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Case

# Workforce Scheduling for Airport Immigration on the Island of Tropical Paradise

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**Abstract.** This case study focuses on modeling and analyzing the practices concerning the staffing of the immigration agency at the Island of Tropical Paradise International Airport (ITPIA), which is responsible for processing arriving passengers into the country. Immigration at ITPIA has engaged you to understand the trade-offs between the number of employees and the time passengers spend in the queue waiting to be processed by an immigration employee. A specific overview of the current practices of this staffing and a discussion of the analysis required to be conducted is provided.

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**Keywords:** workforce scheduling • OR practice • engineering curriculum

## 1. Case Background

The Island of Tropical Paradise<sup>1</sup> is a small island in a tropical sea covering about 400 square kilometers and has a population of 75,000. Although this may seem like a small landmass, they see about five times their population in tourists annually coming by way of commercial aircraft. To enable the tourists to enter and exit successfully, immigration at the Island of Tropical Paradise International Airport (ITPIA) has a staffing schedule for commercial flights but feels the processing time is not effective, and they do not have a deep understanding of the trade-offs between staffing and the average time passengers spend in the queue waiting to be processed by immigration. Therefore, immigration at ITPIA has engaged you and your classmates to explore the trade-offs between the number of immigration employees and the queue time for the passengers to improve the passenger experience, to help ensure consistency in staffing, and to help the agency meet their staffing and budget needs.

Immigration processing requires that everyone aboard each plane must go through an immigration queue prior to being processed by an immigration employee. It is important to note here that some

planes arrive close together and there could be carry-over of individuals not processed from the first flight when the second flight is arriving. The standard expectation is that each passenger requires a total of one minute at the immigration counter in order for an immigration staff member to process them into the country. However, passengers may have issues that delay their processing, and the impact of these issues on the immigration processing time is often based on the country of origin of their arriving flight and/or its airline. Although there are many airlines that fly into ITPIA, for purposes of the impact on immigration processing, these flights can be grouped into four categories: Coconut Island flights, Banana Island flights, Ocean Air flights, and all other normal flights. Table 1 provides an overview of the average processing time of a passenger with an issue in each of these categories as well as the percentage of passengers on each flight that have issues with immigration. Last, it should be noted that Ocean Air flights are notoriously late: over 60% of their flights experience a delay of some kind. The percentage of passengers with issues and the processing time of these passengers may likely impact the length of time

**Table 1.** Characteristics of Different Types of Flights

	Type of flight			
	Coconut Island	Banana Island	Ocean Air	Normal flights
Average processing time of passengers with issues (minutes)	4.3	3.6	3.6	2.0
Percentage of passengers with issues (%)	80	60–70	5–10	5–10

passengers spend in line waiting to be processed by immigration. In the provided Excel data, flights are color coded by their category.

The flight schedules are relatively consistent over several weeks, and, therefore, weekly immigration staff schedules may be created to staff much of the

entire month. However, the flight schedules can vary from month to month (including peak travel months into the Island of Tropical Paradise), and immigration at ITPIA is interested in knowing the impact of this variability on its staffing requirements. Data have been provided for five months over one year

**Figure 1.** Sample Flight Data for March 2016 in Terms of the Number of Arriving Passengers

Arrival Time (Military Time)	07-Mar-2016	08-Mar-2016	09-Mar-2016	10-Mar-2016	11-Mar-2016	12-Mar-2016	13-Mar-2016
9:51		79	71	83	82	121	109
10:20	74	48	70	96	67	90	112
10:35						111	73
10:55	93					68	
11:30		58	66	68	88	84	114
11:40						162	
11:50	45	47	88	108	117	182	188
11:51	67	82	150	121	139	188	166
11:55		91	88		97		97
12:13	78					139	
12:41		73	121	137	139	136	144
13:05		69	58		81	66	
13:05						137	
13:19		110	166	165	186	184	161
13:43	147					159	
13:43						133	
13:45						66	
13:49		72	62	91	64		83
13:50	67			37	20	61	71
13:52	100	36	64	25	32	22	50
14:11							
14:36				65	58	93	85
14:44	51						
14:50	62						
14:55							
15:10							
15:30						138	
15:40				48			101
15:45		49	46	61		54	
15:50					69		122
16:01	66				78		
16:20				86	81	102	92
16:30	63	108	72	76	61		111
16:45	80					24	
17:20							
18:41	93				40		

(including ones in peak travel) and include a breakdown of the countries of origin. Figure 1 provides example data that show the flights arriving into ITPIA for a one-week period in March 2016 between 9:00 a.m. and 6:45 p.m., with flights color coded by category. It is important to note that not all flights fly on all days, and the number of arriving passengers may vary for the same flight over the course of the week.

The immigration processing area will likely need the maximum number of employees between Friday and Monday and between the hours of 10:00 a.m. and 3:00 p.m. The area opens one and a half hours prior to the first arrival/departure and closes after the last scheduled flight arrives and is processed (11:55 p.m. on Friday–Sunday and 10:25 p.m. on Monday–Thursday).

An overview of the current practices of the immigration agency at ITPIA is now provided. All immigration officers (which process the passengers) are full-time employees and are expected to work between 35 and 40 hours per week. A normal employee shall work five 7.5-hour shifts over the course of the week and should ordinarily start each shift at the same time (i.e., if they start their shift at 9:00 a.m. on Monday, they should start other shifts at 9:00 a.m.). For a 7.5-hour shift, an individual may receive two breaks of 15 minutes and a 60-minute lunch break. The current schedule is built with the workweek from Monday to Sunday. Employees may be off any day of the week, as coverage over weekends is required. The immigration agency tries to schedule a large percentage of workers (ideally 100%) on a schedule where they work five consecutive days and then receive two days off. Overtime may occur when an employee works over a 7.5-hour shift in a day, but no employee should work more than 8 overtime hours in a week. Overtime is used liberally within the budget constraints. The agency currently does not consider part-time staffing but could be open to the idea should it provide benefits in terms of their workforce.

From an employee perspective, one-week notice should be provided for changes to an employee's shift. Employees who worked the prior holiday should not work the next one. Some employees have expressed a desire to have shifts that have start times that vary day to day during the week because it allows them more freedom without requiring them to take paid time off. Employees are entitled to 10 sick days and between 18 and 28 vacation days. The schedule should be robust enough to handle employees calling in sick and/or requiring vacation days.

## 2. Required Analysis

Immigration at ITPIA is interested in quantitatively analyzing its workforce scheduling in order to meet specific metrics of performance, including the amount of time passengers arriving into the country spend in line waiting for immigration officials to process them into the country. They have not yet set a specific target metric for the time spent in line; however, they would like to understand how the size of their workforce impacts this metric. It is also not clear to them whether this metric should focus on the average time a passenger from the same flight spends in line or the maximum time any passenger could spend in line. Furthermore, they are particularly interested in exploring the potential impacts of different high-level policies on the required number of immigration employees. Examples of high-level impacts could be the incorporation of part-time employees into immigration processing, a move away from the requirement that an employee begin his or her shift at the same time each day, or different workweek requirements (e.g., four 9.5-hour shifts versus five 7.5-hour shifts).

## Endnote

<sup>1</sup> This particular case was motivated by a country that hired Deloitte Consulting to examine its workforce scheduling in its immigration agency; however, to preserve their confidentiality, we will use this fictitious name.