Simio December 2019 Student Competition

Regional Airport Passenger Experience Improvement Project

Simio
Forward Thinking

Overview

Simio Regional Airport (SRA) is a local airfield that is noticing a steady increase in passengers. The surrounding communities have experienced recent economic growth which is putting new stresses on the aging SRA design and leading to long passenger wait times and crowding. Thanks to work done by the surrounding communities, SRA was recently awarded a $1M federal capital grant to improve their operations. The objective of this project is to provide a recommendation on how to best allocate the $1M budget to achieve the greatest operational improvement at SRA. The scope of this project is the curbside operations, passenger departure hall (check-in process and bag drop), security screening, and terminal passenger flow to the departure gates. The holding rooms and gate procedures, like boarding, are being investigated by another team, so they are not included in this project.

The recommended improvements also must consider the expected growth and volume increase in future passengers. The surrounding local governments and federal offices have provided passenger volume forecasts until the end of 2021 based off the economic growth trend. Due to gate constraints, the airlines that operate out of SRA are initially planning on handling the increase in passenger volume by upgauging (booking more seats per flight via utilizing different aircrafts, rather than adding more daily flights). The forecasted flight demand for the next three years is provided in *Forecasted Flight Schedule*. Therefore, the budget allocation must also be robust and provide the same positive returns with the increasing passenger volume.

Passenger Arrival to the Departure Hall

The process for departing passengers arriving to SRA is like a conventional airport. SRA has observed 80% of passengers arrive by personal car and walk to the departure hall. The distance from the parking lots to the departure hall is between 1000 and 2500 feet (depending on where they can park, which can be represented by a uniform distribution). The other 20% are dropped off at the departure hall curbside.

Passengers arrive between 10 and 120 minutes prior to their flight departure time (e.g., when boarding closes). SRA utilizes a matrix to determine when passengers arrive per flight more precisely. The table below provides estimates for the percentage of passengers that arrive for each 10-minute interval prior to the flight departure. For example, approximately 8% of passengers will arrive between 9:10am and 9:20am for a 10:00am scheduled flight.

Table 1: Departing passenger arrival matrix.

Percentage of passengers arriving to airport by 10 minute periods prior to flight departure per flight											
120 -110	110-100	100 - 90	90 - 80	80 - 70	70 - 60	60 - 50	50 - 40	40 - 30	30 - 20	20 - 10	10 - 0
1%	7%	12%	16%	20%	10%	9%	8%	9%	5%	3%	0%

Check in and Bag Drop

Once the passengers enter the terminal, they head to check in or directly to the security screening. Approximately 50% of passengers have checked bags or need their boarding pass and walk to the check in counters (75 feet from the entry door). Currently, there are 20 conventional check-in counters operated by airline agents. The other 50% of passengers walk directly to security (150 feet) as they have checked in online. SRA collected the check in times for five days and gathered observations, this data is included in

the *Check in Process Time Study*. The time study also recorded the airline type that the passenger was flying with, conventional or budget. This data was collected because the airport has observed that budget airlines are attracting vacation flyers who have more checked bags than the conventional airlines who primarily serve business flyers (who mostly have just carry-ons). However, SRA is unsure if the difference has an impact on the check in time.

After the passengers leave the check in counter, those with checked bags walk 50 feet to the checked bag drop area then another 75 feet to security. The other passengers walk directly to security (125 feet from the check in counter). SRA currently has three checked baggage scanners. Each scanner requires two security agents to operate. A separate team at SRA collected observations on the bag drop processing time for passengers. This data is provided in Bag Drop Processing Time. The passengers then proceed to security.

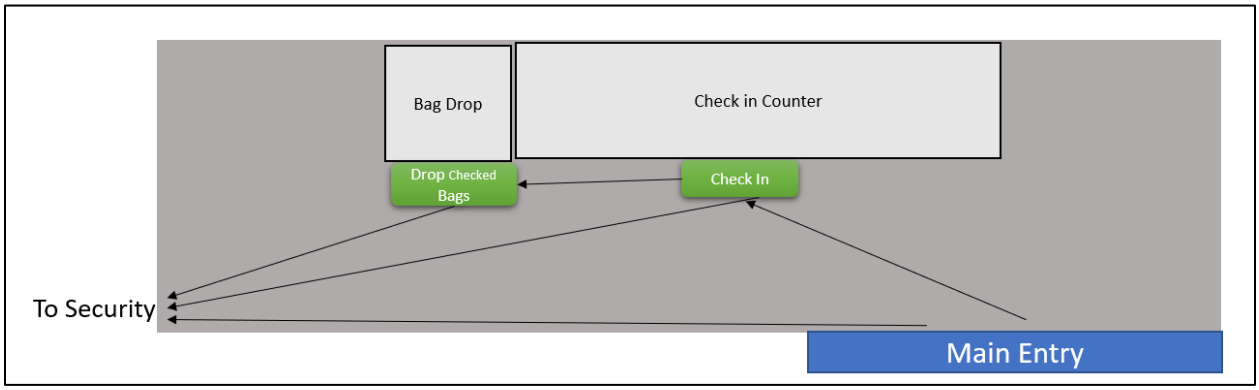

Figure 1: Departure hall current layout.

Security

The security area is divided into two sections, standard and expedited screening. Within each of these two sections there are multiple ID check stations, divesting stations, x-ray bag scanners, passenger metal detectors, body search stations, manual bag search stations, and revesting stations. The security process is the same in both areas, but the number of stations is different. The number of stations for expedited and standard in the current system is provided below.

Table 2: Details of the number of stations in the expedited and standard security screening sections.

Station	Expedited Screening	Standard Screening
ID Check	4	6
Divesting Station	3 per x-ray bag scanner	3 per x-ray bag scanner
X-Ray Bag Scanners	4	6
Passenger Metal Detectors	2	3
Revesting Station	5 per x-ray bag scanner	5 per x-ray bag scanner
Manual Bag Search	4	6
Body Search	2	3

Passengers first have their ID and boarding pass checked by a security agent. Some passengers fail this check and must return to the check in counter to obtain a new boarding pass (where they are given priority over passengers who haven't checked in yet). Next, passengers move to the divesting area. Passengers are directed to go to the line with the smallest queue. Here they place all their belongings in trays on the x-ray bag scanner conveyor. If space opens on the other line they can switch if they have not yet begun to

divest and place their items in trays. The current security sections (standard and expedited) have a divesting area that is large enough for three passengers at a time, per x-ray bag scanner, and utilize a system where the passengers load trays on a table then push the filled tray on to the x-ray bag scanner feed conveyor. This system thus prevents slower passengers from blocking other passenger's trays.

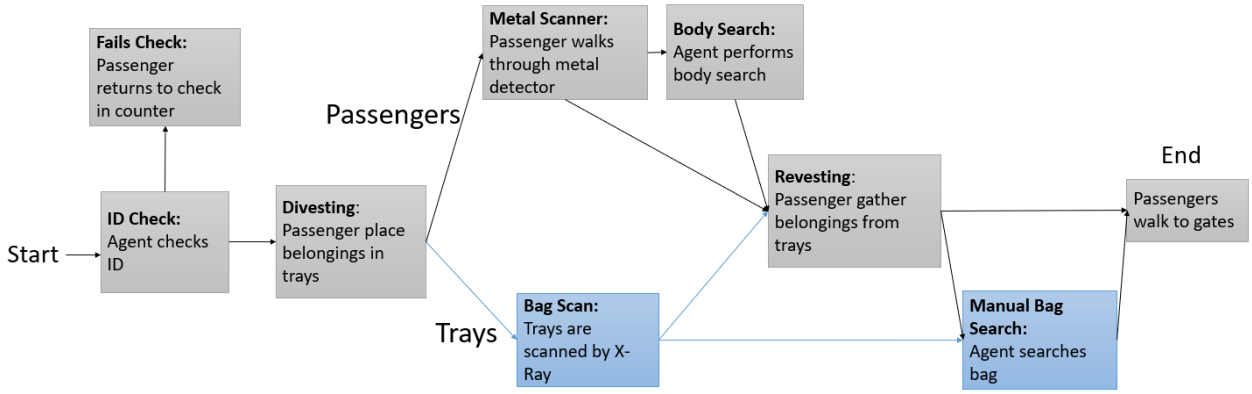

Figure 2: Process flow map for security in expedited and standard screening sections.

Once all their belongings have been placed in trays (which are 15 inches wide each), passengers then walk through the metal detector, while their belongings (in trays) are scanned by an x-ray machine. The conveyors before the x-ray bag scanner are 10 feet long each. Occasionally, some passengers will require an additional body search (primarily from the metal detector false alarms) at a separate station. Currently, there are three body search stations for standard screening and two body search stations for expedited screening. The passengers then walk to the revesting station and gather their belongings from the conveyor or wait for their bags to be scanned. The revesting area has space for five passengers per x-ray bag scanner. Once the passenger gathers their belongings, they stack the empty trays to allow more passenger to revest. Additionally, a passenger's bag may require a manual bag search by an agent (one station per x-ray bag scanner). This search is done with the passenger after they gather their other bags from the revesting station (if they have any). The current security staffing consists of 40 agents (plus the six agents in the checked baggage scanner station).

The agents required for security are as follows.

- One agent per ID Check station is required to check IDs and boarding passes.
- One agent per x-ray bag scanner is required to instruct passengers how to divest (what they need to remove and place in trays).
- One agent is required to read the x-ray bag scanner.
- One agent per metal detector is required to direct passengers.
- One agent per metal detector is needed to perform the body search. *
- One agent is required to perform manual bag searches. *

*Note: The body search and manual bag searches can be done by a single agent, who can work in both the expedited and standard areas.

SRA conducted a time study on the security process for one week and observed passengers being processed at security. The data collected includes the security area the passenger utilized (expedited or standard), the number of trays they used, and the processing times for each step. This data is provided in the *Security Time Study*.

Terminal Passenger Flow

The passengers then walk to their gate before departure. Gates 1-5 are in Terminal A, while Gates 6-10 are in Terminal B. The distance from the end of security to the beginning of each terminal is 1000 feet, and each terminal is 750 feet long. The terminal layout is shown below. The gates in the middle of each terminal (1, 5, 6, and 10) are 400 feet from the beginning of each terminal.

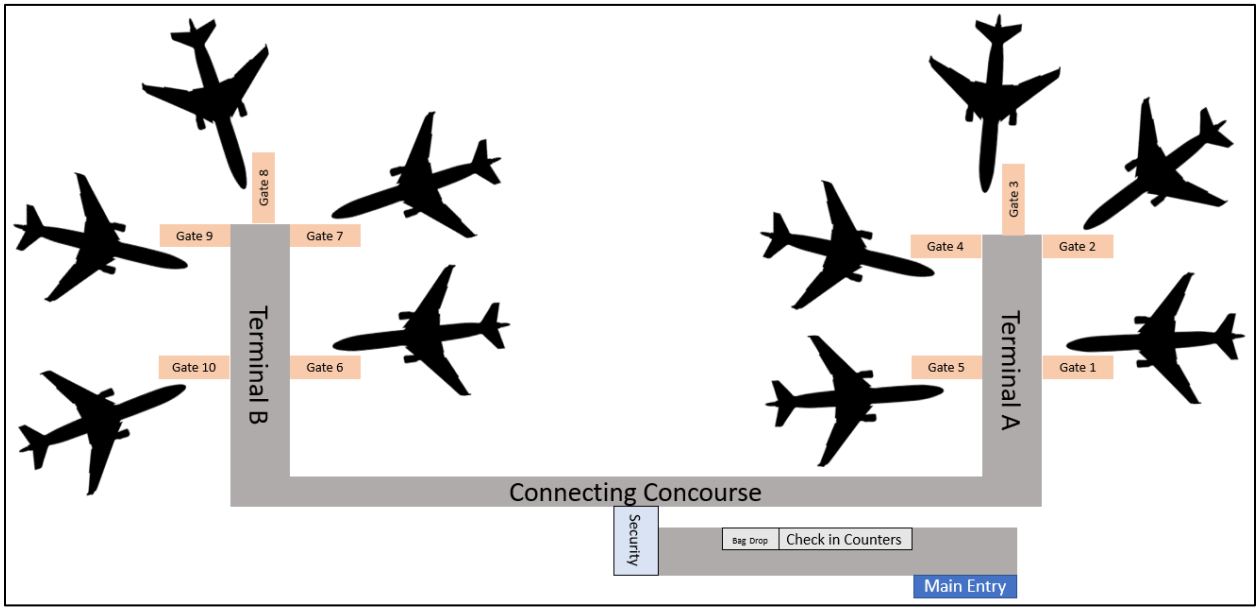

Figure 3: SRA terminal map.

Improvement Options

The improvement options that SRA is evaluating are focused on enhancing the check in process, security area, and passenger movement in the terminal. This section will provide the detailed options that SRA is evaluating.

Check in Process

SRA is relying on an older check in method which uses only counter agents. Newer, automated self-serve kiosks are one option. The self-serve kiosk manufacturer estimates their kiosks can reduce the check in time but did not provide specifics. Luckily, SRA was able to obtain processing time data from another airport that recently installed the self-serve kiosks. Each kiosk would cost $20,000 and requires 20 square-feet of floor space in the departure hall. The counter agents would still be needed to assist passengers with using the kiosks (1% require a counter agent to check in with the kiosk), but two agents can manage up to three kiosks so there is a labor saving by using the kiosks. With this option, the kiosks would simply replace the process that occurred at the check in counter.

The other option would be to add more counter stations at check in, or a combination of counter stations and kiosks. The equipment cost for each additional counter station would be $5,000 and require 100 square-feet.

Table 3: Check in improvement options and associated costs.

Equipment	Cost	Processing Time	Space Requirement
Self-Check Kiosk	$20,000 each	Min 30sec, Mode 90sec, Max 4.5min	20 square-feet
Counter Stations	$5,000 each	Provided in *Check in Process Time Study*	100 square-feet

The secondary concern that SRA is facing is space limitations. The departure hall consists of a counter area that is large enough just for the 20 pre-existing stations and 10,000 square-feet of floor space (which could be used for self-serve kiosks). The departure hall can be expanded, but at a cost of $275 per square-foot. The check in area is staffed by the airlines, and is not the responsibility of SRA. Therefore, the number of agents is not a constraint for this analysis. However, the airlines have requested that the agents required by any alternative check in configuration be efficiently utilized.

Bag Drop

SRA can also expand their capacity at the checked baggage drop station to improve their operations. This option would include purchasing additional bag scanners. SRA recently upgraded their current bag scanners so the additional scanners would be the same model and process at the same rate. Each additional scanner costs $50,000 and requires 500 square-feet of floor space. Since the bag drop is in the departure hall with the check in stations, the 10,000 square-feet of floor space can also be used for additional checked baggage scanners and expanded at the same cost of $275 per additional square-foot.

Table 4: Bag drop for checked luggage improvement options.

Equipment	Cost	Processing Time	Space Requirement
Checked Baggage Scanner	$50,000 each	Provided in *Bag Drop Processing Time*	500 square-feet

Security

The security process is another area SRA is investigating for improvement opportunities. One option is to purchase Advanced Imaging bag scanners that can scan bags faster and are more powerful resulting in less manual bag searches. The newer bag scanners also do not require passengers to remove large electronics from bags, speeding up the divesting and revesting process. Additionally, SRA can purchase new Advanced Imaging body scanners that can process passengers quicker and more reliably (less false alarms). SRA was provided the processing times and percentage of additional screenings (manual bag searches and body searches) from a federal security office. These estimates along with the costs for new equipment are provided below.

Unfortunately, SRA's options at security are limited due to security regulations that a passenger cannot lose sight of their carry-on bags while on the bag scanner conveyor. This means that using the traditional security design, at most two bag scanners could be used with one body scanner. However, SRA recently discovered an innovative mount that can stack bag scanners on top of each other. This would result in double the bag scanning capacity per body scanner (four bag scanners could be used with one body scanner).

The mount can be used with both the Advanced Imaging bag scanner and the standard x-ray bag scanner ($15,000 per mount). If SRA decides to purchase the mounts, then the bag scanners that are stacked, can use the same divesting and revesting conveyors. But if any additional bag scanners are purchased that will

not be stacked, then SRA will need to purchase additional bag scanner conveyance systems ($50,000). The stock conveyance systems have capacity for three divesting passengers (with the system that avoids blocking of trays) and five revesting passengers, but this can be expanded at an additional cost.

Table 5: Equipment upgrade options and associated costs and performance details at security.

New Equipment	Cost (each)	Processing Data Estimates
Advanced Imaging Bag Scanner	$150,000	5 seconds per tray to scan. 5% of bags would require manual searches 20 seconds on average to divest, 45 seconds on average to revest
Advanced Imaging Body Scanner	$180,000	5 seconds per passenger 5% of passengers would require manual body search
Bag Scanner Stacking Mount	$15,000 per mount	
Bag Scanner Conveyance System	$50,000	Capacity for 3 divesting passengers and 5 passengers at revesting simultaneously

Another option that SRA has with security is to expand their existing system by purchasing more older machines or expanding their conveyance systems. The costs for more standard bag scanners and standard metal detector are shown below.

Table 6: Standard equipment improvement options and associated costs at security.

Existing Equipment	Cost
Standard Metal Detector	$10,000
X-Ray Bag Scan	$50,000
Additional Divesting Conveyors	$5,000 per additional passenger divesting capacity
Additional Revesting Conveyors	$5,000 per additional passenger revesting capacity
Body Search Station	$2,000 per station
Manual Bag Scan station	$1,000 per station

The last improvement option in security is changing how the area is setup overall. The federal security authority mandates that SRA has an expedited screening area with dedicated bag and passenger scanner(s) but does not regulate the sizing or capacity. The security team has advised that the passengers who utilize the expedited screening will increase proportionally with the volume increase. Therefore, SRA needs to determine how to setup their security lanes given the increasing volume forecasts.

The other security limitation is space. A security lane is 40ft long and 25ft wide. These dimensions are the same if the security lane has two bag scanners and one metal detector, or if the security lane has one bag scanner and one metal detector. However, each additional passenger capacity on the divesting/revesting conveyors will increase the lane length by three feet. The security area has tall, 20ft, ceiling so stacking bag scanners will not require construction. The space requirements for more manual bag search stations and body search stations are eight square-feet and 12 square-feet, respectively. The current security area has no additional space, so any addition equipment would require renovations. If SRA decided they need more space, then the security area can be expanded at cost of $300 per square-foot.

The security agents needed for the new layout must follow the same requirements described in the previous section. However, the cost of additional agents is not included in the overall budget. As with other capital projects, the funding is for the expansion and associated equipment upgrades. The staff

required then become the responsibility of the security authority. However, the security authority has advised that they would prefer to use their agents as efficiently as possible and avoid configurations that have underutilized staff. For this reason, SRA is trying to minimize the number of additional security staff necessary for the improved system.

Terminal Moving Sidewalks

SRA is also evaluating whether to install moving sidewalks in the Connecting Concourse and terminals. The moving sidewalks come in various sizes and costs (provided below). Each sidewalk can move at 5ft/sec. For the analysis, SRA is assuming that all passengers will take the moving sidewalk if available. Once on the moving sidewalk, all passengers will walk (rather than just stand on it). The sidewalks are also wide enough to enable passenger to pass. SRA needs to consider if these moving sidewalks are beneficial and how many to purchase and what lengths.

Table 7: Moving sidewalk improvement option with costs.

Equipment	Length	Cost	Travel Speed
Moving Sidewalk	300 feet	$30,000	5 ft/sec
	500 feet	$50,000	5 ft/sec
	900 feet	$60,000	5 ft/sec

Project Deliverables and Analysis

For this project, you are tasked with evaluating the improvement options and providing a detailed recommendation for how to allocate the $1M budget. The recommendation should be supported by data and show operational improvements at SRA. In order to gauge improvements, a current state model needs to be developed to compare the different improvement options. The current state model can use first 9 months of 2019 as the passenger demand data. The primary concern is to propose improvements that will enable more passengers to be processed efficiently while considering the yearly volume cycles, overall volume increase, and budget constraints.

Some metrics to consider:

- Passenger throughput
- Passenger time in system
    - Airside dwell time (SRA is looking to maximize the time passengers spend in the terminal near their gate prior to departure, as it promotes shopping and increased airport revenue.)
- Budget
- Resource utilizations
- Percentage of passengers who miss their flight

Historical Analysis

SRA has conducted a preliminary analysis using historical data and determined that 10-15% of passengers miss their departing flights. This data point should be used to validate and verify your current state model.

Questions to Answer:

1. How will you plan to handle the passenger volume cycles?
2. How will the check in process be set up? What is the number of check in counters and/or self-check kiosks?
3. How will the security area be arranged?
    a. How many expedited and standard screening lanes should SRA create? Should SRA change this number throughout the year?
    b. How many bag scanners and which type (Advanced Imaging or x-ray) should SRA operate?
    c. How many body scanners and of which type (Advanced Imaging or metal detectors) should SRA operate?
    d. How should SRA organize their security lines? Should any bag scanners be stacked?
    e. Should SRA add more conveyance for divesting and/or revesting?
    f. How many manual bag search stations should be used?
    g. Should SRA build additional body search rooms?
4. Should SRA invest in any moving sidewalks? If so:
    a. How many moving sidewalks should they purchase?
    b. What lengths should SRA purchase?
    c. Where should SRA install the moving sidewalks?

Optional Challenge Problem

The transit authority has made a proposal to help alleviate the congestion at SRA by offering space at a bus terminal located on the other side of SRA (SRA is surrounded by municipal land). The bus terminal would be converted to a remote security screening area. This would allow passengers to be screened prior to boarding the bus, then dropped off past security at the connecting concourse (near the beginning of Terminal A). This route would have a bus arriving at SRA every 15 minutes and utilize separate service roads (thus preventing further congestion). The transit authority has estimated the buses will take between 10 and 15 minutes to drive from the bus terminal to SRA. To start, this option will only be available to passengers who precheck and don't have any checked bags. SRA has decided to evaluate the option with only the prechecked passengers before expanding and including all passengers (as it would mean check in and bag drop stations would need to be added to the bus terminal).

The transit authority has offered to provide the buses for this proposal (with a capacity of 50 passengers), but SRA needs to develop the screening area and purchase the equipment. Since the security screening at SRA will still exist, SRA will only be evaluating this option by creating standard security screening at the bus terminal. The cost for the equipment would be the same as described above in the security improvement option, but there would be an additional $150k cost to set up the bus terminal and create the new bus stop at SRA.

For this analysis, assume that for all passengers flying out of SRA, 40% will use the bus terminal to arrive. For this proposal, SRA is looking to evaluate the impact on their operations if passengers arrive to the new bus terminal using the same arrival matrix.

Questions:

1. How would you recommend SRA respond to the transit authority's proposal?
    a. Things to explore:
        i. How many security lanes should be established at the bus terminal?
        ii. How many buses should SRA ask from the transit authority?
        iii. Does establishing the remote screening help reduce the passenger time in system? (include bus transit time in this metric)
2. If the cost to establish the bus station security screening is included in the $1M budget, how does this impact your overall recommendation for improving SRA?
    a. How many security lanes are needed at SRA if there is a separate bus terminal screening area?

Provided Data

Below is description of the data sets provided along with this problem statement.

Forecasted Flight Schedule

Contains the actual and forecasted flight departures out of SRA from 2019 to 2021, and the forecasted seats filled using historical data and estimated volume increases. Data contains, departure date, time, gate info and passengers per flight.

https://cdn.simio.com/StudentCompetition/2019Dec_ForecastedFlightSchedule.xlsx

Check in Process Time Study

Contains the data airline type and check in time (in minutes) for 10,000 passengers.

https://cdn.simio.com/StudentCompetition/2019Dec_CheckInTimeStudy.xlsx

Bag Drop Processing Time

Contains the processing time (in minutes) for all passengers who had to drop off a checked bag. A zero-time observation signifies the passenger did not have any checked bags and proceeded directly from the counter to security.

https://cdn.simio.com/StudentCompetition/2019Dec_BagDropProcessingTimes.xlsx

Security Time Study

Contains observations for 10,000 passengers that were processed through security. Observations include which security area the passenger used, the number of trays need for their bags, and the processing time for divesting, bag scanning (note: this time is for all the passenger's bags to be scanned), body scanning (via the metal detector), revesting, and manual bag search and/or body scan if required. A zero-time observation signifies the passenger did not require that step (manual bag search or body search). All time observations are in seconds.

https://cdn.simio.com/StudentCompetition/2019Dec_SecurityTimeStudy.xlsx