steer davies gleave

Identifying the benefits of an improved understanding of Network Rail's costs and cost drivers

Final Report
May 2015

Office of Rail Regulation

Our ref: P22781801
Client ref: ORR/CT/14-58

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Introduction

As part of its preparation for the periodic review prior to Control Period 6 (CP6), the Office of Rail Regulation (ORR) has begun to review the structure of Network Rail's costs, charges and incentives. To help inform decisions on possible changes to the charging structure, ORR wishes to identify, and as far as possible quantify, the benefits of an improved understanding of Network Rail's costs. Accordingly, this study focuses on the ways in which knowledge of costs, whether expressed through charges or not, inform and influence decisions made across the industry. Our methodology comprises four key elements as follows:

- Identification of a number of types of decision and decision-maker that are influenced by information on costs and cost drivers, and consideration of the effectiveness of the various transmissions mechanisms through which cost information is currently communicated;
- The preparation of a number of case studies of decisions in the rail industry in Great Britain, with the aim of determining, and where possible quantifying, the impact that better cost information might have had on the outcome;
- A review of measures (mainly regulatory), including changes to the structure of charges, applied in other, primarily network-based, industries, with the aim of improving cost information and/or price signals, and an assessment of the outcomes; and
- Drawing on the case study analysis and review of experience in other sectors, consideration of the opportunities for improving decision-making within the rail industry through an improved understanding of costs and cost drivers.

Decisions and decision-makers

Any organisation concerned with improving its efficiency will seek a better understanding of its cost base, and in particular of the way in which its costs change with the level and quality of outputs. In Network Rail's case, the ongoing investigation of its costs and cost drivers will be central to securing further efficiency gains in successive Control Periods. However, a better understanding of rail infrastructure costs will also help to inform a wide range of decisions taken by other parties, including:

- DfT and other transport authorities seeking to specify and fund services and service enhancements;
- ORR, in estimating Network Rail's efficient costs and determining its required revenue in order to set both the structure and level of access charges;
- Passenger and freight operators, when planning service changes and determining the deployment of rolling stock;
- Rolling stock providers, when specifying and designing new stock;
- Other suppliers, when determining their products, programmes of work and working methods in order to support Network Rail in its management of the infrastructure; and
- Investors and creditors providing debt finance to both Network Rail and other parties.

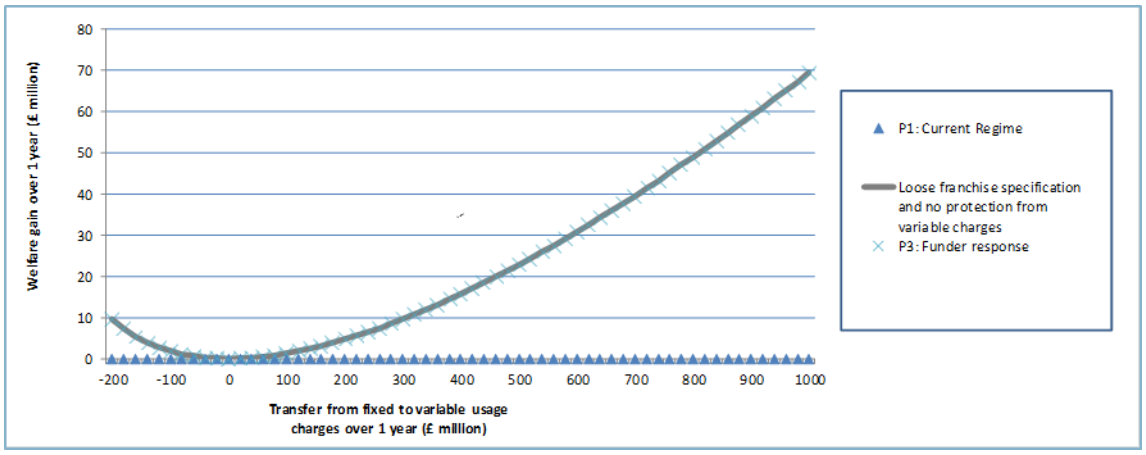
In our view, the types of decisions made by all these parties fall into six principal areas, which we list in the table below.

Decision area	Are Network Rail's costs relevant to the issue?		Decision-making process
Appropriate level of Network Rail's outputs	✓	Comparing the costs and benefits of outputs, and where necessary the availability of funds (SoFA)	Development of HLOS and SoFA ORR's regulatory determinations
Appropriate level for Network Rail's allowed revenues	✓	Determining Network Rail's efficient costs, including operating, maintenance and renewals costs as well as the cost of finance	
Appropriate use of existing capacity and capability in the short term	✓	Understanding of Network Rail's variable costs: • Short term: operations and maintenance • Longer term: renewal	Operator and funder decisions on use of the infrastructure
Appropriate use of existing capacity and capability in the long term	✓	Understanding, allocating and apportioning Network Rail's fixed costs to services and parties	Assessment of costs of provision of franchises and groups of services (which may increase with devolution of policy decision-making)
Appropriate capacity enhancements	✓	Understanding Network Rail's enhancement costs: • To optimise efficient investment • To allocate or apportion enhancement costs	Operator and funder decisions on expansion and enhancement
Appropriate allocation of capacity	✓	Understanding costs of capacity provision at the margin Understanding operators' opportunity costs might also be required	Network Rail and ORR decisions on capacity allocation

Transmission mechanisms

Some elements of Network Rail's costs are sufficiently well understood that they are captured in access charges, although these vary in the extent to which they are intended to incentivise behaviour in response to cost information rather than simply recover a particular category of costs. Other cost information is communicated directly, in the sense that cost estimates are prepared in order to directly inform a given decision, for example through their inclusion in a commercial business case prepared by a train operator or an economic appraisal undertaken by a transport authority. Hence, the benefits of improved cost information do not derive solely from the use of access charges as a transmission mechanism, although a thorough understanding of cost drivers is a precondition for the development of a charging structure that more accurately reflects underlying costs.

Nevertheless, in order to illustrate the potential benefits of using charges as a means of transmitting cost information to decision-makers, we have undertaken a quantitative estimate of the possible magnitudes of the welfare gains that could be achieved if the current variable-fixed charge balance was incorrect and was rebalanced to the correct proportions. The methodology, which has been applied separately for passenger franchise, open access and freight operators, together with the results, are described in detail in Appendix B. An illustration of the results for franchise operators is shown in the figure below.



The figure shows how the estimate of economic welfare changes with the assumption about the correct balance of fixed and variable charges relative to the current position. The value of zero on the horizontal axis represents the assumption that the current position is fully reflective of the underlying balance between fixed and variable costs. As the assumption changes, such that an appropriate balance would result in an increase in revenue raised through variable charges, the estimated welfare gain also increases. For example, if it were the case that the balance between fixed and variable charges were incorrect such that some £600 million of revenue should transfer from the former to the latter (reading along the horizontal axis), the implied welfare gain from rebalancing charges in this way would be approximately £30 million per year (reading along the vertical axis). This suggests that the value from correcting the balance could be considerable over the long term, although much depends on what the appropriate balance is considered to be and other assumptions set out in Appendix B[1].

Rail sector case studies

We have defined a number of broad types of decision within the rail industry and, in discussion with ORR, identified one or two examples of projects or schemes illustrating how cost information, or a lack of it, can affect decision-making in practice. In each case, we have prepared a short case study, seeking to describe, in qualitative terms, the benefits that could have been achieved through a better understanding of Network Rail's costs. Where possible, we have also sought to quantify these benefits, although this analysis was necessarily limited and subject to qualification given the information available to us. The results of our analysis of benefits is summarised in the following table.

[1] The analysis is based on the assumption that both the elasticity of demand for track access with respect to track access charges and the marginal cost of capacity provision are constant. This allows the derivation of an algebraic expression for the welfare gain arising from a movement to the 'correct' level of variable access charge whereby welfare is a function of the demand elasticity, marginal cost and the current access charge.

Decision type	Case study	Issue	Opportunity	Estimate of potential cost saving
Network enhancement	GWML electrification: choice of branches	Branches may have been included without robust incremental case	More granularity of options to identify those with poor or zero marginal BCR	£50-100 million per Control Period (across the network)
	Northern Hub and northwest electrification	Identification of all the consequential costs of the scheme appears to have been problematic	More detailed investigation of the cost implications of specific proposals for service enhancements	Not estimated, although level of cost overrun suggests significant potential
Station capacity enhancement	Reading station redevelopment	Some elements of expenditure may not be needed to deliver the required operational functionality	Identification of specific costs of meeting operational requirements and explicit costing of incremental improvements to station environment	Not estimated, although additional enhancement costs could be significant proportion of total scheme costs
	Station enhancements at Oxford	Business cases may have been based on poor estimates of station costs	Clearer identification of incremental requirements to specific service proposals	£15 million per Control Period (individual scheme)
Rolling stock procurement	Class 444/450s on Wessex routes	Inaccurate VUC may mean that choice of stock was sub-optimal	Better reflection of maintenance and renewal costs resulting from new rolling stock in VUC, resulting in more efficient procurement decisions	£60 million per Control Period
Rolling stock deployment	Mk III v Mk IV stock on ECML	VUC charges averaged across the network may provide perverse incentives on one route	Direct comparability of variable costs of alternative stock operating the same service	£25 million
Service enhancement	Services, Knottingley to Wakefield Kirkgate	Initial analysis based on poor information on the costs of adding a passenger service on freight-only lines. Network Rail and the operator also had insufficient information incentivise efficient decisions	Regular reviews of value for money of retaining lines with only lightly-patronised services	£30,000 per annum (individual scheme – potentially greater depending on scope for line and station closure)
Total				**£100-200 million per Control Period**

In summary, taken together, these case studies highlight a number of opportunities where improving the understanding of Network Rail's costs could have benefits. These include:

- More **geographical disaggregation of the scope and costs of major enhancements** through the definition of options for enhancing different parts of a wider route, taking account of the need to integrate the planning of electrification, signalling and other works at a more granular level;
- A more **rigorous definition of the scope of an enhancement** programme, specifying increments to a base programme that are aligned with options for service improvements required by stakeholders;
- A more **disciplined approach to the allocation of costs to distinct enhancement projects**, particularly where these are related but developed and implemented according to different timescales and with a view to achieving distinct outcomes;
- Ongoing **improvements to the estimation of track maintenance and renewal costs**, based on thorough investigation of the impact of rolling stock operations and taking account of the effects of operating speeds as well as network geography; and
- More **rigorous allocation of costs to groups of services**, recognising the impact of operations on both short run and long run costs.

These opportunities, if realised, would in turn benefit the further development of the railway in a number of ways. While it is not possible to quantify this benefit with confidence, since it depends on the evolution of the policy, regulatory and financial framework over an extended period, it is likely to be substantial. The potential impact of these various improvements on different aspects of industry activity is summarised in the table below.

Industry activity	Benefitted by:					Summary of impact
	Geographical disaggregation of scope/ cost of enhancement	Rigorous definition of scope of enhancement	Disciplined approach to allocation of costs between enhancements	Improvements to estimation of track maintenance/renewal costs	Rigorous allocation of costs to groups of services	
Franchise specification	✓	✓	✓	✓	✓	DfT would specify franchises with a full understanding of the underlying costs, including the costs of any supporting enhancement programmes.
Franchise bidding		✓		✓	✓	Bidders would respond more effectively to a franchise specification if the costs were defined and understood clearly at the earliest possible stage. If captured in track access charges, more accurate cost information would support more efficient decisions on rolling stock deployment and operation of new services.
Cost efficiency initiatives	✓	✓	✓	✓	✓	All parties would be in a better position to identify realistic efficiency improvements if the base level of operating, maintenance, renewals and enhancement costs were better defined. Options for joint efficiency initiatives would also be clearer.
Investment in enhancements	✓	✓	✓		✓	The quality of both scheme appraisals and commercial business cases would increase, improving both government and private-sector decision-making.

Industry activity	Benefitted by:					Summary of impact
	Geographical disaggregation of scope/ cost of enhancement	Rigorous definition of scope of enhancement	Disciplined approach to allocation of costs between enhancements	Improvements to estimation of track maintenance/renewal costs	Rigorous allocation of costs to groups of services	
Devolved funding decisions	✓	✓	✓	✓	✓	The allocation of funding required to support rail services at the regional and local level would be clearer. Stakeholders would have a better understanding of how public funding of the railway was distributed.
Balance of fares and subsidy	✓	✓	✓	✓	✓	A better understanding of the levels of subsidy provided at the regional and local level would enable a more informed debate about the appropriate balance between fare payer and tax payer funding.
Commercial strategy				✓	✓	Commercial decisions of franchised, open access and freight operators would be better informed, with services provided taking better account of underlying costs. This could become a more important consideration if franchised operators were given more flexibility to specify services in the future.
Innovation	✓	✓	✓	✓	✓	The value of innovations intended to reduce costs, increase capacity or improve the allocation of capacity would be clearer.

Experience in other sectors

We have also investigated how the understanding of costs in other regulated and non-regulated sectors has been improved. The results are set out as a series of case studies, reported in full in Appendix A. A number of key studies, which in our view may be particularly relevant for the rail industry, are summarised in the table below.

Case study	Summary	Potential for application to rail
Case Study A: **understanding demand-side** in the water industry	Collecting information on the value that customers of water and sewerage services place on an improved service such as reduced sewer flooding has allowed the regulator to design an incentive regime that focusses on these outcomes.	In rail, where key outputs are specified by government on behalf of the taxpayer, collection of information on the value to customers of specific improvements by Network Rail may be better undertaken as part of the HLOS process. Nevertheless specific valuation exercises, sponsored by DfT or Network Rail, could be made more explicit and used to inform the Initial Industry Plan as well as HLOS. They could also be undertaken by Network Rail to determine the value placed on particular improvements by freight and open access operators.
Case Study E: **constructive engagement** in the Australian rail industry	The rate of return that was agreed by the parties involved was greater than that which the regulator (ACCC) initially deemed appropriate. This outcome was achieved through a more secure service in return for the higher cost of accessing the service.	Again, there is arguably a rail sector analogy to constructive engagement in the HLOS process, which involves extensive engagement between DfT and Network Rail prior to publication of the HLOS. At the same time, there may be scope for additional engagement between Network Rail and commercial operators (passenger and freight) in order to determine the value that they place on specific improvements of value to them.
Case Study F: **unit costs** in Healthcare	Generating an improved understanding of the unit costs of treatments has allowed providers to be rewarded by commissioners on the basis of each service provided. In principle, it was expected that as the price that they would receive for completing a particular treatment would be fixed and they would be able to retain and invest any surpluses, this would incentivise improvement in efficiency through reduced costs going forward. In practice, however, it is not yet clear whether the regime has led to efficiencies.	Network Rail could be remunerated on a per-activity basis according to defined unit costs. This would require the definition of standard activities, which could be challenging in practice, although unit rates could be permitted to vary across routes or other geographical areas. Note, however, that as the efficiency benefits of this approach in healthcare have not yet been fully demonstrated, movement to such a regime in rail would appear to be premature. Nevertheless, the approach could have useful applications through the introduction of transfer pricing, discussed further below.
Case Study L: **Long Run Avoidable Costs** in ports	The proceedings of a public inquiry into Dover Harbour Board's tariffs in 2011 emphasised that the LRAC of a group of services (in this case ferry operations) provides an estimate of the savings that would be made if the group of services were ceased. It therefore provides an indication of the methodology that could be pursued to derive analogous charges in a rail context.	LRAC could be applied to allocate the costs of the existing network to individual franchises or groups of services. This would require the identification of the costs that would be saved if well-defined groups of services were removed from the network. The approach has already been used in the rail industry to determine Railtrack's vesting charges at privatisation, although its application in that case proved relatively onerous.

Case Study R: **transfer pricing** in German firms	Wolff (2007) found that an internal transfer pricing system increases efficiency. He explains that "an increase in efficiency can be achieved firstly by increasing the internal efficiency pressure and secondly by a potential improvement in short and medium term allocation decisions."	Transfer pricing could be applied within Network Rail in order to encourage different parts of the organisation to source services from the most efficient provider. For example, Network Rail Routes , operating as commercially-focused profit centres, could buy and sell maintenance services with a view to exerting competitive discipline on in-house maintenance teams. These transfer prices would need to be fully cost reflective, which would itself require a better understanding of costs at the Route level.

Future scenarios

The benefits of a better understanding of Network Rail's costs will depend partly on the policy and regulatory environment, and in particular on the extent to which different parties can respond to improved cost information through changes to their investment programmes, the level and quality of service delivery and the approach to operations. It follows that the measures for improving cost information identified above might be more or less effective depending on the evolution of the policy framework. In discussion with ORR, we have identified a number of possible future industry scenarios that could change the relationship between improved cost information on the one hand and improved decision-making on the other. These are discussed in more detail in Appendix C.

1 Introduction

Background

1.1 As part of its preparation for the periodic review prior to Control Period 6 (CP6), the Office of Rail Regulation (ORR) has begun to review the structure of Network Rail's costs, charges and incentives. It regards the current structure of charges as sub-optimal for a number of reasons, in particular:

- Most of the charges and incentives do not take into account local variations in costs and there is also a lack of transparency about how costs vary at local level;
- A large proportion of Network Rail's costs are treated as fixed costs and are not attributed between operators according to which operators' services drive costs; and
- The charges and incentives do not fully incentivise Network Rail to allocate or expand capacity optimally.

1.2 To help inform decisions on possible changes to the charging structure, ORR wishes to identify, and as far as possible quantify, the benefits of an improved understanding of Network Rail's costs. Accordingly, in December 2014 it issued an Invitation to Provide a Proposal (IPP) for a study entitled "Identifying the benefits of an improved understanding of Network Rail's costs and cost drivers", which Steer Davies Gleave were subsequently appointed to carry out. The study has been undertaken in parallel with other work on the future of the rail industry, and the role of cost information and charges within it, which is being undertaken by the Department of Transport (DfT), the Rail Delivery Group (RDG) and Network Rail.

Our approach

1.3 We have focused on the ways in which knowledge of costs, whether expressed through charges or not, inform and influence decisions made across the industry. Our methodology comprises four key elements as follows:

- Identification of a number of types of decision and decision-maker that are influenced by information on costs and cost drivers, and consideration of the effectiveness of the various transmissions mechanisms through which cost information is currently communicated (see Section 2);
- The preparation of a number of case studies of decisions in the rail industry in Great Britain, with the aim of determining, and where possible quantifying, the impact that better cost information might have had on the outcome (see Section 3);
- A review of measures (mainly regulatory), including changes to the structure of charges, applied in other, primarily network-based, industries, with the aim of improving cost information and/or price signals, and an assessment of the outcomes (see Section 4); and

- Drawing on the case study analysis and review of experience in other sectors, consideration of the opportunities for improving decision-making within the GB rail industry through an improved understanding of costs and cost drivers (see Section 5).

1.4 More detailed explanation and information supporting different elements of our approach can be found in the following appendices:

- In Appendix A, we provide more detailed information on other sectors, organised as a series of case studies;
- In Appendix B, we describe our methodology for quantifying the benefits of changing the balance between fixed and variable track access charges, based on an application of economic welfare analysis;
- In Appendix C, we set out a number of possible future scenarios in which improved cost information could inform decision-making; and
- In Appendix D, we list the principal sources of information on experience in other sectors.

1.5 PwC has supported SDG in undertaking this work, specifically contributing towards the welfare analysis and case studies from other sectors. SDG takes full responsibility for the content of this report and all views expressed herein are those of SDG and are not necessarily those of PwC. PwC accept no liability (including for negligence) to anyone else in connection with this report.

1.6 This document has been prepared only for the Office of Rail Regulation and solely for the purpose and the terms agreed with the Office of Rail Regulation in our agreement dated 16 January 2015.

2 Decision-making in the rail industry

How costs inform decisions

Key decisions and decision-makers

2.1 Any organisation concerned with improving its efficiency will seek a better understanding of its cost base, and in particular of the way in which its costs change with the level and quality of outputs. In Network Rail's case, further investigation of its costs and cost drivers will be central to securing further efficiency gains in successive Control Periods. More specifically, the identification of the relationship between network use and required levels of operational resource, maintenance and renewals will enable Network Rail to plan more effectively to meet both the High Level Output Specification (HLOS) determined by DfT and the regulatory targets set by ORR. At the same time, analysis of the costs of particular enhancement schemes, while they are invariably bespoke to the scheme in question, will enable better planning of future investment programmes.

2.2 In addition, a better understanding of rail infrastructure costs will also help to inform a wide range of decisions taken by other parties. Key decision makers requiring robust cost information include the following:

- **DfT and other transport authorities:** while in principle, the HLOS process only requires DfT to specify outputs, leaving Network Rail and other industry parties to determine the inputs needed to deliver the specification, in practice the development of the HLOS must be informed by a thorough understanding of costs and cost drivers. This enables DfT to define an HLOS that can be realistically achieved given the Statement of Funds Available (SOFA) for the control period. In addition, the specification of franchises requires a thorough understanding of infrastructure and other costs. Similar arguments apply in respect of other transport authorities providing funding for rail schemes and specifying rail services at the regional and local level.
- **ORR:** under the well-established building block approach to periodic reviews of access charges, ORR must develop a thorough understanding of operations, maintenance, renewals and enhancement costs in order to determine Network Rail's revenue requirement. This has typically involved a thorough and detailed review of the infrastructure manager's proposals for resourcing and efficiency improvements as well as benchmarking against the normalised costs of other rail industries across Europe. Under route devolution, it will increasingly involve comparison of costs across different route organisations within Network Rail. In addition, in setting the structure of access charges, ORR must have a clear understanding of underlying cost drivers if the framework of charges, including the balance between fixed and variable charges, is to be as cost reflective as possible.

- **Passenger and freight operators:** all train operators require information on the costs of infrastructure access when planning new services. The majority of such costs are communicated via charges set at each periodic review for the duration of the subsequent five-year Control Period, and which vary according to factors such as the type of rolling stock and the intensity with which particular parts of the network are used. However, some costs, for example the costs of relatively minor modifications to the infrastructure to deliver necessary line speed improvements, are specific to the new service proposals in question and are not captured by regulated access charges.
- **Rolling stock providers:** rolling stock leasing companies (ROSCOs) and train manufactures need to understand the costs incurred as a result of the operation of their trains on the network, including wear and tear costs and any costs of electricity consumption used for traction. The trade-off between minimising these costs on the one-hand, and improving train performance characteristics such as speed and acceleration on the other, is a critical consideration in the specification of new rolling stock.
- **Other suppliers:** third party suppliers of various kinds, for example renewals contractors, must similarly understand the impact of their products, working methods and programmes on Network Rail's costs in order to plan their activities efficiently. This can require investigation of the trade-off between the costs that they incur and those arising from activities directly managed by Network Rail. The trade-off is particularly important in determining the appropriate balance between renewals and maintenance expenditure, which must be optimised over the life of the assets in question rather than minimised in isolation.

2.3 In our view, the types of decisions made by all these parties fall into six principal areas, which we list in the table below.

Table 2.1: Principal opportunities to make use of an understanding of costs

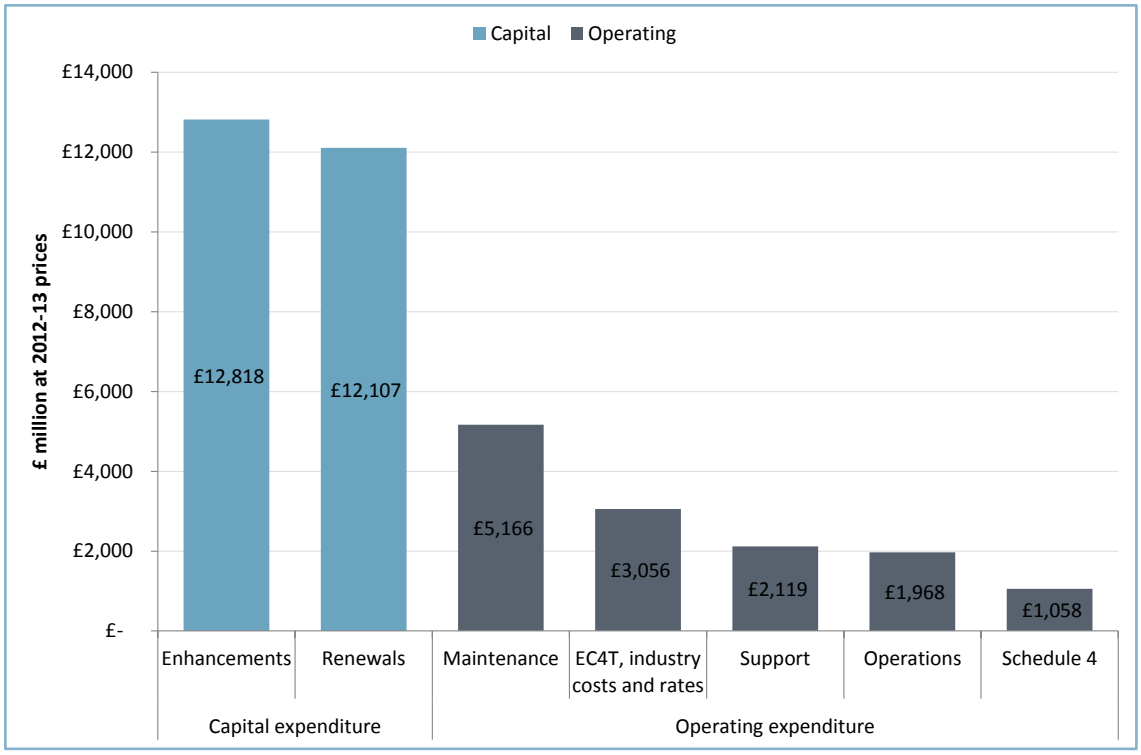
Decision area	Are Network Rail costs the issue?	Decision-making process
Appropriate level of Network Rail's outputs	Comparing the costs and benefits of outputs, and where necessary the availability of funds (SoFA)	Development of HLOS and SOFA ORR's regulatory determinations
Appropriate level for Network Rail's allowed revenues	Determining Network Rail's efficient costs, including operating, maintenance and renewals costs as well as the cost of finance	
Appropriate use of existing capacity and capability in the short term	Understanding of Network Rail's variable costs: • Short term: operations and maintenance • Longer term: renewal	Operator and funder decisions on use of the infrastructure
Appropriate use of existing capacity and capability in the long term	Understanding, allocating and apportioning Network Rail's fixed costs to services and parties	Assessment of costs of provision of franchises and groups of services (which may increase with devolution of policy decision-making)
Appropriate capacity enhancements	Understanding Network Rail's enhancement costs: • To optimise efficient investment • To allocate or apportion enhancement costs	Operator and funder decisions on expansion and enhancement
Appropriate allocation of capacity	Understanding of costs of capacity provision at the margin Understanding of operators' opportunity costs might also be required	Network Rail and ORR decisions on capacity allocation

The structure of Network Rail's costs

2.4 As highlighted in the table, taken together the decision areas identified require an understanding of Network Rail's entire cost base, including both operating and capital expenditure. At the same time, we note that capital expenditure accounts for some 65% of Network Rail's total efficient expenditure for CP5, as shown in the figure below. More specifically, expenditure includes:

- £12.8 billion of capital expenditure on enhancements to network capacity and capability, of which 30% (£4 billion) relates to electrification and 25% to Thameslink and Crossrail;
- £12.1 billion of capital expenditure on renewals of existing assets; and
- £13.4 billion of operating expenditure on a range of activities.

Figure 2.1: ORR's Final Determinations for CP5



Source: ORR "Final determination of Network Rail's outputs and funding for 2014-19 – Summary"

2.5 This suggests that an improved understanding of renewal and enhancement costs, which would support more effective decision-making in the development of the HLOS as well as in the determination of Network Rail's required revenue and access charges, is likely to be particularly beneficial. Nevertheless, better information on the relationship between maintenance and operating costs and the type and scale of train service operated could be expected to have a significant impact on the efficiency with which the current network is used. More generally, there is a need to understand the implications of a range of different changes to services for infrastructure costs in both the short and long term.

2.6 One approach to understanding how costs change with outputs is to estimate the potential cost savings resulting from the withdrawal of a defined service or group of services. This avoidable cost approach to the investigation of cost drivers is already applied in determining the costs of freight only lines, and in principle could be used to establish the relationship between costs and service levels more generally. By way of example, Table 2.2 summarises

the potential impact of different levels of service reduction on infrastructure costs over the short and long term.

Table 2.2: Examples of service reductions and their impact on Network Rail costs

Impact on operations	Size and timescale of change which may drive a change in costs
Reduced electricity consumption	Short term, if a single train not operated, or operated more efficiently
Elimination of signal box shift	Short term, if services are reduced so that one fewer shift is needed
Individual siding, loop or section of track and associated infrastructure no longer required	If not required: • Short term savings in maintenance • Long term savings in maintenance and renewals
Station platforms, connecting subway and lighting and security no longer required	If platforms no longer needed: • Short term savings in lighting and security • Long term savings in provision of facilities when station replaced
Station no longer required	If all operations cease: • Short term savings in lighting, security and some maintenance • Long term savings in remaining maintenance if demolished or sold
Branch line no longer required	If all passenger and freight operations cease: • Short term, maintenance and station operating cost savings • Long term, savings through rationalisation of track and signalling and removal of high maintenance structures

Source: Steer Davies Gleave analysis

2.7 At one extreme, electricity consumption varies in a predictable way with the number of trains operated, their formation and speed, and the additional electricity cost of changes to any of these variables can be predicted as well as metered with considerable accuracy. At a higher level of granularity, provision of earlier or later services on a rural branch line may require providing an extra shift at a signal box, with the associated payroll or overtime costs readily identifiable. At the other extreme, closure of an existing branch line may result in only limited savings in maintenance costs in the short term, since it may not be cost effective to disconnect and isolate track, signalling, electrification and communications equipment until it has deteriorated to the point where a major intervention is needed, which may take several years. In these circumstances, substantial reductions in Network Rail costs may only be possible in the medium to long term as assets can be rationalised or removed.

2.8 Note that either later reversal of these service reductions, or service increases, would produce a different set of cost changes over different timescales:

- Additional electricity consumption, signalling staff, operations and maintenance costs, which would be incurred immediately or shortly after the associated increases in levels of service; and
- Potentially, the capital costs of expanding an existing station or building a new station or branch line, which would be incurred before the associated increases in levels of service.

2.9 Taken together, these examples demonstrate the importance of understanding Network Rail's operations, maintenance and renewals costs and cost drivers at a variety of levels and over a variety of timescales. They also highlight the challenges in applying conventional economic pricing principles such as long run marginal cost pricing to the rail sector.

Transmission mechanisms

2.10 A better understanding of costs will not, in itself, result in any benefits unless it informs a decision which, as a result, delivers either improvement in a Network Rail output or an industry outcome for a given level of costs, or reduction in cost for a given Network Rail output or industry outcome. In either case, cost information must be communicated to decision-makers via a transmission mechanism, which can take one of two principle forms:

- A price signal resulting from cost information being reflected in one or more regulated charges for access to infrastructure; or
- Specific cost information relating to a particular decision to operate a given service, or enhance capacity in order to accommodate future service changes.

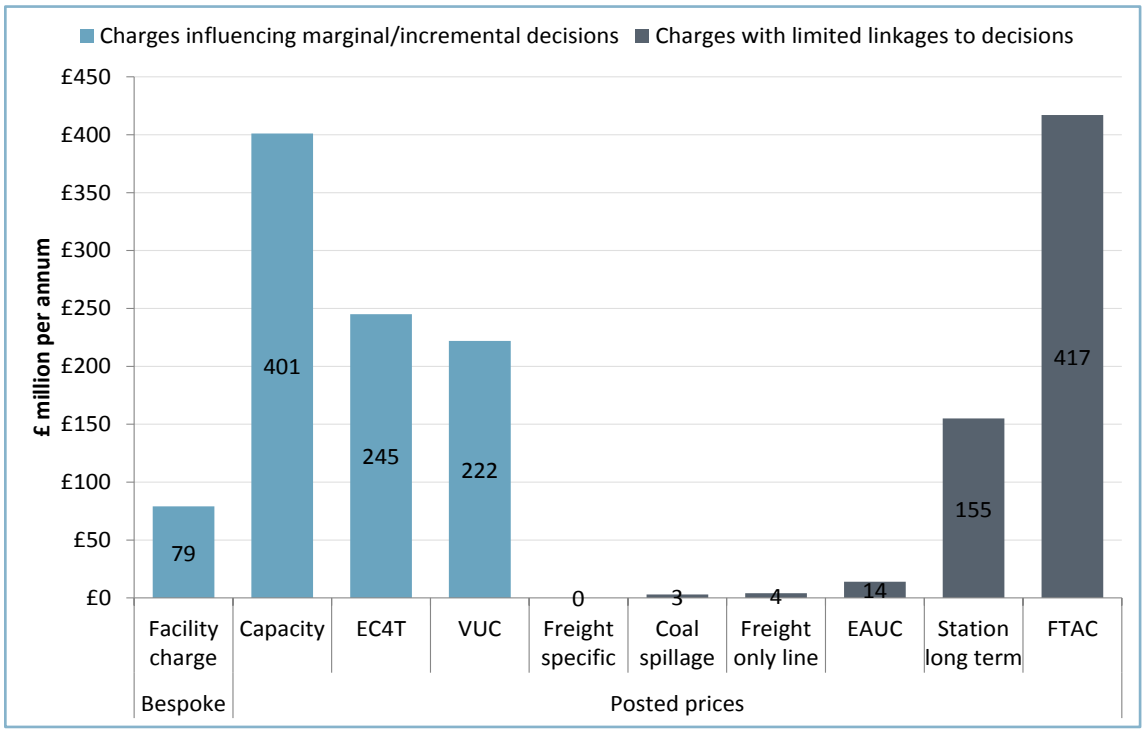
2.11 Accordingly, as required by our terms of reference, we have considered both 'incentive benefits' of improved cost information, driven by the potential to improve price signals faced by different decision-makers, and broader 'informational benefits' derived from the more general improvement in the understanding of cost drivers. Our approach recognises that an understanding of costs may inform, but need not determine, charges and that both costs and charges may inform, but need not determine, decisions and outcomes.

Use of charges as a transmission mechanism

The current structure of charges

2.12 Some elements of Network Rail's costs are sufficiently well-understood and amenable to ex ante analysis that they can be converted into published access charges. Figure 2.2 summarises revenue from forecast charges for 2014-15 and provides an indication of which charges have the greatest impact on decision-making. Note that the FTAC revenue is shown net of the Network Grant, as discussed further below.

Figure 2.2: Network Rail's forecast revenue from charges for 2014-15 (2013-14 prices)



Source: Steer Davies Gleave analysis

2.13 As indicated, a number of charges provide useful price signals. For example, the Variable Usage Charge (VUC) and Electric Current for Traction (EC4T) charges mean that changes in the number of trains operated result in direct changes in operators' costs. VUC and EC4T charges also influence operators and ROSCOs in the specification, and manufacturers in the design, of trains. In addition, while the capacity charge is averaged over a service code and "lagged" in its effect (capacity charges per service code are based on the actual congestion-related reactionary delay, averaged over a service code, in the preceding Control Period), operators have nevertheless reported that the charge is taken into account in developing proposals for new services.

2.14 While other charges have been developed over a long period on sound economic principles, they do not reflect the relationship between a specific category of costs and outputs. In particular, we note that the Fixed Track Access Charge (FTAC) is currently calculated as a residual, effectively ensuring that access charge revenue is sufficient to meet the overall net revenue requirement after taking account of the direct grant paid to Network Rail by DfT. It is then reduced, on a pro rata basis, by the value of the Network Grant. However, this does not mean that FTAC and similar charges, or modifications of them, might not reflect underlying cost drivers in the future.

The effects of changing the balance between fixed and variable charges

2.15 In order to illustrate the potential benefits of using charges as a transmission mechanism, we have undertaken a quantitative estimate of the possible magnitudes of the welfare gains that could be achieved if the current variable-fixed charge balance was incorrect and was rebalanced to the correct proportions. The analysis focuses on internal costs, rather than external costs such as congestion.

2.16 While the application of both variable and fixed charges in the rail industry has a strong foundation in economic theory[2], there has been continued debate about whether the current balance between fixed and variable charges in terms of their respective contribution to cost recovery is appropriate. There may be a number of reasons why current variable charges, and consequently the level of fixed charges, may deviate from the economically appropriate levels, including (but not limited to) the following:

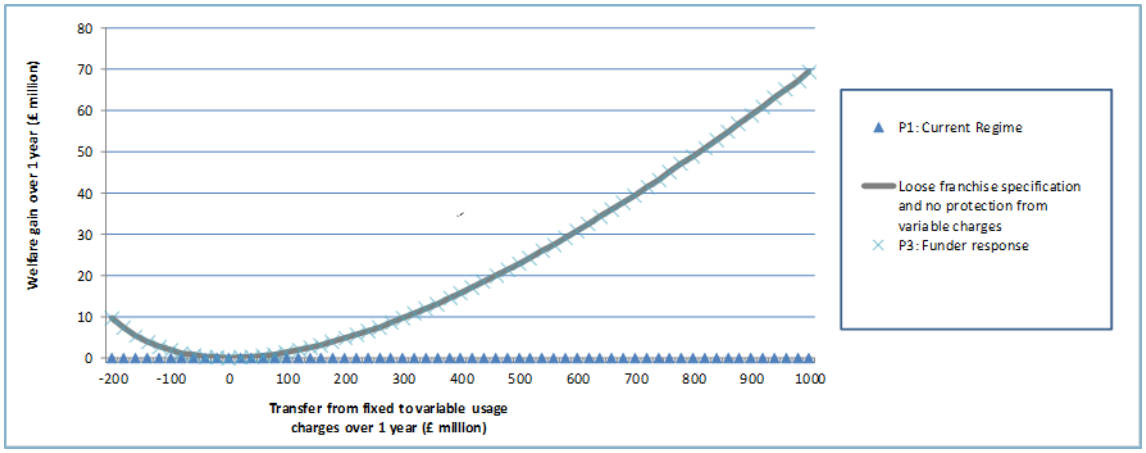
- Available cost information and modelling may not permit the determination of marginal cost with accuracy; and
- Variations in costs with geography are not fully reflected.

2.17 If variable charges for railway access deviate from the appropriate or 'true' marginal costs, resulting in an inappropriate balance between variable and fixed charges, economic theory suggests that, depending on demand and supply conditions, a welfare loss may arise. For example, if variable access charges were set below true marginal costs, demand would be 'too high' and it would cost Network Rail more to accommodate some services than the benefits enjoyed by train operators of running those services. It follows that if variable charges are not at the correct levels, then welfare gains can be generated by adjusting Network Rail's charging structure and changing the balance between fixed and variable charges.

[2] Multi-part prices, which include fixed and variable components, are a means of preserving the efficiency benefits associated with marginal cost pricing while ensuring the full recovery of costs. Under simple marginal cost pricing, cost recovery is not possible in circumstances where the organisation concerned is characterised by fixed costs.

2.18 We have estimated the potential welfare gains arising under different assumptions about the 'correct' balance between fixed and variable charges for freight, franchised passenger and open access operators. The methodology and results are described in detail in Appendix B and an illustration of the results for passenger franchise operators is shown in the figure below.

Figure 2.3: Passenger franchise welfare gains



2.19 The figure shows how the estimate of economic welfare gains from correcting charges varies with the assumption about the correct balance of fixed and variable charges relative to the current position. The value of zero on the horizontal axis represents the assumption that the current position is fully reflective of the underlying balance between fixed and variable costs. As the assumption changes, such that an appropriate balance would result in an increase in revenue raised through variable charges, the estimated welfare gain also increases. For example, if the appropriate balance of fixed and variable charges involved some £600 million of revenue transferring from the former to the latter, the implied welfare gain for the franchised passenger network would be approximately £30 million per year (the analysis in respect of freight and open access operators is contained in Appendix B).

2.20 Note that this analysis does not provide an estimate of the correct balance between fixed and variable charges. However, it does suggest that if the current balance is incorrect, such that the proportion of revenue generated by variable charges is too small, the gains from moving towards a more appropriate balance could be considerable. If it were appropriate to shift £1,000 million of revenue from fixed to variable charges this would, for example, deliver welfare gains of £350 million over a Control Period.

Identification of rail industry cost drivers

2.21 Regardless of whether cost information is communicated through access charges or more directly, the effectiveness of the transmission mechanism will depend on how far it correctly captures the underlying relationship between rail industry outputs and costs. This, in turn, requires a thorough understanding of the different relevant cost drivers defining, in particular:

- How costs vary with geography; and
- How costs vary with the scale of output, as measured, for example, by the number and type of services operating over a given part of the network.

2.22 The identification of these relationships raises a number of issues that must be taken into account in considering how cost information informs decision-making in practice. These are summarised in the following paragraphs as a precursor to the discussion of specific decisions in the next section.

Geographical differentiation between costs

2.23 A common observation in the discussion of rail infrastructure costs is that these should be specific to a particular geography. In general, the impetus for reflecting geography of location relates to the need to improve the mapping between costs and at least one of the following:

- An individual service group, service code, line or station;
- An operator or funding body such as a Local Enterprise Partnership (LEP); and
- An administrative region.

2.24 As an example of this last point, on 19 January 2015 the House of Commons Transport Select Committee recommended:

"a fairer allocation of rail investment across the country; other regions, such as the far south west, have been "starved" of investment".

2.25 This statement appears to be based, at least in part, on the current allocation of Network Rail's costs. In practice, however, differentiating costs according to geographical location can be challenging, since much depends on the definition of the geography in question. For example, while costs will vary geographically where they relate to specific local assets, associating an asset unambiguously with either a location or a cost may be problematic, for two reasons:

- First, some assets may serve infrastructure over a wide area, requiring some process of allocation or apportionment of their costs to locations and services they control. By way of illustration, the Hitchin flyover, constructed to relieve congestion at the Welwyn viaduct on the East Coast Mainline, benefits a number of services operating to different parts of the country. Hence, the costs of the asset could be allocated to a number of different geographies depending on the allocation approach taken, as illustrated in Table 2.3.
- Second, many older assets will be fully depreciated and valued only as part of the asset base assigned to Railtrack, and subsequently to Network Rail, on respective creations. The outturn cost of new assets is identified and, where appropriate, included in Network Rail's Regulatory Asset base (RAB), but a station built in 1850, for example, will have no specific net book value in Network Rail's accounts. Valuation on the basis of Modern Equivalent Asset Value (MEAV) is possible, which would in principle require a detailed construction cost estimate for each asset. A more practical alternative would be to prepare broad average estimates of the typical costs of different asset categories, possibly with some adjustment for regional or local variations in the costs of land and construction prices, although the value of such an alternative relative to the current approach would need to be considered.

Table 2.3: Allocation of the costs of the Hitchin flyover

Allocation approach	Implied geographical allocation of cost
Location of congestion problem	East of England
Location of solution	East of England
Stations at which services benefitting from asset call (as indicated by LENNON data)	A wide range of stations between Inverness and Brighton
Passengers benefitting from asset (as indicated by MOIRA, crowding models)	Passenger flows across the national network

Source: Steer Davies Gleave assessment

2.26 Similarly, the costs of operating and maintaining assets can in principle be identified and associated with their location, subject to the need to average in at least one of two ways:

- Over time: for assets requiring little or no attention for a number of years, actual expenditure may be zero in many years, or over an entire Control Period, and costs must necessarily be based on a medium to long term past, or forecast future, average rate of expenditure.
- Over geography: for much routine maintenance, such as track patrolling or fence repairs, a number of elements of infrastructure may be dealt with in a single shift, and costs must be apportioned to them on some basis.

2.27 Further, Network Rail's costs can be driven according to how particular assets are used, which may also vary by location. For example, the short run costs of track usage vary not only with the type and condition of the track and the characteristics of the rolling stock operating on it, but also with the speed of the rolling stock. While this information is known, it can vary over time with changes in line speeds introduced to enable modifications to the timetable, with the result that cost estimates may need to be recalculated periodically.

Variability of costs

2.28 As noted above, many of Network Rail's current charges are based on short run costs although, as Table 2.2 suggests, more costs are likely to be variable in the longer term. In practice, while methods to identify the drivers of costs over the long run are available, the data recording how costs have historically changed with the extent and capability of the infrastructure are limited. This means that, while it may be possible to demonstrate that a given category of costs is determined in part by a particular cost driver, estimated average changes in cost associated with a given change in outputs may differ substantially from the actual marginal or incremental change at any given location or time. Nevertheless, in view of the potential welfare benefits of recognising the likely variability of costs in the long run, as discussed above and in Appendix B, there is a strong case for further investigating this relationship with a view to informing a wide range of investment and operational decisions across the network.

3 Case studies of decision-making in the rail industry

Overview

3.1 In discussion with the ORR, we have identified a number of case studies illustrating the potential impact of inadequate cost information on rail industry decision-making. These cover a range of types of decision, and are summarised in the table below. In the following paragraphs we provide, for each case:

- Some background on the decision;
- The identity of the decision maker and the type of decision;
- A discussion of the opportunity to improve cost information and a summary of what an improved understanding of costs might involve;
- A description and, where possible, a quantification of the benefits of a better understanding of costs; and
- A brief discussion of the potential costs of improving cost information.

Table 3.1: Selection of rail case studies

Decision category	Proposed case study	Issues and notes
Network enhancement	GWML electrification: choice of branches	Branches may have been included without robust incremental business case
Network enhancement	Northern Hub and northwest electrification	Identification of all the consequential costs of the scheme appears to have been problematic
Station capacity enhancement	Reading station redevelopment	Some elements of expenditure may not be needed to deliver the required operational functionality
Station capacity enhancement	Station enhancements at Oxford	Business cases may have been based on poor estimates of station costs
Rolling stock procurement	Class 444/450s on Wessex routes	High VUC and impact on infrastructure may mean that choice of stock was sub-optimal
Rolling stock deployment	Mk III v Mk IV stock on ECML	VUC charges averaged across the network may provide perverse incentives on one route
Service enhancement	Services, Knottingley to Wakefield Kirkgate	Initial analysis had poor information on the costs of adding a passenger service on freight-only lines

3.2 Note that the discussion and quantification of benefits focuses on the potential for cost savings as a result of better information rather than the scope for increasing the level or quality of services. The quantification exercise is therefore likely to understate the benefits as it does not take account of the value to passengers and other stakeholders resulting from material changes to the service that might be expected to arise. It is further limited in that we have not been able to investigate a wide range of case studies or reliably extrapolate the

results of individual studies to give a value of potential cost savings for the industry as a whole. Hence, taken together, the estimates are at best an indication of the lower bound of the potential benefits of improved cost information.

Network enhancement: electrification of Great Western Mainline branches

3.3 This case study relates to the choices of branches to be electrified on the Great Western Main Line (GWML) in association with the replacement of the current High Speed Train (HST) fleet with Intercity Express Project (IEP) trains in either electric of bimode (electric or diesel) variants.

Background

3.4 Figure 3.1 gives an overview of the electrification scheme.

Figure 3.1: Great Western electrification plans

Source: Network Rail "Modernising the Great Western"

3.5 In June 2009, DfT put forward proposals for the electrification of at least part of the GWML and its branches to take advantage of the procurement of electric and bimode trains expected to operate on the East Coast Main Line (ECML). In the initial proposals, electrification was expected to cover the routes between London Paddington and Oxford, Cardiff, Bristol Temple Meads and Newbury. A year later, increased scrutiny led to a value for money assessment of different extensions. This gave rise to a new business case covering the related decisions on:

- An illustrative future timetable for the GWML and branches;
- The extent of electrification; and
- The size and mix of IEP fleet required to operate the timetable.

3.6 In July 2012, the Secretary of State for Transport published the HLOS for CP5, including a requirement to extend the scope of electrification to include the branches from Acton to Willesden, Slough to Windsor, Maidenhead to Marlow and Twyford to Henley-on-Thames. We have reviewed the cost information provided by Network Rail to inform the associated

business case, considering in particular the desirability of more disaggregate cost estimates to identify the incremental costs of electrification of individual branches, either as part of the main project or as standalone enhancements at a later date.

3.7 Figure 3.2 illustrates one of the ways in which decision-making may be poor, and costs may be excessive, when viable combinations of packages are not all considered. In this simplified example, there is an opportunity to introduce Package A, with costs of 5 and benefits of 6, Package B, with costs of 4 and benefits of 8, or both, with costs of 8 and benefits of 11. At first sight, all these Packages and combinations have benefits that exceed their costs, although it can be seen that Package B has a higher Benefit-to-Cost Ratio (BCR) than Packages A and B combined, which in turn have a higher BCR than Package A alone.

Figure 3.2: Inefficient investment through poor attribution of costs and benefits

Source: Illustrative example devised by Steer Davies Gleave

3.8 One way in which the decision-making process might proceed is by appraising Package A and noting that it has a BCR or 6/5, greater than one, and then appraising Package B as an increment, noting that it has in incremental BCR of 5/3, also greater than one, thereby apparently making the case for both Packages. However, if instead Package B is appraised first, giving a BCR or 8/4, greater than one, there is no incremental case for adding Package A, which has an incremental BCR of 3/4, less than one.

3.9 The efficient outcome of Package B alone will only be identified if the costs and benefits of all of Package A, Package B and Packages A and B are estimated on a consistent basis and the incremental costs and benefits of each Package given the other are correctly identified. In practice, this can happen either:

- Through failure to collect and understand the cost information; or
- Through failure to use the cost information correctly, such as assuming that Package A will come first and failing to estimate its BCR as an increment to Package B.

3.10 Where the different packages of services being added are independent of each other, the number of possible combinations of outcomes rises more than proportionately to the number of packages[3].

3.11 In the case of the branch line schemes investigated, we concluded that the cost data appeared to be insufficient to enable the comprehensive and systematic appraisal of options. This was highlighted by the proposed electrification of the branch from Maidenhead to Marlow, which includes reversal in the platforms at Bourne End station which can only accept two-car trains. In the absence of any proposal to buy two-car electric stock, it appears that this electrification will be unused unless a further infrastructure enhancement is made. The proposed investment is therefore prima facie not efficient at the margin, unless there is a reasonable prospect of future acquisition of suitable electric stock and the incremental costs of the electrification of the 7½ mile branch are small. However, we have found no evidence that cost estimates have been prepared at this level of disaggregation.

3.12 Referring to Figure 3.2:

- Package A, electrification without the Marlow branch, may have a BCR greater than one.
- Packages A and B, electrification with the Marlow branch, may have a BCR greater than one.
- Package B, as an increment on Package A, may have costs but no benefits, a BCR of zero.

Decision-maker and decision type

3.13 The decision-maker for the electrification of the Marlow branch is DfT, advised by its own IEP team and by Network Rail and its advisors as well as operators including First Great Western. The decision type is an enhancement: electrifying a branch line to increase network capability.

Opportunity

3.14 There is a lack of disaggregate information on the incremental costs of electrification of individual branches, either as part of the main project or as standalone enhancements at a later date. This means that it is not possible to determine whether the branch should be electrified as part of the main scheme, at a later date when suitable stock might be procured, or not for the foreseeable future.

3.15 The opportunity would be to develop more disaggregate estimates of the incremental costs of individual elements of the electrification programme based on the extent of electrification, the timetables that would be operated and the rolling stock that would provide them. This would, potentially, allow the removal of any elements of the overall programme for which the incremental costs exceed the incremental benefits. An improved understanding of costs would therefore involve:

- More detailed investigation of potential timetable and fleet options;
- Greater granularity in the costs of electrification to inform the investment decision; and
- Greater granularity in the costs of the associated rolling stock fleet including IEP.

[3] The number of outcomes rises as N! (N factorial, where N is the number of packages), of which one is the base case with no packages and hence N!-1 is the number of combinations which need to be appraised relative to the base case.

3.16 Accordingly, the benefits of an improved understanding would, potentially, be specification of a cheaper scheme with a higher BCR, releasing funds for other investment in the railway or elsewhere.

Quantification of benefits

3.17 We examined the cost data available with the aim of at least estimating the incremental infrastructure costs associated with the Marlow branch, but found that cost estimates had been estimated on an aggregate basis and then pro-rated on the basis of single track miles. The estimated cost of electrification work on all the branches is approximately £50 million, all of which is expected to be spent during CP5. If we assume that, in the absence of more granular information, half this expenditure is inefficient, then this suggests that the potential benefit of a better understanding of costs would be approximately £25 million on the Great Western Main Line. However, this represents only a portion of Network Rail's projected CP5 electrification expenditure of over £3 billion. Over the electrification programme as a whole, we indicatively estimate that a better understanding of costs might allow savings of £50-100 million over CP5, based on the assumption that the programme includes between two and four programmes where equivalent savings are possible.

Cost of obtaining benefits

3.18 We also considered the cost of obtaining these benefits in the form of the potential additional workload to specify a larger range of schemes, to estimate the associated costs, and to identify and confirm the incremental business cases for peripheral elements of the programme. Increasing the granularity of the cost information would require additional work in a number of areas:

- Illustrative timetables and rolling stock diagrams would need to be prepared for a range of electrification options.
- To provide greater granularity, the process for estimating the cost of each geographical increment might need to be based on a more integrated approach in which electrification, power supply and signalling components were in tandem with reference to the relevant geography.
- Cost estimates would also be required for the different size and mix of fleets associated with each timetable.
- Cost estimates would need to be both produced and updated on a consistent basis: we understand that one difficulty on larger programmes is that costs estimates prepared at different dates may be based on different price bases and with different assumptions, with the effect that apparent differences between them may not be realistic measures of incremental costs.

3.19 We have not attempted to assess the costs and complexity of improving the granularity of analysis of a programme as large and complex as the GWML electrification and IEP, but note that they could be significant. Such costs would need to be balanced against the possible benefits of improved decision making before introducing a more disaggregated approach to appraisal of the kind described above.

Network enhancement: Northern Hub and Northwest Electrification

Background

3.20 The Northern Hub is a package of infrastructure and service improvements designed to provide additional capacity across the north and in particular to divert many TransPennine

Express services to serve Manchester Victoria before using a new chord at Ordsall to reach Manchester Piccadilly and Manchester Airport. The reduction in conflicts, particularly outside Manchester Piccadilly station, unlocks capacity for a range of additional services. We understand that the combined infrastructure costs may now exceed £1 billion instead of around £500 million estimated earlier in the project.

Decision-maker and decision type

3.21 The decision-maker for the Northern Hub is DfT, supported by Network Rail, but there is also involvement from Rail North, a body set up to promote the development of rail services in the north of England, interested transport authorities and existing operators.

3.22 The decision type is a major network enhancement including:

- New connectivity, notably between Manchester Victoria and Manchester Piccadilly;
- New capacity, through removal of conflicts between existing services and additional track work; and
- New capability, through electrification and other changes.

3.23 This involves coordinated changes in infrastructure connectivity, capacity and capability as well as rolling stock and service patterns.

Opportunity

3.24 We understand that one of the difficulties which arose is that, as more detailed planning was carried out, it was found that the core Northern Hub infrastructure alone would not permit the operation of all the planned services and all the other services with which they would conflict, interact, connect or share infrastructure across the north of England or on lines that ran through it. This meant that the costs initially estimated were insufficient to achieve the benefits originally expected. Hence, the opportunity was to understand the full infrastructure costs of the proposals at an earlier date, which would have resulted in a better-informed, and potentially different, decision at some point.

3.25 An improved understanding of costs would have required extensive and detailed forward planning of the infrastructure, rolling stock and timetable, potentially over the period to 2033, when completion of High Speed 2 to Manchester and Leeds is in any case likely to lead to a major recast of services to and around Manchester. This would have ensured that decision-makers at every stage understood the full incremental costs and benefits of their decisions in the context of other decisions, such as changes to services elsewhere in the north, that had already been made.

3.26 The benefits of an improved understanding would, potentially, be a more efficient investment decision, for example through not proceeding with elements of the Northern Hub, or the Northwest Electrification Programme. It is possible, for example, that components of these schemes have the characteristics of Package A in Figure 3.2, such that the marginal benefits of delivering them are insufficient to give a BCR in excess of one. The extent of the cost overrun reported above suggests that the BCR of each component and the relationship between them was not properly understood when the scheme were originally planned.

Quantification of benefits

3.27 We have not attempted to quantify the potential benefits of a better understanding of Network Rail's costs in relation to the Northern Hub and Northwest Electrification Programme as investigation of the complex relationship between their various components is beyond the

scope of the study. However, the extent of the cost overrun suggests that they are likely to be substantial.

Cost of obtaining benefits

3.28 At the same time, securing these benefits might require a detailed long term plan for service levels, infrastructure and timetables throughout the North, and on all the lines running through it, potentially over the period to 2033. This could, in extremis, mean having an integrated plan comprising annual timetables to 2033, including the investments in infrastructure and rolling stock required during four Control Periods (CP5 to CP8 inclusive) required to implement them. As in the previous case, there is therefore a balance to be struck between improving cost information and decision-making on the one hand and undertaking the extensive optioneering, planning and cost estimation activity required to enable this on the other.

Capacity enhancement: Reading station

Background

3.29 Reading station and the lines and junctions immediately east and west of it are being rebuilt to provide new capacity and capability. This includes:

- Additional platforms allowing more trains to stop or terminate;
- Greater grade separation of conflicting movements between passenger and freight services;
- Potential to accommodate Crossrail, which would originally only have operated as far as Maidenhead; and
- Potential for through services between points such as Oxford, Guildford and Gatwick Airport.

3.30 In parallel, operation of intercity services on the GWML through Reading is being converted from HST to IEP and, following the decision to electrify part of the GWML and its branches, as discussed above, the IEP fleet will contain both electric and bimode stock instead of being restricted to diesel operation.

3.31 We understand that the costs of Reading station redevelopment have risen to some £800 million. Some of these costs relate to the refurbishment of the station to a high standard rather than to the capacity enhancement project itself.

Decision-maker and decision type

3.32 The decision-maker for the project is DfT, advised by its own IEP team and by Network Rail and its advisors, and also by First Great Western, the incumbent operator of intercity services. The decision type is a comprehensive enhancement of service levels through changes in infrastructure and rolling stock and the introduction of electrification.

Opportunity

3.33 It is possible that a lower cost project, potentially with a higher overall BCR, could have been identified if some of the enhancements to Reading station not necessary to deliver the operational and service benefits had been excluded. By way of illustration, we note that enhancements have been carried out at Clapham Junction station, where new passenger facilities, principally in glass, steel and concrete, providing circulating space and step-free access have been added to the original structure, much of which remains clad in wood.

Clapham Junction is used by 25 million passengers per annum compared with 15 million passengers per annum at Reading, but there was no apparent need to rebuild the entire station.

3.34 The implication is that decision-makers could have been provided with the option of a lower cost scheme if the costs of the Reading station enhancement had been disaggregated according to whether they were driven by capacity enhancement strictly defined, or more general station improvements. The benefits of this improved understanding would, potentially, be scope for decision-makers to decide whether some increments of the Reading station redevelopment were value for money at the margin. At the same time, we note that it is also possible that the additional costs of improving the station, over and above those of delivering the capacity enhancement, might have been limited given the substantial scope of work that was anyway required. However, this proposition could only be tested with sufficiently disaggregated cost data and the identification of the relevant incremental costs for a given, well-defined scope of capacity-related works.

Quantification of benefits

3.35 We have not attempted to quantify the potential benefits of a better understanding of Network Rail's costs in relation to the Reading station redevelopment as we did not have access to the detailed information underpinning the business case.

Cost of obtaining benefits

3.36 We also briefly considered the cost of obtaining these benefits. This would, potentially, require exploring the feasibility of an alternative design for Reading station, either reducing the space provided in new areas or, if feasible, making greater use of the original facilities to avoid the cost of replacing them.

Capacity enhancement: Oxford station

Background

3.37 The House of Commons Transport Select Committee, in its Seventh Report of Session 2014-15 "Investing in the railway" reported that:

"Pteg argued that the fact that decisions on rolling stock and decisions on infrastructure were 'often made by separate people at distinct points of time' was 'an important weakness' in the rail network."

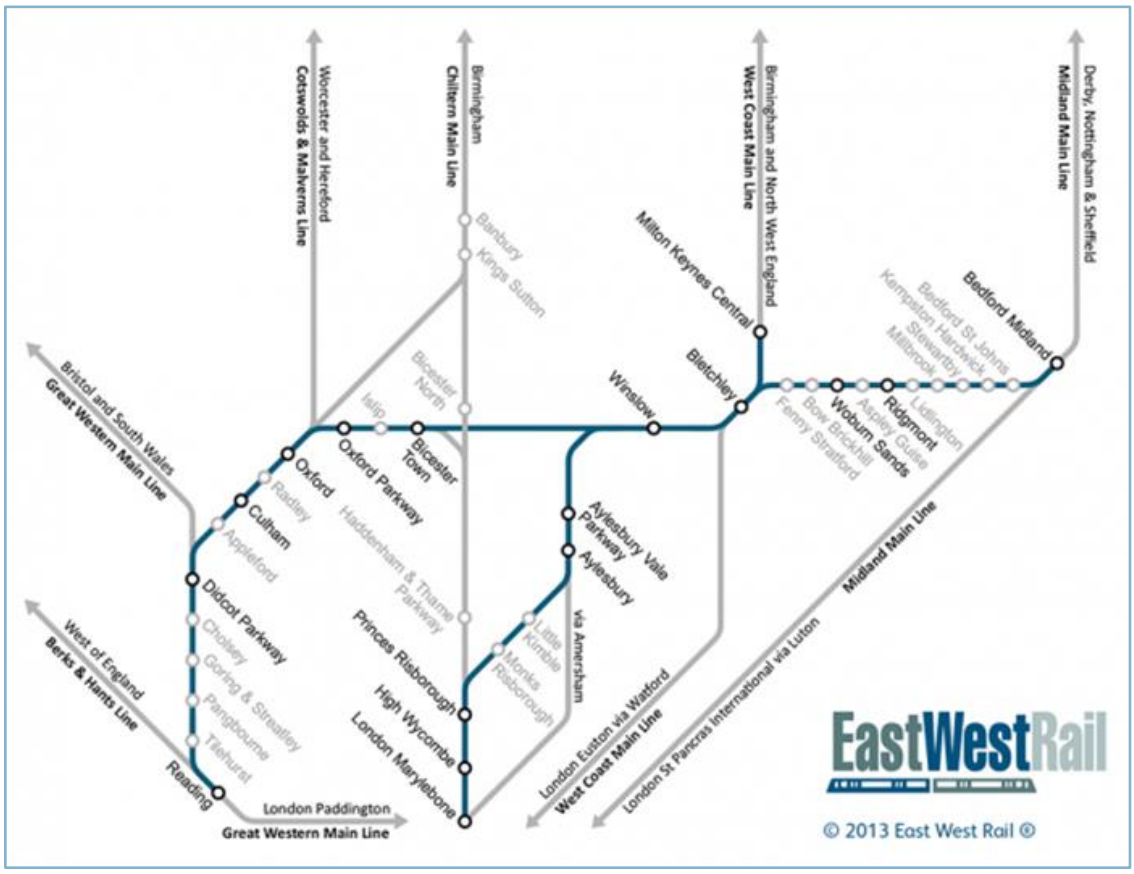
3.38 This case study relates to enhancements at and around Oxford station, made at distinct points in time and apparently by separate people, which do not appear to have been clearly attributed to particular services and hence to their business cases.

3.39 Oxford station could, potentially, be served by a number of new services, as shown in Figure 3.3. These include:

- Evergreen 3, providing a through route between London Marylebone and Oxford, via a branch from Bicester approaching Oxford from the north;
- Great Western IEP and electric EMUs between London Paddington and South Wales and the West of England, with a branch from Didcot Parkway approaching Oxford from the south;
- East West Rail from Reading via Oxford to Bicester, Bletchley and Bedford Midland; and

- The Electric Spine, a proposal to create an electrified route from Southampton to the Midlands and the North following the route of East West Rail between Reading and Milton Keynes on the West Coast Main Line and Bedford Midland on the Midland Main Line.

Figure 3.3: Oxford station: Evergreen 3, Great Western IEP, East West Rail and Electric Spine



Source: East West Rail

3.40 We examined a number of documents which refer to these various schemes, as summarised in Table 3.2.

Table 3.2: Enhancements planned, committed or under construction affecting Oxford

Scheme	Promoter	PR13 (2011)	CP5 HLOS (2012)	CP5 determination (2013)
Oxford capacity enhancements	Network Rail	Proposed project £35-37 million	Capacity and station expansion is sought at Oxford in conjunction with East West Rail and the Electric Spine.	Proposed scheme £81 million The scheme will align with the signalling works at Oxford to achieve maximum synergy and cost benefit
East West Rail	EWR Consortium	No specific proposal, but referred to in relation to Oxford capacity enhancements	Committed scheme Oxford – Bedford core route, including electrification as part of Electric Spine	Committed project £351 million
Electric Spine	Department for Transport	No specific proposal, reference to IEP and GW electrification	Committed scheme Electrification of the East West Rail corridor mentioned	Committed project The overall cost of Electric Spine is £1,417 million, of which £121 million is for the EWR corridor

Source: Steer Davies Gleave analysis of PR13 Initial Industry Plan Supporting Document (2011), CP5 HLOS (2012), Strategic Business Plan: Definition of CP5 Enhancements (2013)

3.41 This suggests that the costs of Oxford capacity enhancements rose from £35-37 million in 2011, when East West Rail and the Electric Spine were not committed, to £81 million when they were. However, it was not clear what part, if any, of the cost increase was directly attributable to the newer proposals. More generally:

- Some documents suggested that later enhancements would benefit from capacity or capability already committed as part of earlier enhancements; and
- Some suggested that earlier enhancements would give rise to additional costs as a result of their interaction with newer enhancements.

3.42 However, the documents provided no clear statement of what costs resulted from what services or outputs, whether or how costs had been allocated or apportioned to the services that caused them, and whether those proposing the schemes to which costs had been allocated accepted that they were necessary and part of their business case. It was not clear either that the infrastructure cost implications of different services, or the incrementality or avoidability to each element of service, had been identified. In terms of Figure 3.2, it was not clear which packages of services or infrastructure provision resulted in a positive BCR at the margin. Moreover, we note that there is also a risk that costs identified late will be allocated to the service with the strongest business case or BCR, or justified at the margin as "unavoidable", rather than the incremental case for each service being demonstrated in advance on a consistent basis.

Decision-maker and decision type

3.43 The identity of the decision-maker for the Oxford station improvements is unclear but the primary sponsor is DfT, advised by its own IEP team, and by Network Rail and its advisors, as well as the EWR Consortium and Chiltern Railways in relation to both Bicester to Oxford services and proposals to extend services south of Oxford onto the Cowley branch. The decision type is the upgrading of the infrastructure at and around Oxford station to provide for a range of proposed future services.

Opportunity

3.44 The principal issue at present appears to be that there is no clear understanding either of:

- What infrastructure capacity and capability, and hence costs, would be required by each possible combination of services; or
- How these costs should be attributed to particular services or service frequencies, whether calculated as incremental costs (if new services are added, any incremental costs are deemed attributable to those services) or avoidable costs (if a given package of services is in operation, which elements of the infrastructure could be removed in the partial or complete absence of each of them).

3.45 The opportunity is therefore both:

- A better understanding of the infrastructure capacity, capability and costs associated with any given combination of services; and
- A better allocation of these costs to particular services, or elements of the services (potentially including details such as frequency and absolute or relative timing), on some basis such as incremental or avoidable costs.

3.46 This would potentially mitigate a number of the potential risks set out in the discussion in paragraphs 3.7 to 3.9, and in particular that one or more elements of the Packages adopted have fewer incremental benefits than costs. The benefits would, potentially, be the saving in costs in exchange for a smaller, or even zero, foregone benefit. In the case of the illustrative example in Figure 3.2, the benefits of implementing Package B instead of both Packages would save costs of 4 while forgoing benefits of 3, a net gain of 1.

Quantification of benefits

3.47 The evidence suggests that the costs of the Oxford capacity enhancements rose by approximately £45 million between 2011 and 2013. We note that some or all of this additional cost might provide capacity or capability which would not be provided if the full costs were identified to the services which actually cause them. We do not have sufficient information to assess how much of this increase was due to an inadequate understanding of costs. However, by way of illustration, if one third of the additional cost could have been avoided through a better allocation of costs to particular services, this would suggest a potential saving of approximately £15 million for the scheme as a whole.

Cost of obtaining benefits

3.48 The cost and complexity of examining multiple packages in this case do not appear to be excessive. In our view, any benefits could be secured largely through a clearer prioritisation and definition of schemes, coupled with a more rigorous allocation of the costs of each increment.

Rolling stock procurement: Class 444/450s on Wessex routes

Background

3.49 This case study relates to the replacement of Mark I “slam door” Electric Multiple Unit (EMU) rolling stock on services south of the Thames with new trains as part of the Southern Region New Trains project (SRNTP). The Mark I EMUs were introduced from the mid-1950s to provide services on the 750V DC network of the former Southern Region. Over the period 1980 to 1987, some South Central and South Western routes benefitted from the introduction of Class

319/442/455/456/508/EMUs and between 1992 and 1997 South Eastern routes benefitted from Class 365/465/466 “Networker” trains, originally conceived as a standard design for London commuter services. These trains all had modern powered doors and a stronger body. At franchising, the electric services of the former Southern Region were subdivided into five train operating companies – South Eastern, South Central and South Western and the smaller Thameslink and Gatwick Express – which leased the inherited Mark I and Mark II rolling stock from the ROSCOs.

3.50 Following a number of accidents, the Railway Safety Regulations 1999 required the withdrawal of Mark I stock. This resulted in the withdrawal of over 1,750 vehicles and the introduction of over 2,000 new ones in the SRNTP. Under the post-privatisation structure, however, responsibility for the selection of new trains rested with the train operating companies, each of which selected a different replacement stock. In particular:

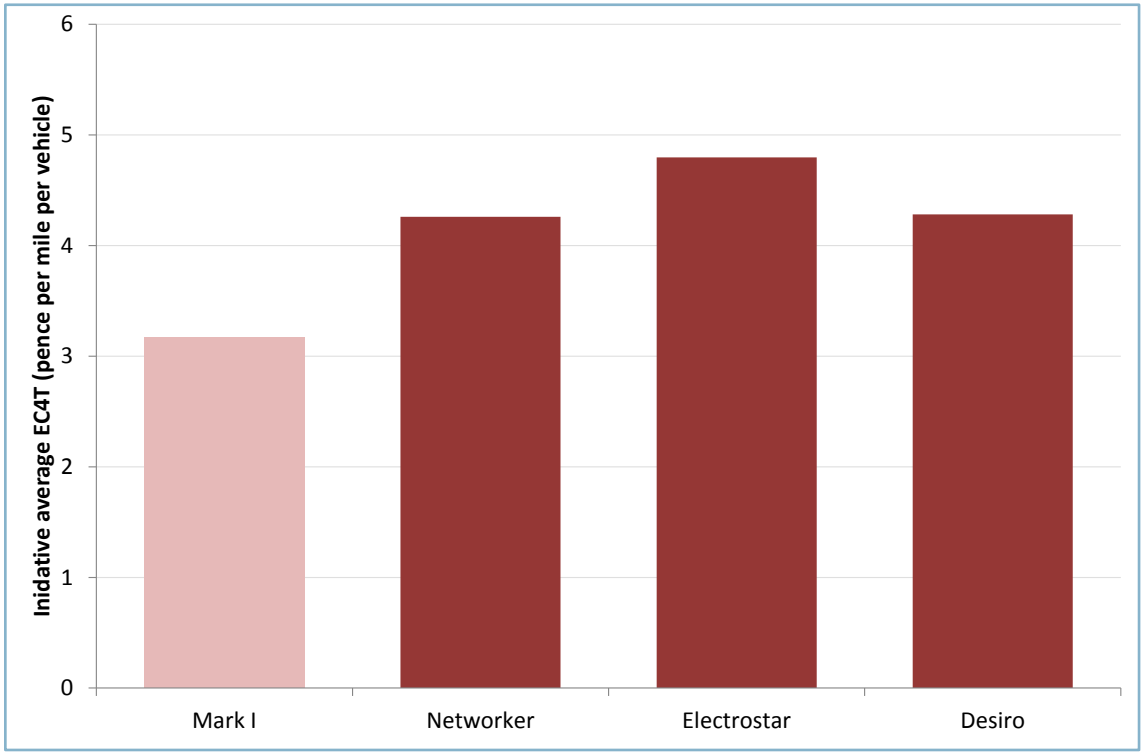
- Connex South Eastern ordered Electrostar units, now Class 375/376, built by Bombardier;
- Connex South Central ordered Electrostar units, now Class 377, built by Bombardier; and
- South West Trains ordered Desiro units, now Class 450 and Class 444, built by Siemens.

3.51 Figure 3.4 compares the typical average EC4T charges per vehicle for a four-car set of the Mark I, Networker, Electrostar and Desiro stock designed for outer suburban or regional services. It shows how the Networker and subsequent stock consume more energy than the Mark I stock that they replaced, reflecting some or all of increased mass, higher acceleration, higher maximum speed and increased on-board equipment such as air conditioning.

3.52 In the event, Network Rail identified that previous power supply upgrades to support the operation of the new stock did not always provide sufficient power. It was therefore necessary to carry out further work, including the construction of approximately 100 new and upgraded substations and 375 route-kilometres of new or upgraded high voltage cable. In 2004, the costs of the SRNTP work were estimated as £594 million in Network Rail’s Route Plans, and at £1.2 billion including “up to £837 million for power supply work” in the NAO report “Improving passenger rail services through new trains”. In aggregate, South West Trains was paid £12 million per annum “for extra Network Rail charges to pay for increased power consumption, longer platforms and changes to depots for new trains” although we have not been able to identify what proportion of these additional charges related to EC4T.

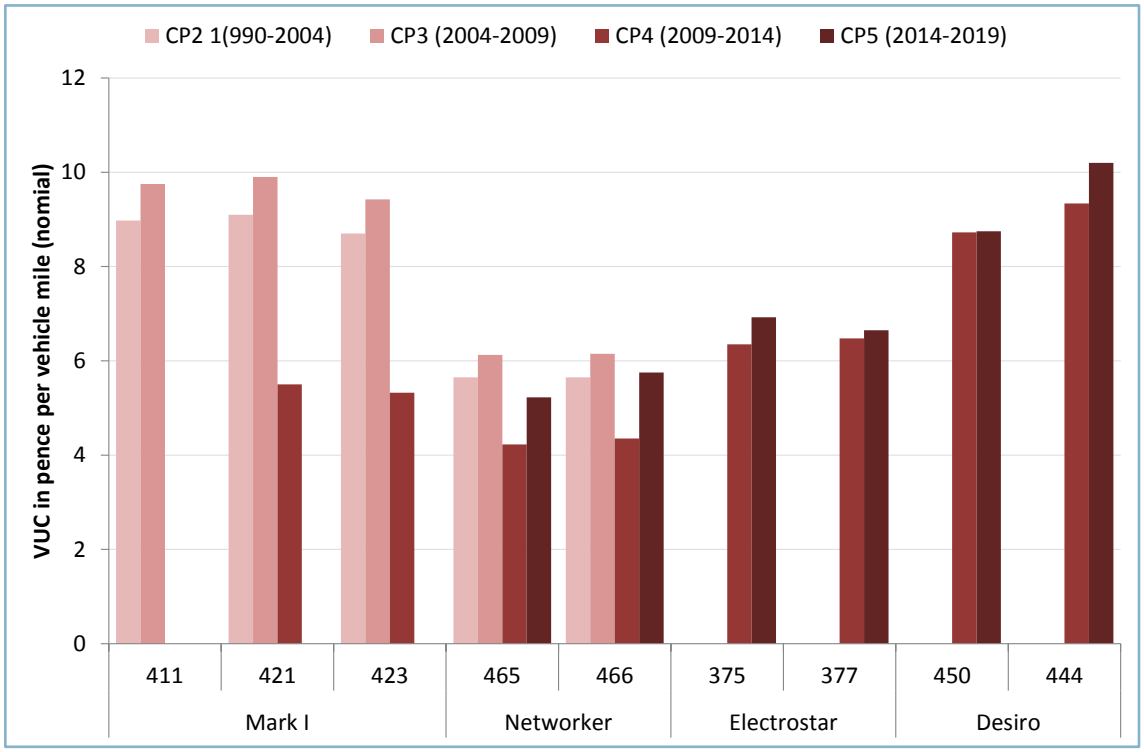
3.53 A second issue was the relative costs imposed on Network Rail’s infrastructure by each type of stock, estimates of which form the basis of Network Rail’s VUC and predecessor variable charges. Figure 3.5 compares the variable charges applied during Control Periods 2, 3, 4 and 5.

Figure 3.4: Mark I and replacement stock: comparative EC4T charges



Source: Steer Davies Gleave data on typical rolling stock characteristics

Figure 3.5: Mark I and replacement stock: comparative variable charges



Source: Railtrack and Network Rail charges, in adjusted nominal prices

3.54 The Figure reveals two principal features about the absolute and relative level of charges for the fleets:

- The absolute level of charges calculated for the older Mark I and Networker stock fell in CP4 and CP5, particularly those for the Mark I stock, which fell from 9-10 pence per vehicle mile to around 6 pence per vehicle mile.
- The level of charges calculated for the different fleets in CP5, presumably representing the best current understanding of the drivers of variable cost, was lowest for the Networker stock, higher for the Electrostars and higher still for the Desiro stock of the same generation and capability.

3.55 This latter effect suggests that the decision, by South West Trains, to procure Class 444/450 stock resulted in approximately 40% higher costs to Network Rail than if they had selected the broadly comparable Class 375/377 stock.

Decision-maker and decision type

3.56 The decision-maker for the procurement of Class 444/450 stock was the train operator, South West Trains, informed by Network Rail's variable charges for fleets existing at the time of the order in 2001 during CP1. The decision type was investment in rolling stock, with consequent effects on Network Rail's variable track costs and the costs of providing electrification infrastructure and electricity.

Opportunity

3.57 The case study illustrates two weaknesses in the understanding of costs and their drivers:

- The failure fully to anticipate the additional power requirements of new EMU stock, and specifically the cost of £12 million paid to South West Trains (this is the cost incurred by the operator, additional to the cost of the upgrade to Network Rail referred to in paragraph 3.52); and
- The selection, during CP2, of Class 444/450 stock in the absence of information, available by CP4, on the 40% higher variable costs it would impose on Network Rail's infrastructure as compared with the Class 375/377.

3.58 The opportunity therefore relates to the better understanding of costs which is now available:

- In the case of the power supply, a better understanding of the requirements of the newer fleets; and
- In the case of the variable costs, more refined modelling of the costs imposed by vehicles of different characteristics.

3.59 An improved understanding of costs would ensure that operators, ROSCOs and manufacturers considering leasing, buying and manufacturing new rolling stock were informed by robust estimates. The associated benefits would, potentially, be better design of rolling stock to give due (but not excessive) weight to Network Rail's marginal operating, maintenance and renewal costs within the overall costs of operating the vehicle over its working life. Operators and ROSCOs would each be incentivised to ensure that the consequences of higher marginal OMR costs were communicated to the manufacturer, who would in turn be incentivised to keep these as low as possible.

Quantification of benefits

3.60 We estimated the reduction in costs across the network if the variable costs caused by fleets of Desiro stock were reduced to those of the broadly equivalent Electrostar stock. We estimate that, all other things being equal, this would result in a reduction of £11 million per annum in Network Rail's costs, or approximately £60 million per Control Period.

Cost of obtaining benefits

3.61 The costs of obtaining the benefits include publicising the research on Network Rail's variable costs and the models used to estimate VUC, which are already available on Network Rail's website. However, over the longer term, they include the costs of improving the models used for estimation, which are difficult to determine ex ante, although we note that collection of the necessary monitoring information could be expected to fall with the application of improving technology and that further development of VTISM and other relevant models should arguably be part of established continuous improvement processes.

Rolling stock deployment, Mk III and Mk IV stock on ECML

Background

3.62 This case study relates to the poor understanding of the relative variable costs imposed by alternative fleets. This results from setting the charges for each fleet on the basis of its average speed nationally, rather than its average speed on the services for which it is being considered as an alternative.

3.63 When Railtrack's original "vesting" track access charges for CP1 were developed, a decision was taken to set the variable charge per vehicle-mile at a national average rate, based on average operating speeds, rather than to have variation across the network. As we noted in our proposal, we understand that this decision partly reflected the fact that British Rail was structured as a number of new business sector organisations, and there was no evidence that costs would vary by sector *per se*.

3.64 It was noted at the time that this averaging resulted in an apparent perverse incentive, at the margin, to the ECML franchise operator, which has fleets of both Mk III and Mk IV stock:

- Mark III stock, powered by two Class 43 HST power cars, operated over a range of routes on the East Coast, Midland, Great Western and CrossCountry networks, often at relatively low speeds; and
- Mark IV stock, powered by a Class 91 locomotive, and with a Driving Van Trailer (DVT), operated exclusively on the electrified ECML between London and Leeds and Edinburgh, with extensive operation at 200 kilometres per hour.

3.65 As a result, when the East Coast operator was deciding which stock to use at the margin, it faced variable charges for Mark III stock based on a low average speed, and variable charges for Mark IV stock based on a high average speed, although the information required was the relative cost of operating the same service at the same speed. Against this background, we note that Network Rail's "Control Period 5 (CP5) Variable Usage Charge (VUC) guidance document" states that:

"*User calculated operating speed: If an operator considers that the standard formula used to estimate a vehicle's operating speed, based on its maximum speed, gives rise to a result that is not a reasonable estimate of the vehicle's true operating speed it has the option to calculate an operating speed based on the published timetable. If an operating speed based on the*

timetable is entered into the user calculated operating speed field, this value will be used in the VUC calculation rather than the operating speed derived from the vehicle's maximum speed.

When calculating an operating speed based on the timetable, the operator should take a weighted average of the relevant journeys and exclude stopping time at stations. Where a new vehicle type is used by more than one operator on more than one route, it would need to be agreed between the relevant parties that the user calculated operating speed is a reasonable assumption for all operators. Without such agreement the operating speed should be derived from the maximum speed as set out above. If an operator wishes to use an operating speed based on its analysis of the timetable it should provide sufficient supporting information to Network Rail / ORR demonstrating that this speed is appropriate."

Decision-maker and decision type

3.66 The decision-maker for this case study was the franchise operator on the ECML, the only route which, for historical reasons, has been operated using both Mark III and Mark IV stock. The decision type was which of two rolling stock fleets to use, at the margin, to provide services which could be provided with either. In practice, this meant services wholly using electrified track which could be operated with either Mark III or Mark IV stock.

Opportunity

3.67 The opportunity was to ensure that variable usage charges – the predecessors to VUC – were calculated on a consistent basis for fleets, capable of operating on the same infrastructure and service group, which were potentially substitutes for each other. This would mean that variable usage would need to be calculated for each service group in which the fleet was used, at least where there was scope for substitution by other fleets.

3.68 An improved understanding of costs would ensure that the relative infrastructure costs imposed by different fleets would be taken into account by operators selecting rolling stock to serve a particular service group. The benefits would be better-informed selection from existing rolling stock fleets when either transferring stock between services or deciding, at the margin, which of two or more types of available stock to use.

Quantification of benefits

3.69 We examined the current VUC charges for this stock based on the CP5 Track Usage Price List. The charges for Mark III and Mark IV stock are now both based on the same operating speed of just over 80 miles per hour, and so differences between charges in CP5 do not introduce the distortion that we understood to have existed during CP1. Nonetheless, we summarise the results in Table 3.3.

Table 3.3: CP5 variable usage charges (VUC) for Mark III and Mark IV formations

Mark III stock	VUC	Mark IV stock	VUC
Class 43 power car	37.35	Class 91 locomotive	49.31
Mark III	6.46 x 9	Mark IV	11.00 x 9
Class 43 power car	37.35	Driving Van Trailer (DVT)	10.64
Total	**132.84**	**Total**	**158.95**

Source: Network Rail, all charges in pence per vehicle mile in 2012-13 prices

3.70 The results suggest that the VUC for a Mark IV formation is over 26 pence per train mile, or almost 20%, more than that for a Mark III formation. A difference of this magnitude would amount to just over £100 for a single London-Edinburgh journey, up to around £300 for a daily diagram operated wholly on electrified ECML. We estimated that, if the variable costs of the Mark IV fleet were actually reduced by the difference between the current VUC charges, then the variable cost saving to Network Rail would be approximately £5 million per annum of £25 million per Control Period. We note, however, that the use of Mark III stock on the ECML is arguably a special case as these are the fastest services in the world operated by diesel traction. The materiality of a distortion of this size in the relative VUC of alternative fleets would also depend on a number of factors including the availability of the types of stock to the operator, their relative fuel and variable maintenance costs and their relative seating capacities.

3.71 A provisional conclusion is that a better understanding of costs might result in different decision-making if VUC were calculated for each group of vehicles of each type which effectively acted as a single fleet. In the case of Mark III stock, this could result in different VUCs for Anglia, East Coast, East Midlands Trains, Great Western, CrossCountry, Grand Central and, from later in CP5, ScotRail.

3.72 There are, however, potentially two distortions which could arise:

- VUC for an individual fleet being based on national averages rather than local costs, as we understood was the case for the Mark III stock.
- VUC for two or more fleets that are potential substitutes in the same service group being based on their average speeds in their current or past use in two different service groups in widely different conditions. For example, operators choosing between rolling stock to be cascaded from different service groups with different operating speeds would ideally be informed by VUCs calculated on the basis of the speeds at which they would be operated in the "receiving" service group.

Cost of obtaining benefits

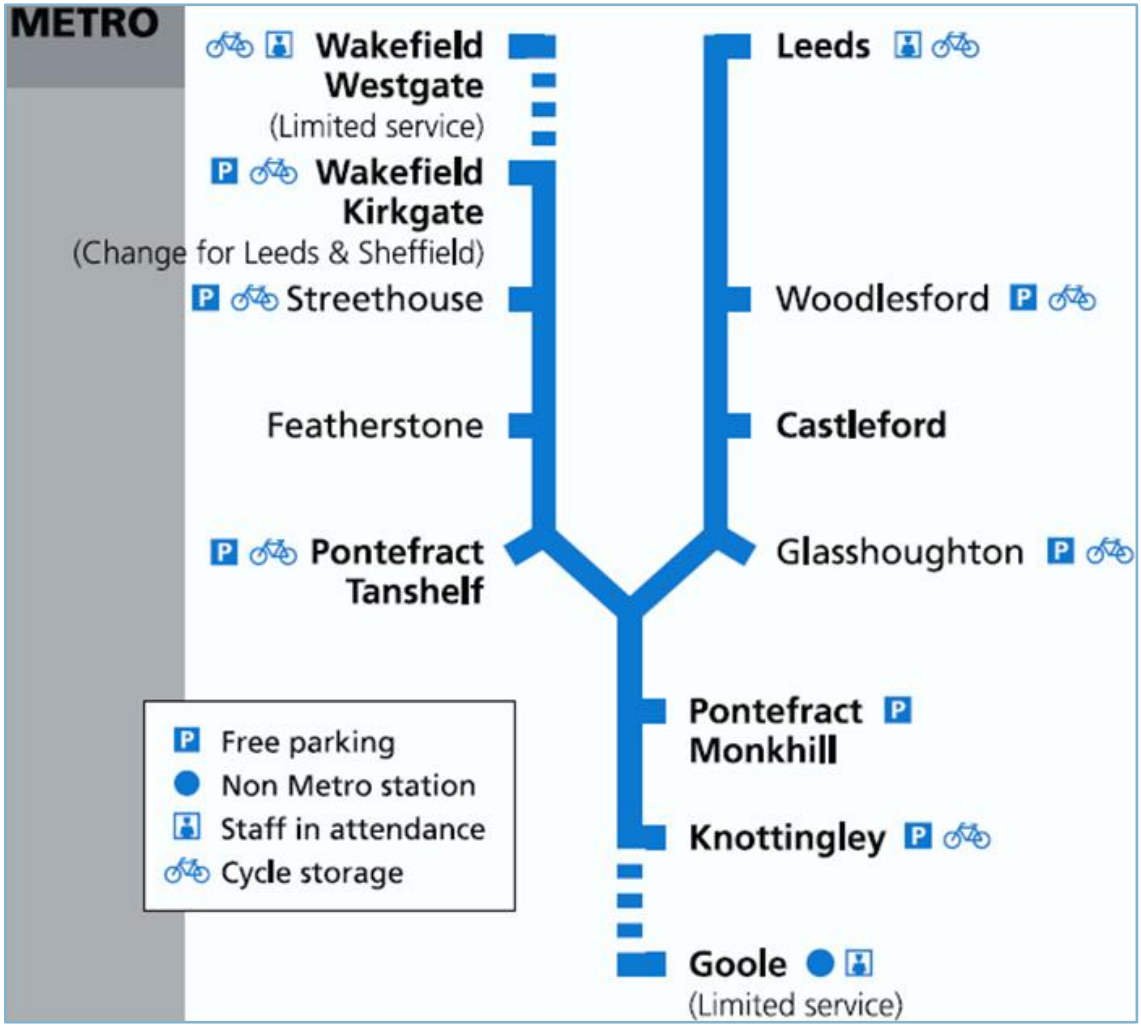
3.73 The cost of obtaining these benefits again includes the cost of publicising the relevant information and of improving approaches to modelling the impact of the operation of rolling stock infrastructure. As already noted, such improvement could be expected through the application of established processes for delivering continuous improvement.

Service enhancements: Knottingley to Wakefield Kirkgate

Background

3.74 This case study illustrates how inadequate cost information can lead to a passenger service attracting very few passengers being introduced and operated over a number of years. We examined the "Pontefract Line" between Knottingley and Wakefield Kirkgate via Pontefract, the left branch of the service network shown in Figure 3.6.

Figure 3.6: The "Pontefract Line" from Knottingley to Wakefield Kirkgate



3.75 In 1992 West Yorkshire Passenger Transport Executive (West Yorkshire PTE) led the reopening of the line between Knottingley and Wakefield Kirkgate and passenger services on the line have since been included as part of the Northern franchise. There is currently an hourly all stations service calling at Pontefract Monkhill, Pontefract Tanshelf, Featherstone and Streethouse. ORR's station usage data for 2013-14 show that over 500,000 passengers used Wakefield Kirkgate. 80,000 used Featherstone, but fewer than 40,000 used Pontefract Tanshelf and fewer than 30,000 used Streethouse. This means that the intermediate stations between Pontefract Monkhill and Wakefield Kirkgate are on average used by only 400 passengers a day.

3.76 Serving these passengers imposes a number of costs not only on the train operator but also on Network Rail, in the form of:

- The maintenance and renewal costs of the three intermediate stations, recovered through the station long term charge of approximately £25,000 per annum or an average of 16p per passenger using the stations;
- The marginal wear and tear on the infrastructure, recovered through VUC payments which we estimate amount to £5,000 per annum for an hourly service run by Class 156 two-car DMUs (we note that these are the most frequent passenger services on this line and that, without them, Network Rail might be able to reduce the complexity of the

signalling, or make further savings through the lower maintenance requirements of a freight only line); and
- The fixed costs of the infrastructure, which we understand is currently also used by freight and passenger open access services, but which it might be possible to avoid if these services were rerouted.

Decision-maker and decision type

3.77 The decision-maker for the service introduction appears to have been West Yorkshire PTE, before 1992, although we have been advised that it is extremely unlikely that it will be possible to locate an original business case, if one existed. Responsibility for continued inclusion of the service in the specification of the Northern franchise now lies primarily with DfT. The decision type was the enhancement, and continued operation, of a passenger rail service, which would in principle be supported by an ongoing business case supported by social cost benefit analysis.

Opportunity

3.78 At present, it is not clear whether the full recurring costs to Network Rail of operating the Pontefract Line have been identified and taken into account in the decisions to continue to specify and operate the service. The opportunity is the assembly of a clear understanding of the Network Rail costs which would be avoided if the service was removed. As we illustrated in Table 2.2, these are likely to include, over various timescales:

- Track maintenance costs; and
- Station maintenance and renewals costs.

3.79 The extent of the cost savings would depend, inter alia, on the scope to:

- Reduce track maintenance standards to those of a freight only line;
- Remove station buildings and passenger facilities;
- Reduce the line to single track; and
- Simplify signalling and other systems.

3.80 Access to this information, and the profile of the cost savings, would allow the funder and specifier of the service to make a more informed decision regarding its continuation.

3.81 An improved understanding of costs would require that Network Rail calculated or at least estimated the costs of some of these potential changes. Some of these calculations would need to be bespoke and specific to a particular location. For example, the feasibility and net cost of singling the line and making the associated modifications to the signalling system might require a specific and detailed study. Other calculations, in contrast, might be more amenable to standardisation. These might include an indicative saving per track mile from reverting to the standards for a freight only line, or from closure and removal of station facilities. Potentially, indicative values of these costs could be published by Network Rail as an aid to funders wishing to review the value for money of marginal services.

3.82 The benefits of an improved understanding would, potentially, be a more informed decision about the operation of a marginal service.

Quantification of benefits

3.83 We have identified annual station long term charges of £25,000 and VUC charges of £5,000 associated with operations on the Pontefract line. In addition it appears that removal of

services from the Pontefract Line might allow closure, if freight and occasional open access service on the line could be diverted, but we have not been able to quantify the potential saving. A full analysis of the impacts of closure would also need to take into account savings in rolling stock and operating costs, and the associated loss of passenger revenue and other benefits.

Cost of obtaining benefits

3.84 As we set out above, in some cases the likely scale of Network Rail cost savings could be based on indicative estimates which could probably be prepared relatively simply and published by Network Rail. In other cases, however, additional analysis would be needed to determine the avoidable costs of reducing a service. As we illustrated in Table 2.2, the scope for cost savings would grow in stages with the removal of one of the intermediate stations, or all the intermediate stations, or complete removal of the passenger service.

Summary

In summary, taken together, these case studies highlight a number of opportunities for improving the understanding of Network Rail's costs. These include:

- More **geographical disaggregation of the scope and costs of major enhancements** through the definition of options for enhancing different parts of a wider route, taking account of the need to integrate the planning of electrification, signalling and other works at a more granular level;
- A more **rigorous definition of the scope of an enhancement** programme, specifying increments to a base programme that are aligned with options for service improvements required by stakeholders;
- A more **disciplined approach to the allocation of costs to distinct enhancement projects**, particularly where these are related but developed and implemented according to different timescales and with a view to achieving distinct outcomes;
- Ongoing **improvements to the estimation of track maintenance and renewal costs**, based on thorough investigation of the impact of rolling stock operations and taking account of the effects of operating speeds as well as network geography; and
- More **rigorous allocation of costs to groups of services**, recognising the impact of operations on both short run and long run costs.

3.85 These opportunities, if realised, would in turn benefit the further development of the railway in a number of ways. While it is not possible to quantify this benefit with confidence, since it depends on the evolution of the policy, regulatory and financial framework over an extended period, it is likely to be substantial. The potential impact of these various improvements on various aspects of industry activity is summarised in the table below.

Table 3.4: Impact of improved understanding of costs on rail industry activity

Industry activity	Benefitted by:					Summary of impact
	Geographical disaggregation of scope/ cost of enhancement	Rigorous definition of scope of enhancement	Disciplined approach to allocation of costs between enhancements	Improvements to estimation of track maintenance/renewal costs	Rigorous allocation of costs to groups of services	
Franchise specification	✓	✓	✓	✓	✓	DfT would specify franchises with a full understanding of the underlying costs, including the costs of any supporting enhancement programmes.
Franchise bidding		✓		✓	✓	Bidders would respond more effectively to a franchise specification if the costs were defined clearly at the earliest possible stage and understood. If captured in track access charges, more accurate cost information would support more efficient decisions on rolling stock deployment and operation of new services.
Cost efficiency initiatives	✓	✓	✓	✓	✓	All parties would be in a better position to identify realistic efficiency improvements if the base level of operating, maintenance, renewals and enhancement costs were better defined. Options for joint efficiency initiatives would also be clearer.
Investment in enhancements	✓	✓	✓		✓	The quality of both scheme appraisals and commercial business cases would increase, improving both government and private-sector decision-making.
Devolved funding decisions	✓	✓	✓	✓	✓	The allocation of funding required to support rail services at the regional and local level would be clearer. Stakeholders would have a better understanding of how public funding of the railway was distributed.
Balance of fares and subsidy	✓	✓	✓	✓	✓	A better understanding of the levels of subsidy provided at the regional and local level would enable a more informed debate about the appropriate balance between fare payer and tax payer funding.
Commercial strategy				✓	✓	Commercial decisions of franchised, open access and freight operators would be better informed, with services provided taking better account of underlying costs. This could become a more important consideration if franchised operators were given more flexibility to specify services in the future.
Innovation	✓	✓	✓	✓	✓	The value of innovations intended to reduce costs, increase capacity or improve the allocation of capacity would be clearer.

4 Improving cost information in other sectors

Introduction

4.1 We examined a number of case studies from other sectors to identify examples where the benefits of better understanding of costs which might be transferrable to the rail industry in Great Britain. Our analysis drew on a workshop, discussions with internal and external sector experts, and a review of documentation including:

- Documents referred to in ORR's IPP;
- Documents we identified in our proposal as potentially relevant;
- Documents provided by ORR in the course of our work; and
- Documents identified through a further literature search.

4.2 In excess of 20 case studies have been considered as part of this analysis, from a range of regulated and unregulated sectors. A number of key case studies are presented in this chapter, with a comprehensive set of studies reported in Appendix A. Our overall approach to the case study analysis is summarised in Figure 4.1.

Figure 4.1: Approach to case study analysis

4.3 In paragraph 2.2, we listed a number of parties whose decisions relating to the rail industry might be informed by a better understanding of Network Rail's costs. In the remainder of this section we discuss in turn the implications of the case studies for decisions by:

- ORR, as the industry's economic regulator;
- Funders, including national, regional and local bodies;
- Network Rail; and
- Investors and creditors.

Implications for ORR

4.4 The case studies suggest that a better understanding of Network Rail's costs might inform ORR decisions in three main areas:

- The appropriate level of Network Rail's outputs;
- Network Rail's allowed revenues; and
- The structure and levels of access charges.

The appropriate level of Network Rail's outputs

4.5 In principle, the appropriate level of a particular output should be set at the point at which the marginal benefits to society equal marginal costs. In the rail industry, the high-level outputs are set out by governments by means of the HLOSs. However, ORR's role continues to be very important in determining much of the detail. For example, whilst DfT sets the overall level of PPM to be achieved in England and Wales, ORR determines the level by TOC (captured implicitly in Schedule 8 benchmarks).

4.6 In reality, ORR has imperfect knowledge of both the marginal benefits of particular outputs or outcomes and Network Rail's marginal costs of delivering them. This means that the level of Network Rail's outputs, to the extent that they are determined by ORR on the basis of economic principles, may be sub-optimal.

4.7 This is a common issue in other regulated industries and has been addressed through two broad approaches:

- A direct approach is for the regulator to collect, or require the regulated business to collect, information on the costs and benefits of particular outputs. Case Study A, below, illustrates how regulators and regulated businesses in the water industry have gone about evaluating marginal benefits in the water industry. It should be emphasised that given that Network Rail is one step removed from the passenger and that outputs are set at a high level by governments, to the extent that the water industry model may replicable in rail, it may require whole-industry leadership. For example, it would likely require collective commitment from Network Rail, train operators and government to engage in such a way with railway users. Case Study B, presented in Appendix B, considers statistical approaches – again pursued in the water industry – which may help understand the marginal costs associated with providing different outputs.
- An indirect approach is to promote dialogue between regulated businesses, their customers and other stakeholders, potentially allowing them to agree on aspects of the regulatory settlement in a mutually beneficial way. This approach of 'constructive engagement' bypasses the need to collect detailed information on costs and benefits by appealing to the parties' 'revealed preference' (the idea being that if parties agree to a settlement which is different to one suggested by the regulator, at least one party must be better-off and the other parties no worse-off), and has been supported by leaders in regulation in other industries. Case Studies C and D in Appendix A illustrate this approach in the UK aviation and energy sectors. Case Study E, below, presents an interesting example from the Australian rail industry demonstrating, in particular the potential for constructive engagement to lead to 'gains from trade' – stakeholders agreeing to a more demanding set of outputs relative to that which the regulator might have determined in exchange for increased compensation.

4.8 The case studies suggest that there might be scope for use of constructive engagement in the rail industry through some form of stakeholder group with the aim of industry parties agreeing on outputs and/or outcomes, which may be more efficient than their imposition by regulators. Other possible benefits of a constructive engagement approach include:

- Reducing transaction costs (the CAA notes that parties have supported the approach, which reduces the need to produce long and detailed responses to consultations);
- Producing more innovative outcomes; and
- Providing a better consumer understanding of the regulatory process.

4.9 That said, it should be noted that the initial model of negotiation of access rights and charges between Railtrack and its customers was abandoned in favour of the current system of mainly posted price charges determined by ORR, on the basis of an understanding of costs. A particular issue was the weak negotiating position of franchise operators, since they were contractually bound to deliver their franchise commitments. Therefore, the value of the constructive engagement approach in passenger rail is likely to depend on the future role of franchisees in the specification, as distinct from the delivery, of services. In addition, it would need to be integrated with the HLOS process, which arguably already involves constructive engagement between Network Rail and DfT as well as Transport Scotland, the latter acting as customers for publicly funded rail services. We note, however, that such engagement could apply more readily to commercial freight and open access operators in the current environment.

Case Study A: understanding demand-side in the water industry

Context

Ofwat (2011) recognised that a traditional output-based approach to regulation "may no longer deliver the outcomes that customers want, need and are willing to pay for in the best and most proportionate way, given the challenges now facing the water and sewerage sectors. For example, the companies have told us that it constrains them from choosing different, better, solutions". In its 2014 Price Review, Ofwat introduced the a new incentive regime for water companies: "for the first time in this price review, companies have to focus on delivering what matters to customers, such as the reliable delivery of water that is safe to drink, and what matters to society more widely, such as environmental outputs"(Ofwat, 2014).

Benefits and transmission mechanism

Benefits	Transmission mechanism
Better understanding of customer benefits of service changes	Collecting information on the value that customers of water and sewerage services place on an improved service such as reduced sewer flooding has allowed the regulator to design an incentive regime that focusses on these outcomes. Ofwat (2014) suggests that a regime which penalises and rewards companies based on performance below or above a certain standard (respectively), which was demonstrated to be of value to customers, will allow companies to focus on customers' needs.

It should be noted that the full effects of this approach have not yet been realised, so that it is too early to determine the overall impact. However, early responses by companies indicate significant support for the scheme:

- South East Water (2013) stated: "we have chosen to embrace the concept of outcomes in our business plan for 2015-20 … this approach will allow us to use a wide ranging set of actions to improve customers' satisfaction, not just focusing on the traditional output but engaging with customers in a more effective way as well. We believe this approach can bring a change in culture and improve our relationship with our customers"; and
- Severn Trent Water Limited (2012) stated: "we support improvement in incentives. In our publication 'Changing Course' (Severn Trent Water, 2010) we argued for changes in the regulatory framework, with an increased emphasis on incentives. Such an approach will help to ensure that companies deliver the outcomes which customers and other stakeholders want, encourage innovation, and reduce the need for regulatory information collection".

Information used and key enablers

Importantly, to use this alternative incentive regime, an understanding of customers' willingness to pay for improvements of service was needed. This is summarised by Ofwat (2014): "our methodology required companies to demonstrate that the ODIs (Outcome Delivery Incentives such as "excellent water quality") represent value for money. They were asked to provide evidence that the proposed incentives reflected the value of the outcomes delivered to customers, justified by evidence of customers' willingness to pay for the costs of delivery. They also had to provide evidence to justify the performance levels to which they were committing, typically demonstrating that these levels represented an improvement on past performance and that the levels were at least as good as those achieved by efficient companies."

Case Study E: constructive engagement in the Australian rail industry

Context

The Australian Competition and Consumer Commission (ACCC) is an independent authority designed to represent and protect consumers' interests and has the power to grant access to the transport network in Australia. The Australian Rail Track Corporation (ARTC) is a federal government-owned corporation that owns, controls, maintains and leases the majority of the railway lines in Australia. In 2004, rights were granted to the ARTC to lease the Hunter Valley network for the next 60 years. In 2011, an agreement was reached on the terms under which operators, mainly privately owned corporations, could access the network (ARTC, 2011) – this is agreement is called the Hunter Valley Access Undertaking (HVAU). In developing the agreement, the ACCC encouraged the parties involved to engage with each other to come to an agreement over the HVAU.

Benefits and transmission mechanisms

Benefits	Transmission mechanism
Appropriate levels of output	The rate of return that was agreed by the parties involved was greater than that which the regulator (ACCC) initially deemed appropriate. This outcome was achieved through a more secure service in return for the higher cost of accessing the service. In this instance, both parties received a better outcome than would have been possible without constructive engagement.

Information used and key enablers

This experience of constructive engagement highlights the benefits that can be gained by allowing 'trading' between the parties: in effect, the parties were able to move closer to the allocatively efficient level of output than would otherwise have been possible. To achieve this, four key things were discussed as part of the negotiations:

- The process for ARTC investing in the railway during the period for which the access undertaking dictated the terms and framework for access to the network;
- The prices that would be set to ensure that ARTC made efficient use of the network and recovered costs;
- Timelines and key performance indicators that would be used to ensure ARTC met the obligations that it agreed to as part of the undertaking; and
- Other critical issues that were otherwise left unresolved for the final settlement which included the period of time for which the access undertaking would be binding and the plan for how changes agreed as part of the undertaking would be enacted.

Network Rail's allowed revenues

4.11 In common with other regulators, ORR uses a "building block" approach to determining Network Rail's net revenue requirement, including assumptions on Network Rail's current and potential future efficient costs. ORR could in principle develop its understanding of Network Rail's costs and cost drivers through its work on benchmarking, whether:

- Top down, through econometric analysis of costs and cost drivers; or
- Bottom up, through a detailed model of the unit costs of individual operation, maintenance and renewal activities.

4.12 In agreement with ORR, we have not considered approaches to top-down benchmarking as part of this study.

4.13 Unit cost estimates are developed in rail and a number of other sectors. In health the "payment by results" (PbR) regime uses unit costs for remunerating healthcare providers and may be especially relevant. The regulated healthcare entities are, like Network Rail, in the public sector, and receive funding largely on the basis of assumed unit costs. A detailed regime has developed based on the estimated unit costs of an extensive range of treatments, as described in Case Study F below.

4.14 A recurring theme in the case of the PbR regime is the inconclusive evidence on whether the intended benefits have been achieved, and this difficulty might also arise in the case of Network Rail. This suggests that:

- It is important to take into account the ownership, funding and remuneration framework in designing incentives; and
- Funding Network Rail on a "per activity" basis, even if achievable, might provide no better incentives than the current approach.

4.15 However, we also note that a better understanding of unit costs could be used to set transfer prices within Network Rail and that this could give rise to benefits, as we discuss further below. Experience in the healthcare sector suggests that robust unit costs can sometimes be identified at a granular level even in highly complex environments, but that:

- It is important to define units which reflect the underlying cost drivers;
- It may be important to reflect variations in costs with geography, as discussed in Section 2;
- Narrowly-defined unit costs may involve greater transactions costs;
- Costs and activities must be recorded in a consistent way over time and geography; and
- A unit cost approach will only be meaningful for certain types of activity and asset: in healthcare, for example, it has not proved possible to unitise mental health services.

4.16 Nonetheless, we conclude that it might be appropriate to review what Network Rail costs can be unitised and to develop further guidelines for the calculation of unit costs of activities.

Case Study F: unit costs in Healthcare

Context

This case study assesses remuneration for providers of secondary healthcare i.e. services provided in hospitals (which may be elective procedures, such as a kidney transplants, or non-elective services, such as stroke care in acute settings).

Since 2003/4, so called 'Payments by Results' (PbR) has been the standard methodology for reimbursing large parts of NHS-funded secondary care. Under PbR, a national tariff is set by the health regulator, Monitor, for each treatment that is carried out. The national tariff takes into account the complexity of the patient's healthcare needs. This is then paid by NHS commissioners to healthcare providers. The national tariff is calculated through so called 'reference costs', which are a national average of costs for activities submitted by trusts for services provided.

Prior to the introduction of PbR, secondary care was funded through block grant payments that were determined locally by commissioners and providers. These contracts were typically based on historic baselines and adjusted for inflation and efficiencies (akin to the current framework in rail).

As an example to illustrate the workings of the PbR regime, suppose Guy's and St Thomas' NHS Foundation Trust performs an emergency hip replacement in respect of an elderly patient. The amount that is paid to the provider would be based on the average cost of replacing a hip, and also other factors. These include the additional cost of complications involved in treating an elderly patient, reimbursement for the procedure being immediate, and an adjustment for the specific location of the healthcare provider.

Importantly, under PbR, providers' income is based on the volume of services that they deliver (i.e. on the basis of their activity) rather than the quality of the work that they carry out (i.e. the outcome). This has been a major criticism of the PbR regime, but there is currently a move towards a tariff structure that is more closely based on outcomes rather than activity (Department of Health, 2012).

Benefits and transmission mechanisms

Benefits	Transmission Mechanism
Increased patient choice	Generating an improved understanding of the unit costs of treatments has allowed providers to be rewarded by commissioners on the basis of each service provided. In principle, this was expected to facilitate increased patient choice over where individuals are treated, as money 'follows the patient' to the provider. This is in contrast to the 'Block Payments' regime that was previously in place where the funding is fixed for each healthcare provider. Note, however, that whether PbR has increased patient choice continues to be debated and at present there is little evidence of patients (or doctors) actively choosing among providers. Where there is patient choice, it may be that this is primarily driven by choice reforms in the Health and Social Care act in 2012 rather than PbR.

Improved healthcare service (e.g. Shorter average waiting times)	Generating an improved understanding of the unit costs of treatments has allowed providers to be rewarded by commissioners on the basis of each service provided. In principle, this incentivises providers to improve their service provision in order to improve their reputation and therefore attract a greater volume of patients in the future. Importantly, under a PbR regime, providers are able to reinvest any surpluses of income over costs[4]. In practice, evidence suggests that PbR may have improved services. While only being one measure, there was a reduction in average length of stay for elective treatments by 2.5% between 2002/03 and 2007/08 (Aberdeen and Dundee Universities (2010)). Another example is that of waiting times for outpatients[5], which fell from an average of 4.8 weeks in2005 to 2.4 weeks in 2009 (Department of Health).
Improvements in efficiency	Generating an improved understanding of the unit costs of treatments has allowed providers to be rewarded by commissioners on the basis of each service provided. In principle, it was expected that, as the price that they would receive for completing a particular treatment would be fixed and they would be able to retain and invest any surpluses, this would incentivise improvement in efficiency through reduced costs going forward. In practice, however, it is not yet clear whether the regime has led to efficiencies.
Non-discrimination	Generating an improved understanding of the unit costs of treatments has allowed remuneration on a non-discriminatory basis. In principle, two identical providers offering the same treatment would receive the same remuneration.
Increased transparency	Generating an improved understanding of the unit costs of treatments has allowed providers to be rewarded by commissioners on the basis of each service provided. With the overall funding paid to providers being uniform based on the volume/complexity of the service (rather than specific to a local agreement between a commissioner and provider), there has been increased transparency in the system.

The table sets out the theoretical benefits of the regime, but also describes whether the benefits have materialised in practice. A recurring theme is that the evidence as to whether the theoretical benefits have materialised is not clear. It is possible that the reason for this is that ownership, funding and remuneration structure of providers means that they may not respond to the incentive effects of the regime in the same way that a commercial provider might be expected to.

Key Issues

There are a number of issues associated with the PbR regime in the healthcare sector.

Large quantity of data required

The first issue is the requirement of a large quantity of data to implement such a reimbursement programme. For example, roughly 26,000 codes are used to describe interventions and diagnoses in the PbR regime. These are grouped using an annually updated algorithm into healthcare resource groups (HRGs)[6], which then constitute a 'currency' for payment i.e. the units over which tariffs are defined (e.g. a hip replacement for an elderly patient in London). Indeed, in part as a result of the large data requirements, some healthcare services (e.g. mental health and community-based services) continue to be funded through block contracts rather than PbR (Audit Commission (2011) and Department of Health Reference Costs Guidance (2010)).

Collecting the data is subject to inaccuracy

There are two broad reasons why unit costs (and therefore the tariffs paid by providers) might be

[4] They have a facility through which they have the autonomy to make investment decisions to improve the services they provide.

[5] These are patients who visit a healthcare provider for diagnosis/treatment but do not stay for longer than 24 hours.

[6] There are over 1400 HRGs (Health and Social Care Information Centre (on 25/02/15) **http://www.hscic.gov.uk/hrg4**).

inaccurate:

- There may be errors in the collection of data.
- Currencies or units may not be defined at a sufficiently granular level.

To illustrate the point about errors in data, PwC (2012) states that, "we found that 30% of unit costs reported by providers were at least 50% away from the national average unit cost for that HRG (weighted by activity)". The report goes on to state that, given the complexity of the data gathering task and through anecdotal evidence collected, it is likely that at least some variation in cost of service responses by healthcare providers results from the way in which the cost estimates were collected. A particularly important issue with data accuracy relates to how capital expenditure or Private Finance Initiatives are treated by healthcare providers which provide data. If one-off expenditures are included in the accounts, the data will be inaccurate and show large variations not only between different hospitals but also for the same hospitals over different periods of time. In addition, providers are not incentivised to report capital expenditure as this makes them appear less efficient than other providers. However, as this applies to all providers, the average tariff set is lower than it would be if capital expenditure had been reported. Furthermore, fundamental changes in costs that take place over time are not always appropriately captured. The three year time lag in tariff calculation means that step changes in costs or a change in case mix faced by providers that fundamentally changes cost (e.g. as a result of simpler procedures being moved into community settings) are not captured and accounted for in prices (PwC, 2012). Finally, some specific costs involved in delivering services such as minimum capacity requirements and economies of scale are not captured in how providers are reimbursed (PwC, 2012).

To illustrate the second point (that currencies or units may not be defined sufficiently granularly) PwC (2014) notes that uncontrollable differences in input costs such as land, labour and the costs of delivering services that arise from geographical dispersion of the local population are not controlled for at a sufficient level of detail. Furthermore, despite the already relatively granular nature of the currency, data is now being collected at the individual level (Patient-level Information and Costing Systems or PLICS)[7], suggesting that currencies do not fully take account of co-morbidities[8] and age, therefore failing to make the reference cost reflective of the true cost of a given service that is provided.

If the underlying tariffs associated with the provision of treatments are not representative of the cost, two key problems can result: cross-subsidisation and "cherry-picking".

Cross subsidies

Under PbR, if payments received by a provider for a treatment do not cover the provider's costs for the treatment, it may choose to cross-subsidise that service from surpluses from other activities (where revenues exceed costs), rather than fail to deliver required outputs or face reputational damage.

Turning to the empirical evidence of cross-subsidies in England, PwC (2012) cites evidence of high year-on-year volatility in PbR and non-PbR revenues in a sample of 69 NHS Trusts. Since treatment volumes are likely to be relatively stable over time, this suggests that cross-subsidies do indeed take place.

The principal problem associated with cross-subsidies is that providers may not need to respond to incentives created by PbR-type schemes, since shortfalls can be made up from other revenues.

[7] PLICS includes a record of the resources that are used to treat individual patients and information on the cost that is incurred by the organisation in using these resources. Combining the two, the cost of individual treatments for patients is calculated.

[8] A co-morbidity is where an individual has one or more additional disorders (or diseases) co-occurring with a primary disease or disorder.

Moreover, cross-subsidies can prevent competition since they enable providers to prevent entry to the market of competitors. Cross-subsidies may also discourage transparency of financial flows and improvements in cost information.

Cherry picking

The lack of accuracy in tariffs could lead to cherry-picking or "vertical cream-skimming", whereby providers choose to treat those patients with lower perceived risk (Newhouse, 1996; Ellis, 1998; Levaggi and Montefiori, 2005), and avoid treating patients with higher perceived risk. Such activities have been observed empirically in the US (Desai et al, 2009; Friesner and Rosenman, 2009) and Norway (Martinussen and Hagen, 2009). While we are is not aware of reliable evidence relating to cherry-picking in the English NHS, opportunities for such activities have existed for some time (Pollock, 2001) and it is difficult to rule out such practices (Appleby et al, 2012; PwC, 2012).

The most obvious – and perhaps most pernicious – problem associated with cherry-picking is that it implies incompleteness of markets, with some patients being left without the level of health coverage they require (Newhouse, 1996).

Cherry-picking may also have detrimental impacts on the structure of the "market" for healthcare. In particular, the ability to cherry-pick may differ across providers. In this case, providers that are more able to screen patients may "dump" high risk patients on providers less able to cherry-pick. Therefore, providers with less ability to cherry-pick could find themselves underfunded (Levaggi and Montefiori, 2005), and appear less productive even if they are not (Pollock, 2001). In extremis, inefficient providers which are successful cream-skimmers may drive efficient providers out of the market (de Ven and van Vliet, 1992). Overall, survival in the market could depend on the ability to screen rather than to be efficient per se, with the result that overall efficiency could be undermined.

Information used and key enablers

The PbR reimbursement system is based on currency (i.e. defining the 'units') and costing. Costing involves setting the amount that is reimbursed to providers. Information is collected from providers across the country which records the average costs of providing particular treatments. This data is then further averaged across the country and used to calculate the amount of reimbursement for each treatment. This reimbursement is based on the direct costs of the activity (e.g. doctors and drugs), indirect costs (e.g. labs) and overheads (e.g. board, finance, human resources, buildings) that are weighted according to their consumption by the activity analysed.

The structure and levels of access charges

4.17 ORR's Final Determination of Network Rail's efficient expenditure assumptions for Control Period 5 (CP5) state that:

"Cost-reflective prices incentivise efficiency by encouraging customers to purchase output if and only if the value of it to them exceeds the cost and by encouraging Network Rail to provide the product if and only if the value to customers exceeds the cost. This principle underlies our consideration of access charges".

4.18 ORR also recognises that it may be appropriate for charges to take account of costs and benefits that are external to Network Rail, or the railway sector more generally. The case studies provide a number of examples of two issues related to the structure and level of access charges:

- The variation of charges with geography, which we highlighted as an issue in Section 2, and also potentially by time; and

- Approaches to reflecting long run costs, particularly through the estimation of Long Run Incremental Cost (LRIC) or Long Run Avoidable Cost (LRAC).

Charges which vary with geography and/or time

4.19 A number of case studies include charges which vary with geography and/or time, as we summarise in Table 4.1. The full case studies are discussed in Appendix A.

Table 4.1: Case studies of charges which vary with geography and/or time

Issue	Costs reflected in charges	Method	Sector	Study
Geographical pricing	Local variation in costs	Distributed generation access charges	Energy	G
Peak load pricing	Increasing marginal costs	Peak load pricing	Energy	H
Congestion charging	Externalities	London Congestion Charge	Road	I
Scarcity charging	Opportunity cost	Capacity auctions	Gas	J
			Electricity	K

4.20 Network Rail's EC4T charges and Capacity Charge both vary to reflect variations in costs with location and time. The Capacity Charge is an example of peak load pricing, reflecting Network Rail's increasing internal marginal costs of delays, under the Schedule 8 regime, at places and times where the network is busy. The opportunities for, and implications of, making more charges vary with location in the rail industry will depend on whether and how such charges could be implemented and how Network Rail's customers would respond to them.

4.21 We understand that disaggregating charges across geography would require an upgrade to Network Rail's current billing system since it does not permit charging across geography (note that the current regime uses Service Groups to proxy for geography). In addition, while disaggregating charges across time would be technically feasible with the industry's current recording and billing system if charges were based on departure times, a number of issues would need to be considered and addressed before implementing a time-varying charging regime:

- Track access agreements contain "flex" provisions which allow Network Rail to move departure times within certain bounds. It might be necessary to create a mechanism by which Network Rail held operators neutral for any changes in charging resulting from Network Rail exercising this flex.
- Demand for paths might "cluster" just within cheaper time bands, creating artificial congestion at these times.

4.22 Freight and passenger open access operators are, at present, fully exposed to charges and may, in principle, be able to respond to charges which vary with geography and/or time. Freight operators, in particular, may be able to respond by changing either the timing or the routing of their services. In other work for ORR, we have reported evidence that freight operators may have retimed or rerouted services in response to charges in Belgium.

4.23 Passenger franchise operators, in contrast, may have less opportunity to respond to charges which vary with geography and/or time, as their franchise agreements generally require them to provide services on specified routes throughout the day, and in particular at times of peak demand, in accordance with a relatively detailed specification. We note that it is possible to envisage a policy framework in which franchisees are given greater flexibility, although we

have not examined the practicalities of them either avoiding peak periods and locations or passing variations in charges with geography and/or time on to passengers.

Approaches to reflecting Long Run Marginal Cost

4.24 The majority of Network Rail's variable charges currently reflect estimates of short run marginal cost, as we illustrated in Section 2. There may be benefits in moving to charges based on a long run approach, although these may depend on whether the approach used is to examine:

- The decremental or avoidable cost of removing existing services (LRAC); or
- The incremental cost of adding additional services (LRIC).

4.25 Table 4.2 lists a number of case studies examining LRAC and LRIC approaches in other sectors. Case Study L below, which considers the application of LRAC in ports is a particularly pertinent example, providing an illustration of the application of LRAC in respect of business-to-business relationships in the transport sector. These other studies are set out in Appendix A.

Table 4.2: Case studies of charges using LRMC approaches

Approach	Sector	Study
Long Run Avoidable Costs (LRAC)	Ports	L
Long Run Incremental Costs (LRIC)	Telecommunications	M
	Energy	N
	Airports	O

4.26 In principle, the benefit of using one of these approaches in the rail industry is that it could provide an indication of the long run costs associated with a given set of services. More specifically LRAC/LRIC could be used to:

- Set variable charges in a way which may be more reflective of underlying costs;
- Allocate fixed charges between operators, funders and geographies in a more cost-reflective way;
- Determine whether a self-contained package of services was commercially and/or economically viable and hence inform decisions on franchise specification, funding and subsidy; and/or
- Identify and, if appropriate and desirable, eliminate distorting cross-subsidies.

4.27 However, it would be necessary to consider the practical application before determining whether the benefits can be realised.

Case Study L: Long Run Avoidable Costs in ports

Context

Ferry operators P&O Ferries Holdings Limited, SeaFrance SA, and subsequently DFDS Seaways, lodged objections to the harbour tariffs (which are made up of a conservancy fee, harbour dues, passenger dues, wharfage and security charges) charged by Dover Harbour Board (DHB) in the calendar years 2010 and 2011. The operators argued that the tariffs were excessive and ought to be imposed at a lower rate. A public inquiry was held in 2011 into the objections made.

A Long Run Avoidable Cost (LRAC) approach was employed to assess whether the charges levied by DHB were commercial and competitive. For charges to be commercial, the revenues associated with the charges would need to at least cover the port's costs. For charges to be competitive, since over the long-term, market pressures would force charges to a level which are not unduly in excess of costs, they should cover the firm's costs plus a fair return on capital.

The inquiry found in favour of DHB, with the inspector concluding that "having found the 2010 dues to be commercial and competitive, fair and equitable and, on balance, reasonable I see no compelling reason to interfere with the 2010 dues as imposed" (Rodgers, 2012). The Secretary of State for Transport agreed with inquiry's findings (Department for Transport, 2012, a & b).

This case provides a useful example of the application of a LRAC approach in the transport sector, and in an industry in which the customer-supplier relationship is characterised by a small number of businesses purchasing network access from the supplier.

Benefits and transmission mechanisms

Benefits	Transmission mechanism
Provides an indication of long-run costs associated with accommodating a set of services	The proceedings emphasised that the LRAC of a group of services (in this case ferry operations) provides an estimate of the savings that would be made if the group of services were ceased. As such, it provides an indication of the minimum level of charges that would need to be recovered by the supplier (in this case DHB) if it was to have the incentive to continue accommodating the services in the long run.

Key enablers

LRACs were derived for DHB's ferry business and "other" businesses with some costs being regarded as common across the two. The approach used for deriving avoidable costs provides an indication of the informational requirements required to calculate LRACs. The approach for deriving avoidable costs for the largest cost categories was as follows (PwC, 2011):

- **Maintenance expenditure.** Maintenance expenditure was DHB's largest operating cost. Maintenance expenditure was invoiced separately for each asset type. Invoices were therefore allocated to specific assets and then assets were linked to ferry and non-ferry users.
- **Chief Executive's office costs.** Although it was recognised that some of these costs could be avoided by the removal of ferry services (e.g. the business may have become simpler, requiring less management resource), this was ultimately regarded as a common cost since it would have been difficult to establish what the management costs of differently configured versions of DHB would have been.
- **Utility costs.** Since, at the time, ferry and non-ferry services were in discrete geographic locations where utility usage was recorded and billed separately, estimating avoidable costs was straightforward.
- **Police costs.** DHB estimated that the police costs of the business in the absence of the ferry business, and the difference was regarded as the avoidable costs associated with the ferry

business.

- **Business rates.** The business rates avoidable were estimated by apportioning total rates according to the levels of profit in different parts of the business.
- **Security costs.** DHB estimated that security costs would have been zero in the absence of the ferry business, so all security costs were regarded as being avoidable.
- **Contract cleaning.** The cleaning cost contract specified requirements for each geographic area of the port. Avoidable cleaning costs were therefore assumed to be the cleaning costs incurred in the ferry-specific geographic areas of the port.
- **Cruise costs.** Since cruise costs would continue to be incurred at the same level in the absence of the ferry business, no cruise costs were regarded as being avoidable for ferry services.
- **Tugs and dredger costs.** DHB estimated that 50% of tugs and dredger costs would be avoided in the absence of the ferry business.
- **ICT delivery costs.** These were treated as common costs.
- **Buildings insurance costs.** Avoidable buildings insurance costs of the ferry business were derived as the costs of insuring buildings relating only to the ferry business.

Implications for funders

4.28 Funders such as the DfT, Transport Scotland and other devolved administrations may need to make decisions related to:

- The appropriate level of Network Rail's outputs, as discussed above; and
- Network Rail's allowed revenues, at least in developing the SoFA.

4.29 Better understanding of Network Rail's costs and cost drivers could also be used to inform funders of the consequences of the implications for the SoFA of particular choices in the High Level Output Specifications (HLOSs). The various approaches identified through the case study analysis and reported above could therefore have significant benefits for funders as well as ORR. As already noted, the value of the constructive engagement process and its potential integration with the HLOS process under the current policy framework may merit further consideration.

Implications for Network Rail

4.30 The case studies suggest that Network Rail might benefit from a better understanding of costs and cost drivers through the use of transfer prices. There is only limited direct evidence of the efficacy of transfer pricing within regulated entities, but Case Study R below considers evidence from a number of German firms and Case Study S in Appendix A examines remuneration in pharmacies in England, to which the Department of Health pays a standard market average price for dispensing a prescription item (whilst this is not a transfer pricing mechanism since the payment goes from DoH to pharmacies, the case study provides an illustration of how private organisations may respond to similar incentive mechanisms).

4.31 Transfer prices are used internally within an organisation and can increase the efficiency of business units by improving:

- Coordination, in that business units understand, and can respond to, the costs of services that they receive from elsewhere in the organisation, promoting allocative efficiency; and
- Motivation, if business units have their own profit and remuneration structures, to improve financial performance.

4.32 Transfer pricing is likely to be most effective when costs and their drivers are well understood and reflected. Transfer prices that overcompensate may deter efficient expenditure, and fail

to drive down costs, while those that undercompensate may incentivise inefficient expenditure. Empirical evidence suggests that transfer prices are likely to be most effective when they are set at "market levels" (which in the case of a regulated company means the efficient cost of delivery plus a reasonable margin).

Case Study R: transfer pricing in German firms

This case study looks at the benefits of using a market based internal transfer pricing. Wolff (2007) used questionnaires' to collect data on 73 German companies' internal transactions in order to test hypotheses on whether a market price based internal transfer pricing system increased motivation and improved efficiency. These companies varied in size from less than 5,000 employees to greater than 100,000, and included industries from a wide range of sectors.

Benefits and transmission mechanisms

Benefits	Transmission Mechanism
Increased efficiency	Wolff found that an internal transfer pricing system increases efficiency, which is measured as being improvements in outputs from inputs to production. He explains that "an increase in efficiency can be achieved firstly by increasing the internal efficiency pressure and secondly by a potential improvement in short and medium term allocation decisions."

Key enablers and information used

Wolff (2007) states that "The use of coordination mechanisms that are similar to markets within the company can include the use of an external market for the intermediate product with the corresponding issue of orders to external parties and open-result negotiations on the internal purchase and sale".

4.34 We noted above, in the context of the "payment by results" (PbR) regime for remunerating healthcare, that use of unit prices might not be an appropriate means of compensating Network Rail as a whole. However, unit prices in the form of transfer prices could be used more extensively within Network Rail, particularly if Network Rail Routes are expected to act as commercial profit centres.

4.35 Transfer prices could be used within Network Rail in a number of ways. For example, Network Rail Routes could be compensated for delivery of particular units of output, for example renewal of a specific type of signal or replacement of a length of track. Similarly, certain goods and services – for instance where there are scale economies, for example in respect of high-output plant – could be provided by 'the centre' and procured by Routes.

4.36 Under the right conditions, this could send appropriate price signals to Network Rail Routes which could encourage them to make efficient decisions and incentivise efficient delivery. To be most effective, evidence from other sectors suggests that:

- The Routes would need to be structured in a way that closely resembled commercial organisations, for example with Route managers being remunerated on the basis of financial performance; and
- Transfer prices would need to be set to approximate the charges that would be seen in a competitive market, which underlines the need for a better understanding of costs.

Implications for investors and creditors

4.37 Decisions by investors and creditors may be important in determining overall industry costs if they affect the cost of capital of the sector.

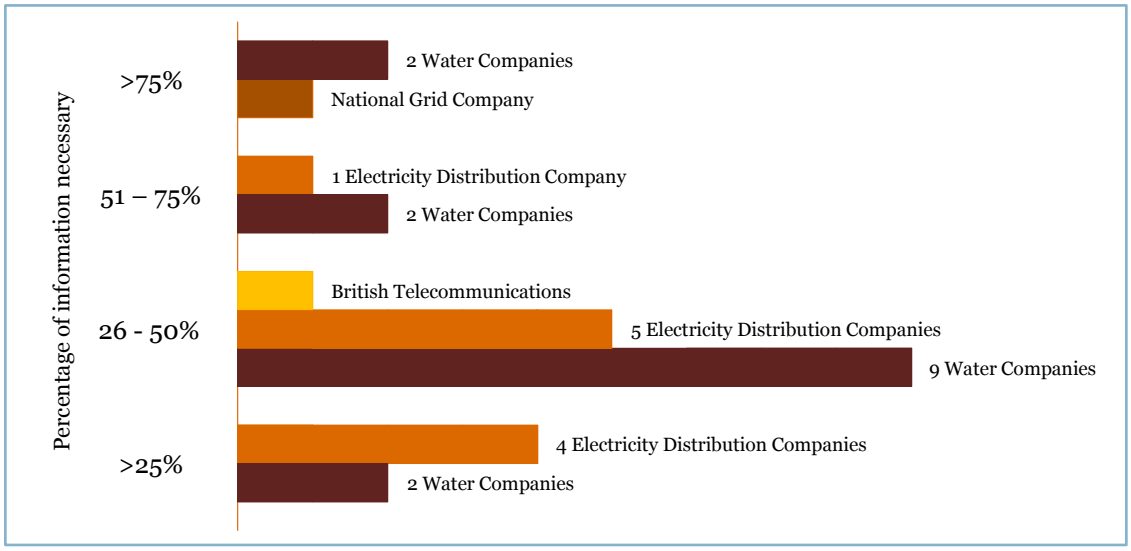
4.38 Network Rail's reclassification as a public sector entity in September 2014 means that it will no longer issue its own debt, and it seems unlikely that a better understanding of its costs and cost drivers will affect its financing costs unless there are further structural changes in the way that it is financed. However, Network Rail's access charges are key input costs for train operators, and in particular for freight and passenger open access operators which have no protection from changes in charges. An improved understanding of costs and cost drivers could in principle lead to less uncertainty in future charges and hence reduce the effective rate of return required by investors and creditors and therefore the operators' effective cost of capital.

4.39 Case Study T in Appendix A examines whether the effect of uncertainty in the regulated charges paid by airlines for airport and air navigation services could affect the airlines' cost of debt. The evidence suggests that that uncertainty relating to future charges could, at the margin, lead to a reduced credit rating which would in turn affect airlines' borrowing costs.

The costs of obtaining better information

4.40 We also considered the costs of gaining a more detailed understanding of costs, as the discussion above suggests that the these might be significant. A 2002 study by the National Audit Office (NAO) (Figure 4.2 below) found that 16 of 27 regulated companies spent more than £0.5 million in staff costs to prepare the data required by their regulator during the previous price review. Some regulated companies also suggested that regulators request more information than is necessary, and that not all the information provided is used.

Figure 4.2: Regulated companies' views on regulators' information requirements



Source: NAO. The figure shows the response of BT, National Grid and ten electricity distribution companies.

4.41 This suggests that regulators should consider the cost implications of additional information requirements if they wish to promote overall efficiency. Possible approaches, some of which have been suggested by the NAO, include:

- Ensuring that regulators articulate a clear need for each set of information required from the regulated entity;
- Ensuring that the benefits of requesting each set of information are likely to outweigh the costs of obtaining and processing it;

- Consulting widely in developing data requests, and being open to adjusting them in the light of representations made by stakeholders; and
- Demonstrating ex post how data has been used and what benefits it has yielded.

Conclusion

4.42 This review of experience in other sectors has highlighted a number mechanisms that have helped to improve cost information for the benefit of regulators, customers and other stakeholders. The table below provides a summary of the main mechanisms that we consider particularly relevant, together with observations on their potential application to the rail sector. Their possible role in realising opportunities for improving the understanding of Network Rail's costs and cost drivers is discussed further in the following final section.

Table 4.3: Summary of key experience from other sectors

Case study	Summary	Potential for application to rail
Case Study A: **understanding demand-side** in the water industry	Collecting information on the value that customers of water and sewerage services place on an improved service such as reduced sewer flooding has allowed the regulator to design an incentive regime that focusses on these outcomes.	In rail, where key outputs are specified by government on behalf of the taxpayer, collection of information on the value to customers of specific improvements by Network Rail may be better undertaken as part of the HLOS process. Nevertheless specific valuation exercises, sponsored by DfT or Network Rail, could be made more explicit and used to inform the Initial Industry Plan as well as HLOS. They could also be undertaken by Network Rail to determine the value placed on particular improvements by freight and open access operators.
Case Study E: **constructive engagement** in the Australian rail industry	The rate of return that was agreed by the parties involved was greater than that which the regulator (ACCC) initially deemed appropriate. This outcome was achieved through a more secure service in return for the higher cost of accessing the service.	Again, there is arguably a rail sector analogy to constructive engagement in the HLOS process, which involves extensive engagement between DfT and Network Rail prior to publication of the HLOS. At the same time, there may be scope for additional engagement between Network Rail and commercial operators (passenger and freight) in order to determine the value that they place on specific improvements of value to them.
Case Study F: **unit costs** in Healthcare	Generating an improved understanding of the unit costs of treatments has allowed providers to be rewarded by commissioners on the basis of each service provided. In principle, it was expected that as the price that they would receive for completing a particular treatment would be fixed and they would be able to retain and invest any surpluses, this would incentivise improvement in efficiency through reduced costs going forward. In practice, however, it is not yet clear whether the regime has led to efficiencies.	Network Rail could be remunerated on a per-activity basis according to defined unit costs. This would require the definition of standard activities, which could be challenging in practice, although unit rates could be permitted to vary across routes or other geographical areas. Note, however, that as the efficiency benefits of this approach in healthcare have not yet been fully demonstrated, movement to such a regime in rail would appear to be premature. Nevertheless, the approach could have useful applications through the introduction of transfer pricing, discussed further below.

Case Study L: **Long Run Avoidable Costs** in ports	The proceedings of a public inquiry into Dover Harbour Board's tariffs in 2011 emphasised that the LRAC of a group of services (in this case ferry operations) provides an estimate of the savings that would be made if the group of services were ceased. It therefore provides an indication of the methodology that could be pursued to derive analogous charges in a rail context.	LRAC could be applied to allocate the costs of the existing network to individual franchises or groups of services. This would require the identification of the costs that would be saved if well-defined groups of services were removed from the network. The approach has already been used in the rail industry to determine Railtrack's vesting charges at privatisation, although its application in that case proved relatively onerous.
Case Study R: **transfer pricing** in German firms	Wolff (2007) found that an internal transfer pricing system increases efficiency. He explains that "an increase in efficiency can be achieved firstly by increasing the internal efficiency pressure and secondly by a potential improvement in short and medium term allocation decisions."	Transfer pricing could be applied within Network Rail in order to encourage different parts of the organisation to source services from the most efficient provider. For example, Network Rail Routes , operating as commercially-focused profit centres, could buy and sell maintenance services with a view to exerting competitive discipline on in-house maintenance teams. These transfer prices would need to be fully cost reflective, which would itself require a better understanding of costs at the Route level.

5 Opportunities for improving the understanding of Network Rail's costs

Introduction

5.1 In the previous sections, we have demonstrated the importance of improving the understanding of Network Rail's costs and cost drivers while highlighting some of the associated challenges. As discussed in Section 2, the benefits of better cost information do not derive solely from the use of access charges as a transmission mechanism, although a thorough understanding of cost drivers is a precondition for the development of a charging structure that more accurately reflects underlying costs. There is therefore merit in the further investigation of the relationship between railway outputs and costs regardless of how the framework of access charges develops.

5.2 Our review of rail industry decisions suggests that there are a number of deficiencies in the current understanding of costs, as summarised in the table below.

Table 5.1: Weaknesses in current understanding of costs

Weakness	Comment
Estimates have not been made	The relationship between costs and outputs may be too complex to enable reliable estimates to be derived
Estimates are inaccurate	Costs may be based on poor estimates, limited analysis, or an unsuitable basis, such as historic costs (HCA) rather than current costs (CCA)
Estimates are insufficiently granular	VUC may not be based on local speeds, enhancement costs may not be specific to local conditions
Estimates are not allocated to the correct causation of driver	Where multiple services use a location, allocation of costs to particular service can be problematic or absent
Estimates are not available at the same level of granularity for all elements of a scheme	Appraisal of options involving benefits resulting from changes to train services cannot be carried out effectively unless benefits, operating, rolling stock and infrastructure costs are estimated consistently for each option
Estimates are not available for some options	Some options may not have been examined, or poor incremental investments may have been "bundled" with better ones, leading to inefficient expenditure at the margin
No clear business case has been assembled	Cost data, while available, may not have been collated with other relevant information to support a decision by network Rail, operators or funders
Decision-makers have not made best use of cost information	Decisions may not have made best use of cost-informed analysis

Source: Steer Davies Gleave analysis

5.3 In turn, these deficiencies can lead to inefficient outcomes of various kinds, including sub-optimal investment in the enhancement of infrastructure as well as the operation of services whose costs exceed their benefits. The case studies reported in Section 3 illustrate how, in particular, inadequate understanding of the costs arising from different elements of an enhancement programme, or of the long term impact of operations on track and other infrastructure, can give rise to an unforeseen escalation of costs as well as a lack of transparency. At the same time, these specific findings have implications for broader industry processes, for example relating to the efficiency of franchise and rolling stock procurement and the provision of public subsidy at the national and regional level.

5.4 The investigation of measures to improve the understanding of costs and cost drivers applied in other sectors, reported in Section 4 and Appendix A, indicates that similar issues have been addressed, more or less successfully, in a wide range of industries including, although not limited to, the network-based utilities subject to bespoke economic regulation. While any application of equivalent measures to the rail industry would need to take account of its specific characteristics, not least its likely ongoing dependence on public subsidy, a number approaches already applied elsewhere appear to merit further investigation. Their usefulness will depend, inter alia, not only on the scope for practical application under the current policy and regulatory framework but on how this might change in the future, as discussed further below.

5.5 In the remainder of this final section, we summarise our findings on the benefits of an improved understanding of costs and comment further on measures for improving cost information, drawing on the experience from other sectors as well as from developments in the rail industry since privatisation. We conclude with a brief review of the implications of possible changes to rail sector policy and regulation.

The benefits of a better understanding of costs

Summary of potential cost savings

5.6 Table 5.2 summarises the apparent savings which the case studies suggest might be achieved, either in relation to the particular scheme, over the network as a whole, or on a recurring basis over a whole Control Period.

5.7 These estimates are partial and based on high level assumptions about the scope for cost savings across the network and over an individual Control Period. Moreover, given the unique characteristics of the individual case studies, we have not been able to identify a robust means of extrapolating from them to give a reliable estimate of the potential cost savings for the industry as a whole. Hence, in our view, the total of £100 – 200 million per Control Period represents the lower end of the range of potential cost savings, and should be taken together with the results of the welfare analysis reported in Section 2 in drawing conclusions about the value of further work to improve the understanding of Network Rail's costs.

5.8 At the same time, these findings serve to illustrate the potential benefits of further investigation of the scope for improving specific aspects of cost information, notably in respect of major infrastructure and rolling stock investment schemes. The case studies of the GWML, Northern Hub and Oxford station, in particular, demonstrate the importance of a structured approach to the scoping of major programmes of investment and a thorough understanding of how costs increase with each increment to an original specification. In addition, we note that the benefits of a more comprehensive understanding of the long run cost of operations, as implied by the study of the Pontefract – Wakefield Kirkgate service, could substantially exceed

the reduction in associated costs captured by VUC alone, particularly if similar opportunities for the withdrawal of services were available across the network.

Table 5.2: Case studies: potential benefits of better understanding of Network Rail costs

Decision type	Case study	Issue	Opportunity	Estimate of potential cost saving
Network enhancement	GWML electrification: choice of branches	Branches may have been included without robust incremental case	More granularity of options to identify those with poor or zero marginal BCR	£50-100 million per Control Period (across the network)
	Northern Hub and northwest electrification	Identification of all the consequential costs of the scheme appears to have been problematic	More detailed investigation of the cost implications of specific proposals for service enhancements	Not estimated, although level of cost overrun suggests significant potential
Station capacity enhancement	Reading station redevelopment	Some elements of expenditure may not be needed to deliver the required operational functionality	Identification of specific costs of meeting operational requirements and explicit costing of incremental improvements to station environment	Not estimated, although additional enhancement costs could be significant proportion of total scheme costs
	Station enhancements at Oxford	Business cases may have been based on poor estimates of station costs	Clearer identification of incremental requirements to specific service proposals	£15 million per Control Period (individual scheme)
Rolling stock procurement	Class 444/450s on Wessex routes	Inaccurate VUC may mean that choice of stock was sub-optimal	Better reflection of maintenance and renewal costs resulting from new rolling stock in VUC, resulting in more efficient procurement decisions	£60 million per Control Period
Rolling stock deployment	Mk III v Mk IV stock on ECML	VUC charges averaged across the network may provide perverse incentives on one route	Direct comparability of variable costs of alternative stock operating the same service	£25 million per Control Period
Service enhancement	Services, Knottingley to Wakefield Kirkgate	Initial analysis had poor information on the costs of adding a passenger service on freight-only lines. Network Rail and the operator also had insufficient information incentivise efficient decisions	Regular reviews of value for money of retaining lines with only lightly-patronised services	£30,000 per annum (individual scheme – potentially greater depending on scope for line and station closure)
Total				**£100-200 million per Control Period**

Source: Steer Davies Gleave analysis, all estimates are illustrative

5.9 We note, however, that improving the understanding of Network Rail's costs itself has resource implications, in particular for the systems and processes used to estimate, record and report costs. We have not investigated these in detail, but conclude that they could be significant and should be balanced against any estimates of the benefits of better cost information.

Opportunities for improving cost information

5.10 We have considered the potential application to the rail industry in Great Britain of a number of regulatory measures adopted in other sectors, highlighting some of the associated challenges, in Section 4. While we are not required to make recommendations on the most appropriate measures for implementation, we have nevertheless identified a number of approaches that we consider merit further investigation as part of the preparatory work for the next periodic review. These are shown in the table below, which identifies, for key areas of rail industry activity, the main potential deficiencies in the understanding of Network Rail's costs as well as possible responses. The table also summarises the potential benefits from these responses and highlights some of the issues surrounding implementation that require further investigation.

Table 5.3: Opportunities for improving cost information

Industry activity	Need for better understanding of Network Rail's costs	Potential application of other sector measures					Possible methodologies for improve calculation of costs	Issues for further investigation
		Understanding demand side	Constructive engagement	Standard unit costs	Long Run Avoidable Cost	Transfer pricing		
Franchise specification	Geographical disaggregation of scope/cost of enhancement Rigorous definition of scope of enhancement Disciplined approach to allocation of costs between enhancements Improvements to estimation of track maintenance/ renewal costs Rigorous allocation of costs to groups of services	✓	✓	✓	✓	✓	More explicit valuation of customer benefits of capacity enhancements, supported by constructive engagement, would enable better alignment between the scope of enhancements and franchise specification. Application of standard unit costs and LRAC-based approach (or other approaches to attribution of long-run costs on a geographical basis) would improve understanding of the overall costs of different franchise specifications and of the costs of specific services. This would enable better value for money through improvements to franchise specification.	Integration of demand side and constructive engagement processes with the development of HLOS and the Initial Industry Plan would need to be defined. Standard unit costs and transfer prices could be difficult to define given the difficulties of measuring geographical variations in cost discussed in Section 2. Previous experience of the application of LRAC in the rail industry suggests it could be onerous. However, even relatively infrequent application (e.g. every ten years) or more focused application to determine the impact of changes to franchise specifications could help to improve the understanding of franchise costs (and reduce the costs of the exercise itself).

Industry activity	Need for better understanding of Network Rail's costs	Potential application of other sector measures					Possible methodologies for improve calculation of costs	Issues for further investigation
		Understanding demand side	Constructive engagement	Standard unit costs	Long Run Avoidable Cost	Transfer pricing		
Franchise bidding	Rigorous definition of scope of enhancement Improvements to estimation of track maintenance/ renewal costs Rigorous allocation of costs to groups of services	✓	✓		✓		Explicit valuation of customer benefits of investment, coupled with constructive engagement, could result in infrastructure enhancement plans better aligned with the requirements of franchised operators as well as franchise bids based on a better understanding of expected infrastructure capability. An LRAC-based approach to setting access charges (or other approaches to attribution of long-run costs on a geographical basis) would enable bidders to prepare business cases for additional services that fully reflected long run costs.	The timing of valuation of benefits and constructive engagement exercises could not be aligned with both the periodic review cycle (which drives the development of enhancement programmes) and the franchise bidding cycle (driven by the expiry of franchise terms and the need to reduce, as far as possible, peaks and troughs in franchising activity). The frequency with which LRAC methodology could realistically be applied would need to be considered, although even relatively infrequent calculation could have benefits. However, a more focused application to determine the impact of changes to franchise specifications could help to improve the understanding of franchise costs.

Industry activity	Need for better understanding of Network Rail's costs	Potential application of other sector measures					Possible methodologies for improve calculation of costs	Issues for further investigation
		Understanding demand side	Constructive engagement	Standard unit costs	Long Run Avoidable Cost	Transfer pricing		
Cost efficiency initiatives	Geographical disaggregation of scope/cost of enhancement Rigorous definition of scope of enhancement Disciplined approach to allocation of costs between enhancements Improvements to estimation of track maintenance/ renewal costs Rigorous allocation of costs to groups of services	✓	✓	✓	✓	✓	Each of the measures identified would enable a better understanding of the base capability and costs of the infrastructure, enabling a more accurate calculation of the effects of any initiative for improving cost efficiency. A better understanding of customer benefits and constructive engagement would also support the assessment of the value of existing infrastructure and potentially help to identify assets that were no longer required. Transfer pricing could itself encourage Network Rail Routes to become more efficient.	As noted above, the implementation of standard unit costs and transfer prices would be likely to be challenging given the difficulties of determining the underlying geographical variability of costs. The frequency with which LRAC methodology could realistically be applied would need to be considered, although even relatively infrequent calculation could have benefits.
Investment in enhancements	Geographical disaggregation of scope/cost of enhancement Rigorous definition of scope of enhancement Disciplined approach to allocation of costs between enhancements Rigorous allocation of costs to groups of services	✓	✓	✓		✓	Most of the measures identified from the review of other sectors would support more rigorous scoping and cost of enhancement schemes. Explicit valuation of customer benefits and constructive engagement would enable scheme sponsors and Network Rail to better understand the potential benefits of an enhancement for operators. Standard unit costs and transfer pricing could help to determine estimates of the efficient cost of some, although probably not all, aspects of scheme delivery.	Again, integration of demand side and constructive engagement processes with the development of HLOS and the Initial Industry Plan would be required if they were to inform the regulatory determination as well as third party investment based on commercial criteria. In practice, it may be difficult to determine standard unit costs and/or transfer prices for larger enhancement schemes, most of which will involve bespoke activity that may not have been undertaken in the past.

Industry activity	Need for better understanding of Network Rail's costs	Potential application of other sector measures					Possible methodologies for improve calculation of costs	Issues for further investigation
		Understanding demand side	Constructive engagement	Standard unit costs	Long Run Avoidable Cost	Transfer pricing		
Devolved funding decisions	Geographical disaggregation of scope/cost of enhancement Rigorous definition of scope of enhancement Disciplined approach to allocation of costs between enhancements Improvements to estimation of track maintenance/ renewal costs Rigorous allocation of costs to groups of services	✓	✓	✓	✓	✓	Valuation of customer benefits and constructive engagement would enable funders at the regional and local level to help determine the scope of individual enhancements and service specifications. Standard unit costs and transfer pricing would enable more robust cost estimates, giving regional and local stakeholders greater confidence that schemes and service improvements could be delivered within defined budgets. The application of LRAC (or other approaches to attribution of long-run costs on a geographical basis) would enable a better understanding of the costs of service provision at the regional or franchise level.	The implementation issues already identified for franchise specification and investment in enhancements would apply equally if these activities were sponsored at the regional rather than the national level. In addition, given the issues surrounding geographical allocation of costs identified in Section 2, the alignment of costs with the boundaries of regional and local decision-making bodies such as transport authorities and LEPs is likely to be challenging.

Industry activity	Need for better understanding of Network Rail's costs	Potential application of other sector measures					Possible methodologies for improve calculation of costs	Issues for further investigation
		Understanding demand side	Constructive engagement	Standard unit costs	Long Run Avoidable Cost	Transfer pricing		
Balance of fares and subsidy	Geographical disaggregation of scope/cost of enhancement Rigorous definition of scope of enhancement Disciplined approach to allocation of costs between enhancements Improvements to estimation of track maintenance/ renewal costs Rigorous allocation of costs to groups of services	✓	✓	✓	✓	✓	Taken together, the approaches identified would enable better estimates of the costs and benefits of specific enhancements, franchises and groups of services. This, in turn, would enable a better understanding of subsidy requirements for a given network capability and/or level of service. In addition, the application of LRAC (or other approaches to attribution of long-run costs on a geographical basis) would allow costs to be allocated to regions and franchises, at least at a broad level, as discussed above, and would therefore help to inform an understanding of how public subsidy was allocated at the regional level.	As for franchise specification and devolved funding decisions.

Industry activity	Need for better understanding of Network Rail's costs	Potential application of other sector measures					Possible methodologies for improve calculation of costs	Issues for further investigation
		Understanding demand side	Constructive engagement	Standard unit costs	Long Run Avoidable Cost	Transfer pricing		
Commercial strategy	Improvements to estimation of track maintenance/ renewal costs Rigorous allocation of costs to groups of services	✓	✓		✓		Valuation of customer benefits and constructive engagement would enable Network Rail to better understand the network capability required by open access and freight operators. An LRAC-based approach (or other approaches to attribution of long-run costs on a geographical basis) to the determination of access charges would also support a more optimal determination of the level of all discretionary services, including those planned and operated by franchise operators.	In isolation, application of an LRAC-based approach for all charges would be likely to undermine the commercial case for both freight and open access services. The potential impact of the approach would need to be considered alongside other policy objectives, for example the encouragement of competition in rail services and increasing rail's share of freight transport. The degree of compliance of LRAC-based access charges with EU rail legislation would also require investigation.
Innovation	Geographical disaggregation of scope/cost of enhancement Rigorous definition of scope of enhancement Disciplined approach to allocation of costs between enhancements Improvements to estimation of track maintenance/renewal costs Rigorous allocation of costs to groups of services	✓	✓	✓	✓	✓	All of the measures identified would enable a better understanding of baseline costs and hence more robust estimates of the impact of cost saving innovations. LRAC-based charges would encourage train operators to develop innovative ways of using capacity more efficiently. Transfer pricing would encourage Network Rail Routes to adopt innovations already adopted on other parts of the network.	No additional implementation issues beyond those already identified above.

Future scenarios

5.11 We have already noted that the benefits of a better understanding of Network Rail's costs will depend partly on the policy and regulatory environment, and in particular on the extent to which different parties can respond to improved cost information through changes to their investment programmes, the level and quality of service delivery and the approach to operations. It follows that the measures for improving cost information identified above might be more or less effective depending on the evolution of the policy framework. In discussion with ORR, we have identified a number of possible future industry scenarios that could change the relationship between improved cost information on the one hand and improved decision-making on the other, as discussed in detail in Appendix C. Here, we note that in view of the importance of future changes to the way in which the rail industry is specified, planned, funded and regulated, it will be important to take account of the impact of potential changes in any further exercise to improve the understanding of Network Rail's costs.

A Experience of understanding costs in other sectors

Introduction

A.1 This Appendix summarises details of case studies from sectors outside the rail industry of Great Britain, summarised in Table B.1.

Table B.1: Case studies from other sectors

Issue	Sector	Study	See
Understanding demand-side	Water	A	A.3
Understanding supply-side	Water	B	A.6
Constructive engagement	Aviation	C	A.10
	Energy	D	A.12
	Australian rail industry	E	A.15
Unit costs	Healthcare	F	A.17
Geographic cost differences	Electricity distribution	G	A.36
Peak-load pricing	Energy	H	A.42
London Congestion Charge	Highways	I	A.50
Capacity auctions	Gas	J	A.57
	Energy	K	A.59
Long Run Avoidable Costs (LRAC)	Ports	L	A.63
Long Run Incremental Costs (LRIC	Electricity distribution	M	A.68
	Mobile telecommunications	N	A.73
	Airports	O	A.75
Current Cost Accounting (CCA)	Telecommunications	P	A.78
	Ports	Q	A.82
Transfer pricing	Various industries in Germany	R	A.85
Reimbursement with standard tariffs	Pharmacies	S	A.87
Cost of capital and debt	Airlines	T	A.93

A.2 We discuss each of these case studies in turn below.

Case Study A: understanding demand-side in the water industry

Context

A.3 Ofwat (2011) recognised that a traditional output-based approach to regulation "may no longer deliver the outcomes that customers want, need and are willing to pay for in the best and most proportionate way, given the challenges now facing the water and sewerage sectors. For example, the companies have told us that it constrains them from choosing different, better, solutions". In its 2014 Price Review, Ofwat introduced the a new incentive regime for water companies: "for the first time in this price review, companies have to focus on delivering what matters to customers, such as the reliable delivery of water that is safe to drink, and what matters to society more widely, such as environmental outputs"(Ofwat, 2014).

Benefits and transmission mechanism

Benefits	Transmission mechanism
Better understanding of customer benefits of service changes	Collecting information on the value that customers of water and sewerage services place on an improved service such as reduced sewer flooding has allowed the regulator to design an incentive regime that focusses on these outcomes. Ofwat (2014) suggests that a regime which penalises and rewards companies based on performance below or above a certain standard (respectively), which was demonstrated to be of value to customers, will allow companies to focus on customers' needs.

A.4 It should be noted that the full effects of this approach have not yet been realised, so that it is too early to determine the overall impact. However, early responses by companies indicate significant support for the scheme:

- South East Water (2013) stated: "we have chosen to embrace the concept of outcomes in our business plan for 2015-20 … this approach will allow us to use a wide ranging set of actions to improve customers' satisfaction, not just focusing on the traditional output but engaging with customers in a more effective way as well. We believe this approach can bring a change in culture and improve our relationship with our customers"; and
- Severn Trent Water Limited (2012) stated: "we support improvement in incentives. In our publication 'Changing Course' (Severn Trent Water, 2010) we argued for changes in the regulatory framework, with an increased emphasis on incentives. Such an approach will help to ensure that companies deliver the outcomes which customers and other stakeholders want, encourage innovation, and reduce the need for regulatory information collection".

Information used and key enablers

A.5 Importantly, to use this alternative incentive regime, an understanding of customers' willingness to pay for improvements of service was needed. This is summarised by Ofwat (2014): "our methodology required companies to demonstrate that the ODIs (Outcome Delivery Incentives such as "excellent water quality") represent value for money. They were asked to provide evidence that the proposed incentives reflected the value of the outcomes delivered to customers, justified by evidence of customers' willingness to pay for the costs of delivery. They also had to provide evidence to justify the performance levels to which they were committing, typically demonstrating that these levels represented an improvement on past performance and that the levels were at least as good as those achieved by efficient companies."

Case Study B: understanding supply-side in the water industry

Context

A.6 As part of its PR14 price control, Ofwat developed water and sewerage econometric cost models (see Ofwat (2014) and CEPA (201)). The models seek to establish the key drivers of total expenditure in wholesale water and wholesale sewerage. The particular methods used by Ofwat are similar to the methods used by ORR to benchmark Network Rail's costs.

A.7 In developing its cost models, Ofwat considered a wide range of cost drivers. For its wholesale water models, these included measures of network size and input prices, but also output and quality measures including leakage (CEPA, 2014).

A.8 The modelling indicates, for example, that total costs are negatively related to leakage: the preferred model which identifies this affect suggests that reducing leakage by 10% is associated with an increase in total costs of around 2%, although this result is not statistically significant. Similarly, the results suggest that increasing the proportion of mains relined by 10% associated with an increase in total costs of around 0.3% to 0.7%.

Benefits and transmission mechanisms

Benefits	Transmission mechanism
Better understanding of costs	Although the principal purpose of the modelling undertaken by Ofwat and its consultants was to benchmark efficiency among companies, by including measures of outputs and quality in its modelling framework Ofwat has sought to recognise the trade-off that is likely to exist between outputs delivered and costs. Moreover, in principle the models provide insight into the possible costs that may need to be incurred (or saved) if an improved (or reduced) level of output/quality was determined (although to our knowledge, Ofwat has not used the models for this purpose).

Information used and key enablers

A.9 The modelling undertaken by Ofwat required information on total expenditure, as well as information on cost drivers, across regulated firms in England & Wales and over time. The analysis was enabled by the employment of sophisticated econometric methodologies, many of which are well-known to ORR through its own econometric work.

Case Study C: constructive engagement in the aviation industry

Context

A.10 In 2005, the Civil Aviation Authority (CAA) encouraged airlines and airports to come together to discuss and agree on parts of the next airport price control. The CAA retained the role of making the final decision on key regulatory issues such as analysis of market power and assessing the cost of capital.

Benefits and transmission mechanisms

Benefits	Transmission mechanism
Appropriate levels of output	As a result of the constructive engagement process, Heathrow and the airlines agreed to three areas of priority for Q6 (Heathrow, 2012): • Deliver a better 'hub of choice' passenger experience through Heathrow, including improvements in areas that are most meaningful for Heathrow's passengers; • Ensure sufficient hub capacity is in place to handle forecast aircraft and passengers, with improved resilience; and • Ensure a competitive total cost of operation relative to Heathrow's passenger mix, service and facilities. Put simply, the framework allowed the outputs to be delivered by the regulated firm to be set with relevance to airlines and the demand of passengers. This means that the determined level of output may be more efficient than would have been the case otherwise.

Information used and key enablers

A.11 Negotiations between airports and airlines were established and overseen by the CAA. This included the formation of a Constructive Engagement Working Group (CEWG) which consisted of senior airline trade body representatives (such as commercial/operational directors) who have the power to make decisions and commit on behalf of their organisations. A statement was produced explaining areas of agreement and disagreement between airlines and airports. This was used as an input to the CAA's final decision as part of the price control.

Case Study D: constructive engagement in the energy industry

Context

A.12 Pollitt (2008) envisaged an energy sector in which "decisions on investments in capacity and quality should be negotiated between the parties in the industry… [and] the regulator would move from being the key decision maker to being the auditor of decisions agreed between the buyers and sellers".

A.13 As part of its fifth price control for the distribution network, Ofgem, the energy regulator, accepted an "enhanced engagement" model of constructive engagement. Stakeholders, including customers and Distribution Network Operators (DNOs) responsible for delivering energy in a particular geographic area to customers including electricity suppliers, would engage in more discussion and have more opportunities to influence Ofgem's decision-making process as part of the price control. In establishing the constructive engagement process, Ofgem was careful to define the "boundaries" clearly. It stated that the final decisions regarding the price control would remain with Ofgem, but that it would welcome views on a number of areas such as the long-term focus of the industry and the different financing options that determine how costs are balanced between existing and future customers.

Benefits and transmission mechanisms

Benefits	Transmission mechanism
Appropriate levels of output	Encouraging greater interaction of stakeholders in the regulatory process increased stakeholder engagement in the energy sector. In principle, this could provide greater opportunity to discuss and reach agreements that would otherwise not be reached.

Information used and key enablers

A.14 Information was gathered by means of a price control review forum, together with market research and consumer challenge groups.

Case Study E: constructive engagement in the Australian rail industry

Context

A.15 The Australian Competition and Consumer Commission (ACCC) is an independent authority designed to represent and protect consumers' interests and has the power to grant access to the transport network in Australia. The Australian Rail Track Corporation (ARTC) is a federal government-owned corporation that owns, controls, maintains and leases the majority of the railway lines in Australia. In 2004, rights were granted to the ARTC to lease the Hunter Valley network for the next 60 years. In 2011, an agreement was reached on the terms under which operators, mainly privately owned corporations, could access the network (ARTC, 2011) – this is agreement is called the Hunter Valley Access Undertaking (HVAU). In developing the agreement, the ACCC encouraged the parties involved to engage with each other to come to an agreement over the HVAU.

Benefits and transmission mechanisms

Benefits	Transmission mechanism
Appropriate levels of output	The rate of return that was agreed by the parties involved was greater than that which the regulator (ACCC) initially deemed appropriate. This outcome was achieved through a more secure service in return for the higher cost of accessing the service. In this instance, both parties received a better outcome than would have been possible without constructive engagement.

Information used and key enablers

A.16 This experience of constructive engagement highlights the benefits that can be gained by allowing 'trading' between the parties: in effect, the parties were able to move closer to the allocatively efficient level of output than would otherwise have been possible. To achieve this, four key things were discussed as part of the negotiations:

- The process for ARTC investing in the railway during the period for which the access undertaking dictated the terms and framework for access to the network;
- The prices that would be set to ensure that ARTC made efficient use of the network and recovered costs;
- Timelines and key performance indicators that would be used to ensure ARTC met the obligations that it agreed to as part of the undertaking; and
- Other critical issues that were otherwise left unresolved for the final settlement which included the period of time for which the access undertaking would be binding and the plan for how changes agreed as part of the undertaking would be enacted.

Case Study F: unit costs in Healthcare

Context

A.17 This case study assesses remuneration for providers of secondary healthcare i.e. services provided in hospitals (which may be elective procedures, such as a kidney transplants, or non-elective services, such as stroke care in acute settings).

A.18 Since 2003/4, so called 'Payments by Results' (PbR) has been the standard methodology of reimbursing large parts of NHS-funded secondary care. Under PbR, a national tariff is set by the health regulator, Monitor, for each treatment that is carried out. The national tariff takes into account the complexity of the patient's healthcare needs. This is then paid by NHS commissioners to healthcare providers. The national tariff is calculated through so called

'reference costs', which are a national average of costs for activities submitted by trusts for services provided.

A.19 Prior to the introduction of PbR, secondary care was funded through block grant payments that were determined locally by commissioners and providers. These contracts were typically based on historic baselines and adjusted for inflation and efficiencies (akin to the current framework in rail).

A.20 As an example to illustrate the workings of the PbR regime, suppose Guy's and St Thomas' NHS Foundation Trust performs an emergency hip replacement in respect of an elderly patient. The amount that is paid to the provider would be based on the average cost of replacing a hip, and also other factors. These include the additional cost of complications involved in treating an elderly patient, reimbursement for the procedure being immediate, and an adjustment for the specific location of the healthcare provider.

A.21 Importantly, under PbR, providers' income is based on the volume of services that they deliver (i.e. on the basis of their activity) rather than the quality of the work that they carry out (i.e. the outcome). This has been a major criticism of the PbR regime, but there is currently a move towards a tariff structure that is more closely based on outcomes rather than activity (Department of Health, 2012).

Benefits and transmission mechanisms

Benefits	Transmission Mechanism
Increased patient choice	Generating an improved understanding of the unit costs of treatments has allowed providers to be rewarded by commissioners on the basis of each service provided. In principle, this was expected to facilitate increased patient choice over where individuals are treated, as money 'follows the patient' to the provider. This is in contrast to the 'Block Payments' regime that was previously in place where the funding is fixed for each healthcare provider. Note, however, that whether PbR has increased patient choice continues to be debated and at present there is little evidence of patients (or doctors) actively choosing among providers. Where there is patient choice, it may be that this is primarily driven by choice reforms in the Health and Social Care act in 2012 rather than PbR.
Improved healthcare service (e.g. Shorter average waiting times)	Generating an improved understanding of the unit costs of treatments has allowed providers to be rewarded by commissioners on the basis of each service provided. In principle, this incentivises providers to improve their service provision in order to improve their reputation and therefore attract a greater volume of patients in the future. Importantly, under a PbR regime, providers are able to reinvest any surpluses of income over costs[9]. In practice, evidence suggests that PbR may have improved services. While only being one measure, there was a reduction in average length of stay for elective treatments by 2.5% between 2002/03 and 2007/08 (Aberdeen and Dundee Universities (2010)). Another example is that of waiting times for outpatients[10], which fell from an average of 4.8 weeks in2005 to 2.4 weeks in 2009 (Department of Health).
Improvements in efficiency	Generating an improved understanding of the unit costs of treatments has allowed providers to be rewarded by commissioners on the basis of each service provided. In principle, it was expected that, as the price that they would receive for completing a particular treatment would be fixed and they would be able to retain and invest any surpluses, this would incentivise improvement in efficiency through reduced costs going forward. In practice, however, it is not yet clear whether the regime has led to efficiencies.

[9] They have a facility through which they have the autonomy to make investment decisions to improve the services they provide.

[10] These are patients who visit a healthcare provider for diagnosis/treatment but do not stay for longer than 24 hours.

Non-discrimination	Generating an improved understanding of the unit costs of treatments has allowed remuneration on a non-discriminatory basis. In principle, two identical providers offering the same treatment would receive the same remuneration.
Increased transparency	Generating an improved understanding of the unit costs of treatments has allowed providers to be rewarded by commissioners on the basis of each service provided. With the overall funding paid to providers being uniform based on the volume/complexity of the service (rather than specific to a local agreement between a commissioner and provider), there has been increased transparency in the system.

A.22 The table sets out the theoretical benefits of the regime, but also describes whether the benefits have materialised in practice. A recurring theme is that the evidence as to whether the theoretical benefits have materialised is not clear. It is possible that the reason for this is that ownership, funding and remuneration structure of providers means that they may not respond to the incentive effects of the regime in the same way that a commercial provider might be expected to.

Key Issues

A.23 There are a number of issues associated with the PbR regime in the healthcare sector.

Large quantity of data required

A.24 The first issue is the requirement of a large quantity of data to implement such a reimbursement programme. For example, roughly 26,000 codes are used to describe interventions and diagnoses in the PbR regime. These are grouped using an annually updated algorithm into healthcare resource groups (HRGs)[11], which then constitute a 'currency' for payment i.e. the units over which tariffs are defined (e.g. a hip replacement for an elderly patient in London). Indeed, in part as a result of the large data requirements, some healthcare services (e.g. mental health and community-based services) continue to be funded through block contracts rather than PbR (Audit Commission (2011) and Department of Health Reference Costs Guidance (2010)).

Collecting the data is subject to inaccuracy

A.25 There are two broad reasons why unit costs (and therefore the tariffs paid by providers) might be inaccurate:

- There may be errors in the collection of data.
- Currencies or units may not be defined at a sufficiently granular level.

A.26 To illustrate the point about errors in data, PwC (2012) states that, "we found that 30% of unit costs reported by providers were at least 50% away from the national average unit cost for that HRG (weighted by activity)". The report goes on to state that, given the complexity of the data gathering task and through anecdotal evidence collected, it is likely that at least some variation in cost of service responses by healthcare providers results from the way in which the cost estimates were collected. A particularly important issue with data accuracy relates to how capital expenditure or Private Finance Initiatives are treated by healthcare providers which provide data. If one-off expenditures are included in the accounts, the data will be inaccurate and show large variations not only between different hospitals but also for the same hospitals over different periods of time. In addition, providers are not incentivised to

[11] There are over 1400 HRGs (Health and Social Care Information Centre (on 25/02/15) **http://www.hscic.gov.uk/hrg4**).

report capital expenditure as this makes them appear less efficient than other providers. However, as this applies to all providers, the average tariff set is lower than it would be if capital expenditure had been reported. Furthermore, fundamental changes in costs that take place over time are not always appropriately captured. The three year time lag in tariff calculation means that step changes in costs or a change in case mix faced by providers that fundamentally changes cost (e.g. as a result of simpler procedures being moved into community settings) are not captured and accounted for in prices (PwC, 2012). Finally, some specific costs involved in delivering services such as minimum capacity requirements and economies of scale are not captured in how providers are reimbursed (PwC, 2012).

A.27 To illustrate the second point(that currencies or units may not be defined sufficiently granularly) PwC (2014) notes that uncontrollable differences in input costs such as land, labour and the costs of delivering services that arise from geographical dispersion of the local population are not controlled for at a sufficient level of detail. Furthermore, despite the already relatively granular nature of the currency, data is now being collected at the individual level (Patient-level Information and Costing Systems or PLICS)[12], suggesting that currencies do not fully take account of co-morbidities[13] and age, therefore failing to make the reference cost reflective of the true cost of a given service that is provided.

A.28 If the underlying tariffs associated with the provision of treatments are not representative of the cost, two key problems can result: cross-subsidisation and “cherry-picking”.

Cross subsidies

A.29 Under PbR, if payments received by a provider for a treatment do not cover the provider’s costs for the treatment, it may choose to cross-subsidise that service from surpluses from other activities (where revenues exceed costs), rather than fail to deliver required outputs or face reputational damage.

A.30 Turning to the empirical evidence of cross-subsidies in England, PwC (2012) cites evidence of high year-on-year volatility in PbR and non-PbR revenues in a sample of 69 NHS Trusts. Since treatment volumes are likely to be relatively stable over time, this suggests that cross-subsidies do indeed take place.

A.31 The principal problem associated with cross-subsidies is that providers may not need to respond to incentives created by PbR-type schemes, since shortfalls can be made up from other revenues. Moreover, cross-subsidies can prevent competition since they enable providers to prevent entry to the market of competitors. Cross-subsidies may also discourage transparency of financial flows and improvements in cost information.

Cherry picking

A.32 The lack of accuracy in tariffs could lead to cherry-picking or “vertical cream-skimming”, whereby providers choose to treat those patients with lower perceived risk (Newhouse, 1996; Ellis, 1998; Levaggi and Montefiori, 2005), and avoid treating patients with higher perceived risk. Such activities have been observed empirically in the US (Desai et al, 2009; Friesner and

[12] PLICS includes a record of the resources that are used to treat individual patients and information on the cost that is incurred by the organisation in using these resources. Combining the two, the cost of individual treatments for patients is calculated.

[13] A co-morbidity is where an individual has one or more additional disorders (or diseases) co-occurring with a primary disease or disorder.

Rosenman, 2009) and Norway (Martinussen and Hagen, 2009). While we are is not aware of reliable evidence relating to cherry-picking in the English NHS, opportunities for such activities have existed for some time (Pollock, 2001) and it is difficult to rule out such practices (Appleby et al, 2012; PwC, 2012).

A.33 The most obvious – and perhaps most pernicious – problem associated with cherry-picking is that it implies incompleteness of markets, with some patients being left without the level of health coverage they require (Newhouse, 1996).

A.34 Cherry-picking may also have detrimental impacts on the structure of the "market" for healthcare. In particular, the ability to cherry-pick may differ across providers. In this case, providers that are more able to screen patients may "dump" high risk patients on providers less able to cherry-pick. Therefore, providers with less ability to cherry-pick could find themselves underfunded (Levaggi and Montefiori, 2005), and appear less productive even if they are not (Pollock, 2001). In extremis, inefficient providers which are successful cream-skimmers may drive efficient providers out of the market (de Ven and van Vliet, 1992). Overall, survival in the market could depend on the ability to screen rather than to be efficient per se, with the result that overall efficiency could be undermined.

Information used and key enablers

A.35 The PbR reimbursement system is based on currency (i.e. defining the 'units') and costing. Costing involves setting the amount that is reimbursed to providers. Information is collected from providers across the country which records the average costs of providing particular treatments. This data is then further averaged across the country and used to calculate the amount of reimbursement for each treatment. This reimbursement is based on the direct costs of the activity (e.g. doctors and drugs), indirect costs (e.g. labs) and overheads (e.g. board, finance, human resources, buildings) that are weighted according to their consumption by the activity analysed.

Case Study G: charges reflecting underlying geographic cost differences

Context

A.36 This case study relates to distributed generation in the electricity sector i.e. the production of energy that is supplied to consumers through the distribution rather than transmission network. This energy is supplied at lower voltages than the energy that is supplied via the transmission network. Distributed generation refers to energy that is produced through, for example, micro turbines, solar panels or biomass boilers and that is predominantly generated using renewable sources.

A.37 Generators of such energy face a charge for access to the system known as the Generation Use of System (GUoS) charge. This charge is paid to Distribution Network Operators (DNOs) which are the owners of the distribution network.

A.38 Jamasb et al (2005) consider the benefits and costs of setting the GUoS charge based on location, recognising the different costs associated with connecting to the network in different locations (for example as a result of the distance the energy must 'travel' to market).

Benefits and transmission mechanism

A.39 The authors estimate the benefits of locational charging based on two scenarios, one where the amount of distributed generation is 2000MW and the other where it is 5000MW. In the

first scenario, the total net present value of benefits of locational charging is estimated to be £22.5 million while in the second, it is estimated to be £56.5 million.

Benefits	Transmission mechanism
Better location decision made and increased production of DG energy	Collecting increased amounts of information may allow distribution charges to be set in a way that vary across locations and reflect underlying costs. It is estimated that 25% of the benefits arise from locating Distributed Generation more effectively. The other 75% of the benefits results from changes in the overall quantity of distributed generation. Besides efficiency, the benefits of increased distribution energy (which would result from location varying distribution charging) include reduction of emissions, improved reliability of distribution system, enhanced electricity price elasticity, avoided T+D capacity, reduced system losses and improved provision of ancillary services.

Key Issues

A.40 The key issue associated with location varying charging is identified as the cost of implementation of this methodology. Jamasb et al (2005) suggest that developing and running models to support such charges may have significant costs, perhaps as high as £10-20 million in Net Present Value (for all DNOs together).

Information needed

A.41 Information would need to be calculated for producing a model of distribution charging that captures how costs vary by location.

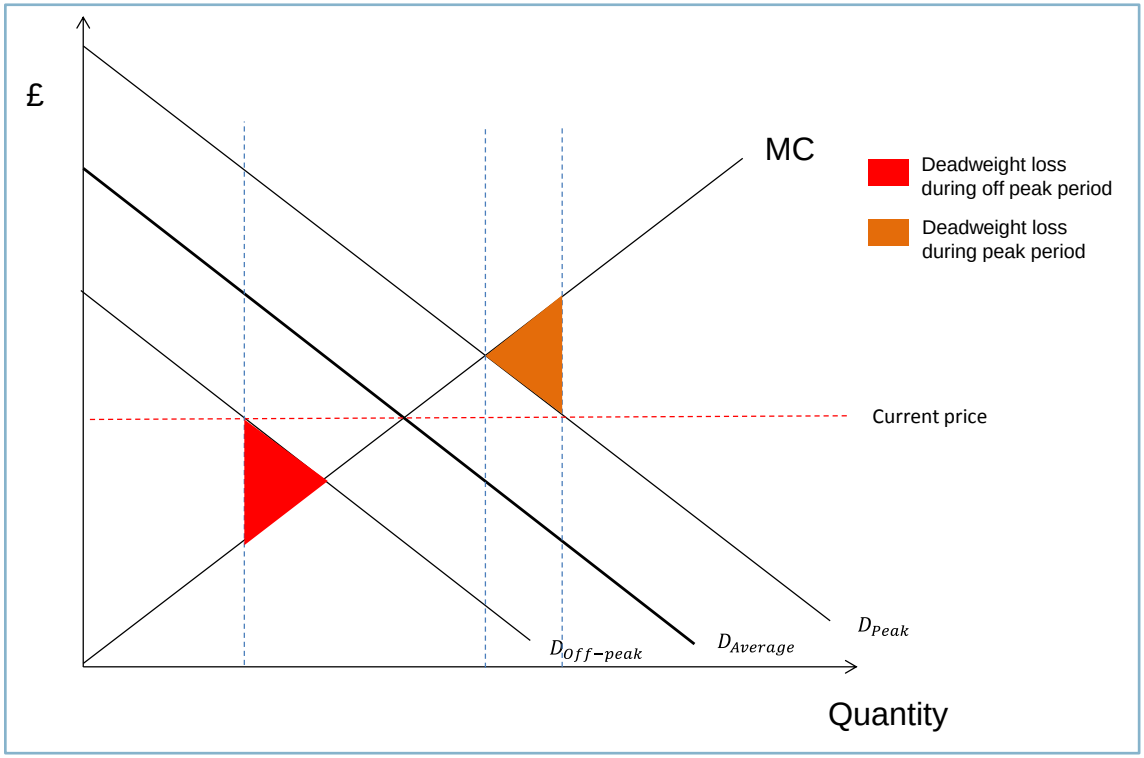
Case Study H: peak-load pricing in energy

Context

A.42 Economic theory suggests that, if demand is variable and marginal costs increase with output, then there is a strong rationale for varying charges across time – this is sometimes called "peak-load pricing". It should be emphasised that when we refer to peak-load pricing, we are considering the specific circumstance when the *internal* marginal cost to the firm is increasing and demand is variable (Marcucci and Polidori, 2000). Peak-load pricing is distinct from congestion charging (whereby prices are set so as to internalise the external costs imposed on other network users, see below) and scarcity charging (whereby prices are set on the basis of the opportunity cost of the user of the network).

A.43 The benefits are illustrated in Figure B.1 below in respect of an example network.

Figure B.1: Pricing on the basis of peak-load costs

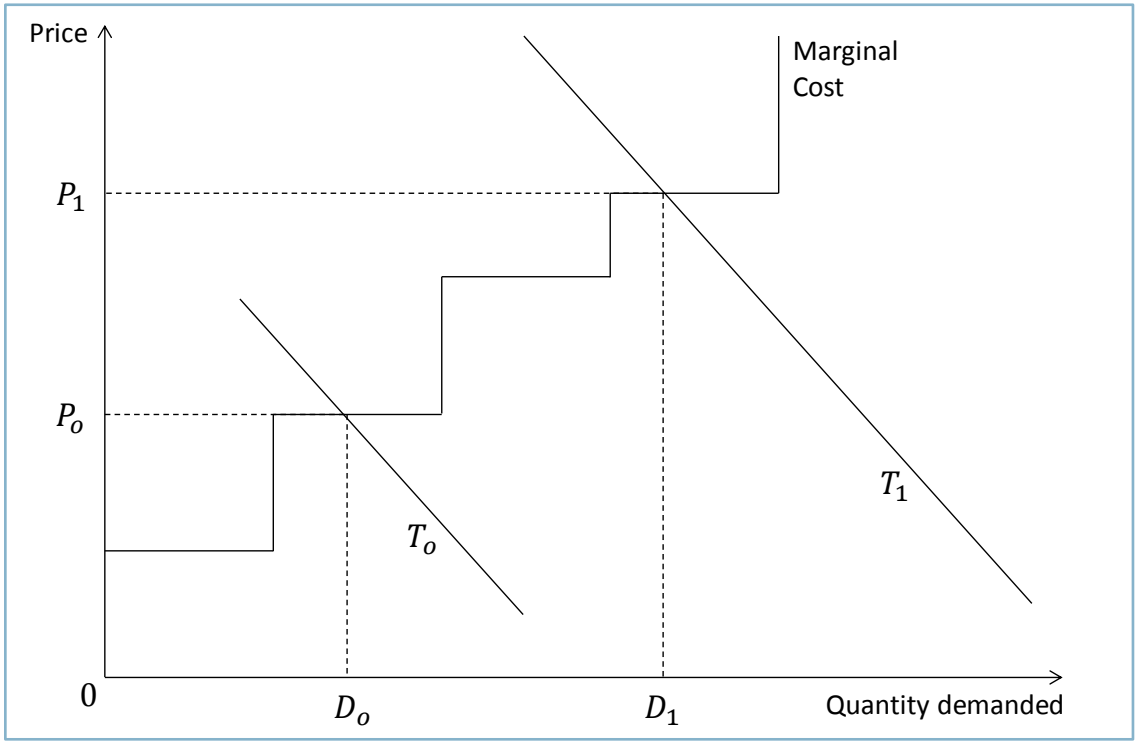


A.44 If demand is at different levels at different times, setting a single charge (for example the price implied by the average level of demand) can lead to inefficiencies: during the peak for some marginal customers, costs are greater than the benefits to the consumer of using the network (and conversely in the off-peak). By setting separate charges, such that demand and marginal costs are equated in both the peak and off-peak, these inefficiencies can be eliminated.

A.45 This case study examines the use of "Time of Use" (ToU) tariffs in the electricity retail market, where customers are offered a tariff that varies at particular times of the day, reflecting the increased underlying generation costs as energy output increases.

A.46 Figure B.2 illustrates that the cost of generating electricity increases in steps; termed the "Merit Order Effect" of electricity distribution (Poyry, 2009). This results from differences in the marginal cost of generating electricity which depends on the form of power generation used. For example, the marginal cost of electricity generation using wind power is cheaper than electricity generation using gas turbines. When demand is low (e.g. D_0), the marginal cost of electricity generation is low (equal to P_0), while when demand is higher, the marginal cost of electricity generation is higher (equal to P_1).

Figure B.2: "Merit Order Effect" in Electricity Markets



A.47 ToU tariffs refer to the programme of electricity suppliers charging consumers different amounts based on the time at which they use energy services, reflecting these underlying generation costs. While being more common in the non-domestic sector currently in the UK, a number of electricity companies offer ToU tariffs for domestic customers as well. For example, at the time of writing, EDF and Npower offer an "Economy 7" package to customers, where they charge lower rates for usage of electricity during 7 hours of the day (typically during the night). This has been facilitated through the rolling out of meters that record and display to customers their usage of electricity during times where they were charged a lower rate and a higher rate.

Benefits and transmission mechanism

Benefits	Transmission mechanism
Efficient management of demand and lower overall costs	Pricing on the basis of the underlying costs produces incentives to change consumption habits. In particular, it shifts consumers' energy consumption from periods of peak demand to periods of off-peak demand. This will lower the average cost of providing electricity.

Key issues

A.48 One issue of ToU tariffs is their dependency on customers changing their consumption patterns in a way that decreases peak loads. This may be inhibited if customers are unable to change. Another issue is that there is a requirement for smart meters that record electricity consumption within households. The cost of installing such meters can be considerable as these meters have additional requirements over standard meters such as being able to read and repeat energy usage at regular intervals.

A.49 A key enabler for ToU tariffs is ensuring that customers have smart meters installed that can be used to track electricity consumption at regular intervals.

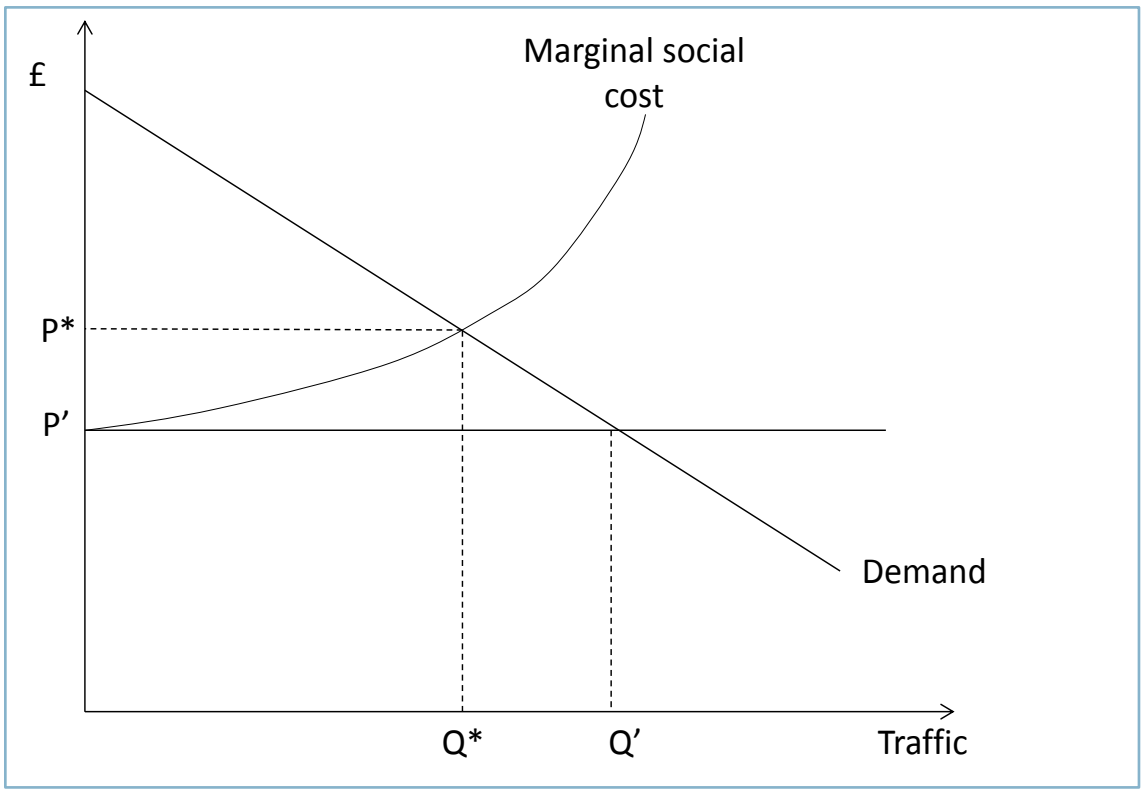
Case Study I: London Congestion Charge

Context

A.50 Economists have long recognised that there may be a rationale for charging above (internal) marginal cost on congested infrastructure (see for example Pigou (1912, 1920), Knight (1924), Beckman et al (1955), Buchanan (1956), Vickrey (1959, 1994), Walters (1954, 1961) and Newbery (1987, 1990)). This recognises the idea that, as a network becomes more fully utilised, an additional unit of traffic imposes costs not only on the owner of the network, but on other network users.

A.51 This is illustrated in Figure B.3 below in respect of an illustrative network. If the regulator was to set charges taking into account only the marginal private (or internal) costs of the monopoly network provider, operators would face a price of P' and output would be Q'. This would mean that traffic is permitted on to the network such that the benefits of doing so are less than the collective costs imposed on other network users and the infrastructure owner. However, if the regulator took account of the fact that each incremental user imposes a cost on all other users as the network becomes more congested, it would set prices at P*, resulting in a lower level of capacity utilisation and congestion. The benefits of congestion charging are, therefore, eliminating inefficiencies associated with negative externalities between network users.

Figure B.3: Pricing on the basis of congestion costs



A.52 This case study, in respect of the London congestion charge for motor vehicles, illustrates the kind of information that may be needed to inform the setting of appropriate congestion charges.

A.53 The London Congestion Charge started operation in early 2003. It operates between 07:00 and 18:00 Monday to Friday. This case study considers the charge in its original form since this has been the focus of research into the effects of the congestion charge. Although the rationales

for the London Congestion Charge were manifold, its principal motivation appears to have been reducing congestion. The London Congestion Charge provides an important illustration of an economically pure congestion charge: as Leape (2006) puts it "the introduction of the London congestion charge is, in important respects, a triumph of economics."

Benefits

A.54 As emphasised by authors as far back as Walters (1954), estimating true cost and demand curves, and therefore the appropriate charges and ensuing welfare changes, is a difficult task. For London however, attempts have been made. One example is Prud'Homme and Bocarejo (2005). Their analysis suggests that the £5 initial charge was somewhat below the optimal level of £8 (although a different study by Santos and Shaffer (2004) suggested that the original figure of £5 may provide a close approximation to an average optimal congestion charge for London). The applied charge of £5, they argue, resulted in an observed reduction in daily vehicle kilometres from 1.39 million to 1.16 million, compared to an optimum level of 1.06 million (which may have been achieved by a charge of £8). Given that the deadweight loss is proportional to the square of excess congestion, the actual charge of £5 involved a 92% reduction in the deadweight loss, or £68 million annually.

Transmission mechanism

A.55 By internalising these costs to drivers, the charge was intended to reduce traffic – and the level of congestion – to the socially optimal level.

Information used

A.56 While the theory of congestion charging (considered above) is straightforward, in practice identifying the optimal level of the charge can be extremely difficult, especially for a complex road network such as that of central London. Congestion at junctions is a particularly important feature of network congestion, for example, and needs to be carefully assessed. Nevertheless, in the case of the London, a broadly appropriate charge was established, albeit at a highly averaged level. According to Leape (2006), "the London experience… illustrates that the practical problems of congestion charges are not insurmountable" and demonstrates "the benefits of carefully designed congestion charges in large urban areas appear… to be both significant and within reach."

Case Study J: gas capacity auctions

Context

A.57 This case study considers use of auctions for allocating rights to companies for the use of the National Transmission System (NTS) in the natural gas industry in Great Britain. National Grid Gas is the owner of the transmission network for gas in Great Britain. It transfers gas through the high pressure network (across the country) and also lower pressure gas through local distribution zones.

A.58 In October 1999, Transco (now National Grid Gas), the owner of the transmission and distribution network for gas, launched a system of auctions for allocating short-term (i.e. monthly and daily) capacity for entry of gas to the network. Moreover, in January 2003, long term gas auctions were introduced (known as Quarterly System Entry Capacity (QSEC)). This is an annual auction that is held in March and auctions capacity between 2 and 16 years ahead (of the time when the auction was held) on a quarterly basis.

Benefits and transmission mechanism

Benefits	Transmission mechanism
Efficient use of network capacity	Auctioning scarce capacity may provide an efficient mechanism through which capacity can be allocated. The capacity will be allocated to the agent with the highest willingness to pay and therefore to the party able to extract most value from the asset.
Better investment decisions	The regulator uses auctions to allocate access to capacity on the transmission network. The auctions of longer terms capacity (through QSEC) act as an additional indicator for the value placed on access in the longer term and therefore allows National Grid Gas to make investment decisions that are based on long term demand. Commitments made by companies are firm, and therefore there is greater certainty that capacity bought reflects the true perceived value of the network by companies.[14]
Increased transparency	The regulator uses auctions to allocate access to capacity on the transmission network. In principle, the price at which this capacity is sold is the market clearing price and should represent the value that is placed on these access rights. This therefore increases transparency over efficient prices (compared to a scenario where the regulator sets prices and has to look at willingness to pay and cost data to determine this).

Case Study K: electricity capacity auctions

Context

A.59 This case study relates to electricity interconnection which is the market for cross border transmission of electricity. Electricity suppliers pay the interconnector for use of capacity on the network. Britain is connected to other countries in Europe through four connections:

- IFA: France
- BritNed: Netherlands
- Moyle: Northern Ireland
- East West (owned by EirGrid): Republic of Ireland

A.60 In 2012, Moyle and East West did not provide for intraday trading. This was assessed to be counter to European regulations (Moyle Interconnector Limited and EirGrid Interconnector Limited, 2012). Two options for how excess capacity should be reallocated in the intraday market were analysed by the companies. These options included “use it or lose it” (UIOLI) and “use it or sell it” (UIOSI). These are defined as follows:

- UIOLI: Re-auctioning unused capacity with the proceeds of the sale going to the interconnector owner rather than the previous holder of the capacity.
- UIOSI: Re-auctioning unused capacity with the proceeds of the sale going to the previous holder of the capacity.

A.61 Under an intraday trading mechanism, there is a first stage market where only the current capacity holder (which has purchased the capacity on the long term market) can purchase capacity. If this firm does not purchase capacity in the first stage, this capacity becomes available in the second stage to all bidders and the capacity is allocated through an auction. Under UIOSI, if this capacity is then purchased in the second stage, the previous holder of the capacity gets the proceeds of the sale.

[14] Moreover, if National Grid Gas is unable to provide the capacity which is sold on a firm basis, then it incurs liabilities of up to £12.5 million annually under the provisions of the Uniform Network Code (Ofgem, 2006).

A.62 In August 2012, Moyle (Ofgem, 2012) and East West (Ofgem, 2012) interconnectors requested approval of the implementation of an intraday trading market for the interconnectors which was accepted by Ofgem (Ofgem, 2012). This was for a UIOSI (i.e. with the proceeds going to the interconnector owner) mechanism rather than UIOLI.

Benefits and transmission mechanisms

Benefits	Transmission mechanism
Efficient use of network capacity	Allocating capacity through intraday auctions may provide an efficient mechanism through which capacity can be allocated. Capacity will be allocated to the agent with the highest willingness to pay at that point in time and therefore to the party able to attract most value from the asset.
Increased transparency	Suppliers, by purchasing capacity on the intraday trading market through an auction, reveal the value of the capacity to them (and therefore the efficient price for this capacity).

Case Study L: Long Run Avoidable Costs in ports

Context

A.63 Ferry operators P&O Ferries Holdings Limited, SeaFrance SA, and subsequently DFDS Seaways, lodged objections to the harbour tariffs (which are made up of a conservancy fee, harbour dues, passenger dues, wharfage and security charges) charged by Dover Harbour Board (DHB) in the calendar years 2010 and 2011. The operators argued that the tariffs were excessive and ought to be imposed at a lower rate. A public inquiry was held in 2011 into the objections made.

A.64 A Long Run Avoidable Cost (LRAC) approach was employed to assess whether the charges levied by DHB were commercial and competitive. For charges to be commercial, the revenues associated with the charges would need to at least cover the port's costs. For charges to be competitive, since over the long-term, market pressures would force charges to a level which are not unduly in excess of costs, they should cover the firm's costs plus a fair return on capital.

A.65 The inquiry found in favour of DHB, with the inspector concluding that "having found the 2010 dues to be commercial and competitive, fair and equitable and, on balance, reasonable I see no compelling reason to interfere with the 2010 dues as imposed" (Rodgers, 2012). The Secretary of State for Transport agreed with inquiry's findings (Department for Transport, 2012, a & b).

A.66 This case provides a useful example of the application of a LRAC approach in the transport sector, and in an industry in which the customer-supplier relationship is characterised by a small number of businesses purchasing network access from the supplier.

Benefits and transmission mechanisms

Benefits	Transmission mechanism
Provides an indication of long-run costs associated with accommodating a set of services	The proceedings emphasised that the LRAC of a group of services (in this case ferry operations) provides an estimate of the savings that would be made if the group of services were ceased. As such, it provides an indication of the minimum level of charges that would need to be recovered by the supplier (in this case DHB) if it was to have the incentive to continue accommodating the services in the long run.

Key enablers

A.67 LRACs were derived for DHB's ferry business and "other" businesses with some costs being regarded as common across the two. The approach used for deriving avoidable costs provides an indication of the informational requirements required to calculate LRACs. The approach for deriving avoidable costs for the largest cost categories was as follows (PwC, 2011):

- **Maintenance expenditure.** Maintenance expenditure was DHB's largest operating cost. Maintenance expenditure was invoiced separately for each asset type. Invoices were therefore allocated to specific assets and then assets were linked to ferry and non-ferry users.
- **Chief Executive's office costs.** Although it was recognised that some of these costs could be avoided by the removal of ferry services (e.g. the business may have become simpler, requiring less management resource), this was ultimately regarded as a common cost since it would have been difficult to establish what the management costs of differently configured versions of DHB would have been.
- **Utility costs.** Since, at the time, ferry and non-ferry services were in discrete geographic locations where utility usage was recorded and billed separately, estimating avoidable costs was straightforward.
- **Police costs.** DHB estimated that the police costs of the business in the absence of the ferry business, and the difference was regarded as the avoidable costs associated with the ferry business.
- **Business rates.** The business rates avoidable were estimated by apportioning total rates according to the levels of profit in different parts of the business.
- **Security costs.** DHB estimated that security costs would have been zero in the absence of the ferry business, so all security costs were regarded as being avoidable.
- **Contract cleaning.** The cleaning cost contract specified requirements for each geographic area of the port. Avoidable cleaning costs were therefore assumed to be the cleaning costs incurred in the ferry-specific geographic areas of the port.
- **Cruise costs.** Since cruise costs would continue to be incurred at the same level in the absence of the ferry business, no cruise costs were regarded as being avoidable for ferry services.
- **Tugs and dredger costs.** DHB estimated that 50% of tugs and dredger costs would be avoided in the absence of the ferry business.
- **ICT delivery costs.** These were treated as common costs.
- **Buildings insurance costs.** Avoidable buildings insurance costs of the ferry business were derived as the costs of insuring buildings relating only to the ferry business.

Case Study M: Long Run Incremental Costs in electricity distribution (Distributed Network Operators)

Context

A.68 This case study considers the benefits and issues of LRIC that were predicted and have been experienced in the electricity distribution market since its introduction as a costing methodology.

A.69 In 2007, Ofgem approved the use of Long Run Incremental costs (LRIC) as one of two methodologies[15] for distribution network operator's (DNOs) charges for Extra-High Voltage

[15] The other methodology was Forward Cost Pricing (FCP)

(EHV) access to customers[16]. The 14 DNOs are each responsible for delivering energy in a particular geographic area to their customers including electricity suppliers. Importantly, the price that is charged is produced locally and is based on a calculation of the local incremental cost of an additional unit of demand at a part of the network.

Benefits and transmission mechanisms

Benefits	Transmission Mechanism
Signals for efficient use of available capacity	A study by the University of Bath (2005) which modelled the introduction of LRIC in the Western Power Distribution (South Wales) DNO found that: "The LRIC models create a dynamic interaction with network users over the study years that produces a more efficient network. Charges at all nodes converge over the period as demand and generation are attracted to locations where they can make optimal use of the network. In time an equilibrium should be created between the cost of the assets at a node and the utilisation of those assets."

A.70 The University of Bath (2005) study concluded that "there would be a significantly lower cost to reinforcing the network if the economic charging approaches were adopted in place of the conventional DRM [approach]." Quantifying expected benefits, the authors stated that "if this were extrapolated across the GB system it would imply a cost saving in the region of £200 million."

Key Issues

A.71 A key issue of the LRIC methodology was determined by Ofgem (2012) to be that it is based on assumptions that require a degree of subjective judgement. In particular, assumptions such as one made in the calculation of charges that there would be a 1% increase in distributed generation growth across all areas, were contested in consultations held in 2011 (Ofgem, 2011). Another issue of LRIC was identified by Ofgem was volatility of charges. The methodology was found to produce very high or low prices based on the assumed capacity level of the network and the rate of underlying load growth. It was as a result of these disadvantages that in 2012, Ofgem decided that DNOs could use costing methodologies other than LRIC to set charges for their customers to access EHV electricity.

Information used and key enablers

A.72 The information required to charge at LRIC includes modelling the "relationship between locational increases in G[eneration] and L[oad], the general evolution of demand and grid disconnections, and the investment plan of the DNO" (Jamasb, Neuhoff, Newbery and Pollitt, 2005). Information specific to the connection assets of each DNO is also used and electricity suppliers are required to inform the regulator on the quantity entering the system and being delivered, allowing them to send information on energy lost from the system to the regulator.

Case Study N: Long Run Incremental Costs in mobile telecommunications

Context

A.73 Termination charges compensate the terminating network's operator for the costs of receiving calls by charging the originating network operator. A LRIC approach is used on the basis that it

[16] Extra High Voltage refers to energy supplied at 220kV or above

provides an indication of the charge that would be levied by a competitive firm in the long-run[17].

Benefits and transmission mechanisms

Benefits	Transmission mechanism
Provides an indication of long-run costs associated with accommodating a set of services	LRIC ensures that the originating network has the incentive only to send calls for termination which can cover the incremental cost they impose (including costs which may vary in the long run).
Provides appropriate investment incentives	It has been suggested that, since charges are based on the projected costs of upgrades assuming a given level of growth in the market, it provides appropriate incentives for investment in the network.

Information used and key enablers

A.74 Incremental cost information has proven relatively difficult to extract from top-down accounting data in telecoms, where joint and common costs make up a high percentage of total costs. Instead, bottom-up engineering models have been used more often to estimate incremental costs. These models can be time-consuming and complicated to build and maintain, and have significant requirements for input data.

Case Study O: Long Run Incremental Costs in airports

Context

A.75 This case study examines the use of a long run incremental cost (LRIC) approach to determine the access charges that airports levy on airlines. For its sixth five-yearly review on economic regulation of airports, the Civil Aviation Authority (CAA) considered setting the charges airlines pay to use airports based on LRICs. While LRIC was considered as a pricing mechanism for the 2014 – 2018 airport price control period, it was not implemented for reasons discussed below. This case study analyses the theoretical benefits/issues of using LRIC in the aviation industry.

[17] In 2011, Ofcom switched the costing standard used to calculate mobile termination rates from a LRIC+ basis to pure LRIC. Both of these cost standards are constructed using LRIC principles, though the use of either can result in a distinct set of benefits and issues. The key distinction between LRIC+ and pure LRIC is that LRIC+ includes an allocation of any common costs, while pure LRIC includes only the costs that are attributable to the service in question. In telecommunications networks, a large portion of total cost is made up of joint and common costs, since many network elements are used in the delivery of multiple services and are not incremented to a service or set of services. Therefore, the difference between LRIC+ and pure LRIC can be very substantial. For instance, in Ofcom's 2011 decision, the move to pure LRIC resulted in a termination rate of 0.69p per minute, compared with 1.61p per minute under LRIC+.

Benefits and transmission mechanism

Benefits	Transmission Mechanism
Reduces distortion of competition among incumbent firms in the upstream market	A key benefit of using a LRIC costing methodology is, according to the CAA, a reduced distortion of competition among incumbent firms since charges are set at levels that would be delivered in a competitive market.
Increases prospect of entry in upstream market	A LRIC model reflects the costs that the incumbent firm in the market faces and sends price signals that encourage entry by external firms, which may enter the market as competitors if they are able to supply services at lower costs.

Key issues

A.76 A possible issue for the use of LRIC is identified by the CAA as being the inapplicability of this methodology where lump sum investment is concerned: "it has been argued that it was not an effective proxy for competitive airport prices where investments are very lumpy. The CAA continued to consider that when setting prices it was important to take account of the effects of the capital-intensive nature of airports and of the lumpiness of capacity increments" (CAA, 2012).

Information used and key enablers

A.77 Prior to collecting information on costs, the goods/services for which costs will be estimated have to be defined. The specific costs that then need to be estimated depend on whether bottom-up models (engineering models that approximate an efficient business, in which detailed unit cost and engineering information is required) or top-down models (accounting models of current businesses that typically include adjustments to take account of inefficiencies, in which different detailed accounting data and assumptions about cost causation is needed) to calculating LRIC is used.

Case Study P: Current Cost Accounting in telecommunications

Context

A.78 In the rail industry, a Historic Cost Accounting (HCA) approach is used as the basis for Network Rail's charges and its allowed revenues. This means that charges are set on the basis of the costs incurred previously by Network Rail, rather than the costs that would be incurred at today's prices. An alternative approach is a Current Cost Accounting (CCA) approach. Under this approach, charges are set on the basis of replacement costs at current prices. CCA is used in a number of sectors on the basis that it ensures that regulated businesses are fully compensated for the actual costs of operating their businesses in the current climate.

A.79 This case study relates to the regulated wholesale access charges that are paid to BT, the regulated incumbent fixed telecoms operator in the UK. Key events in the evolution of access charges insofar as they relate to CCA versus HCA are as follows:

- In 1997, Oftel (now Ofcom) moved its asset valuation methodology for BT's infrastructure from a HCA basis to a CCA basis.
- Subsequently, in 2005, Ofcom introduced a hybrid of CCA and HCA: it uses historical cost accounting for assets that are pre-1997 and current cost accounting for post-1997 assets.

Going forward, as assets are renewed by BT, all costs will be calculated by the CCA methodology (Ofcom, 2005). This change was made because the expected benefits of a CCA approach had not been realised (see below).

Benefits and transmission mechanisms

Benefits	Transmission mechanism
Efficient entry into upstream market	Obtaining information on costs allowed the regulator to set charges based on a CCA rather than HCA methodology. Oftel originally introduced the CCA methodology with the purpose of encouraging greater infrastructure competition in the UK telecommunications market. In principle, pricing all assets at current replacement costs should have encourage infrastructure competition, since competitors that may have been able to replicate BT's infrastructure at a lower cost should have had incentives to do this rather than to pay for wholesale access to BT's network.
Encourages efficient replacement by the regulated firm	HCA was identified as being insensitive to the way that costs of investment changes over time, therefore investment decisions based on a HCA methodology would be inefficient and arbitrary – in the context of increasing costs over time, BT would be disincentivised from investing in its network since doing so would not allow it to recover its costs. In contrast, a CCA methodology would allow BT to recover – but not over-recover – its costs associated with investing in the network, thereby encouraging efficient renewals decisions.

Key issues

A.80 There is a question around whether the hypothesised gains from CCA as significant as may be expected. In particular, despite an expansion of network coverage by cable operators, BT maintained a monopoly as the provider of infrastructure services in more than half of the UK. Partly because the anticipated benefits of HCA not being realised, Ofcom reintroduced the use of HCA for assets in use that dated back to before 1997.

Information used

A.81 The HCA approach uses information from audited accounts on the actual cost that was incurred in the purchase of assets. On the other hand, CCA assesses the current replacement cost of BT's assets. In order to use CCA therefore, the modern equivalent asset (MEA) value was calculated. In addition, both a top-down model based on BT's operations and a bottom-up model based on a hypothetically efficient firm that replaced BT were used to estimate costs using the CCA methodology.

Case Study Q: Dover Harbour Board Current Cost Accounting

Context

A.82 As described above, a number of ferry operators lodged objections to the harbour tariffs charged by Dover Harbour Board (DHB) in the calendar years 2010 and 2011.

A.83 As discussed, a Long Run Avoidable Cost (LRAC) approach was employed to assess whether the charges levied by DHB were commercial and competitive. A key issue was whether a CCA or HCA approach should be used to examine costs, and the case illustrates some of the benefits that have been put forward for a CCA approach to setting charges in this context.

Benefits and transmission mechanism

Benefits	Transmission Mechanism
Avoiding "spikes" in prices	In principle, under a CCA approach, costs better reflect the replacement costs of assets. Therefore, charges that are calculated using costs based on a CCA approach will be less inclined to produce "spikes" when assets are replaced.

Benchmark for the competitive price	Using a CCA approach provides an appropriate benchmark for a competitive price since a hypothetical entrant would incur costs and set its prices on the basis of prices that are based on replacement cost. Competition authorities often refer to the modern equivalent asset value (MEAV) as being the appropriate asset base in an assessment of competitive profitability. If the firm is economically and efficiently configured, a CCA approach provides a reasonable proxy for the MEAV.
Inclusion of all assets	While some assets may have been written-off from an accounting perspective, they may still be in use. Using a CCA approach ensures that the costs of all assets can be captured in charges.

Key enablers

A.84 Replacement costs were estimated using the DHB's Fixed Asset Register (FAR), albeit with a small number of adjustments (for example removing assets which are unlikely to be of productive use in future).

Case Study R: transfer pricing in German firms

A.85 This case study looks at the benefits of using a market based internal transfer pricing. Wolff (2007) used questionnaires' to collect data on 73 German companies' internal transactions in order to test hypotheses on whether a market price based internal transfer pricing system increased motivation and improved efficiency. These companies varied in size from less than 5,000 employees to greater than 100,000, and included industries from a wide range of sectors.

Benefits and transmission mechanisms

Benefits	Transmission Mechanism
Increased efficiency	Wolff found that an internal transfer pricing system increases efficiency, which is measured as being improvements in outputs from inputs to production. He explains that "an increase in efficiency can be achieved firstly by increasing the internal efficiency pressure and secondly by a potential improvement in short and medium term allocation decisions."

Key enablers and information used

A.86 Wolff (2007) states that "The use of coordination mechanisms that are similar to markets within the company can include the use of an external market for the intermediate product with the corresponding issue of orders to external parties and open-result negotiations on the internal purchase and sale".

Case Study S: reimbursement of pharmacies

Context

A.87 Pharmacy funding under the national framework for England, introduced in April 2005, comprises two elements:

- Reimbursement refers to the payment pharmacies receive for the cost of drugs and appliances supplied against an NHS Prescription form.
- Remuneration refers to the payment pharmacies receive for the provision of pharmaceutical services (e.g. consultations with patients), also commonly known as "fees and allowances".

A.88 Reimbursement covers the actual cost of drugs purchased, and a retained margin above the purchase cost. In particular, pharmacies are reimbursed for each drug item dispensed according to a national drug tariff. These reimbursement prices, which are published monthly, are deliberately set higher than the actual cost of medicines to pharmacies, so that across

England pharmacies can earn the agreed target for the retained margin. The current agreed target for a retained margin is £800m per annum across all pharmacies in England. If excess funding is achieved due to market growth or smart purchasing, then contractors receive the benefit of that in year (known as regulatory lag) but the Department of Health have subsequently reduced the reimbursement prices of medicines to seek to prevent such excess from being earned in the future. The drug tariffs are determined using regular Margin Surveys of the actual purchase prices paid by pharmacy contractors.

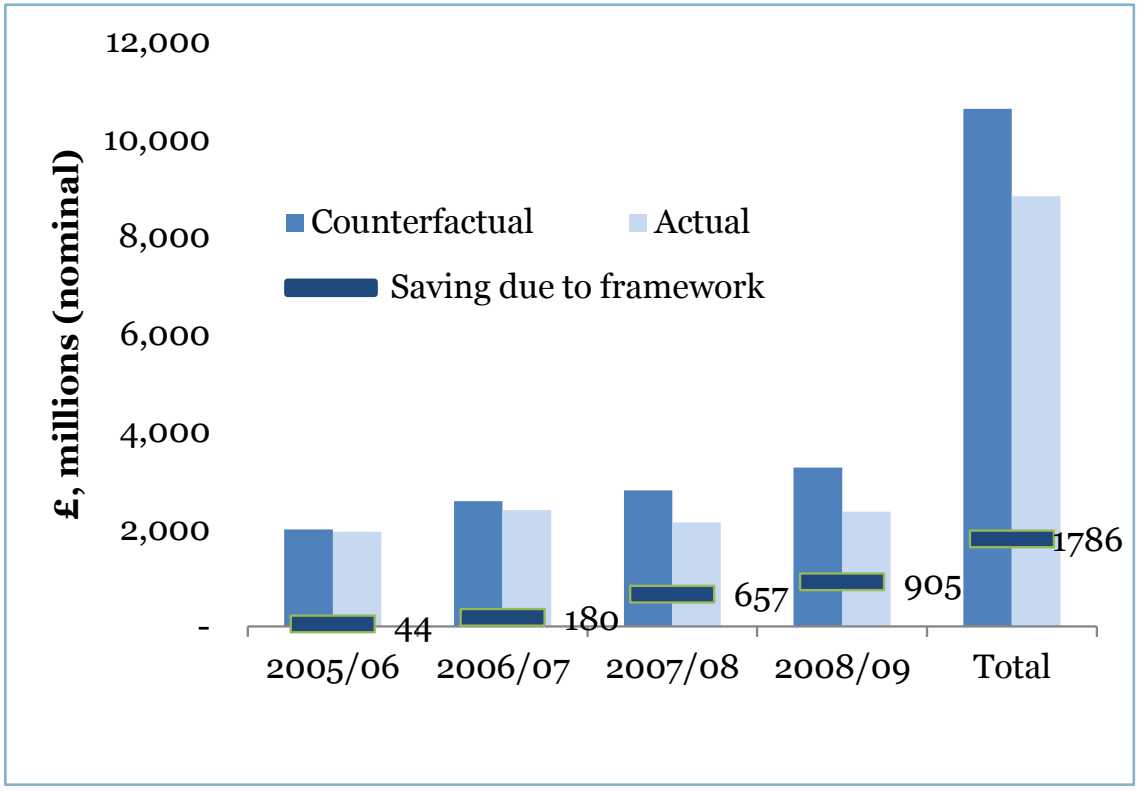
Benefits and transmission mechanisms

Benefits	Transmission mechanism
Reduction in effective drug purchase prices	The regime, supported by the information collected through the Margin Survey, appears to have incentivised pharmacies to source drugs more cheaply since pharmacies are able to retain any savings made relative to the national tariff. For example, pharmacies regularly "shop around" for medicines to secure economical prices and a market has emerged in which drugs are imported from abroad, especially from elsewhere in the EU, to exploit lower prices outside of the UK (parallel imports).
Increased productivity in pharmacies' dispensing activities	According to the NAO (2010), the regime has also incentivised pharmacies to increase the efficiency with which they dispense drugs (for example, between 2005-06 and 2008-09, the number of prescription items dispensed per pound of NHS funding to pharmacies increased by 8%).

Quantification of benefits

A.89 The NAO (2010) undertook a study to quantify the benefit of the regime. The NAO compared expenditure on community pharmacies (both reimbursement and remuneration) following the introduction of the regime to a counterfactual scenario. The counterfactual assumed that drug prices would have remained at their March 2005 levels and that the remuneration (i.e. funding that sits outside of the drug reimbursement regime) element would grow according to past trends (approximately 4.5% per annum). The results are set out in Figure B.4.

Figure B.4: Financial Impact of Community Pharmacy Contractual Framework



Source: National Audit Office (2010)

Key issues

A.90 Although the framework appears to have facilitated significant financial savings, primarily through prices paid for drugs in the community pharmacy sector, the regime has encountered a number of problems. Firstly, significant volatility in drug prices can mean that drug tariffs can become out-dated relatively quickly, potentially resulting in over- or under- compensation for pharmacies in respect of certain drugs (NAO, 2010). Secondly, although the evidence is anecdotal, some pharmacies cite reductions in tariffs as leading to problems of shortages in supply, for example as manufacturers seek to supply output in jurisdictions where higher prices can be realised. Thirdly, where the number of suppliers in a market is small, there have been reports of suppliers increasing prices at the time of Margin Surveys in order to secure increased drug tariffs, which then remain fixed for several months and allow manufacturers to secure excess returns.

Information used and key enablers

A.91 In order for the regime to operate, regular Margin Surveys are conducted to understand the prices paid by pharmacies for drugs. This exercise is currently done jointly by the Department of Health and the Pharmaceutical Services Negotiating Committee (PSNC), but is being taken over by the NHS Business Services Authority from April 2015.

A.92 As the name suggests, the Margin Survey takes a sample of drug prices paid, rather than representing all transactions. In particular, it is based on data from independent contractors i.e. pharmacies with fewer than 6 branches. The current approach to measuring retained purchase margin effectively treats independents' margins as representative of those achieved by larger chains. There are significant difficulties associated with obtaining accurate prices

paid by multiples, not least because three of the largest pharmacy groups (Boots, Lloyds and Rowlands) are vertically integrated with major drug distributors (Alliance, AAH and Phoenix, respectively). Approximately 10 pharmacies, and 300 products, are surveyed each month.

Case Study T: cost of debt for airlines

A.93 Credit ratings produced by rating agencies such as Standard & Poor's and Moody's influence the cost of financing debt for airlines. Evidence suggests that uncertainty around input prices, especially fuel costs, is an important determinant of the rating bestowed on airlines. For example, Moody's May 2014 Credit Opinion on British Airways PLC states that "we also believe that future earnings growth will still be dependent on a number of variables beyond the airlines' control, notably fuel costs" and includes repeated reference to the current stability of fuel in determining ratings. We consulted with Moody's / S&P by telephone in February 2015. They indicated that, although airport and air navigation charges constitute a smaller proportion of input prices relative to fuel, regulated charges of airports and air navigation services are considered in determining airlines' ratings and that it was possible that uncertainty around regulatory charges could affect the rating given to an airline. This, in turn, could have an impact on the cost of debt.

B Welfare analysis of fixed and variable access charges

Introduction

B.1 This Appendix presents an indicative quantitative estimate of the possible magnitudes of the welfare gains that could be achieved if the current variable-fixed charge balance was found to be incorrect and was rebalanced to the correct proportions. The analysis should be regarded as indicative in nature as it is necessary to make a number of assumptions in order to generate estimates. These assumptions are detailed below. The analysis focuses on internal costs, rather than external costs such as those associated with congestion.

B.2 According to economic theory, in order to maximise economic welfare, prices should be set equal to marginal costs. However, when regulating a firm such as Network Rail, which is characterised by significant fixed costs, equating prices to marginal cost would not generate sufficient revenues to cover the organisation's total costs. The same is true of network providers in many other regulated industries such as water, gas and telecommunications.

B.3 Ronald Coase (1946) proposed a solution to this problem in the form of so called "multi-part pricing" or "two-part tariffs". Put simply, under this approach charges are made up of two components: a variable or volumetric component paid per unit of demand and equal to marginal cost, and a fixed component which does not vary with the level of consumption. This approach forms the basis of the track access charging regime in the Great Britain rail industry. In particular, under the current regime Network Rail's Net Revenue Requirement is recovered through a combination of:

- A number of variable charges levied on train operators, discussed in Section 2; and
- A Fixed Track Access Charge (FTAC) (paid by operators) and the Network Grant (which is also fixed and paid by government in lieu of FTAC), which are set to recover the residual between Network Rail's Net Revenue Requirement and income from other sources (including variable access charges).

B.4 While the two-part structure of the charging regime in the rail industry has robust underpinnings in economic theory, there has been continued debate around whether the current balance between fixed and variable charges is correct. However, there may be a number of reasons why current variable charges, and consequently the level of fixed charges, may deviate from the economically appropriate levels. These reasons include:

- Available cost information and modelling may not permit the determination of marginal cost with accuracy; and
- Variations in costs with geography are not fully reflected.

B.5 If variable charges for railway access deviate from the appropriate or "true"' marginal costs, resulting in an inappropriate balance between variable and fixed charges, economic theory suggests that, depending on the shapes of the demand and supply curves, a welfare loss may arise. For example, if variable access charges are set below true marginal costs, demand would be 'too high' and it would cost Network Rail more to accommodate some services than the benefits enjoyed by train operators of running those services.

B.6 If variable charges are not at the correct levels, then welfare gains could be generated by adjusting Network Rail's charge structure and changing the balance between fixed and variable charges.

Approach and assumptions

Demand

B.7 To facilitate the use of elasticity evidence from empirical sources, we assume that train operator demand for railway capacity (however defined) can be described by a constant elasticity of demand (CED) function:

$$x = \alpha p^{\beta}$$

where x is train operator demand, p is the access charge, β is the elasticity of demand with respect to track access charges (note that this is the elasticity with respect to access charges, not fares) and α is a constant reflecting the level of demand. This demand function reflects the underlying profits of train operators. In particular, operators will be willing to pay access charges for a given capacity up to, but no more than, the additional cash (before access charges) that they expect to make from that capacity.

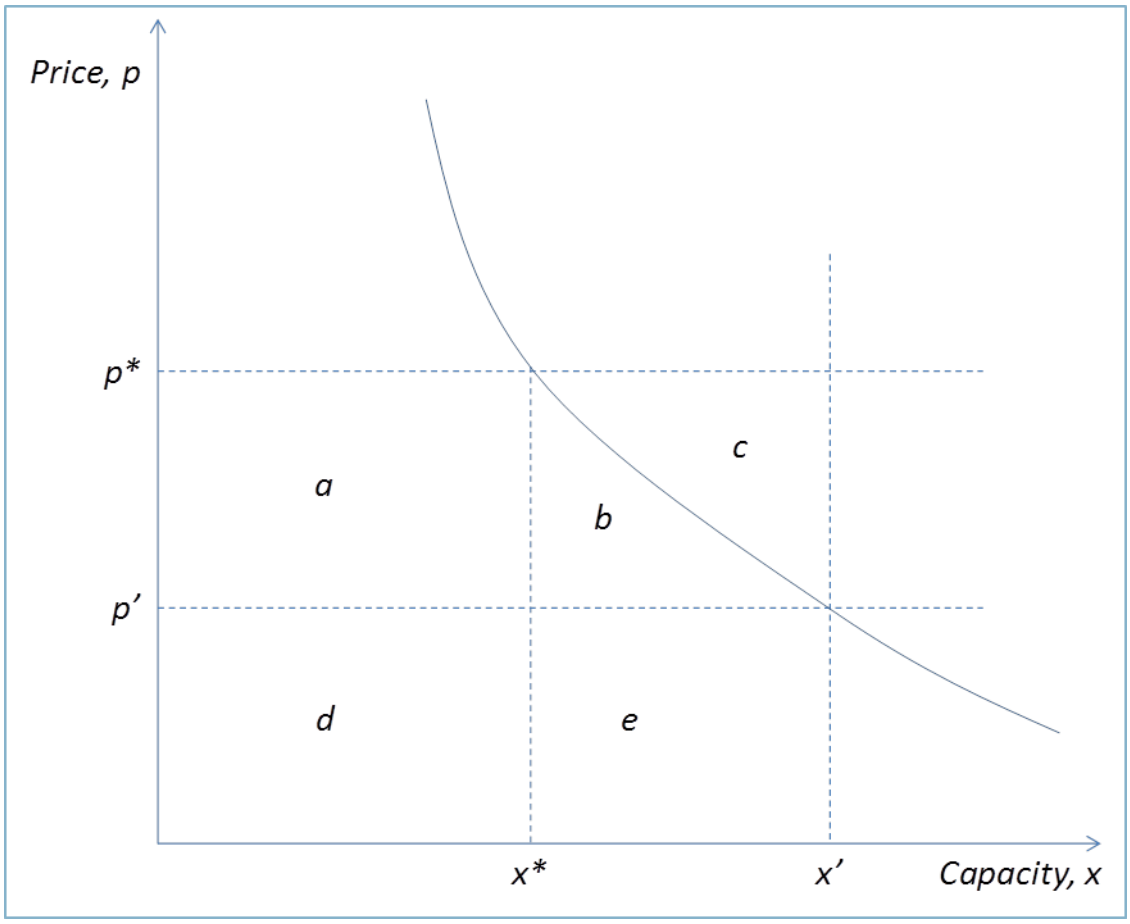
B.8 We recognise that much of the elasticity evidence has been estimated on the basis of "small changes" in price, rather than large changes, whereas much of the analysis below necessarily examines large changes in access charges. We have considered whether this is likely to be a significant problem for the work. As noted above, the analysis presented here is intended to illustrate broad magnitudes of possible effects rather than provide precise estimates. Provided that this is kept in mind, on balance we consider that the analysis remains useful.

B.9 Rearranging the equation above gives the inverse demand function, which is also shown in Figure B.1.

$$p = \left(\frac{1}{\alpha}x\right)^{\frac{1}{\beta}} = ax^{b}$$

where $a = \left(\frac{1}{\alpha}\right)^{\frac{1}{\beta}}$ and $b = \frac{1}{\beta}$.

Figure B.1: Demand for railway capacity



Note: the Figure assumes for illustrative purposes that "capacity" can be quantified, but this may not be the case

The structure of charges

B.10 ORR currently sets variable charges on the basis of a combination of SRMC and avoidable costs, as detailed in Section 2. We assume that ORR sets the variable track access charge at p'.

Determination of output

B.11 We assume that the level of output is determined such that Network Rail supplies the output demanded by operators, given the access charges set by ORR, and so output is x'. This assumption appears reasonable as ORR would usually require Network Rail to grant access unless there were strong operational reasons not to do so.

Structure of costs

B.12 We assume that the infrastructure manager's true marginal costs associated with fulfilling demand are constant at p*. Note that the charge being levied p' could be less than, equal to, or greater than p*, as described above, but the diagram illustrates the case when p'<p*.

Welfare gains from setting access charges at true marginal cost

B.13 We now consider the economic welfare effects of changing access charges so that they are equal to the infrastructure manager's true marginal costs p*, rather than p'. Suppose that ORR was able to determine that the true costs were p*, and therefore increased prices to p*.

B.14 The consumer surplus decreases by the area a+b in Figure 6.1, as a result of the increase in access charges. The change in producer surplus is more subtle. When charges were originally at p', the producer actually made a marginal loss equal to the area a+b+c (because its costs are the whole area a+b+c+d+e (i.e. p*.x') but its revenues were just d+e (i.e. p'.x')). When the price rises to p*, the producer breaks even at the margin and its variable revenues and variable costs are both equal to p*.x*. Overall therefore, the movement in price from p' to p* means that the losses to the producer of a+b+c are eliminated, and the producer surplus rises by a+b+c. With consumer surplus falling by a+b and producer surplus rising by a+b+c, the net economic effect is a net welfare gain of c.

B.15 The overall gain follows from the fact that the cost savings to the infrastructure manager are greater than the loss of profits resulting from the decreased capacity for train operators. Given this analysis, it is possible to derive a mathematical expression for the welfare gain area c associated with moving from p' to p*. This is presented in Box 1.

Box 1 – A mathematical expression for the welfare gain

The welfare gain c is equal to the rectangle p^* multiplied by x' - x^* (i.e. area $b + c + e$) minus the area under the demand curve between x' and x^* ($b + e$, which can be found through integration). Mathematically,

$$\begin{aligned}
\Delta W &= p^*(x^* - x') - \int_{x^*}^{x'} p(x)dx \\
&= p^*(x^* - x') - \int_{x^*}^{x'} ax^b dx \\
&= p^*(x^* - x') - \left[\frac{1}{b+1} ax^{b+1}\right]_{x^*}^{x'} \\
&= p^*(x^* - x') - \left[\frac{1}{b+1} p(x).x\right]_{x^*}^{x'} \\
&= p^*(x^* - x') - \frac{1}{b+1}(p'x' - p^*x^*) \\
&= p^*(x^* - x') - \frac{\beta}{1+\beta}(p'x' - p^*x^*)
\end{aligned}$$

where ΔW is the welfare gain from setting access charges at p^* rather than p'. The final step follows from the fact that $\frac{1}{b+1} = \frac{1}{\frac{1}{\beta}+1} = \frac{1}{\frac{1+\beta}{\beta}} = \frac{\beta}{1+\beta}$.

The same analysis can be repeated for cases when $p^* < p'$ to show that that the above equation also holds in that case.

Data sources and modelling strategy

B.19 We have used two Network Rail models provided by ORR:

- 20130926 -BW- Revised VUC forecast vFINAL.xls
- New VTAC calculator-mb v5a.xls.

B.20 These models contain Variable Usage Charge (VUC) tariffs for CP5 and the projected traffic volumes and the associated VUC income. These models can be used to calculate VUC tariffs for any given level of variable costs that are entered as inputs.

B.21 Suppose that the 'correct' balance between variable and fixed charges was that £x more was recovered through variable charges than is currently the case. The welfare gain from correcting the current charges to the appropriate level is calculated as follows:

- Increase the amount of costs to be recovered through VUC in the models above by £x;
- The models then identify the resulting 'correct' tariff, p*;
- Calculate the demand associated with the correct tariff, q*, using the elasticity, β; and
- Use the ΔW equation to establish the welfare gain associated with adjusting current tariffs to the correct tariffs.

B.22 We understand that the VUC models assumed that traffic levels are fixed and do not respond to increases in VUC. Since, in reality, a reallocation of charges towards VUC may result in a reduction in demand, the increase in tariffs may need to be larger than that implied by the VUC models in order to deliver an increase of £x. Put differently, in order to offset a given reduction in FTAC, tariffs may need to rise by more than the VUC model implies. Since this would result in a larger change in welfare, this means that results presented below should be regarded as a conservative estimate of the size of the welfare impacts.

B.23 In addition, since the approach described above uses the VUC model to convert fixed charges into variable charges, an increase in variable charges will be distributed across traffic based on the determinants of VUC rates: passenger vehicle characteristics and freight commodity types. A different charges model would distribute the resulting increase in charges differently: for example the Capacity Charge model would have distributed the increase in charges according to congestion levels. Since we are assuming a single, market-level, demand elasticity to calculate the welfare effects, it is unlikely that the broad magnitudes of our results will vary significantly as a result of this assumption.

Results

B.24 We carried out this analysis for:

- Freight;
- Passenger franchises; and
- Passenger open access.

B.25 We consider a number of scenarios for how each type of operator might respond to different levels of variable charges.

B.26 The results presented here should be regarded as long run or steady-state, after the full effects of price changes have materialised. In some cases, the fundamental differences between scenarios relate to the amount of time that it is likely to take for the benefits to be realised. All financial values presented below are in real terms at 2012/13 levels.

Freight operations

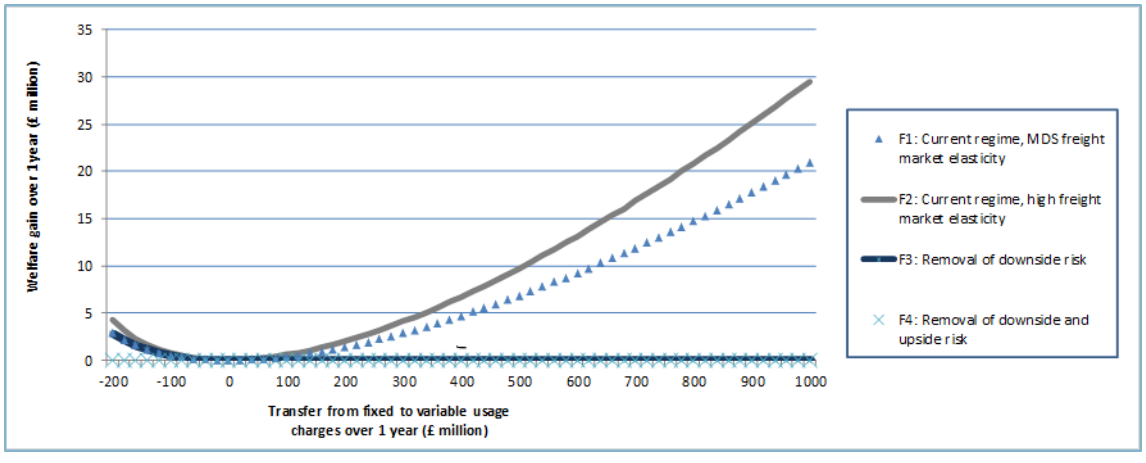
B.27 Under the current regime, freight operators are fully exposed to track access charges. However, we understand that discussions are ongoing between freight operators, governments, ORR and other industry parties regarding whether and how freight operators might be protected from access charges in future. Moreover, changes in the structure of the freight market over time, for example, as a result of the growth of intermodal and/or the decline of coal traffic, could mean that the market becomes more responsive to access charges. The table below defines a number of scenarios for the future of rail freight.

Table B.1: Freight operator scenarios

Scenario		Assumed elasticity of demand with respect to variable charges	Description of scenario
F1	Current regime, MDS freight market elasticity	-0.09	Freight operators are fully exposed to charges. The demand elasticity is taken from research by MDS Transmodal (2012). The figure is the aggregate (i.e. all commodity) elasticity in the freight market. The MDS Transmodal analysis uses the 'GB Freight Model', and MDS Transmodal state that this model has been independently validated by the DfT and now forms part of the DfT's National Transport Model.
F2	Current regime, high freight market elasticity	-0.13	Freight operators are fully exposed to charges. The overall market demand elasticity is set at -0.13, the elasticity estimate for intermodal traffic presented by MDS Transmodal. This reflects a possible future scenario in which coal and nuclear traffic has declined and the freight market is dominated by intermodal traffic.
F3	Removal of downside risk	-0.09 for reductions in charges, 0.00 for increases in charges	Freight operators are protected from increases in access charges, for example by means of a 'pass-through' agreement with government. However, they enjoy the benefits of reductions in access charges. This means that any increase in charges has no impact on demand (implying a zero elasticity) but that reductions in charges do affect demand (by assumption, according to the MDS freight market elasticity in described in Scenario F1).
F4	Removal of downside and upside risk	0.00	Freight operators are protected from increases in access charges but do not enjoy reductions in charges. This means that any change in charges will have no impact on demand (a zero elasticity).

B.28 The figure below shows the results for the scenarios defined above. The horizontal axis shows the amount of charges per annum transferred from being fixed to being variable so that variable charges reflect true marginal cost. The vertical axis shows the welfare gain from correcting the current regime so that the appropriate balance is struck between fixed and variable charges.

Figure B.2: Freight operator welfare gains



B.29 In Scenario F1 (current regime, MDS freight market elasticity), if the appropriate balance between fixed and variable charges involved an additional £200 million per annum being raised through variable charges rather than fixed charges, the welfare gain associated with correcting the current regime would be of the order of £1.5 million per annum. If the

appropriate balance was that an additional £1,000 million was raised through variable charges per annum, the welfare gain from correcting the current regime would be around £20 million per annum (note that the relationship is nonlinear).

B.30 In Scenario F2 (current regime, high freight market elasticity), the welfare gains from correcting the regime are higher, reflecting the increased sensitivity of freight traffic to access charges. For example, if the appropriate balance was that an additional £1,000 million per annum was raised through variable charges, the welfare gain from correcting the current regime would be around £30 million per annum.

B.31 In Scenario F3 (removal of downside risk), there are only welfare gains associated with correcting the current regime if the true level of marginal costs are less than the current levels. There is no welfare gain from correcting charges if the true level of marginal costs is above the current level since, by definition of the scenario, operators are held neutral to any increases in charges.

B.32 Finally, in Scenario F4 (removal of downside and upside risk), correcting charges has no effect, regardless of the size of the mismatch. By definition in this scenario, whether variable charges are increased or reduced, there is no impact on demand and therefore welfare.

B.33 In the scenarios when freight operators are fully or partially protected from charges (F3 and F4), the effective elasticity of demand with respect to charges is zero, at least over some range of charges. This implies that no welfare gain can be realised by means of correcting charges. However, this does not mean that the issue of charges being set at inappropriate levels has been resolved. Rather, it means that changing access charges are no longer available as a tool to help manage the level of demand on the railway to efficient levels.

Franchised passenger operations

B.34 Under the current regime, franchised train operators are unlikely to respond to any rebalancing of charges towards (or away from) variable components since:

- The timetables that they run tend to be specified tightly in franchise agreements with funders, meaning that they will not typically be able to respond to changes in access charges by altering services; and
- Clause 18.1/Schedule 9 of franchise agreements typically holds franchised operators neutral to changes in access charges relative to the point at which the franchise agreement was signed.

B.35 However, it is possible that in future franchised operators may be exposed to changes in access charges.

B.36 The table below defines a number of scenarios for franchised passenger operations. Box 2 presents the analysis underpinning the assumed elasticity of demand.

Table B.2: Passenger franchise scenarios

Scenario		Assumed elasticity of demand with respect to variable charges	Description of scenario
P1	Current regime (no funder response)	0.00	Franchised passenger services are specified in franchise agreements and operators are held neutral to changes in charges. Funders do not take account of charges in their planning and franchise specification decisions.
P2	Loose franchise specification and no protection from variable charges	-0.10	Franchised passenger services are not specified in franchises. Operators are exposed to changes in variable charges (but not fixed charges) through franchise agreements. The elasticity of demand with respect to variable access charges is estimated as per the approach in Box 2.
P3	Funder response	-0.10	Franchised passenger services are specified in franchises and operators are held harmless to changes in charges. However, by assumption, funders do take account of charges in their planning decisions. The elasticity of demand with respect to variable access charges is estimated as per the approach in Box 2.

Box 2 – The elasticity of demand for passenger services to access charges

For the purposes of this analysis, we are interested in the elasticity of train demand with respect to track access charges (as per the demand function above). However, since fares are likely to be a function of access charges, by making a number of assumptions, it is possible to derive a relationship which may shed light on the possible broad magnitude of the elasticity of demand with respect to access charges.

Suppose that train demand x (measured in vehicle miles) is driven by passenger demand y, according to some function g

$$x = g(y)$$

In addition, suppose that passenger demand y is driven by fares f, according to some function h

$$y = h(f)$$

Finally, suppose that fares are driven by access charges p, according to some function i

$$f = i(p)$$

By substitution, we have the composite function

$$x = g\left(h\big(i(p)\big)\right)$$

By the chain rule, we can decompose the impact of access charges on train demand as follows:

$$\frac{\partial x}{\partial p} = \frac{\partial x}{\partial y}.\frac{\partial y}{\partial f}.\frac{\partial f}{\partial p}$$

Multiplying both sides by the ratio $\frac{p}{x}$ we can write the elasticity of train demand with respect to access charges β as,

$$\beta = \frac{\partial x}{\partial p}.\frac{p}{x}$$

$$= \frac{\partial x}{\partial y} . \frac{\partial y}{\partial f} . \frac{\partial f}{\partial p} . \frac{p}{x}$$

Multiplying the right hand side by the ratio $\frac{y.f}{y.f}$ gives

$$\begin{aligned} \beta &= \frac{\partial x}{\partial y} . \frac{\partial y}{\partial f} . \frac{\partial f}{\partial p} . \frac{p}{x} . \frac{y}{y} . \frac{f}{f} \\ &= \left(\frac{\partial x}{\partial y} . \frac{y}{x}\right) . \left(\frac{\partial y}{\partial f} . \frac{f}{y}\right) . \left(\frac{\partial f}{\partial p} . \frac{p}{f}\right) \\ &= \epsilon_{x,y} . \epsilon_{y,f} . passthrough . access\ charge\ share \end{aligned}$$

where $\epsilon_{x,y}$ is the elasticity of train demand with respect to passenger demand, $\epsilon_{y,f}$ is the elasticity of passenger demand with respect to fares, $passthrough\left(\frac{\partial f}{\partial p}\right)$ is the amount (in monetary terms) of access charges that are passed through to the passenger for a £1 increase in access charges. The final term in the equation $access\ charge\ share\ \frac{p}{f}$ is simply the ratio of variable access charges to fares i.e. the proportion of fares made up by variable access charges.

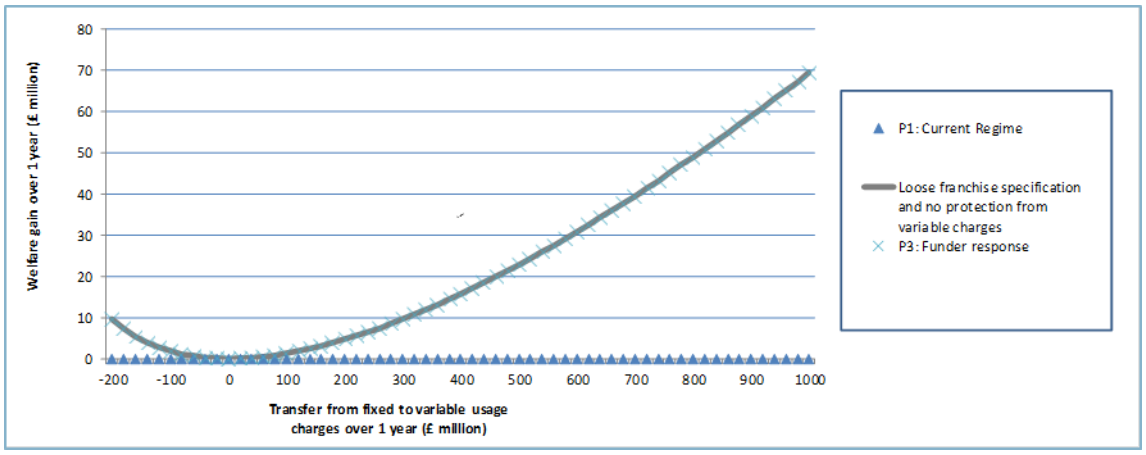
Using this equation, we can derive an estimate of the elasticity of train demand β by making the following assumptions about each of the terms:

- $\epsilon_{x,y}$: We assume that the elasticity of train demand with respect to passenger demand is 1. This implies that a 1% increase in passenger demand increases train demand by the same percentage amount. This is likely to be most representative of the long run relationship.
- $\epsilon_{y,f}$: The elasticity of passenger demand with respect to fares has been studied extensively. The evidence is summarised in the Passenger Demand Forecasting Handbook (PDFH). We understand that the elasticity at the whole-market level provided in the PDFH is approximately equal to -1.
- $passthrough$: We assume that operators are able to pass through changes in access charges to passengers through fares in all markets. Although this would not be possible in respect of regulated services under current franchise agreements, it seems likely that any future regime in which operators were exposed to access charges would include provisions to allow access charges to be handed on to consumers (otherwise operators' businesses may not be viable in the event of changes in access charges). Furthermore, we assume that 100% of access charges are passed through to passengers. This is likely to be more consistent with long-run rather than short-run behaviour (RBB Economics, 2014). We therefore assume that the $passthrough$ term is equal to 1.
- $access\ charge\ share$: In order to estimate this quantity, we note that (i) ORR's PR13 Final Determinations estimates that variable access charges paid by franchised operators under the CP5 charges regime would be £774m (2012-13 prices, 2013-14 traffic levels) and (ii) ORR's GB Rail Industry Financial Information 2013-14 reveals that franchised passenger farebox revenue was £7,915m (2012-13 prices, 2013-14 traffic levels). Therefore, we assume that this ratio is approximately 0.1 (774/7,915).

Combining the above assumptions results in an estimated elasticity of train demand with respect to variable access charges of -0.1.

B.48 The figure below shows the results of the analysis for the scenarios defined above for franchised passenger operations.

Figure B.3: Passenger franchise welfare gains



B.49 In Scenario P1 (current regime), correcting charges has no effect, regardless of the size of the mismatch. By definition of this scenario, whether variable charges are increased or reduced, there is no impact on demand or welfare since neither operators themselves or governments respond to charges. This does not mean that the inefficiencies have been eliminated, but that access charges cannot be used to remove the inefficiencies.

B.50 In Scenario P2 (loose franchise specification and no protection from variable charges), the welfare gains from correcting the regime are higher, reflecting the increased sensitivity of traffic to access charges. For example, if the appropriate balance was that an additional £1,000 million per year was raised through variable charges, the welfare gain from correcting the current regime would be around £70m per year or approximately £350 million over a control period if franchisees or their funders respond to variable charges.

B.51 The results for Scenario P3 (funder response) appear to be identical to those of Scenario P2. However the benefits under option P3 may realised much later compared to P2 because responses may only be possible at the time of franchise specification.

Open access passenger operations

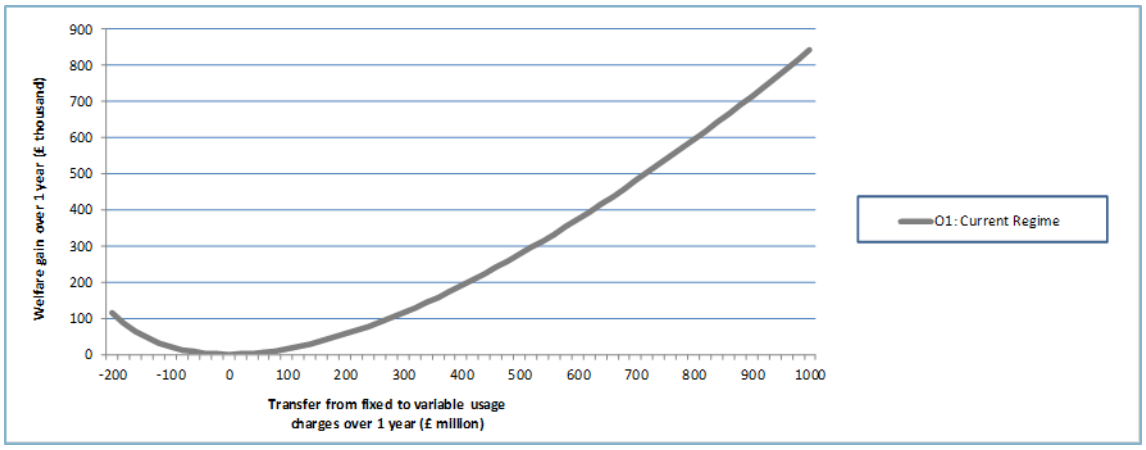
B.52 Finally, we consider open access operations. We consider just one scenario for open access operations, as set out in the table below.

Table B.3: Passenger open access scenarios

Scenario		Assumed elasticity of demand with respect to variable charges	Description of scenario
O1	Current regime	-0.1	Open access operators are fully exposed to charges. The demand elasticity is assumed to be equal to that of franchised operators under scenario P2 (loose franchise specification and no protection from variable charges), above.

B.53 The figure below shows the results of our analysis for open access operations.

Figure B.4: Passenger open access welfare gains



B.54 In scenario O1 (current regime), if the appropriate balance between fixed and variable charges involved an additional £200 million per annum being raised through variable charges rather than fixed charges, the welfare gain associated with correcting the current regime would be of the order of £200,000 per annum. If the appropriate balance was that an additional £1,000 million was raised through variable charges per annum, the welfare gain from correcting the current regime would be around £1 million per annum.

Conclusions

B.55 The analysis of the welfare losses associated with misstating Network Rail's variable charges for the dominant passenger franchise business suggests that, if variable charges understate its variable costs by £1,000 million per annum, then there might be a welfare loss of around £70 million per annum or £350 million per control period. This could, in principle, be avoided with charges informed by a better understanding of costs and cost drivers.

B.56 This analysis is sensitive to a number of assumptions and in particular to the assumed elasticity of demand in each sector with respect to variable access charges. This is particularly difficult to estimate in the case of passenger franchises, where many decisions are currently made on an administered basis although, as we discuss in Appendix C, franchisees might have a different or higher level of flexibility in future, in which case they might be more responsive to charges.

B.57 In addition, this welfare loss calculation does not identify either the aggregate level of variable costs, or the structure and level of the individual variable charges required to eliminate the loss. Nonetheless, taken with the estimates of potential cost savings indicated by the rail case studies, it suggests that the benefits from a better understanding of Network Rail's costs and cost drivers could be substantial, and possibly of the order of one percent of Network Rail's total expenditure on infrastructure per Control Period.

C Future scenarios

Introduction

C.1 ORR's IPP identified a number of possible futures for the rail industry, in which changes to the roles and powers of different players would lead to changes in decision-making processes and hence to different transmission mechanisms between cost or price information and decisions. Table D.1: summarises ORR's futures and our initial comments on some of the related issues.

Table D.1: Possible futures for the rail industry

Conceptual change	Issues noted for consideration
More protection to freight operators	Does "protection" reflect Network Rail costs?
More capacity on the network	Additional capacity may move or reduce constraints, but may not permit specific service aspirations
More on-rail competition, for example through an increase in open access operations	When, where and for what stopping patterns and frequencies will be capacity available?
More regional decision-making	Devolution may mean overlap where political, market and operational boundaries are not coterminous
Changed level of protection to franchised operators from changes to access charges	Less protection *per se* may have little or no effect without corresponding flexibility
Changed degree of franchise flexibility	How is "flexibility" either defined or increased, particular with an hourly repeating timetable and when many station calls may not be commercially viable?
More analytical approach to allocation of network capacity	If possible, this might move administered decisions between funders, Network Rail and ORR
Change in the governments' approach to funding, such as "beneficiary pays for capability"	How is "beneficiary" defined if the cost is avoidable to more than one operator? May there be free-riding?

C.2 In the remainder of this Appendix we discuss each of these proposed futures and attempt to identify:

- What it might mean in practice;
- What consequential changes might be necessary or likely; and
- What the resulting opportunity might be for a better understanding of Network Rail's costs and cost drivers.

More protection to freight operators

Background

C.3 ORR also suggests that there might be more protection to freight operators, which could mean provision of a larger number of paths for potential freight services, or a reduction in charges such as VUC below the costs directly incurred as a result of operating the services. Article 34 of

Directive 2012/34 allows operators to be paid compensation for the demonstrably unpaid environmental, accident and infrastructure costs of competing transport modes, and we understand that in some member states this is achieved through a reduction in access charges between the cost that is directly incurred.

Possible consequential changes

C.4 A possible consequential change would be an increased volume of freight services but, over time, either:

- A need to limit passenger services to be consistent with the constraints imposed by the additional freight services; or
- A need to provide additional capacity and capability, which we discuss next below.

C.5 Moreover, if the VUC paid by freight operators were reduced below variable cost the charge would be a less effective transmission mechanism (potentially blunting incentives to reduce the costs of wear and tear), while the charges paid by passenger operators (and/or subsidy paid to Network Rail) would need to rise in order for a given revenue requirement to be met.

Opportunity

C.6 This would, prima facie, mean reducing freight operators' exposure to the fixed and variable costs that they impose and, in consequence, might not need to be based on costs or depend on a better understanding of them.

More capacity on the network

Background

C.7 A potential benefit of increasing capacity on the network, whether to provide for freight operators or for other purposes, it that it could in principal mitigate many of the constraints and interdependencies and to reduce the workload of the capacity allocation process. However, individual major schemes to enhance capacity such as Crossrail, Thameslink and HS2 typically cost at least £10 billion. Investment to provide significant increases in capacity, relative to growing demand, across the network might cost many times this amount. It is not clear how a business case could be made for a major expansion of capacity beyond that required to meet demand beyond the short to medium term.

C.8 The existing rail network has spare capacity in some areas and not in others. If and where it were possible to increase capacity faster than demand, then spare capacity would be available over larger areas of the network. This overall result, rather a fundamental change in the balance between capacity and demand, would be a shift in the mix of capacity utilisation.

Possible consequential changes

C.9 There would, prima facie, be:

- Less need for incremental charges or facility charges in relation to further enhancements;
- Less scope for information to inform capacity allocation or for scarcity charging;
- Lower capacity charges, as Network Rail's infrastructure failures would affect fewer trains;
- Lower Schedule 8 performance payments, as operator failures would affect fewer trains; and
- A potential focus on the current variable charges based on Short Run Marginal Cost (SRMC) and potentially a fixed charge based on Long Run Avoidable Cost (LRAC).

C.10 However most, if not all, of the issues currently arising on the network would continue to arise in different proportions and at different locations.

Opportunity

C.11 We conclude that any credible increase in the capacity of the network might result in changes to the mix of levels of utilisation and the extent of constraints. It would, however be unlikely to change the nature of the issues currently faced in setting charges, planning enhancements and allocating capacity, or the role of charges within them.

More on-rail competition or an increase in open access operations

Background

C.12 One aspiration for the railway restructuring following the Railways Act 1993 was that wherever possible two or more franchise operators should compete for passengers. This proved difficult to implement in practice, but in the initial franchises some of the major radial routes from London were served by both a long-distance operator and a suburban operator which competed at the margin on a small number of point-to-point flows. However, as the volume of services operated grew, there was an increasing need for services on each corridor to be timetabled as an integrated package, balancing demand between services to make best use of the capacity of both infrastructure and trains. In subsequent franchising rounds there has typically been one franchisee in each corridor, and it might now prove operationally difficult to subdivide the operation to introduce competition.

C.13 Another aspiration for the railway restructuring was there would be extensive open access operation, and even that this would, over time, gradually replace franchising as a means of providing services. Studies at the time suggested possible entry by targeting non-stop long-distance services such as London-Newcastle-Edinburgh, and more recent analysis has also considered medium distance shuttle services such as London-Peterborough.

C.14 In practice, open access has been constrained by at least three factors:

- The limited number of commercially viable markets;
- The Rail Regulator's policy of "Moderation of Competition", now replaced by ORR's approach to open access including the "not primarily abstractive" test to limit services intended mainly to "cherry-pick" existing revenue; and
- Increasingly systemic constraints on infrastructure capacity, in part caused by the increases in frequency on many routes.

C.15 With growing demand it is possible that open access will become commercially viable on more flows. It will be for ORR to decide the extent to which competition is limited, although we note that increased exposure to competition might make it more difficult for funders to persuade franchisees to take revenue risk, at least without some changes to the structure of franchise obligations and rewards.

C.16 The principal potential difficulty in achieving greater competition and open access is that the relevant infrastructure, and in particular the East Coast and West Coast Main Lines (ECML and WCML) are increasingly congested, and planned enhancements in capacity and capability are generally only sufficient for the foreseeable growth in franchise services. Open access might become more widely possible if there were a major expansion in network capacity as discussed above.

Possible consequential changes

C.17 We conclude that increased competition or more open access services is likely also to require one or both of:

- Reduction in commuter services to create more capacity for long-distance services; and/or
- Major increases in capacity on long-distance routes, as might become possible on WCML after 2026 with the opening of Phase 1 of HS2.

Opportunity

C.18 Unless and until more capacity is made available by either of these mechanisms, increased competition or open access might only be possible by reallocating capacity from existing, and mainly franchised operators, to new operators offering competing services.

C.19 In summary, without specific proposals for a major expansion of capacity, introducing more competition or open access might require a reallocation of existing capacity. Open access operators could, in principle, respond to price signals, but would still require efficient diagrams for their stock, which would generally mean keeping the stock in use throughout the day and setting the timing of individual trains to capture peak demand.

More regional decision-making

Background

C.20 A greater degree of regional decision-making would, in principle, also allow funds to flow via or from regional or local authorities to the rail industry.

C.21 In principle, more regional decision-making might mean that funds such as the National Stations Improvement Programme (NSIP) and Access for All (AfA) might become regional funds. This could mean that individual allocations of funding were captive to a regional geography, whether ring-fenced for rail or available for spending on other modes or activities. It does not, prima facie, seem likely that a fund such as the East Coast Development Fund could or should be managed by a regional authority, as the nature of the Fund is that it should be put to use wherever on the route it can deliver the greatest value for money.

C.22 We also note that more regional decision-making might lead to some funders choosing to specify a different or lower level of facilities at stations. This could mean that the station long term charge be restructured to allow different operators at a station to “buy” different levels of facilities, particularly on dedicated platforms, optimised to their requirements.

C.23 In addition to providing funds at regional level, it might also be possible and necessary to allocate costs to funders at regional level, including:

- Calculation of fixed charges for a service, and by implication for its regional funder(s), on a basis such as Long Run Avoidable Costs (LRAC); and
- Change to a “beneficiary pays” basis, an alternative future which we discuss below, with each regional funder being expected to contribute to existing or enhanced infrastructure from which it benefitted.

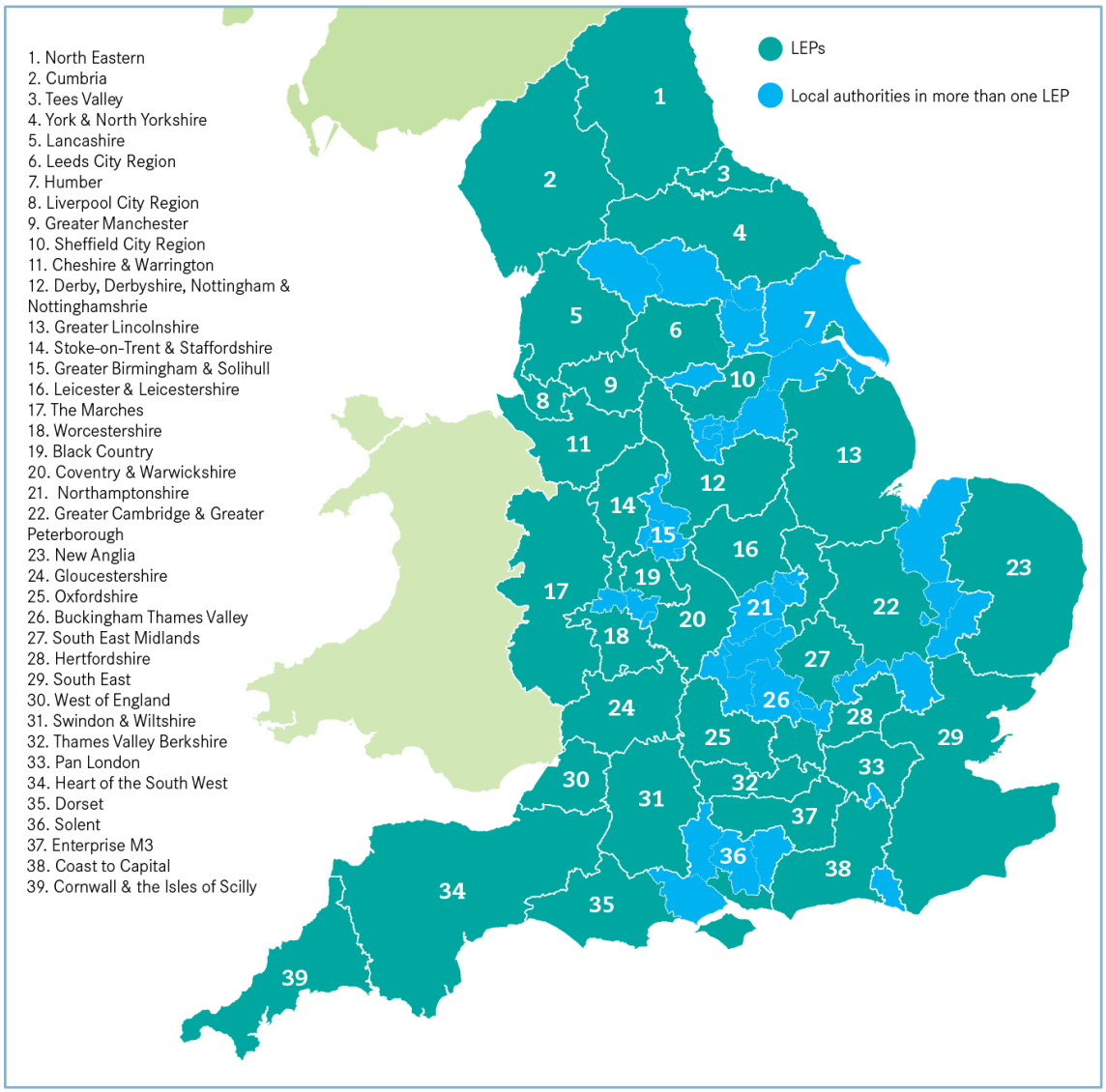
C.24 Such an approach would arguably result in a more equitable outcome in terms of the allocation of costs between regions or routes.

Possible consequential changes

C.25 A move to "beneficiary pays" could mean that proposed enhancements might need to be subject to decision-making by a number of funding regions, or by groupings into which they chose to arrange themselves for the purposes of specifying or procuring rail services.

C.26 We have not attempted to assess how the governance of projects with some many beneficiaries could be managed. However, Figure D.1 shows the current 39 Local Enterprise Partnerships in England and illustrates how enhancements, particularly on the main lines radiating from London, may be relevant to, and attract the interests of, "beneficiary" LEPs along the entire corridor.

Figure D.1: Local Enterprise Partnerships in England



Source: Centre for Cities

C.27 We understand that a relatively minor scheme on the Midland Main Line, realignment of the track and station improvement works at Market Harborough, is the subject of a joint bid by three "beneficiary" Local Enterprise Partnerships (LEPs): Leicester and Leicestershire; Derby, Derbyshire, Nottingham and Nottinghamshire; and Sheffield City Region. This suggests that the

involvement of a large number of authorities is possible, although this might be more complex in cases such as the East Coast Main Line, with beneficiaries extending from the south coast of England to the Scottish highlands, as we discuss further below.

Opportunity

C.28 There appears to be an opportunity for greater understanding of the drivers of costs, in terms of the services or ultimately the passengers who cause or benefit from them.

C.29 This would permit a more detailed and defensible allocation of costs to funding bodies or beneficiaries. It might, however, complicate governance of enhancement projects, particularly if funders in regions remote from a project were expected to contribute on the basis of the benefits to their inhabitants.

C.30 The principal implication would be for the calculation of fixed charges, with possible consequences for the calculation of the Network Grant as a residual after avoidable costs.

Changed level of protection to franchise operators

Background

C.31 At present, the Department for Transport and Transport Scotland indemnify franchisees against any changes in the level of charges incurred as a result of operating the services in their franchise specification. This "future" suggests a situation in which this would no longer be the case, leaving franchisees with at least some exposure to changes in charges at or between Periodic Reviews. We note that a change in the risks they face might also affect the effective cost of capital of franchisees, although in general they have only limited need to borrow to fund their operations.

C.32 ORR has taken steps to moderate, by a number of mechanisms, the effect of large increases in calculated charges between CP4 and CP5 on freight and open access passenger operators. In principle at least, these operators have the option of withdrawing services rather than paying higher charges. This would not be the case for franchise operators, who are currently obliged by their franchise agreements to meet the service specification.

C.33 We also note that alliancing enables franchise operators to "flex" their net exposure to Network Rail's charges at the margin by sharing some elements of costs and/or revenues with Network Rail. However, we doubt that it would be practicable for Network Rail itself to indemnify them against changes in the charges it was required by ORR to make. It might also be difficult to make such an arrangement consistent with European law, if the net charge fell below the estimated "cost that is directly incurred as a result of operating the train service".

C.34 We are not aware of any specific proposals on what a change in the level of protection might mean, but a number of scenarios are possible:

- The level of protection is reduced slightly – for example the indemnification only extends to 95% of the changes in charges – and franchisees are willing to accept the risk
- The level of protection is reduced further, in which case at some point it might either become impossible, or not cost-effective, to let a franchise
- The level of protection is reduced in exchange for some other element of franchise flexibility

C.35 We are not aware of what an element of franchise flexibility might mean. However, to be of value to franchisees it might need to include the right to retime station calls, to remove station

calls, to remove whole trains, or to remove whole service codes or service groups. This might change the nature of a franchise from an obligation to provide a service specification to an option to provide certain services, if it was viable to do so, in some cases in exchange for franchise payments as an incentive. Any changes to the structure of franchises, and in particular to the definition of the Public Service Obligation (PSO), would need to be made consistent with European law including Regulation 1370/2007 on public passenger transport services by rail and by road, as potentially amended by the Fourth Railway Package.

C.36 We note that, if there were a greater degree of regional decision-making, the level of protection offered might be in the gift of regional authorities and vary between franchises according to perceived local requirements.

Possible consequential changes

C.37 Any change by ORR to the structure and level of Network Rail's charges might therefore need to be matched by a change by funders to the structure and level of franchise payments to defend socially necessary elements of the service.

C.38 This could, for example, be on the basis of measure such as all-day or peak passenger numbers, all-day or peak passenger miles, passengers in excess of capacity (PIXC), or number of "social" station calls. At least some of these measures were considered in the 1983 Review of Railway Finances (The "Serpell Report").

C.39 A further issue is that if franchisees were free to reduce or withdraw from some services, it might be presentationally difficult for funders to pay, on their behalf, any form of fixed charges which had been calculated on the basis of the whole current franchise specification. One possibility is that it might be necessary to end FTAC, and the associated allocation issues, and replace it with Network Grant.

C.40 In summary, we conclude that changes in the degree of protection to franchise operators might need to be accompanied by changes by funders and by ORR:

- To make service provision an option rather than an obligation;
- To restructure rewards to focus on specific outputs or outcomes; and
- To avoid a situation in which fixed charges were based on services which were not actually operated.

Opportunity

C.41 In the absence of a more detailed proposal, we have not been able to identify what benefits might arise from an improved understanding of Network Rail's costs and cost drivers. In particular, outcomes would depend on the relative sizes and effects of:

- Network Rail's charges, including FTAC;
- Rolling stock leasing costs and other operating costs;
- Revenues in final passenger markets; and
- Any consequential changes to the structure of franchise payments.

Changed degree of franchise flexibility

Background

C.42 The structure of franchises must remain consistent with European law including Regulation 1370/2007 on public passenger transport services by rail and by road, as potentially amended by the Fourth Railway Package.

C.43 We are not aware of any specific proposals as to how franchise could be more flexible, but the minimum characteristics of a franchise appear to include:

- Limitation to a specific geographical area: otherwise, it would be little different from open access;
- Obligation to operate a minimum volume of train services, or train-miles: otherwise it would be an option rather than a service specification; and
- Obligation to provide a minimum number of station calls: otherwise franchisees might cease to serve minor stations with the aim of cutting costs and growing revenues through faster services between more major ones.

C.44 When specifications for the original franchises were drawn up in the early 1990s, it was found necessary to include a number of other features such as:

- Maximum journey times between key points;
- Maximum intervals between journey opportunities, where direct or using connections, between key points;
- Latest permitted arrival of the first train of the day;
- Earliest permitted departure of the last train of the day; and
- Connections with other services, where these were likely to be important to passengers.

C.45 For example, a service between a regional city and London might be have been specified by a having journey time not exceeding three hours, a first arrival in London no later than 09:00, a last departure from London no earlier than 20:00, and at least seven trains per day each way with the interval between them not exceeding two hours. This would give the first franchise operator the opportunity to retime trains to attract more demand and/or to improve the utilisation of rolling stock and staff.

C.46 Over time, however, services on many routes have standardised on regular intervals of two hours, one hour, or 30, 20, 15 of 10 minutes. In many cases two-hourly services have become hourly, and hourly services have become half-hourly or even every 20 minutes. The increase in the number of trains operated has absorbed much of the spare capacity on the network, which in many cases is now systemically constrained by the capacity and capability of the infrastructure and by the needs of parallel services.

C.47 On some parts of the network a franchisee could still take advantage of a more flexible specification, but in others there would be little scope to make use of such flexibility. One example is the future Thameslink franchise, which when complete will operate among franchised and open access services on the East Coast Main Line and franchises on the Midland Main Line and South Eastern, South Central and South Western networks, all of which have major infrastructure constraints. A franchisee required only to operate the same number of train-miles and station calls within the same geography might be unable to make any material changes to the timetable without restructuring of the timetables of all these other operators.

C.48 We note that, if there were a greater degree of regional decision-making, the degree of flexibility offered in franchises might be in the gift of regional authorities and vary between franchises according to perceived local requirements. It is not clear, for example, what regions would be expected to make decisions on, or provide funding for, infrastructure such as Thameslink.

Possible consequential changes

C.49 Where there was scope for flexibility to modify services this might also be accompanied by changes to the structure of franchise payments to incentivise the provision of services, or in particular station calls, which were considered socially necessary or provided positive externalities, such as the number of "social" station calls.

C.50 One potential difficulty of franchise flexibility is that it would make it more difficult for Network Rail to plan and forecast operator requirements, effectively extending the uncertainty currently associated with freight and passenger open access requirements to franchised passenger services. Greater uncertainty might lead to inefficient investment in the form of stranded assets which are not used in a way which generates the benefits assumed in their business case. Table D.2 lists some examples.

Table D.2: Examples of "stranded assets"

Asset	Issue
Waterloo International	Built to allow Eurostar services to reach Waterloo International, but only used for 13 years (1994-2007)
Nine Elms Junction and Stewarts Lane Viaduct	
Fawkham Junction	
North Pole Depot	
Graham Road curve	Built to allow services into Liverpool Street after the closure of Broad Street, but only used for a few years
Cotswold Line singling	Singled in the 1970s due to declining demand and now being largely redoubled due to rising demand
LUL Jubilee Line Green Park to Charing Cross	Made redundant by the Jubilee Line Extension via Westminster and Waterloo, only used for 20 years (1979-1999)

C.51 Without long term predictability and stability in service patterns it may be more difficult both:

- To plan the efficient scope and scale of large packages of infrastructure; and
- To ensure that such infrastructure, once built, is used to the extent or in the way which formed the basis of its business case.

C.52 Note, however, that a more rigid franchise specification does not, in itself, remove demand, operational and other uncertainty leading to sub-optimal investment. Changes in demand, for example, may mean that the most efficient outcome involves under-utilisation of assets, the costs of which have already been sunk.

Opportunity

C.53 We conclude that greater franchise flexibility might be possible on some parts of the network but might need to be accompanied by a different structure of franchise payments which might mirror or negate some of the effects of a different structure of charges. As we noted above, the outcome would depend on the relative sizes and effects of:

- Network Rail's charges;
- Rolling stock leasing costs and other operating costs;
- Revenues in final passenger markets; and
- The structure of franchise payments.

C.54 In addition, greater flexibility could reduce the contribution of a good understanding of costs to the efficient planning of the network and ensuring that infrastructure enhancements, once built, were actually used in a way which delivered the intended benefits.

More analytical approach to the allocation of capacity

Background

C.55 We have also considered a future with a "more analytical approach to allocation of network capacity". We note, however, that no means has yet been found of either:

- Automating the process of timetable design, except for limited applications to freight services; and
- Incorporating cost or price data into the timetabling process.

C.56 It might in principal be possible to add cost or price information to the Considerations set out in the Network Code. Whether and how such information would actually inform capacity decisions is not clear.

Possible consequential changes

C.57 If it were possible for some or all timetabling processes to be either automated or informed by cost or price information, a number of potential consequences include:

- Less workload for Network Rail in preparing timetables; and
- Less scope or need for ORR to review or impose decisions on capacity allocation, provided that the automatic processes or cost of price information had been correctly applied.

Opportunity

C.58 In principle, it might be possible to use cost or price information to support a more automated approach to the allocation of capacity. As yet, however, this remains a purely theoretical concept, at least for passenger railways, and it is not possible to identify what specific opportunities might arise in practice.

Changed funding, such as "beneficiary pays for capability"

Background

C.59 The House of Commons Transport Committee, in its Seventh Report of Session 2014-15 "Investing in the railway" reported that:

"*We recommend the Department for Transport adopt and publish broader criteria for allocating funding, which consider the contribution to the Government's wider policy objective – such as long-term economic regeneration, environmental policy or social need. Rail funding must still deliver value for money for the taxpayer, with the economic case for each project subject to rigorous testing against the revised criteria. This approach, however, will result in a fairer allocation of rail investment across the country; other regions, such as the far south west, have been "starved" of investment.*"

C.60 In practice, identification of railway investment on enhancements and renewals to beneficiaries involves two distinct steps to link:

- The cost of the enhancement or renewal to a franchise, service group or service code; and
- The franchise, service group or service code to the passengers and others who benefit.

C.61 Figure 2.1 shows how approximately 65% of Network Rail's efficient expenditure relates to capital expenditure on enhancements and renewals. We discussed in Section 2 a number of the issues associated with allocating the fixed operations, maintenance and renewals costs of the existing network to specific franchises or services, and focus here on identifying the beneficiaries of capital expenditure on enhancements, which account for almost 35% of total expenditure.

C.62 We noted in the case studies in Section 3 how individual increments of enhancement expenditure had not always been identified as being associated with, or caused by, individual elements of additional services. More widely, Network Rail's Long Term Planning Process (LTPP) typically proceeds by identifying indicative levels of future demand and services, and the infrastructure capacity and capability likely to be needed to support them, but does not attempt either to identify specific future timetables or to identify services within these timetables as "causing" the infrastructure capacity and capability.

C.63 This might be possible with the more detailed approach to planning infrastructure used in Switzerland but as far as we are aware this does not attempt to identify the "causation" of infrastructure to individual services. To do so might require a number of artificial assumptions regarding the sequence in which services were deemed to be added to the network. Even this approach or assigning a notional order to the services would be difficult where a number of changes were introduced simultaneously within a single timetable, for example by accelerating all services to make use of a higher line speed.

C.64 Even if the cost of a particular infrastructure enhancement were attributed to a particular service, operator or funder as having "caused" the increment, there is also a potential issue of "free riding" from other operators. Examples of issues which might arise include:

- Operator A agrees to pay for an infrastructure enhancement, but once it is completed operator B, who has paid nothing, wishes to transfer services to it;
- Operator A agrees to pay for an infrastructure enhancement, but once it is completed operator A can only benefit fully from it if it is also used by operator B (this may be the case, for example, with an enhancement to allow trains to operate at higher speed); and
- Operator A agrees to pay for an infrastructure enhancement, but once it is completed a new operator C wishes to introduce new services which make use of it or of capacity released because operator A uses it.

C.65 In each case the "ex ante" identification of operator A as "causing" the enhancement, even if accepted by operator A, might not be consistent with an "ex post" analysis of the avoidability of the enhancement to different operators.

C.66 To illustrate some of these issues we examined in greater detail the East Coast Main Line south of York, which has a number of constraints, with varying degrees of severity, as listed in the table below. We compared the constraints:

- Identified in the 2006 ITS "Scoping study for scarcity charges";
- Identified in the 2008 Network Rail "East Coast Main Line RUS"; and
- Addressed in investment carried out to date.

C.67 Table D.3 shows which locations were described as a constraint in the 2006 ITS study or the 2008 RUS (✗), or have since been addressed (✓), illustrating how changing demand can influence the priorities for work to enhance capacity.

Table D.3: "Constraints" on the East Coast Main Line (ECML) south of York

	York	Doncaster	Newark crossing	Grantham	Peterborough	Hitchin crossing	Welwyn viaduct	Alexandra Palace	Finsbury Park	Kings Cross
ITS (2006)	×			×	×	×	×			
RUS (2008)					×		×	×	×	×
Addressed						✓		✓	✓	✓

C.68 The constraints include York and Doncaster stations, a flat crossing at Newark, Grantham and Peterborough stations, a flat crossing at Hitchin, the two track viaduct at Welwyn, intense suburban services between Alexandra Palace and Finsbury Park, and the limited number of platforms at Kings Cross.

C.69 While the Welwyn Viaduct itself has been considered a constraint since at least the 1970s, successive means have been found to mitigate its effects by relieving other constraints which interact with it. Since the 2008 Route Utilisation Strategy (RUS) new infrastructure has been added as follows:

- In Greater London, a new Platform 0 (formerly "Platform Y") at Kings Cross to provide greater flexibility for each type of train, used by each of four operators, to wait before their next journey;
- Also in Greater London, new track between Alexandra Palace and Finsbury Park, to reduce interactions between trains using the main line over the Welwyn Viaduct and those using the Hertford loop; and
- In Hertfordshire, a flyover at Hitchin to allow trains to leave the Main Line without having to cross the paths of other trains and travel to Cambridge in Cambridgeshire.

Identifying the location of the investment

C.70 One approach to identifying the beneficiaries of these investments would be to note that they are in:

- London; and
- Hertfordshire, in the East of England region.

C.71 However, at least for infrastructure used by or benefitting long-distance services, this approach might give a highly-misleading impression of the beneficiaries of the investment.

Identifying the locations served by services using the investment

C.72 We discussed above how three Local Enterprise Partnerships have jointly bid for a scheme outside their area which nonetheless provides benefits to them all through journey time savings on the Midland Main Line connecting them to London. This suggests that local authorities are able and willing to identify themselves as beneficiaries of investments elsewhere.

C.73 A second approach would be to identify, for illustrative purposes, the regions served by trains using each of the elements of infrastructure. On the East Coast Main Line these would be broadly as shown in Table D.4, at least once Thameslink is completed.

Table D.4: Uses and beneficiaries of enhancements on the East Coast Main Line (ECML)

Region	Subdivisions	Kings Cross Platform 0	Alexandra Palace to Finsbury Park	Hitchin Flyover
Scotland	Unelectrified locations north of Edinburgh	Benefit	Benefit	Benefit
	Electrified ECML as far as Edinburgh	Use	Benefit	Benefit
North East		Use	Benefit	Benefit
Yorkshire and the Humber		Use	Benefit	Benefit
East Midlands		Use	Benefit	Benefit
East of England	Cambridge and Kings Lynn	Use	Benefit	Use
	On ECML within Hertfordshire	Use	Benefit	Benefit
	On Hertford loop	Use	Use	Benefit
Greater London	On ECML within Greater London	Use	Benefit	Benefit
	On Hertford loop	Use	Use	Benefit
	St Pancras International and further south	N/A	Benefit	Benefit
South East		N/A	Benefit	Benefit

Source: Steer Davies Gleave analysis "Use" = trains use enhancement, "Benefit" = trains benefit from enhancement
Analysis assumes at least some Thameslink trains between the South East and Cambridge/Kings Lynn
Trains to Cambridge and Kings Lynn which use the Hitchin Flyover have extended journey times and mileages

C.74 This suggests that the beneficiaries of these investments, even if limited to those locations served by trains which use or benefit directly from them, include Scotland and six of the nine English regions, and a potentially larger number of LEPs. To apportion the costs of the enhancements to these beneficiaries might require some additional metric, such as the number of user and beneficiary trains which served a particular geography, or the number of station calls they made in each geography.

Identifying the locations of beneficiaries of the investment

C.75 A further and potentially more elegant approach to "beneficiary pays" would be to use LENNON data to identify passengers who travel on trains directly using or benefitting from the enhancements. This process would effectively identify all passengers travelling over the lower end of the East Coast Main Line between Hitchin Flyover and Kings Cross inclusive, and then apportion the costs of the enhancements pro rata with their origins and destinations. This approach would raise a number of issues:

- The benefit including passengers who made connections onto services using or benefitting from those using the enhancements, such as a passenger between Chichester and Newmarket using Thameslink between East Croydon and Cambridge;
- The benefit of attributing benefits to specific locations, such as to Chichester in the South East and Newmarket in the East of England, allowing a high degree of granularity;
- The potential need to adopt weightings for "user" and "beneficiary" categories; and
- The complexity of carrying out the analysis.

C.76 An alternative would be to identify beneficiaries through modelled reductions in journey time and crowding, although this would require the use of demand and crowding models rather than reliance on revenue data. It could, however, mean that passengers whose service

remained unchanged as a result of the enhancement would not be expected to contribute to its cost.

C.77 The above analysis focuses on identifying the beneficiary of enhancements, but similar approaches could in principle be adopted to identify other costs and charges, including variable charges, to beneficiaries such as:

- Train-kilometres operated within a geographical area; and
- Passenger-kilometres on trips originating or terminating within a geographical area.

Possible consequential changes

C.78 The possible consequential changes of a "beneficiary pays" approach are complex, but one potential implication is that enhancements would need to be sponsored and funded by larger range of beneficiary bodies, as we discuss below.

Opportunity

C.79 There appears to be an opportunity for greater understanding of the drivers of costs, in terms of the services or ultimately the passengers who cause or benefit from them. We have noted that it might be desirable to allocate costs to service code, service group, franchise or operator, and then to national, region or other administrative area. We conclude that it appears theoretically possible for existing costs to be allocated in much greater detail to beneficiaries, if it was concluded that this level of analysis was cost-effective.

C.80 A possible consequence is that the allocation of infrastructure investment across Great Britain on a "beneficiary pays" basis would appear much more even than on a "location of the asset" basis. We note, however, that a "beneficiary pays" approach, at least if based on the principles set out above, would mean that, even if enhancement costs were wholly attributable to a specific location and operator, they might need to be apportioned to a range of beneficiaries. These could be spread widely across either the regions directly served by trains using the enhancement, or even over the regions of passengers using or benefitting from the enhancement.

D Information sources

D.1 This Appendix lists the principal source documents identified from our literature review and referred to in case studies from other sectors and the welfare analysis.

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Control Sheet

Document Title

Identifying the benefits of an improved understanding of Network Rail's costs and cost drivers

Document Type

Final Report

Client Contract/Project No.	SDG Project/Proposal No.
ORR/CT/14-58	P22781801

Issue history

Issue No.	Date	Details
4	8 April 2015	Draft report to ORR
5	28 May 2015	Final Report with minor amendments

Review

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ORR	Confidential P22781801 files only