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Transport Investment Appraisal Case Studies Crossrail and High Speed Rail

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Problem

Cluster of main line termini around central London require many passengers to change on to the Underground to complete their journey

This leads to major overcrowding on the central section of Underground Lines

Solution

A new cross London tunnel connecting existing lines

First proposed in 1940s

Revived by SSRA in 2000

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Key questions

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- Which terminals to link?
- What sort of services
  - metro?
  - Outer suburban (Thameslink?)
  - Long distance

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Crossrail options(SSRA (2000))

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Option	Variant	Capital Cost (£b)		NPV (£b)	B/C ratio
Paddington - Liv St	Metro	2.8		4.4	2.6
	Express	2.3		4.5	3.0
Wimbledon – Liv St	Metro	4.4		5.5	2.3
	Express	4.2		5.3	2.3
Wimbledon – Hackney	Metro	5.3		3.5	1.7
	Express	5.3		4.1	1.8

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Which option to choose?

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- Paddington – Liv St has highest BCR and lowest capital cost

- Wimbledon – Liv St has highest NPV but incremental BCR well below 2

- Paddington –Liv St leaves option of Wimbledon-Hackney at a later date

(Wimbledon – Liv St blocks both other routes)

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Crossrail route map

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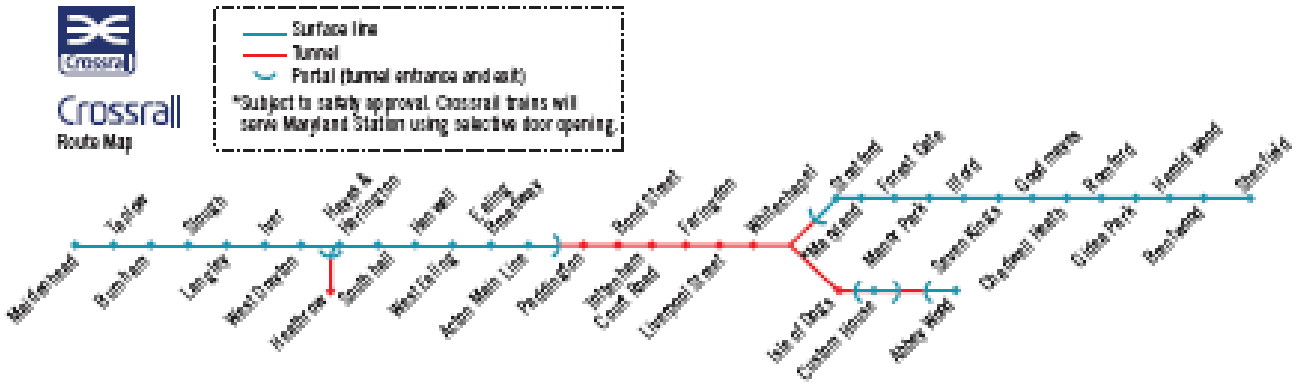

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Advantages of the Metro option

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- Benefits poorer inner London suburbs rather than wealthier commuter areas
- High density rolling stock maximises capacity
- Simpler service pattern aids reliability

(Cf Thameslink)

BUT a longer distance option may generate more revenue

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Objections

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1. BCR on the basis of conventional CBA marginal (1.8)
2. Very expensive if all it did was to make journeys of commuters a bit more comfortable and convenient
3. Benefits would go to property owners (Cf Jubilee Line extension to Docklands) – not a good use of taxpayers money

So

1. Were there wider economic benefits? (Venables report)
2. Could the beneficiaries be made to pay for it?

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Crossrail wider economic benefits (£mPV2002)

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Moves to more productive jobs	3232
Agglomeration economies	3094
Labour force participation	349
Imperfect competition	486
Total	7161

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Crossrail CBA (£mPV2002)

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Time savings	12832
Crowding	2889
Other transport benefits	372
Wider economic benefits	7161
Total benefits	23254
Total costs	13902
Less revenues	-6149
Plus tax loss	1207
Cost to government	8960

BCR 2.6 (1.8 excl Wider economic benefits)

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Further studies suggested

- Voluntary contributions limited – free rider problems
- Scope for specific value capture limited
- Property values would rise generally throughout the area
- So a general supplementary business rate would be a reasonable way of getting beneficiaries to pay

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Funding of Crossrail

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Transport for London direct funding	£1.9bn
Department for Transport direct funding	£4.8bn
Business Rate Supplement/borrowing	£4.1bn
Sale of surplus land and property	£500m
Private sector/Developer contributions	£880m
Community Infrastructure Levy	£300m
Network Rail	£2.3b
Total	£14.8b

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National Audit Office (2014)

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- Latest update of business case showed that growth of London had strengthened the case (BCR excluding WEIs 1.97; including WEIs 3).
- On the whole and to date, the Department together with its co-sponsor Transport for London and its delivery body, Crossrail Limited, have done well to protect taxpayers' interests in the Crossrail programme. Overall, if progress to date can be maintained, and risks managed, Crossrail is on track to achieve value for money.
- But by the time NAO looked at it again in in 2019, it was running late and above budget.

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Appraisal of High Speed Rail

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Outline

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1. Introduction
2. Costs and demand
3. British case studies

-HS1 (London-Channel Tunnel)

-HS2 London-Birmingham-Manchester/Leeds

4. Conclusions

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High Speed Rail (HSR)

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- A high-speed train is a train capable of reaching speeds of over 200 km/h on upgraded conventional lines and of over 250 km/h on new lines designed specifically for high speeds

(European Commission)

I will talk largely about new lines

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Cost per route km of HSR projects

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- Mean £31m
- Range £11m – 79m
- Simple rural routes £11-20m
- Urban routes £43-61m

High proportion of tunnel up to £79m

Source: PWC (2016) *High speed rail international benchmarking study. HS2 Ltd*

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Costs and capacity

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- So HSR inevitably very expensive
- But enormous capacity
- If all trains identical, capacity of up to 18 trains per hour with 1000 seats per train.

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HSR operating costs

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Depend mainly on

- Rolling stock requirements
- Staff requirements
- Energy consumption
- Maintenance costs

Very high utilisation of assets and staff may more than offset high energy and maintenance costs (Civity, 2013)

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Source of High Speed Rail Traffic (%)
(Preston, 2017)

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	Paris-Lyons	Paris-Brussels	Madrid-Barcelona	London-Paris/Brussels
Plane	20	8	60	49
Train	40	47	10	12
Road	11	34	10	19
Induced	29	11	20	20

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Rail Share of the rail/air market and rail station to station journey times (source Nash, 2015)

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Corridor	Year	Travel time	Rail share (%)
Paris–Brussels	2006	1 h 25 min	100
Paris–Lyons	1985	2 h 15 min	91
Madrid–Seville	2003	2 h 20 min	83
Brussels–London	2005	2 h 20 min	60
Tokyo–Osaka	2005	2 h 30 min	81
Madrid–Barcelona	2009	2 h 38 min	47
Paris–London	2005	2 h 40 min	66
Tokyo–Okayama	2005	3 h 16 min	57
Paris–Geneva	2003	3 h 30 min	35
Tokyo–Hiroshima	2005	3 h 51 min	47
Paris–Amsterdam	2004	4 h 10 min	45
Paris–Marseilles	2000	4 h 20 min	45
London–Edinburgh	1999	4 h 25 min	29
London–Edinburgh	2004	4 h 30 min	18
Tokyo–Fukuoka	2005	4 h 59 min	9

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Ex post appraisal of French high speed line construction

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	Sud Est	Atlant-ique	Nord	Inter Connec-tion	Alpes	Mediter-ranean
Passengers in first year (m)	15.8	26.7	19.2	16.6	18.6	19.2
Social rate of return (%), IRR	30	12	5	13.8	10.6	8.1

Source: Conseil Général des Pont et Chaussées (2006) Annex 1 updated from Crozet (2013)

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Ex post appraisal of Spanish high speed line construction (Betancor and Llobet, 2017)

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	Madrid-Andalusia	Madrid-Barcelona
Passengers in 2013 (m)	5.5	8.0
Social return % (50 year life)	0.15	2.55

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Determinants of demand for HSR

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- Population
- Density
- Corridors (‘string of pearls’ in Japan generates over 200m trips p.a.)
- Competitive position with air and car

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High Speed 1

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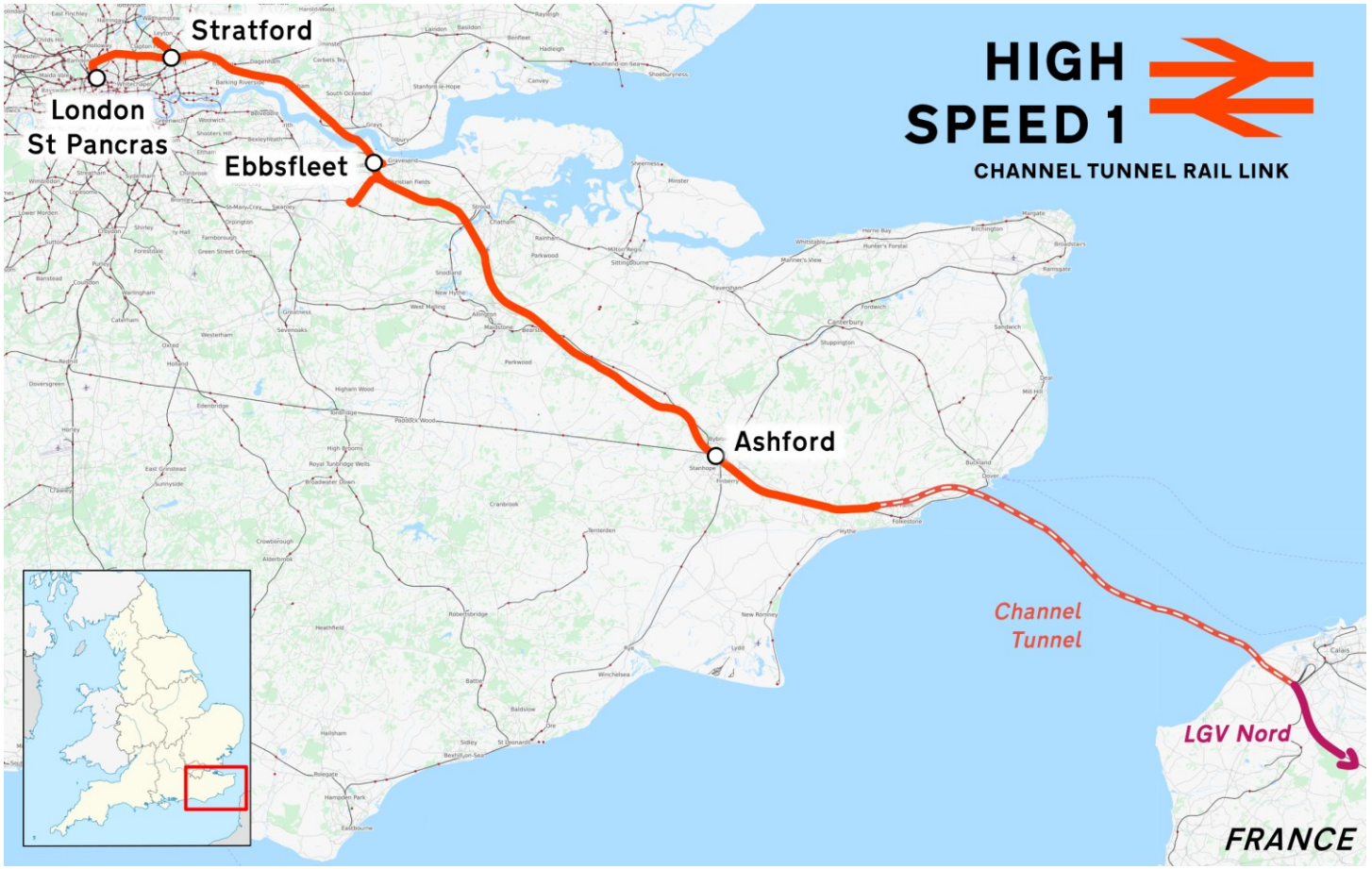

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Passenger traffic on HS1 2018 (m passenger trips)

Eurostar (London –Paris/Brussels)	11m
Javelin domestic services	10m
Total	21m

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Ex ante appraisal of HS1 (London to Channel Tunnel) (£millionPV)

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	1998 Appraisal
Benefits	
User benefits - International Services	1,800
User benefits - Domestic Services	1,000
Road Congestion	30
Environmental benefits	90
Regeneration	500
Total Benefit	**3,420**
Costs	**1,990**
NPV	**1,430**
BCR	**1.72**
(BCR excluding regeneration benefits)	**1.5**

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HS2 Proposal – phases 1 and 2

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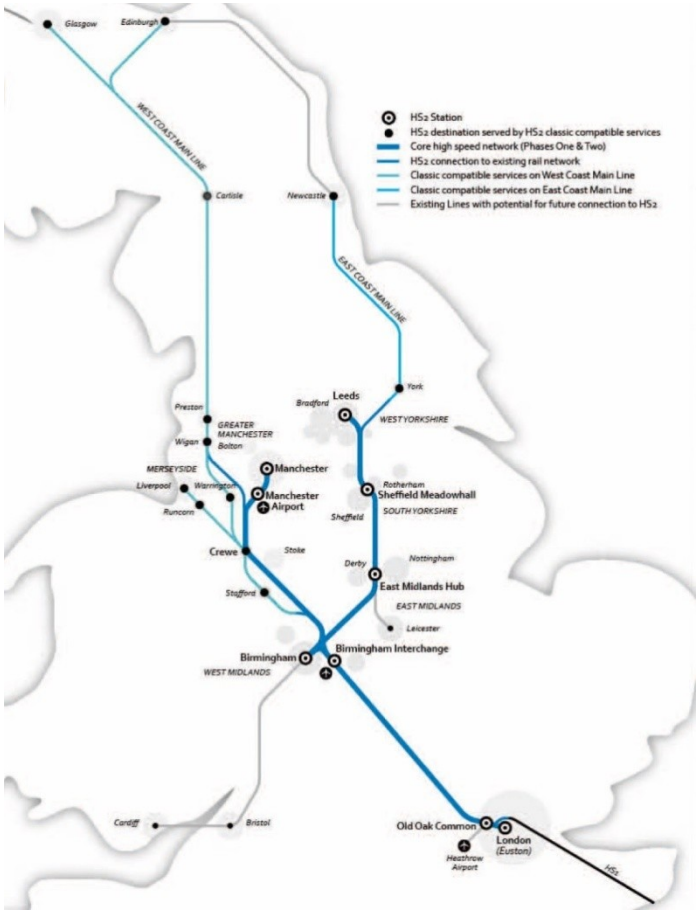

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Options examined

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- East, West, Both or Y shaped network
- Sifting process looked at 60 London termini and 6 routes
- Stations included Old Oak Common (severe loss of user benefits compared with Central London)
- Routes including M1 corridor (closer to built up area so involved a lot of demolition and/or tunnelling)
- New orthodox line (200km p.a.)
- Upgrading existing lines

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Journey times from London

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	now	with HS2
Birmingham	1:21	0:49
Leeds	2.12	1:23
Manchester	2.08	1.08
Newcastle	2.52	2.19
Edinburgh	4.23	3.38
Glasgow	4.08	3.38

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Passengers forecast to use HS2 (>40m p.a.)

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Switch from classic rail	69%
New Trips	26%
Modal Shift from Air	1%
Modal Shift from Car	4%

- Rail already dominant except for London-Scotland
- So not much scope to reduce CO_2 by modal shift.

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Pricing Policy assumed in the appraisal

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- Rail fares rise by RPI +1% from 2020
- HS2 fares same as conventional rail
- Air fares continue to decline
- Motoring costs decline as efficiency improves but no rise in fuel tax or further use of road pricing

So by 2036 in real terms:

Rail	+25%
Air	−30%
Car	−40%

(HS2 forecasts)

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Capacity benefits

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- HSR route has huge capacity
- Relief of capacity problems on parallel routes leading to:
  - Reduced overcrowding
  - Improved reliability
  - More capacity for freight

  Particularly important between London and Rugby, but also approaches to Birmingham, Leeds and Manchester (part of Northern Powerhouse Rail?

  How best to use capacity on the Northern part of the route?

  What would happen without HS2?

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Wider economic benefits

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Current appraisal method considers these only for major conurbations on the assumption of unchanged land-use :

- Agglomeration benefits
- Labour market benefits
- Imperfect competition

The figure of £14billion is on this basis.

Graham examined whether there were further agglomeration benefits from improving inter city rail business travel? Concluded very small (£0.1bn?) due to low share of all journeys in the course of work.

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Wider economic benefits (cont'd)

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Additional mechanisms (Venables, Laird and Overman, 2014).

- Increases in density and city size leading to further agglomeration effects
- Specialisation and economies of scale
- Attraction of additional private investment

KPMG estimate £15b p.a.; but much criticism of how they separate out rail accessibility from other factors.

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Benefits and Costs of the full “Y” network PV, 2015 prices, £bn		(DfT, 2020)
1	Net transport benefits	74.2
2	Wider Economic Impacts (WEIs)	20.5
3	Net benefits including WEIs	94.7
4	Capital costs	78.2
5	Renewals	5.4
6	Operating costs	25.2
7	Total costs = (4) + (5) + (6)	108.9
8	Revenues	45.4
9	Net costs to Government = (7) – (8)	63.5
10	BCR without WEIs (ratio) = (1) / (9)	1.2
11	BCR with WEIs (ratio) = (3) / (9)	1.5

Breakdown of benefits for HS2 (full Y network) (PV, 2015 prices, £m) (DfT, 2020)

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Rail user benefits	76670
Road user benefits	820
Wider Economic Impacts	20500
Reduced External Costs	810
Loss of indirect Tax	-4140
Net Benefits	94660

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National Infrastructure Commission Report on rail needs in the Midlands and the North 2020

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- Northern part of HS2 plus other aspirations (new line Leeds-Manchester; upgrading Sheffield-Manchester etc) not affordable
- Should examine the possibility of terminating the Eastern leg of HS2 in the East Midlands and upgrading the existing line from there north
- This has been adopted as part of the Integrated Rail Plan

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General Conclusions

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1. Rail project appraisal is complex because of the number of options to be considered (including route, rolling stock, price, quality of service)
2. May be able to modify distributive consequences by revising the scheme and how it is financed
3. Interactions between schemes complicated
4. Major uncertainties are:

-future demand (esp post Covid 19)

-wider economic benefits

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See:

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National Audit Office (2019) Completing Crossrail, London

T. Worsley (2011) The Evolution of London's Crossrail Scheme and the Development of the Department for Transport's Economic Appraisal

Discussion Paper 27, ITF, Paris

More information about Cross Rail may be found at www.crossrail.co.uk

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NAO (2012) *The completion and sale of High Speed 1.* Report by the Comptroller and Auditor General, HC1834, 28 March 2012. https://www.nao.org.uk/wp-content/uploads/2012/03/10121834.pdf

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