

A photograph of the Rock of Gibraltar, a large limestone rock formation, with the city of Gibraltar built at its base. The sky is clear and blue. The text "Rock of Gibraltar Airport" is overlaid in a large, light blue font with a drop shadow. Below the title, the names of the authors are listed in a white serif font.

Rock of Gibraltar Airport

Thomas Power
Roberto Vasquez
Jonathan Farland
Sebastian Priest

Gibraltar

- British territory on the Mediterranean Coast
- Ceded from Spain in 1713
- Used as a fortress by the British military in World War II
- 28,000 civilian population
- 12,690 labor force



About Gibraltar Airport

- Located in the British territory of Gibraltar
- Originally built in WWII for strategic advantage
- Harbors both military and commercial aircraft



Tourist Attractions



The Rock of Gibraltar

- 1,400 ft. tall limestone mountain
- Protected wildlife reserve
- Moorish Castle & World War II Tunnel System
- Attracts 4 million visitors every year



Tourism impact on the Economy

- Around 5 million tourists travel to the Gibraltar Peninsula annually
- Amount of tourist expenditure is around 230 million pounds
- Tourism accounts for 30% of Gibraltar's GDP
- Tourist and civilian population account for high levels of congestion

Airport Operations

The Airport of Gibraltar carries 4 airlines

- **EasyJet Airlines**
- **Monarch Airlines**
- **British Airways**
- **Anadus Lineas Airlines**

There are 42-46 weekly commercial flights



Airport Layout

- Harbors only one runway for both departures and arrivals
- Modes of transportation:
 - Car
 - Taxi
 - Bus
 - Motorcycle/Bicycles
- Winston Churchill Ave. crosses the runway through which traffic runs through

The Problem



- <http://www.youtube.com/watch?v=jFgSECUCrgs>

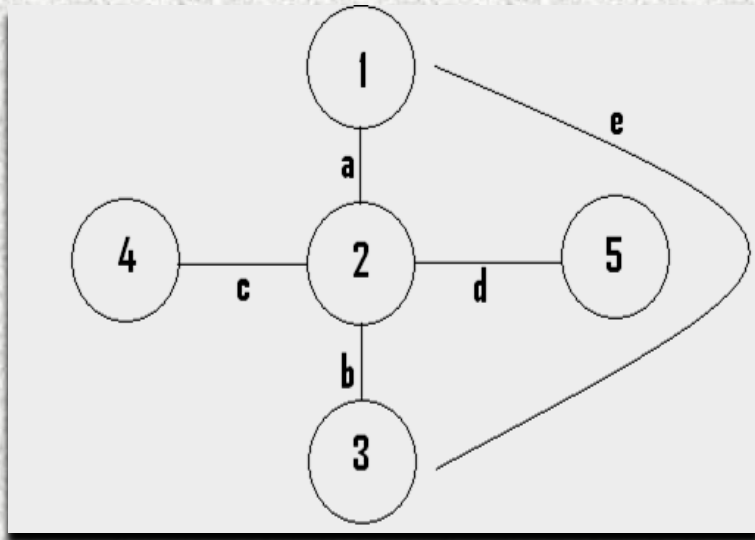


Transportation Facts

- There are around 14 arrivals and departures daily
- The average time Winston Churchill Ave. is closed during an arrival or departure is 10 minutes
- On any given day, the road can be closed for a total of 2 hours
- Alternatives: implement a ferry system around the runway

The Model

Network Topography



Physical Topography



The Issues with Modeling

- Determining...
 - Daily Demand
 - 5 million annual visitors divided by 365 days a year.
 - Associative costs with using Winston Churchill Ave.
 - Bureau of Public Roads Methodology for Road Cost
 - “Practical Capacity” of Utilizing Links ‘a’ and ‘b’
 - Winston Churchill estimated to have a practical capacity of 14,000 cars/day

Bureau of Public Roads (BPR) method of estimating associate road costs:

$$C_a = C_a^0 \left[1 + \alpha \left(\frac{f_a}{t_a'} \right)^\beta \right]$$

C_a: Travel time on link a


F_a: link flow on link a

C_a⁰: free flow travel time

t_a prime: "practical capacity" of link a

α, β : Model Parameters (typically α=.15, β=4)

Non-Linearity!





The Model

Descriptor	Data	Data Type		
Annual Demand	5,000,000	Visitors	Dw	13698.6
Visitation Days/year	365	Days	Period of	1
Daily Demand	13698.63	Visitors/day	Ca(fa)	8.69702
Period of Time (t)	1	Day	Cb(fb,fc)	74.1327
Flights per year	2,288	Flights	C(e)	82.8297
Flights per day(avg)	6	Flights/day	C(p1)	82.8297
Proposed Ferry Distance	2.607	Nautical Miles	C(p2)	82.8297
Mediterranean Ferry Speed	17.38	Nmiles/hour	Fa	12222
Travel Time	0.15	Hours	Fb	12222
Daily Operational Hours	8	hours/day	Fc ^a	6
Time to Load/Unload	0.05	minutes/car	Fd ^a	6
O/D Pair	(1,3)		Fe	1476.59
Path 1 (P1)	(a,b)			
Path 2 (P2)	(e)			
Ca ^a	8			
Cb ^a	13			
Cc ^a	9			
Practical Capacity of "a"	14000	Cars/day		
Practical Capacity of "b"	14000	Cars/day		
Practical Capacity of "e"		Cars/day		
α	0.15			
β	4			

Bureau of Public Roads (BPR) method of estimating associate road costs:

$$C_a = C_a^0 \left[1 + \alpha \left(\frac{f_a}{t_a'} \right)^\beta \right]$$

Ca: Travel time on link a

Fa: link flow on link a

Ca⁰: free flow travel time

ta prime: "practical capacity" of link a

Iberian Government's integrated Traffic, Parking and Transport Plan

- **Car Parking facilities and schemes**
- **Policing and Enforcement of Parking schemes**
- **Public Transport & Car use reduction measures**
- **New Roads**

Car Parking facilities and schemes

- **Local residents in the area where they live**
 - Multi storey car parks in residential areas
 - Permit holders only parking schemes in all residential areas
- **Local residents when paying short visits to other parts of Gibraltar**
 - More short term paying car parks around the city
 - More metered parking spaces in the city centre and in each of the residential areas
- **Visitors to Gibraltar**
 - Unavailability of street parking will force visitors to park their cars in the large multi storey car park

Policing and Enforcement of Parking schemes

- The appointment of Parking and Traffic Enforcement Officers
- The introduction of 'on the spot' parking fines for non locally registered vehicles.
- The raising of the levels of parking fines, including fixed penalty notices
- Increased use of 'tow away' in cases of obstruction or serious unlawful parking
- Clamping of persistent offenders

Public Transport & Car use reduction measures

- Improvements to the availability and reliability of the taxi service
- Improvement and expansion of the bus service, including:
Free bus service on most routes - Increased frequency of services - Late night bus service
- 'Take, ride and leave' facility

New Roads

- **Winston Churchill Avenue Scheme**
- Dual carriageway Tunnel under the runway at Eastern Beach

Old Layout



New Layout



