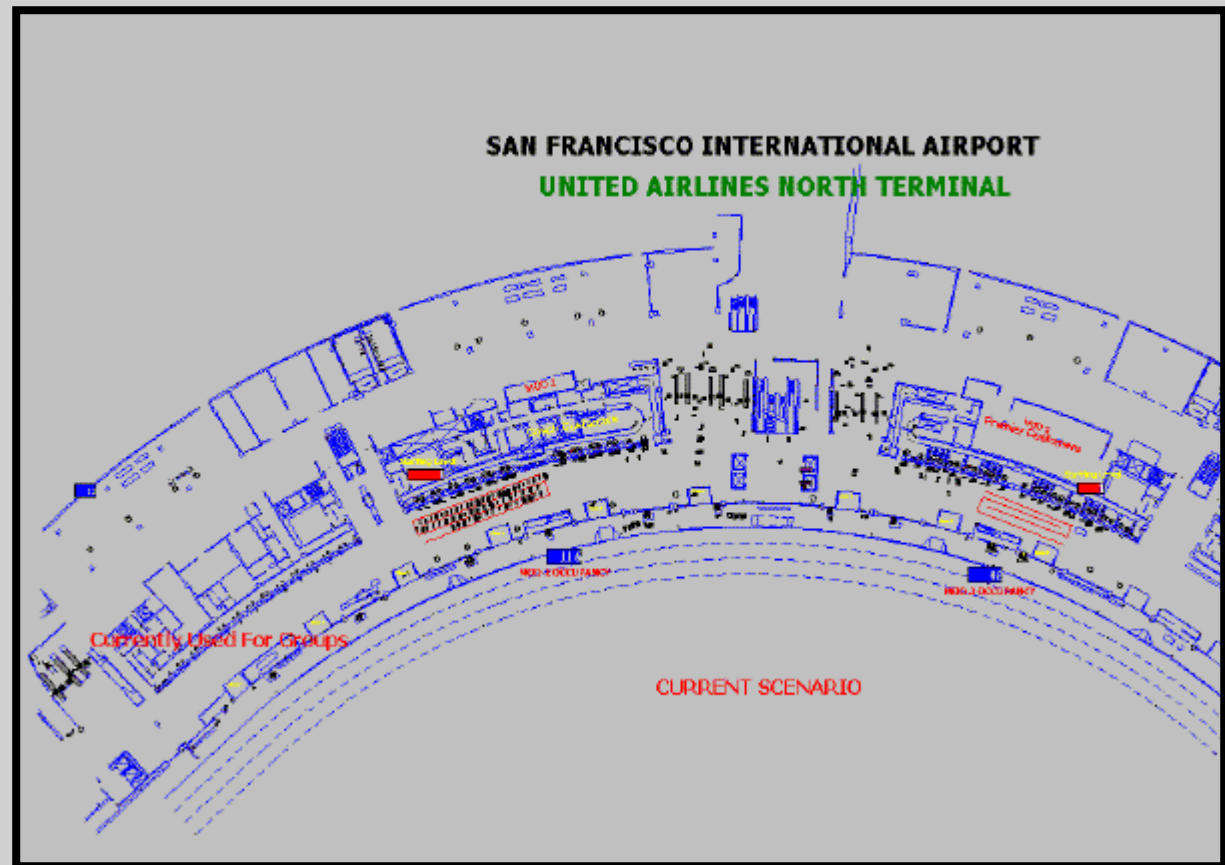
- ➔ Benefits to client
  - ➔ Afforded the client the ability to forecast the impact of scheduled lane closures (due to construction) on curbside roadway traffic
  - ➔ Helped client to determine the required capacity (number of lanes) to meet traffic demand during peak periods





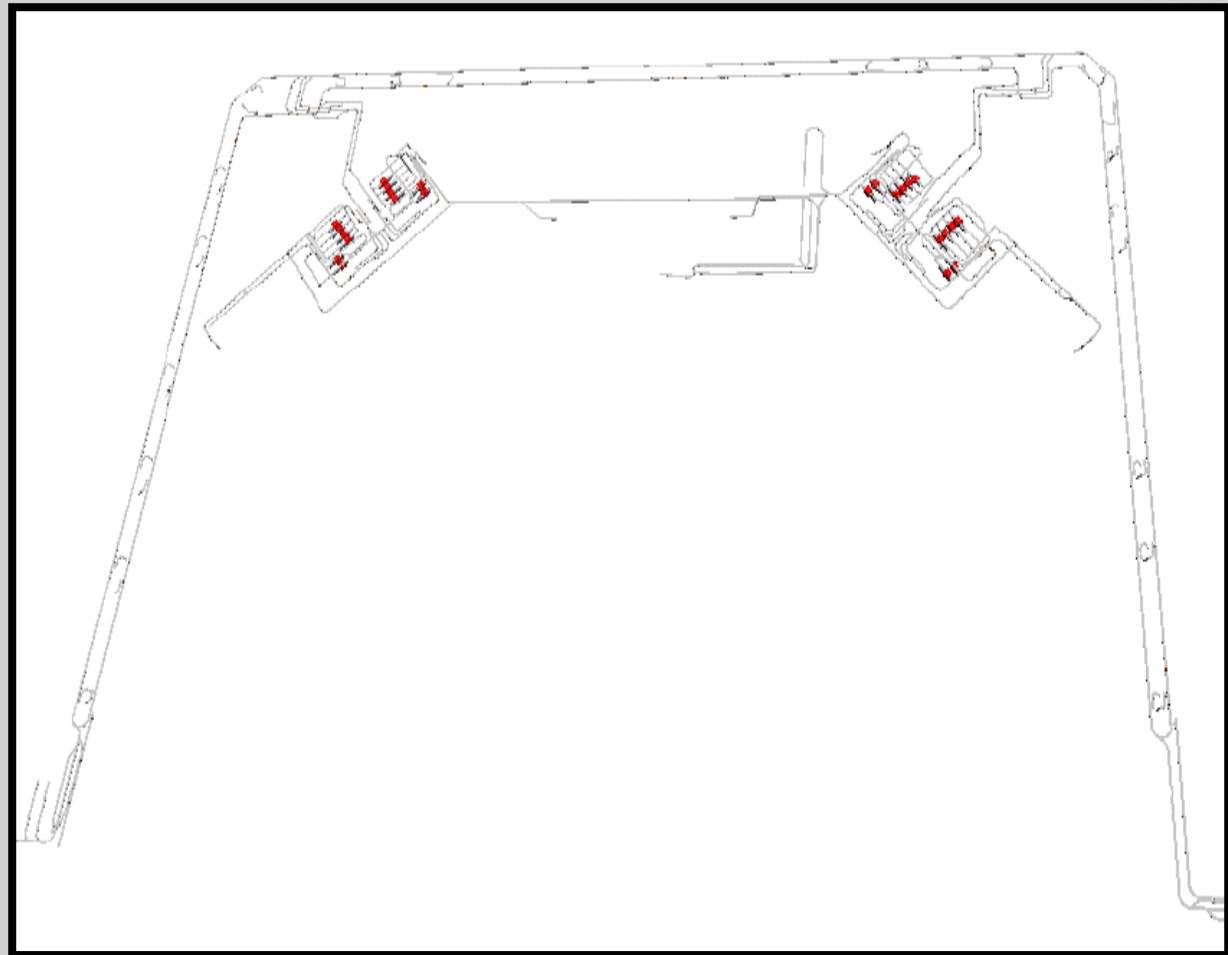
# San Francisco International Airport

- Objective
  - Quantify the impacts of modifications to the ticketing process
- Areas modeled
  - Curbside
  - Ticketing
  - Security checkpoints
- Performance criteria
  - Minimize passenger flow times, queues through ticketing and security
  - Level of Service in the corridors and lobby areas



# Dallas/Fort Worth Baggage System Analysis

- Objective
  - Assist in developing bag system design
- Areas modeled
  - Mainline conveyors
  - EDS screening areas
  - Manual encoders
  - ATO, curbside, and transfer input belts
  - Early bag storage (EBS) facility
- Performance criteria
  - Bags reach gates before departure
  - Prevent excessive queuing in system
  - Adequate EDS processing area



# San Jose International Airport

## → Objectives

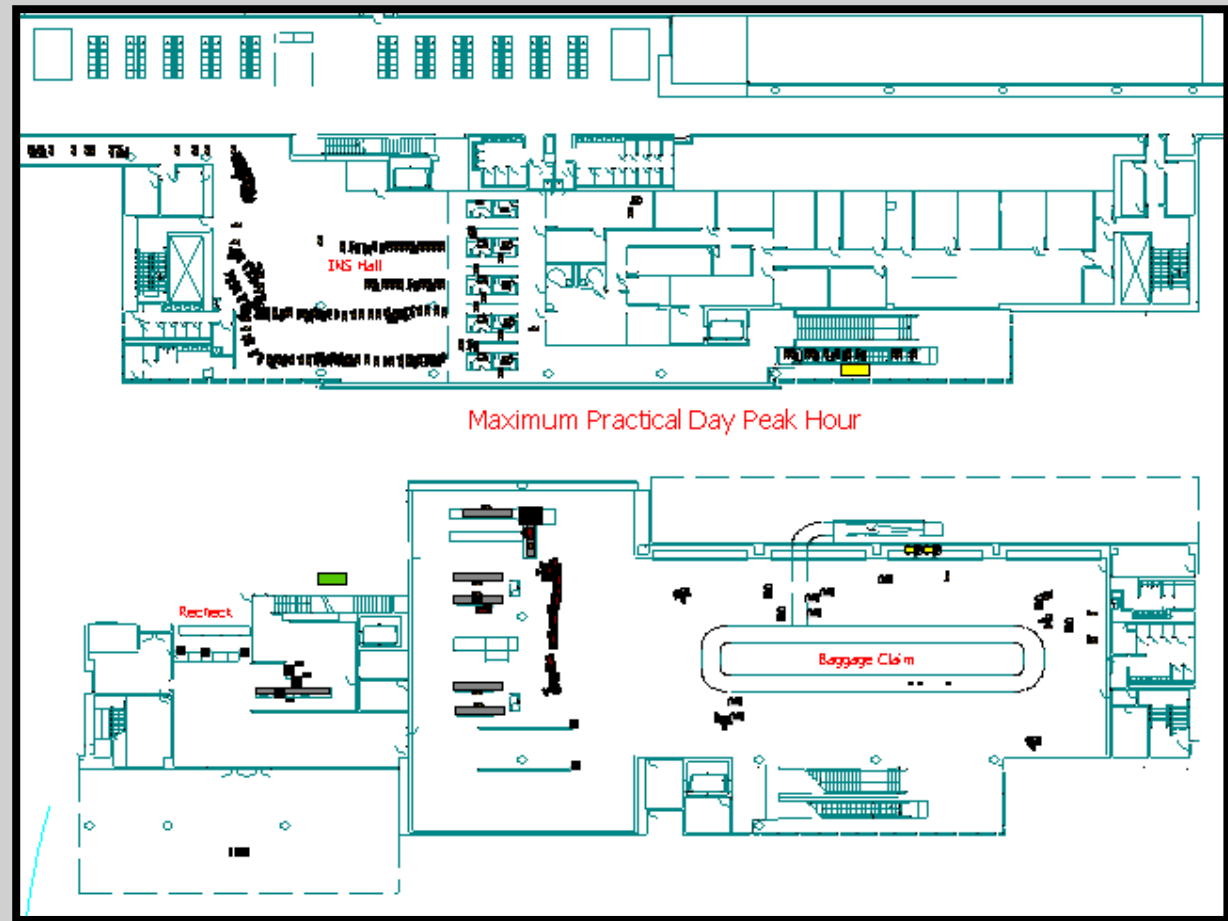
- Evaluate the performance of the proposed Federal Inspection Service (FIS)

## → Areas studied

- Immigration
- International bag claim
- Customs/Agriculture
- Recheck

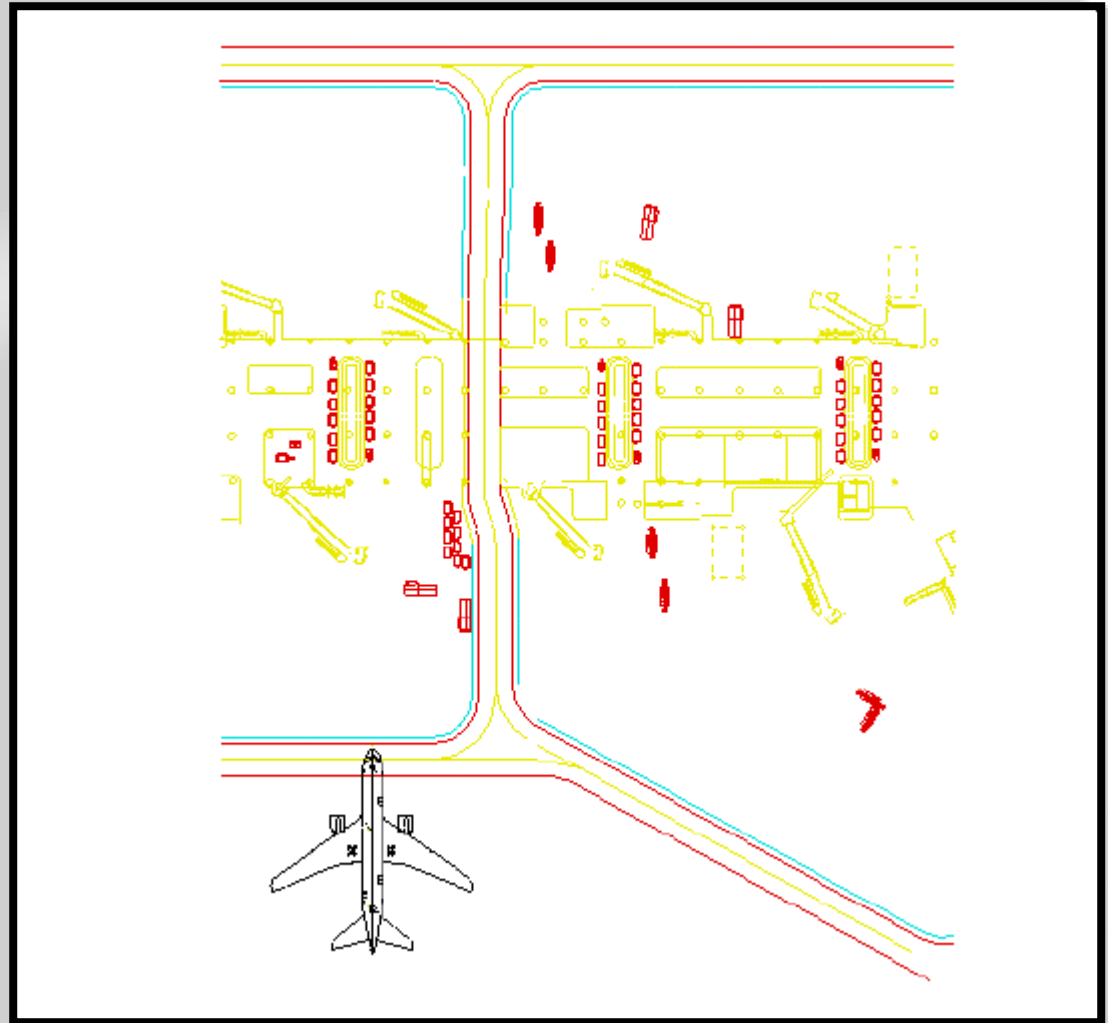
## → Performance criteria

- Queue lengths
- Time through FIS
- Level of service



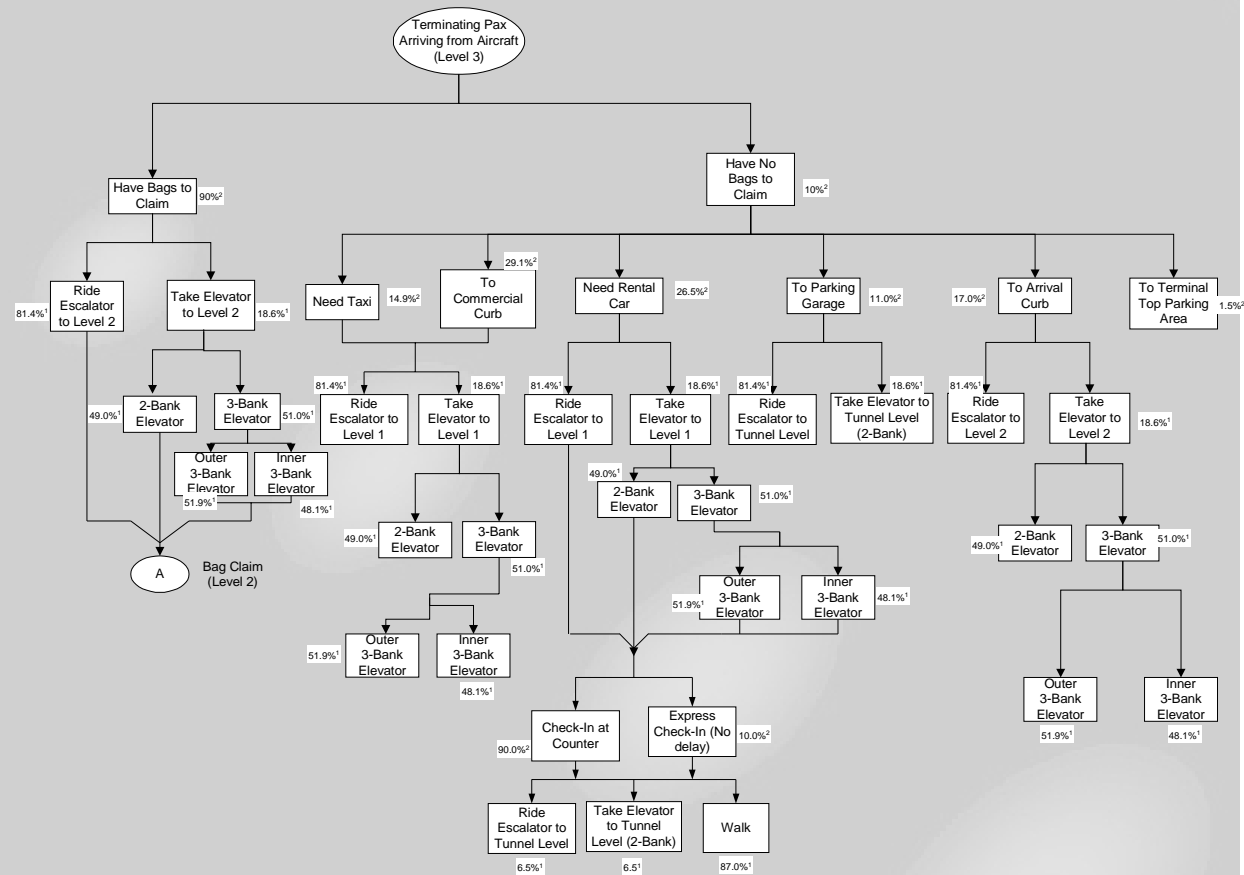
# Miami International Airport Ramp

- ➔ Objective
  - ➔ Determine if adequate space is provided for Ground Support Equipment (GSE) movement
  
- ➔ Areas modeled
  - ➔ Aircraft movement
  - ➔ Cart staging
  - ➔ Aircraft loading/unloading
  - ➔ Vehicle movements
  
- ➔ Performance criteria
  - ➔ Ramp space for staging
  - ➔ Delivery time



# Modeling Passenger Behavior

- Amount of detail depends on modeling objectives
- Behavior needs to be identified through observation and data collection
- Model behavior as discrete events/decisions
  - Vehicles
  - Passenger movements
  - Congestion
  - Discretionary time



# DEN Checkpoint Screening

- Objective
  - Determine number of checkpoints needed
    - Today
    - Future
- Areas modeled
  - South checkpoint
  - North checkpoint
  - Concourse A
- Performance criteria
  - Passenger time in queue



# TRACS Summary

- Provides ability to perform quick analyses
  - Scenario control and data management
  - Flexible and powerful model
  - Automated outputs and graphics development
- User can concentrate on analyses and conclusions rather than managing data or developing code
- Flexible and capable of modeling all landside aspects of airport terminal
- Can be interfaced with other tools to analyze entire airport system

