

C6: Cost of delays

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Objectives

1. To develop a better understanding of the social costs of delays to passengers and freight trains
2. To establish delay cost values for different train types

Tasks

- Review current knowledge regarding punctuality, reliability and unit costs of delays.
- Review railway classification system in the UK and elsewhere.
- Carry out SP research where gaps in knowledge exist.
- Carry out cost benefit analysis of the costs of delays and the benefits of implementing various measures to minimise them.
- Calculate the social costs of delays on future impacts for rail patronage and abstraction to other modes.
- Recommend suitable unit delay costs for different types of passenger and freight train services which can be used to update the existing UK railway classification system.



Objectives

A fair and reasonable balance between

- Minimise delay to passengers (through and connecting)
- Minimise delay to freight/time-sensitive goods
- Minimise overall delay to all train movements
- Maintenance of safety and security

Trade-offs require the respective costs of those delays to be known

New classification system required

- detailed timetabling
- scheduling in times of disruption

Travel time performance measures

Punctuality – is train running to time given an acceptable deviation

Reliability – rated cancellation of services (X%)

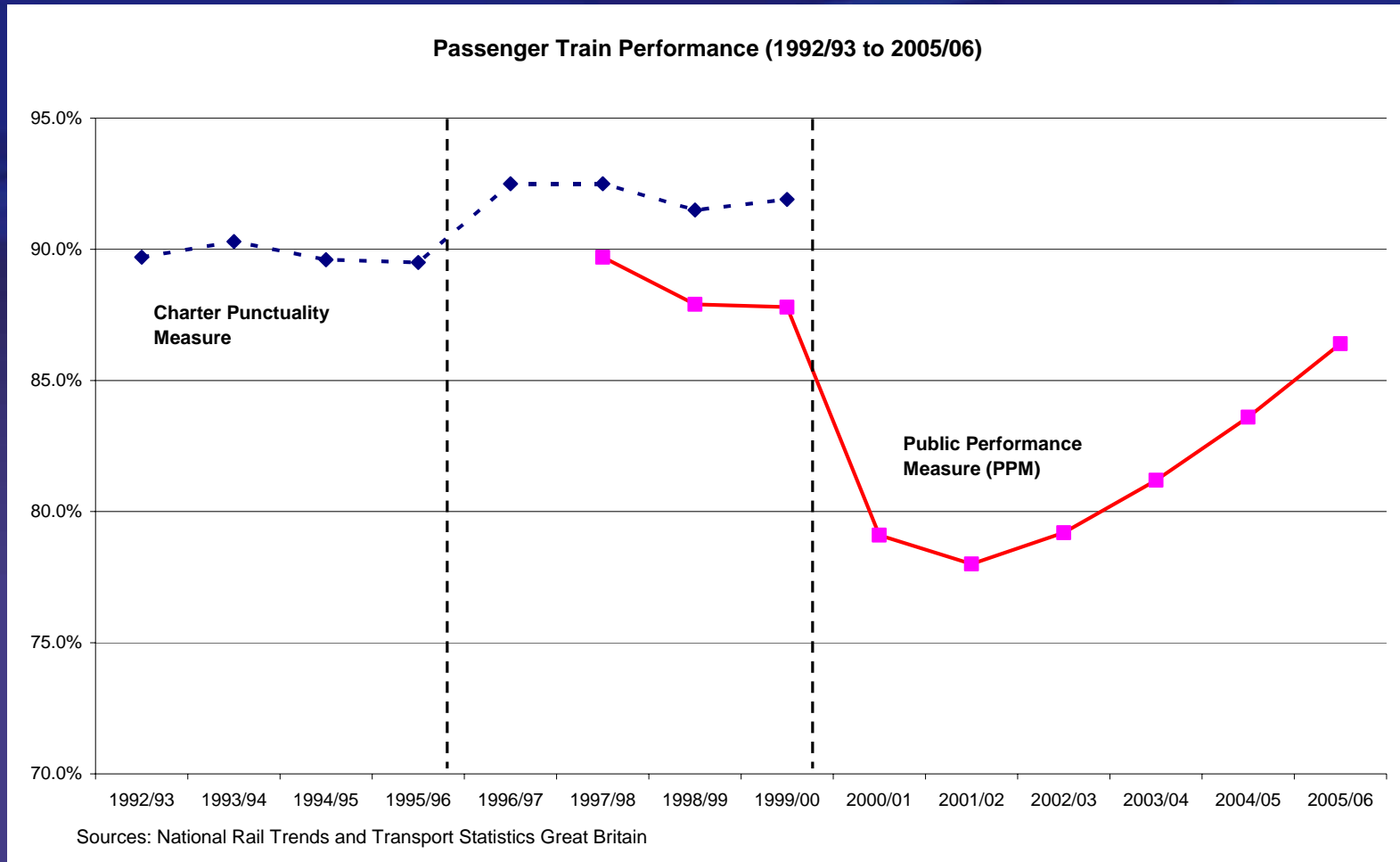
Regularity – deviation from proposed headway

Issues

- If late, how late (mean delay, standard deviation of delay)?
- Probability of an early arrival or departure?
- Punctual on departure and en route?
- Punctuality of passengers door-to-door journey?
- Number of passengers affected?

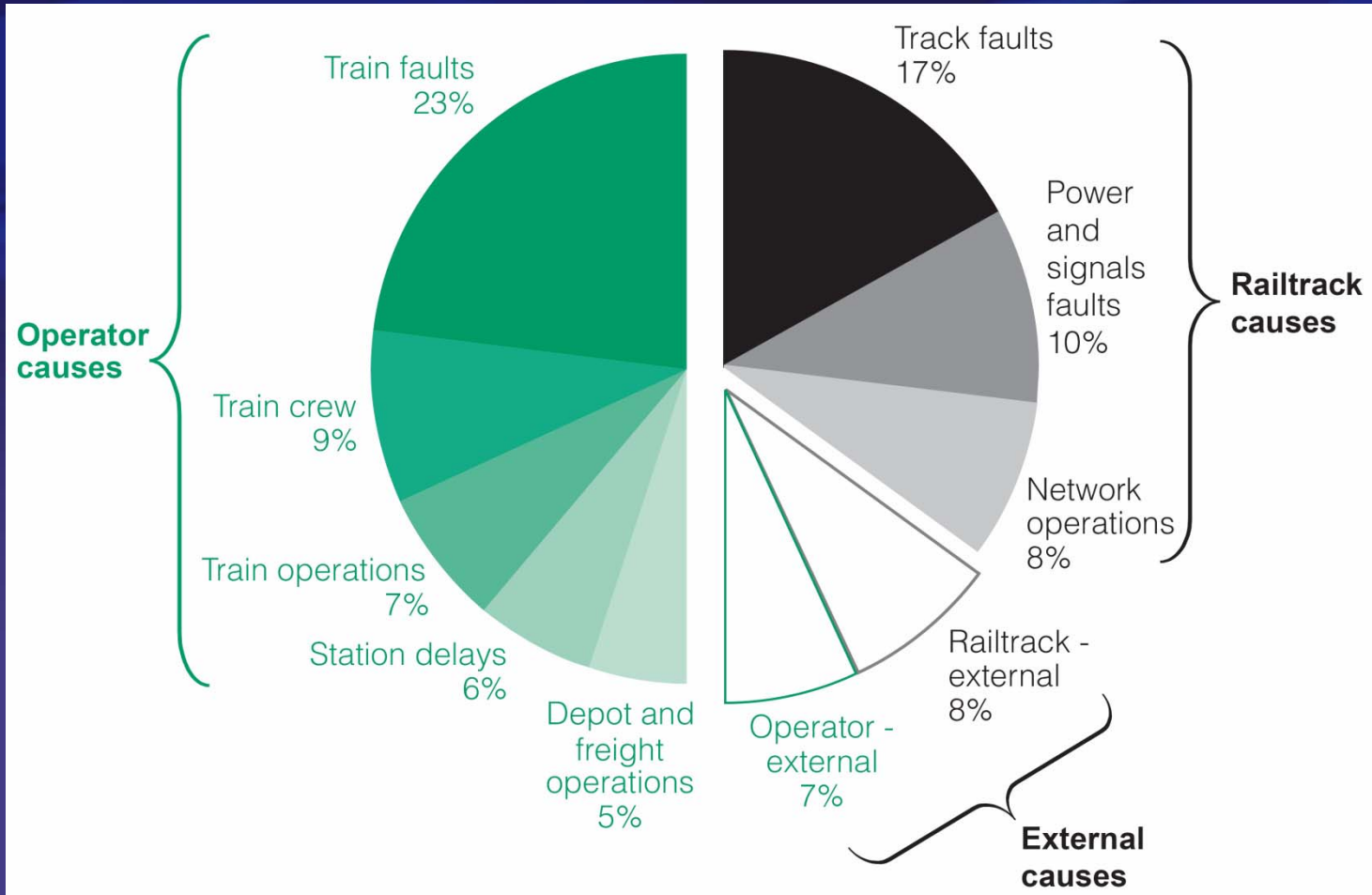
Public Performance Measure (PPM) regime.

Public Performance Measure (PPM)



Targets 90% by March 2009, 92.6% by March 2014

Causes of delay (1999/2000)



Source: NAO (2000)

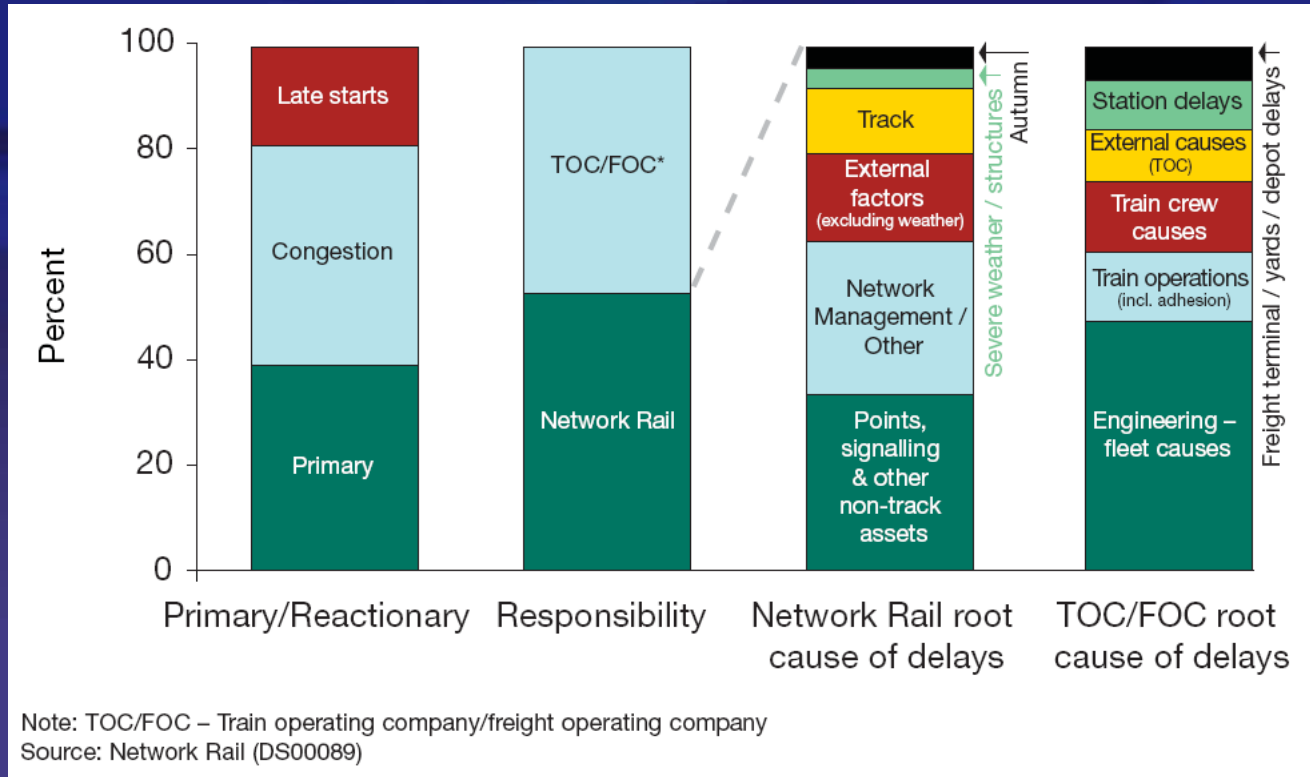
Operator

50%

Network infrastructure /external

50%

Causes of delay (2005/2006)



Source: DfT (2007)

40%

Primary delays

60%

Secondary (knock-on) delays

National Audit Office report

Reducing passenger rail delays by better management of incidents (March 2008)

In 2006/2007

- 800,000 delays on rail network
- 14 M minutes of delay
- £1 B in lost time to passengers
- Fault : Network Rail 42%, TOCs 38%, External 20%

35% passengers - not satisfied how delays are handled

75% passengers - a lack of information when delayed

Better links between NR and emergency services

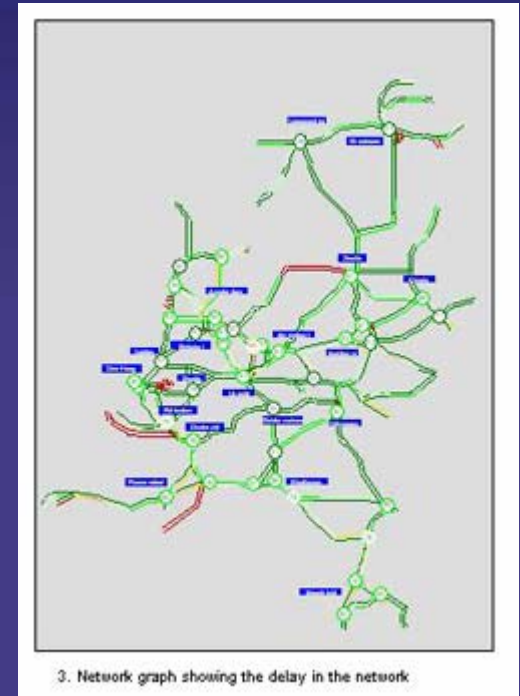
Issuing of passenger information good practice guidelines

Parameters affecting delay

- Train length
- Previous number of stops
- Distance covered
- Track capacity utilisation
- Occupation ratio (passenger/seats)
- Weather (temperature/rainfall)
- Recovery margins (slack in the system)

Use of microscopic simulation models

- produce new timetables
- reorganise routes to minimise congestion
- rearrange schedule and disruption



3. Network graph showing the delay in the network

Passenger Values

PDFH assumes a minute late valued at three times a minute of journey time but suggests sensitivity analysis using the following multipliers.

	Full fare & Season tickets	Restricted use tickets
Airport Journeys	6.5	6.5
Long Distance High Speed Services	6.1	4.2
All Other Services	2.5	2.5

Delay elasticities

	Non-London long distance	Non-London short distance	London to rest of country	London and South East	To and from airports
Long run	-0.347	-0.280	-0.501	-0.082	-0.727
One year elasticity	-0.221	-0.112	-0.268	-0.079	-0.363

Source : Jevons et al (2005)

Freight Values

- Reliability is a key factor in the mode choice of freight shippers, alongside cost and journey times.
- Valuations, based primarily on SP studies, show that values of delay vary significantly across commodities being shipped, with typically lower values for bulks and higher values for containerised, automotive and finished goods.
- The variation is due to the differing degree and impact of associated extra handling, stock-outs, stock saturation, use of reserve modes and administration on costs across different commodities.

Freight Values (I)

All trains	Coal	Petroleum and Chemicals	Bulks (Incl Metals)	Automotive	Finished Merchandise	Containers	Express
Journey time	£54	£278	£19	£351	£421	£317	£1,975
Reliability time £ per train							
15 to 30 min	£643	0	0	0	0	0	£1,094
30 to 60 min	£643	0	0	0	0	0	£2,290
1 to 2 hours	£674	£455	£157	£281	£11,000	£2,319	£5,641
2 to 4 hours	£674	£1,379	£1,209	£468	£21,443	£2,892	£23,895
4 to 8 hours	£674	£3,112	£3,340	£936	£35,799	£3,882	£57,260
8 to 24 hours	£766	£4,440	£4,032	£1,592	£42,130	£5,132	£95,889
Cancelled	£3,488	£4,985	£5,996	£1,440	£4,726	£2,549	£73,021
1% reduction in capacity	£8	£47	£57	£22	n.a	£67	n.a.

Source: BAH/ITS (2004)

Freight Values (II)

Value of Delay Spread – pence/minute/tonne

Coal	0.20	Container	3.00
Metals	0.10	Finished	1.00
Aggregates	0.26	Express	10.00
Oil & Chemicals	0.60	All non bulks	2.00
Automotive	2.50		
Other Bulks	0.43	All sample	1.00
All Bulks	0.98		

Parallel DfT reliability research

- Various initiatives, but especially the recent contract '*Revealed Preference Study to Assess the Impact of Reliability on Passenger Rail Demand*' (DfTRG/0027/2006)
- C6 is exploiting this existing knowledge by:
 - Applying the existing database to extended analysis
 - Supplementing the database through fresh market research
 - Developing a portfolio of follow-on research interests

DfTRG/0027/2006

- Study involved two complementary investigations:

1. *Discrete choice analysis*

- evidence on behavioural responses to reliability at individual level, and associated monetary valuations

2. *Econometric analysis*

- evidence on market elasticity properties of changes in reliability, and inherent dynamics

PDFH forecasting framework

$$I = \left[\frac{1 + \frac{\mu}{\alpha} (\bar{L}_{new} - \bar{L}_{base})}{GJT_{base}} \right]^g$$

PDFH forecasting framework

- As regards valuation, the PDFH issues guidance concerning:
 - *reliability multiplier (=3)*
 - *reliability ratio of ('around 1, but range 0.2-4.0')*
 - *no specific reliability elasticities*

1. *Discrete choice analysis*

- Key findings grounded in SP evidence
- SP offered a choice between two rail services, exhibiting different patterns of reliability
 - i.e. within mode, and no explicit choice of departure time, ticket type or route

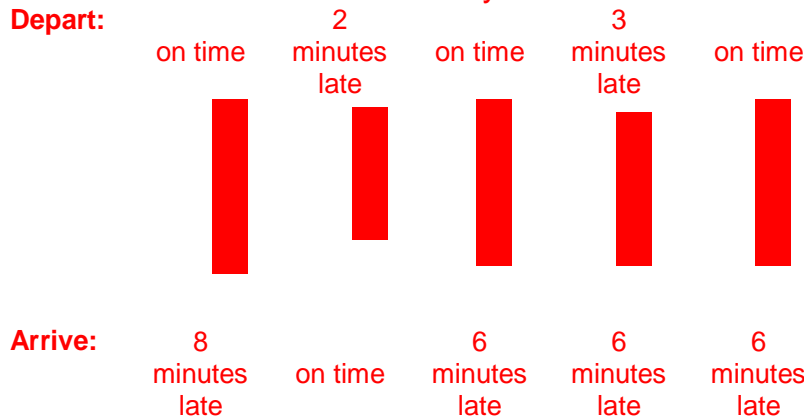
SP experiment

OPTION A

Single Fare: **£26.90**

Timetabled Journey Time: **32 minutes**

Actual Journey Times



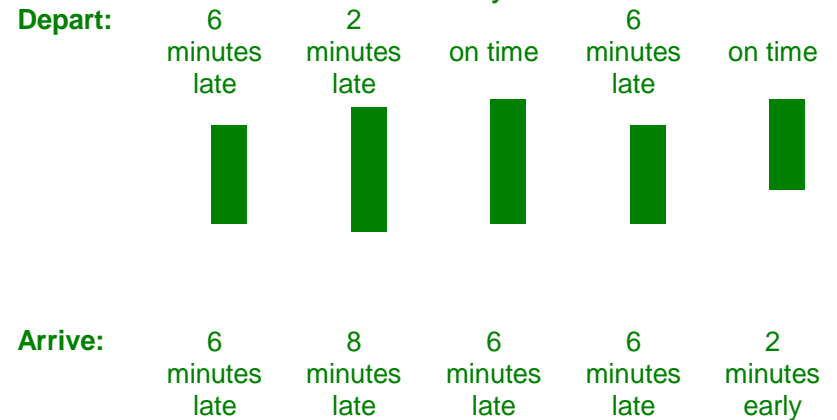
Which option do you prefer? Option A

OPTION B

Single Fare: **£29.20**

Timetabled Journey Time: **24 minutes**

Actual Journey Times



Option B

Key (reliability) metrics

Metric	
Reliability ratio_SB	2.03
Reliability ratio_SC	2.26
Reliability ratio_SO	6.17
Reliability ratio_LB	2.92
Reliability ratio_LC	4.93
Reliability ratio_LO	4.65
Reliability multiplier_DESTINATION_SB	2.24
Reliability multiplier_DESTINATION_SC	2.85
Reliability multiplier_DESTINATION_SO	7.34
Reliability multiplier_DESTINATION_LB	1.19
Reliability multiplier_DESTINATION_LC	1.96
Reliability multiplier_DESTINATION_LO	1.32

2. Econometric analysis

- Key findings grounded in RP evidence
- Range of behavioural responses encapsulated within this data:
 - Short run: departure time, ticket type, route, operator, mode
 - Long run: residential location, car ownership, employment

Data

- Data pertaining to 240 O-D pairs (480 single flows) on a 13-period basis 2002 P1–2007 P8
 - Demand and revenue from LENNON
 - Generalised journey times from MOIRA
 - Reliability/punctuality from BUGLE (O-D level) and PEARS (service group level)

Key metrics

- *Static*
 - ALM elasticities of between -0.03 & -0.06
 - PPM elasticities of between 0.09 & 0.27
- *Dynamic*
 - Short run ALM elasticities of between -0.01 & -0.02
 - Long run ALM elasticities of between -0.04 & -0.05
 - Short run PPM elasticity of 0.05 for non-season
 - Long run PPM elasticity of 0.19 for non-season
- In general, demand effects of reliability small, smaller even than those reported by SDG (2003) and OXERA (2005)

Further Work

- Link reliability multipliers & ratios with theories of behaviour in the presence of risk
- Determine the impact of information on valuations of delay
- Distinguish between late arrivals and whole journey delays
- Determine values of delay for interchanging passengers