



Time Efficiency Comparison of High-Speed Rail vs. Airplane

Group J

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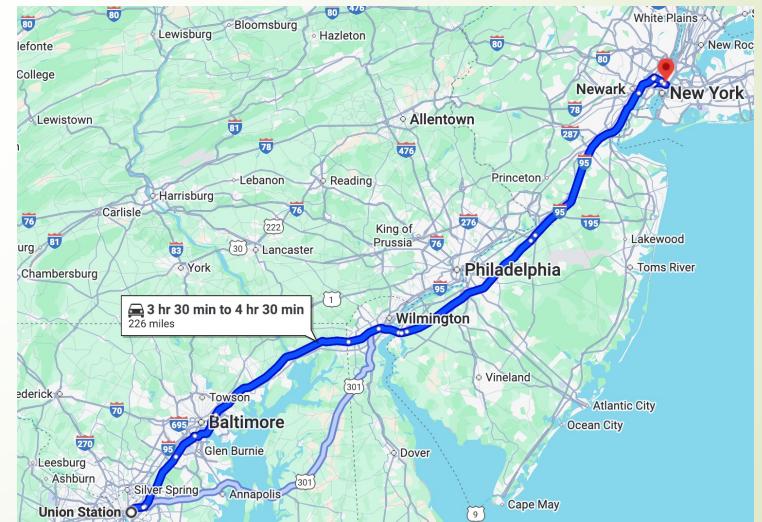


Introduction

- ▶ The speed of an **airplane** is much faster than that of **high-speed rail**.
 - ▶ **900 km/hr** vs **300 km/hr**
- ▶ When taking the total time cost, which option is truly faster?
 - ▶ Security check
 - ▶ Departure frequency
 - ▶ Travel time to hubs (airport/station)

Introduction

- ▶ Union station (Washington DC) ↔ Empire State Building (NYC)
- ▶ Distance: 226 miles (360 km)
- ▶ Travel time comparison
 - ▶ Plane: **239 minutes**
 - ▶ Train: 258 minutes



Source:<https://www.youtube.com/watch?v=Hwd3QHx1DVc&t=650s>

Introduction

- ▶ Taiwan: Taipei ↔ Kaohsiung
- ▶ Distance: 218 miles (350 km)
- ▶ Travel time comparison
 - ▶ Plane: 160 minutes
 - ▶ Train: 130 minutes



Source: <https://hdl.handle.net/11296/f798fh>



Introduction

- ▶ High-speed rail's competitive range: 200 – 1000 km
 - ▶ Accessibility of airports and stations
 - ▶ Train operating characteristics
 - ▶ Train speed
 - ▶ Train stop frequency
 - ▶ Airport passenger processing
 - ▶ Security screening
 - ▶ Baggage drop-off and claim
 - ▶ Delay and reliability

Source1: <https://doi.org/10.1155/2017/8426926>

Source2: <https://doi.org/10.1080/01441640600589319>

Case Study (Shinkansen)

- ▶ Tokyo ↔ Hakata
 - ▶ Osaka (552.6 km)
 - ▶ Okayama (732.9 km)
 - ▶ Hiroshima (894.2 km)
 - ▶ Hakata (1174.9 km)
- ▶ Operating speed: 300 km/hr



Source: <https://www.jrailpass.com/shinkansen-bullet-trains>

Case Study (Access Time)

- ▶ Travel demand is randomly generated at the stations along the Yamanote Line.
- ▶ High speed rail access time (Tokyo station)
 - ▶ Yamanote Line
- ▶ Airport access time (Haneda airport)
 - ▶ Yamanote Line
 - ▶ Transfer waiting time (1 ~ 4 minutes)
 - ▶ Monorail (25 minutes)



Source: <https://japanalytic.com/2021/01/29/yamanote-line-map-info/>



Case Study (Processing Time)

- ▶ High speed rail (20 ~ 30 minutes)
 - ▶ Ticket check / Gate entry
 - ▶ Walking to the platform
 - ▶ Platform waiting time and boarding
- ▶ Flight (60 ~ 90 minutes)
 - ▶ Baggage drop-off / Check in
 - ▶ Security screening
 - ▶ Walking to the gate
 - ▶ Gate waiting time and boarding

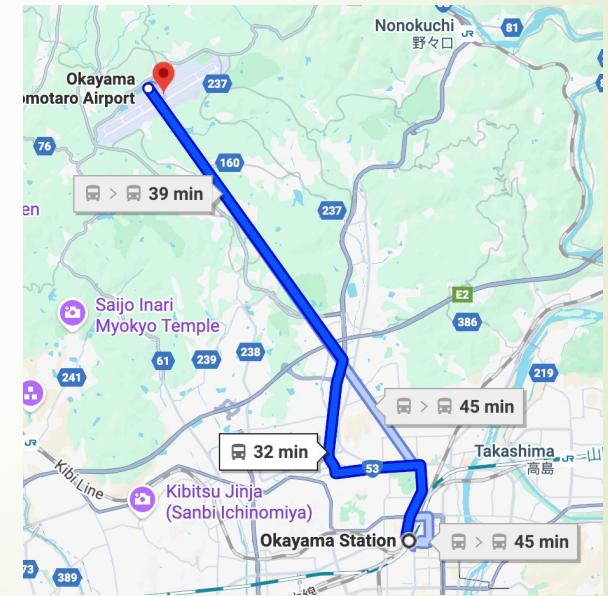


Case Study (Travel Time)

	Mileage (km)	High Speed Rail (mins)	Flight (mins)
Nagoya	366	97	60
Osaka	552.6	150	70
Okayama	732.9	190	80
Hiroshima	894.2	230	90
Hakata	1174.9	300	130

Case Study (Return Time)

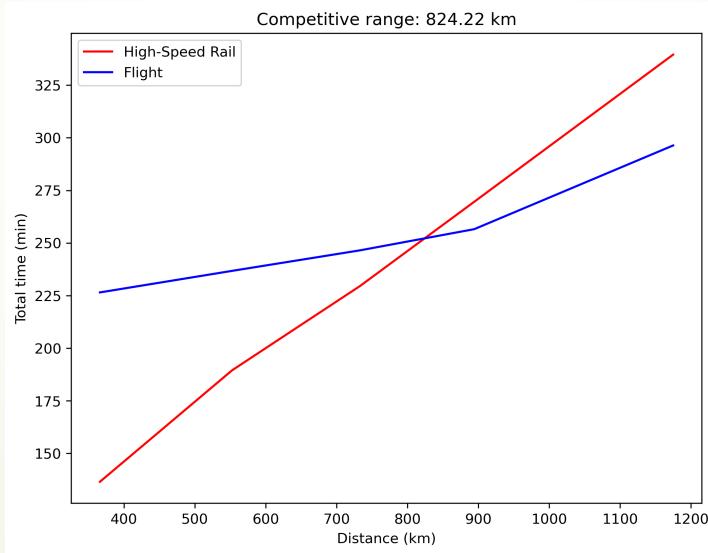
- ▶ High speed rail (0 minute)
- ▶ Flight (40 ~ 60 minutes)
 - ▶ Claim baggage
 - ▶ Back to downtown



Source: <https://japanalytic.com/2021/01/29/yamanote-line-map-info/>

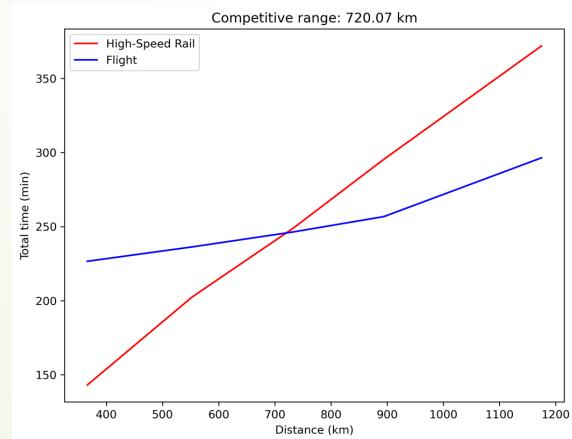
Case Study (Total Time)

- $T_{tol} = T_{access} + T_{processing} + T_{travel} + T_{return}$
- Competitive range: 824 km



Discussion

- ▶ Stop frequency of train
 - ▶ 6.5 minutes of time loss per stop
- ▶ Add an additional stop in each segment
 - ▶ Competitive range: 824 km → 720 km

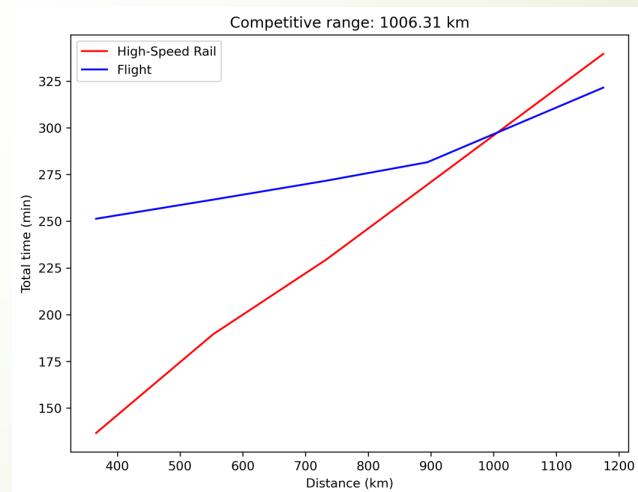
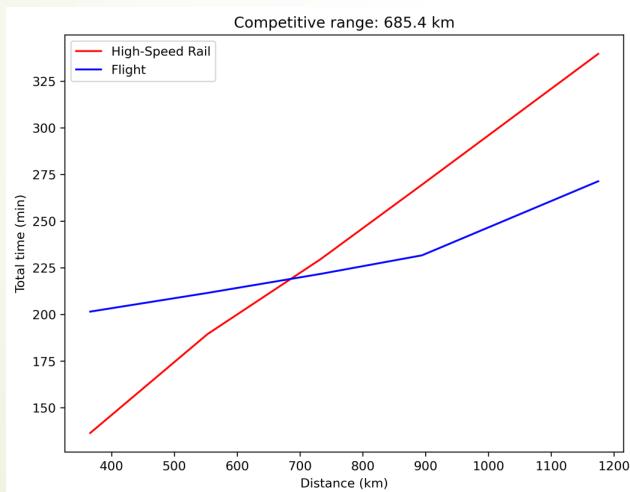


Source: https://infrastructure.aecom.com/transportation/how-fast-is-too-fast-for-high-speed-rail?utm_source=chatgpt.com

Station	Mileage (km)
Tokyo	0
	2 stops → 3 stops
Nagoya	366
	1 stop → 2 stops
Osaka	552.6
	1 stop → 2 stops
Okayama	732.9
	1 stop → 2 stops
Hiroshima	894.2
	1 stop → 2 stops
Hakata	1174.9

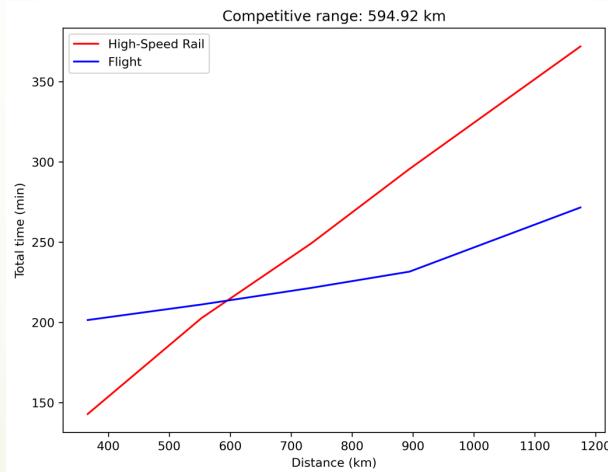
Discussion

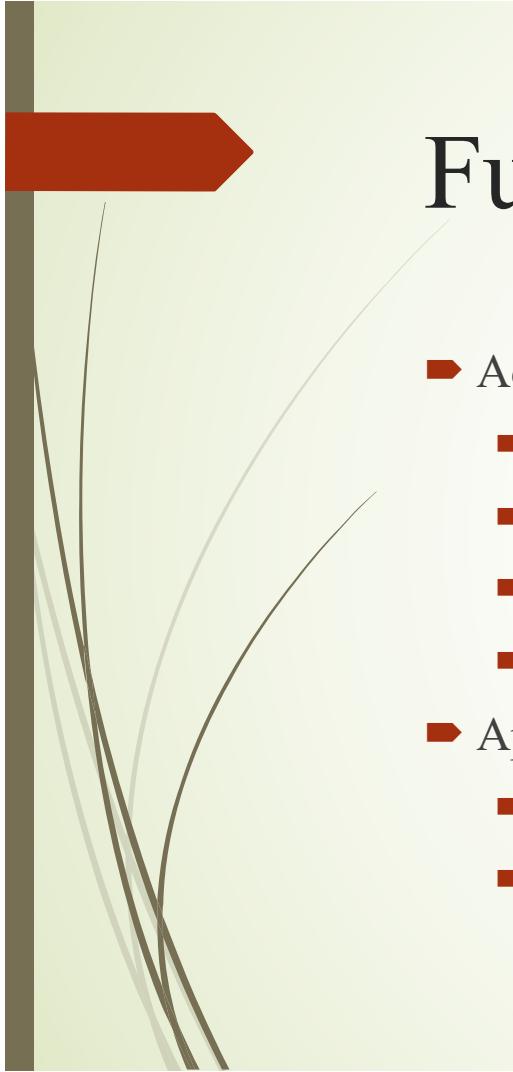
- ▶ Changes in flight processing time (current: 60 ~ 90 minutes, **824 km**)
 - ▶ Off-peak periods: 40 ~ 60 minutes (**685 km**)
 - ▶ Holidays: 80 ~ 120 minutes (**1006 km**)



Discussion

- ▶ Add an additional stop in each segment
- ▶ Off-peak flight processing time (40 ~ 60 minutes)
- ▶ Competitive range: **594.92 km > 552.6 km** (Tokyo ↔ Osaka)





Future Directions

- ▶ Advanced modeling options
 - ▶ Change access time and return time
 - ▶ Adjust train travel time (600 km/hr, maglev train)
 - ▶ Use a different random sampling distribution
 - ▶ Consider delays of trains and flights
- ▶ Application
 - ▶ Determine travel demand
 - ▶ Optimize operations for flight and train companies

Source:<https://www.youtube.com/watch?v=tiufz6wS4dI>