CEPA

Evidence on Top Down and Bottom-up Efficiency Adjustments for Network Rail's CP6 Maintenance and Renewals

8 October 2018

Office of Rail and Road

FINAL REPORT

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1. INTRODUCTION

ORR has appointed CEPA to review and potentially refine its assessment of the scope for efficiency in operations, maintenance and renewal costs in CP6. The costing of enhancement projects is now handled directly between DfT and Transport Scotland and Network Rail. CEPA's assessment builds on work already completed by ORR and its other consultants. The context is that Network Rail's costs have in general been increasing in the present control period, rather than reducing in line with the efficiencies expected at last periodic review. Some of the reasons for this are understood and include some avoidable cost escalation. Initiatives to combat that and improve the efficiency of delivery have been introduced including the further development of route devolution and the potential efficiencies that arise out of that process.

Under the new route structure of Network Rail, each route has made its own costing of its work program following a process developed by Network Rail's central team. Each route has followed a standard method but there are variations in approach and the costings parameters. However, a general issue is that the base costs used to make this costing lie prior to the more recent initiatives implemented to remove the avoidable inefficiencies that have arisen over the course of CP5.

ORR has asked us to take account of the following in refining the likely range for Network Rail's post-efficient costs:

- Setting a baseline based on normalised costs and removing inefficiency from CP5 outturn rates;
- Efficiency that has arisen since 2016/17
- Efficiencies arising from Network Rail's ongoing transformation; and other
- Unquantified savings as established in ORR's efficiencies report

This piece of work has been put together quickly to fit with the timing of ORR's final determination. It therefore draws upon extant data from work previously completed for ORR by CEPA, ORR's own analysis and submissions made to ORR by Network Rail; no new data collection has taken place to support the work.

This working note covers:

- An assessment of top-down evidence that can contribute to assessing efficiency adjustments for Network Rail's CP6 assessment drawing on case study evidence of transformational change in other industries;
- A high-level review of the econometric benchmarking analysis that ORR has carried out using route and maintenance delivery unit (MDU) level data provided by ORR; undertaken by the Institute for Transport Studies (ITS), University of Leeds (see Section 3); and
- A bottom up review of the scope for efficiency in maintenance and renewals drawing on information provided to ORR by Network Rail and ORR's analysis of that.

The following sections cover each of these topics in turn.

2. CASE STUDIES OF TRANSFORMATION

2.1. Introduction

In this section we explore the potential for efficiency savings drawing on the results of organisational transformation in other industries, and the likely timescales for such savings. Given the timescales of this study our approach has been to assess comparators for transformation through case studies and we have focused on taking evidence form case studies we have previously prepared for ORR and other clients. In particular we have drawn upon case studies taken from an unpublished piece of work for ORR undertaken in 2013 and in which we assessed the impact on the pace of change following large shocks to companies, and this forms the main knowledge base for this piece of work. This study included events such as mergers in the energy sector, recovery from large business affecting change in rail and devolution elsewhere e.g. in London Underground. From a long list of case studies, we selected those that we consider have most in common with the current project – Appendix A provides further detail on the selection process. These are:

- The progress of Network Rail's own devolution process;
- Devolution at London underground following the implementation of a public private partnership in 2002/3;
- The restructuring of National Grid Gas; and
- Mergers at SSE

We also comment on a more recent development in aviation regulation – the capex governance process used at Heathrow. This has some parallels with introduction of route supervisory boards within Network Rail. The limitations inherent in this work following from the use of these older, existing case studies should be noted. There may be other, more recent, evidence from other examples, but we have not researched them given the time constraints on this project.

In this section, we focus on the type of transformation Network Rail is currently undertaking, in particular ongoing devolution of infrastructure investment and management to regional business units. We explore Network Rail's approach to devolution and its progress to date. We then compare this to our case studies of other infrastructure organisations that have gone through a form of transformation. At the end we bring the case studies together to summarise our conclusions.

2.2. Network Rail

2.2.1. Devolution overview

Route devolution was an internal organisational change implemented by Network Rail in which:

- new business units were formalised to match Network Rail's existing 'Route' structure; and
- responsibilities and accountabilities were devolved from Network Rail's central organisation ('the Centre') to these new regional units ('the Routes').

Network Rail's degree of centralisation / de-centralisation has varied over time. In 2011 the McNulty Report recommended greater devolution in Network Rail's structure and operational approach. Over time devolution has progressed further, with progressively more of the centre's functions devolved to individual routes. Network Rail expects this to continue throughout the next price control period, with each route having its own regulatory settlement. At a high level, Figure 2.1 shows the progress of Network Rail's devolution since 2011.

Figure 2.1: Timeline for Network Rail route devolution

2011
- McNulty report published recommending greater devolution
- Devolution of Wessex and Scotland routes

2012
- Devolution of remaining routes and creation of Wales route

2015
- Introduction of route-based scorecards

2016
- Further devolution of roles from Network Rail centre to route units
- Route managing directors able to authorise significantly greater volume of maintenance and renewals work

2017
- Pilot of first route supervisory board bringing together train operating companies, Network Rail and passenger representatives

2018
- Route supervisory boards introduced on all routes

2020
- Individual regulatory settlements for each route

2.2.2. Progress with devolution

One of the main aims of route devolution was to transfer responsibility of key functions to a level where they could be more closely aligned with the needs of customers. Rather than making all decisions centrally, route devolution allows the managers of different routes to adapt their approach better to meet the needs of the specific users of the route. In this context, users included train operating companies, freight operating companies and rail passengers.

Prior to devolution, each route had a Route Director and a Route Infrastructure Maintenance Director who both reporting to the centre. Following devolution, responsibility for both operational and engineering activities was combined in the role of Route Managing Director (RMD). RMDs were also given more freedom and autonomy in the way that they spent their budgets and allocate resources.

Following the first wave of devolution, Network Rail sought to clarify responsibilities between the centre and individual routes. Since then, devolution has progressed further with Network Rail producing individual performance scorecards for each route and devolving more roles away from the centre. By 2016, individual RMDs were empowered to authorise significantly greater volumes of maintenance and renewals work, with Network Rail stating that they were able to authorise 99% of orders. More recently, Network Rail has established a series of route supervisory boards made up of representatives from Network Rail, passenger and freight operators, and Transport Focus. The boards will oversee and challenge the development of the route with a specific focus on the interaction between track and train operation.

When we developed our case study (in 2013) we found it difficult to assess the impact of devolution in quantified terms. Then, as now, there were a number of other factors affected Network Rail's performance. The original interviews we carried out with external stakeholders suggested that devolution may have been implemented too quickly and as such, accountabilities and responsibilities were unclear. Since then, Network Rail has sought to further clarify the separation between route-level responsibilities and central responsibilities. Route devolution continues to have strong support across the rail industry.

2.2.3. Recent actions

Network Rail's stated ambition is for the firm to act like a holding company for the individual route businesses, with almost all activity devolved to the route level.[1] For a large part, Network Rail has already undertaken most of the necessary steps to realise this ambition, with a majority of roles and responsibilities now devolved to the route businesses. By the end of 2018, Network Rail is expecting to also have set up all of its route supervisory boards.

In its Strategic Business Plan, the company states that it is expecting some organisational stability to deliver further efficiencies. However, Network Rail is expecting changes to the regulatory treatment of the separate route businesses, which are planned to be implemented as part of PR18. Each route will have its own regulatory settlement for the next control period. By then each route will have its own income stream, business plan and targets for which they would be accountable. Parallel to this, each route business is expected to develop its capability to meet its new responsibilities. Network Rail is also expecting there to be a certain level of competition between the route businesses during the next price control determination, which greater use of comparison between routes.

In terms of cost efficiency, whilst the expected efficiencies from devolution have not separately been identified, Network Rail has embarked on several efficiency initiatives which it believes are more deliverable under a devolved model. For example, Network Rail believes that improvements in business planning with ownership at route level will help deliver efficiency savings in CP6. Of the approx. 5.5%[2] efficiency savings that Network Rail has forecast for CP6 in its Strategic Business Plan, 0.5% are directly attributed to organisational change. It is unclear what contribution to other savings arise from the devolution process.

2.3. TUBE LINES LIMITED

Tube Lines Limited (TLL) was established in 2002 and was London Underground's counterparty in a Public Private Partnership (PPP) contract to provide infrastructure management services to three London Underground lines. Prior to this, infrastructure management was the responsibility of the public sector.

The TLL PPP can be seen as an example of devolution taken to its fullest extent, with the relationship between TLL and London Underground Limited (the public sector body responsible for running the London Underground) governed purely by contract. The experience of the TLL PPP provides a useful comparator against which to assess the potential efficiency savings from Network Rail's devolution. However, it is likely that the efficiencies gained by TLL are on the upper end of what can be achieved, given the more limited devolution in Network Rail and its public sector status.

Our previous analysis had been unable to determine the volumes of work delivered during the period, though we did note that the enhancements programme had been expanding rapidly creating more assets to

[1] *Network Rail's Transformation Plan: update September 2017*, Network Rail, September 2018

[2] This has been calculated from the rounded figures on Page 17 of the Strategic Business Plan – Comprehensive Executive Summary (Regulated Document) and thus may itself be subject to a rounding error as the total is not given.

maintain. Overall, TLL delivered its maintenance programmes in line with its plans and at a level of cost that was slightly lower than expectations – i.e. higher efficiency than expected – during the period studied.

Whilst international benchmarking showed its costs to be comparatively high, TLL made significant progress in reducing its costs towards a 'benchmark range' over the four years of the international study. Our previous analysis showed that TLL reduced track maintenance costs by 30% over a three-year period from 2005/06 to 2008/09, whilst signalling maintenance costs fell by 4% over the same period. This followed a slight increase in costs between 2003/04 and 2004/05. Despite the reductions in maintenance costs, service performance improved by broadly 50% over the period in question (measured by reduction in delays to passengers using the tube network).

The pace with which TLL was able to deliver efficiencies in maintenance costs was due to a move to risk-based approaches for some elements of maintenance and a greater focus on what could be achieved within each track possession. Similar savings are likely to be achievable by Network Rail as under the route devolution process, each route would have greater control over the programming of maintenance and would be able to align them closer with planned train operations.

In terms of support and operations, costs reduced by approximately 20% over the 7.5 year review period and were judged to be consistent with best practice. Most of this reduction occurred in the first few years of the PPP contract, with administration costs staying relatively constant afterwards. In some areas a change of strategy delivered early costs savings, such as moving headquarters to a less expensive location. In other areas, there was early investment to deliver longer term savings, such as in IT and procurement. Whilst some of these actions are unlikely to be replicable by Network Rail, others such as the changes to procurement are deliverable and match the changes being proposed by Network Rail in its Strategic Business Plan for CP6.

Further details on the Tube Lines Limited example can be found in Appendix A.

2.4. National Grid Gas

Prior to 2005, National Grid owned all of Great Britain's gas distribution infrastructure under its subsidiary, Transco. Following an internal restructure in 2002 where National Grid created eight regional gas distribution networks (GDNs), Ofgem decided to create separate regulatory settlements for each of the GDNs in 2004. In 2005, National Grid sold four of the GDNs and retained four. It was estimated that the sale of the GDNs would lead to efficiency benefits of 1.13% per annum in addition to 3% per annum on-going efficiency targets.

The separation of the GDNs into eight business units has key similarities with Network Rail's devolution. The distribution networks moved from a more centralised structure all covered by a single regulatory settlement, to eight separate GDNs units each with their own management structures and own price controls. This is similar to what is expected for Network Rail's devolved route businesses. Additionally, comparing the experience of the retained GDNs against the four sold GDNs may be useful to illustrate the degree of efficiency gains that could be achieved from devolution rather than full divestment.

The performance of National Grid's retained GDNs has been mixed. In terms of replacement expenditure (repex), costs per unit of gas demand have increased significantly since 2003/04 (at around 7% per year). This is largely due to the requirements imposed on gas distribution networks since 2002 under the HSE iron mains replacement programme, which is to an extent outside of National Grid's control. Additionally, there have been real price effects on the cost of mains replacement. Without a measure of output, we have not been able to assess what if any efficiency effect there may have been.

On the other hand, National Grid has reduced its GDNs' controllable operating costs, which includes support, operations and maintenance costs, by approximately 15% between 2005/06 and 2010/11. This is most likely due to rationalisation and standardisation processes undertaken by National Grid to reduce support and operations costs, and to a recent reduction in maintenance costs. However, as gas demand fell by even more than costs controllable operating costs per unit of gas demand have risen very slightly over the same period.

Overall in terms of improving operating cost efficiencies, the sale of four distribution networks in 2005 has seemingly had a greater impact to date on the networks which were sold. Benchmarking by Ofgem showed that the four retained GDNs were consistently less efficient than the four that were sold, despite National Grid reducing its operating costs.[3] This suggests that greater autonomy for the business units may result in greater savings. It may also be an indication that the size of effect expected for Network Rail's routes might not be as much for the GDNs that were sold. The key differences between GDNs that were sold and those retained by National Grid is that the former experienced new shareholders likely keen to improve performance, and truly independent regulatory comparisons. Thus the GDNs that National Grid retained bear more similarity to Network Rail's routes than those that were sold. It might also be suggested that National Grid, although clearly in the private sector, may have retained a more public sector attitude, since it has largely operated the monopoly parts of the energy networks without competition or independent comparison.

Further details on the experience of the four retained National Grid GDNs, can be found in Appendix C.

2.5. SSE

SSE, an electric utility company, was part of a consortium which purchased two gas networks from National Grid (Scotland Gas Networks and Southern Gas Networks) in 2005, and so added a gas distribution business to its portfolio. Upon acquiring these two companies, SSE and its consortium of buyers brought them under the same name, Scotia Gas Networks (SGN).

The acquisition of the SGN led to the two gas distribution networks moving from a more centralised structure to a more independent structure. Whilst Scotia Gas Networks retained its own board and management, the 50% stake acquired by SSE allowed the firms to share management best practices and identify opportunities for efficiencies through economies of scale and synergies in business support functions. As such, the experience of SEE and SGN may offer useful lessons for Network Rail on the areas where centralised support functions can offer efficiencies over more devolved functions, and also, as we see below, on sharing some costs with another part of the value chain.

SGN's two gas distribution networks have seen fairly continuous improvements to their efficiency relative to their peers, with Ofgem benchmarking showing improvements in both repex and opex over the period from the acquisition to 2008/09.

SSE also saw improvements in its administration and maintenance expenditure following its partial acquisition of SGN, amounting to a 5% reduction in maintenance costs over six years and a 13.9% per annum reduction in administration costs between 2004/05 and 2009/10.

[3] Ofgem's results are shown in the full case study in the annex. They are in the form of a ranking table rather than a cost difference.

SGN and SSE identified a number of areas where they believe their strategy contributed to efficiency improvements in SGN's performance. These include sharing of depots, equipment and vehicles between SGN and SSE, common training centres, economies of scale in procurement strategies, and synergies in back office functions.

Further details on the experience of SSE, can be found in Appendix D.

2.6. CAA CAPEX GOVERNANCE CHANGES

As part of the Q6 price control for Heathrow Airport Limited, the regulator CAA introduced changes to Heathrow's capex governance processes to give airlines greater oversight over HAL's capital expenditure. This was done through the creation of a Capital Portfolio Board (CPB), which was responsible for managing the capital portfolio and monitoring the Q6 capex allowance envelope set at the beginning of the price control period. This governance structure is in operation and on-going for the current price control.

The greater role for airlines in capex governance may offer some useful insights for Network Rail following the introduction of route supervisory boards (RSBs). Whilst the role of RSBs is currently more limited than that of airlines, there are three main relevant insights that can be drawn from the CAA experience.

- The incentive to do this well lies mainly when the value for money of investments goes to the pocket of the scrutinising stakeholders. Airlines have a strong incentive to assess the value for money of HAL's spending from their own perspective. This is because they directly bear all the net[4] cost of HAL's investments, and have to consider their ability in an unregulated, competitive air market to pass on costs to passengers. In contrast, TOCs are largely able to pass on net costs of infrastructure to government through the franchising process, and thus have less incentive to consider the value for money of infrastructure developments.
- A key determinant to the success of devolution will be the capacity of the route supervisory boards to effectively scrutinise Network Rail's activity, particularly if there is a large volume of material to scrutinise. Airlines have the assistance of an Independent Financial Assessor, but their own individual ability to scrutinise the investments is constrained by the leanness of their organisations and lack of detailed technical expertise.
- The ability of the scrutinised body to manage the process to side-step scrutiny and reallocate budgets. Because of airlines' concern about value for money, and a slow process, HAL has tended to split up projects to proceed with those parts that are accepted while delaying others until agreement is reachable on scope and budget. This may help obscure any tendency for overall costs to escalate.

The case study does not lead to any quantified assessment of cost reduction, because there are no unit costs for airport capex that can be compared against each other. Also, part of the value of this process is to improve the value for money for customers through better alignment of project scope with customer expectations. This again cannot be quantified. Airline customers say they consider the process to be an improvement on their experience in previous control periods, by giving them greater opportunity to scrutinise capex plans and become involved in processes such as cost benchmarking.

[4] Net of any income that the airport can earn outside of regulated charges, such as commercial income from passengers.

Further details can be found in Appendix E.

2.7. Summary of conclusions

The examples explored in this section and detailed in the appendices show that organisational transformation akin to that experienced by Network Rail, can lead to significant efficiencies in maintenance, renewals, operations and support expenditure. Where we have been able to quantify estimates of improved efficiency, they are summarised in Table 2.1. These tend to present the upper bounds of what may be achievable by Network Rail. However, as the experiences of the above firms show, these improvements in efficiency are not guaranteed.

Table 2.1: Maintenance, renewals and operating cost reductions related to Network Rail's cost categories (real)

Company	Maintenance	Renewals	Human Resources	IT	Finance and accounting	Procurement, property and corporate	Operations and other
Tube Lines Limited	30% reduction in track maintenance over three years (11.2% per annum reduction) 4% reduction in signalling maintenance over three years.		24% reduction in HR costs over 7.5 years (3.6% per annum).	9% reduction in IT costs over 7.5 years (1.2% per annum). 26% reduction in communications costs over 7.5 years (3.9% per annum).	52% reduction in costs over 7.5 years (9.3% per annum).	51% reduction in accommodation costs over 7.5 years (9.1% p.a.). 52% reduction in procurement costs (9.3% p.a.). 40% lower legal costs (6.6% p.a.).	33% reduction in operations costs over 7.5 years (5.2% per annum).
National Grid Gas Distribution	10% reduction in maintenance and repairs expenditure over five years (1.9% per annum).	43% increase in replacement expenditure over six years, largely due to increased mains replacement (6.2% p.a.). Costs per linear metre of mains replaced increased at about 2% per year.	15% reduction in controllable opex over five years (3.2% per annum). Human Resources make up approximately 5% of controllable opex.	15% reduction in controllable opex over five years (3.2% per annum). IT makes up approximately 33% of total controllable opex.	15% reduction in controllable opex over five years (3.2% per annum). Finance and accounting comprises approximately 12% of total controllable opex.	15% reduction in controllable opex over five years (3.2% per annum). Procurement, property and corporate makes up approximately 43% of total controllable opex.	15% reduction in controllable opex over five years (3.2% per annum).
SSE	5% reduction in costs over six years (0.9% per annum reduction).		53% reduction in administration costs over five years (13.9% per annum reduction).	53% reduction in administration costs over five years (13.9% per annum reduction).			

3. INTERNAL BENCHMARKING OF NETWORK RAIL

3.1. Introduction

ORR has carried out an internal benchmarking of Network Rail.[5]. We have undertaken a short, high level review of this work assisted by colleagues from the Institute for Transport Studies, University of Leeds. On this basis, we draw conclusions on its value for the review. We have not however carried out a full peer review of this work and are not fully aware of all the data and other issues that may be relevant.

Our main finding is that the work is of a level that is useful as a cross-check on ORRs conclusions and supportive of the conclusions it draws in the determination.

3.2. Description of benchmarking

Two separate benchmarking exercises were carried out,

- NR's 10 routes, covering both maintenance and renewals costs, with 5 years of data each,
- NR's 37 maintenance delivery units, maintenance costs only, with 2 years of data.

Using standard assumptions that many regulators have previously used, or similar to them, and quoting the results of the preferred model specifications, the first suggests a level of either 12% - 16% inefficiency, the higher figure coming from making a steady state adjustment for the renewals expenditure. The second exercise, using maintenance delivery unit data, also produced a 16% inefficiency, a striking similarity that tends to support the broad size of these estimates.[6]

Table 3.1: Average inefficiency levels relative to most efficient unit, using preferred model, 25% adjusted for noise, internal benchmarking of Network Rail

Units benchmarked	Corrected Ordinary Least Squares model, steady state adjusted	Corrected Ordinary Least Squares model, not steady state adjusted
Route benchmarking	16%	12%
Maintenance delivery unit benchmarking	N/A	16%

Source: PR18 Econometric top-down benchmarking of Network Rail, ORR, July 2018

In considering the use that might be made of these estimates two of the key underlying assumptions are particularly relevant.

- This is internal benchmarking, so it does not identify efficiency differences with external organisations. In effect, it identifies only relative efficiency between units, not any general inefficiency that all units might have. This might suggest that the level of inefficiency could be greater than was found in these studies.

[5] *PR18 Econometric top-down benchmarking of Network Rail*, ORR, July 2018

[6] A steady state adjustment is only relevant to the renewals expenditure, and thus is not a relevant consideration in benchmarking the MDUs.

- It is likely that some of the differences identified are not in fact inefficiency, but either statistical noise or else real differences in the cost of doing work in those different units. The analysis does include variables as proxies for differences that might systematically affect cost, but it is unlikely that all relevant differences are represented, and as a statistical model it is likely to have some noise. An adjustment is typically made for this effect, and a range of alternative approaches for doing it are available (though assumptions are required). An assumption that has commonly been used by economic regulators is to benchmark to the upper quartile rather to the lowest cost unit. ORR has made a similar but different assumption that 25% of the efficiency differences is noise or real difference. Further work would be needed to assess whether the ORR's adjustment differs materially from making an upper quartile adjustment in terms of the impact on the resulting efficiency scores. The results presented above are after adjustment for this assumption.

In summary we conclude that the approach appears consistent with regulatory precedent, the results appear sensible and have been adjusted to take account of known issues. We consider that they can be used to gain comfort for similar numbers taken from ORR's wider analysis but given the limited data series on which they are based they are not a replacement for this wider analysis. The approach should clearly be developed in future as most of the limitations that are identified are due to a shortage of data, which is ameliorated with the passage of time. In the following subsection we provide a summary of our appraisal of the work done by ORR.

3.3. SUMMARY ASSESSMENT OF THE WORK CARRIED OUT

The analysis that ORR has carried out is in many ways comparable in quality and approach to work done by other economic regulators. The route-level analysis, whilst the dataset is relatively small (ten routes; 5 years), and the model relatively simple, is not dissimilar to models used, for example, by Ofwat (ten sewerage companies with 7 years data). Ofwat has also been developing models with a relatively small number of explanatory variables, and the CMA review of Bristol Water was supportive of parsimonious specifications such as those that ORR has used. ORR has also tried a range of more complex models in terms of functional form and assumptions about the efficiency component of the model. A wide range of sensitivities have also been tried and ORR seems to have made good use of the existing data.

Perhaps the most significant omission is the lack of an input price variable, which is generally desirable in such a model. We acknowledge that ORR did attempt to do this, and it is not only ORR among UK economic regulators who have struggled to obtain sensible models with input prices. Another key issue is the relatively high elasticity on usage (0.76 to 0.94) the models identify. This is considerably above the range of estimates from past econometric studies for maintenance and renewals from a range of European countries and datasets (broadly 20-45%); whereas variable track access charges in Great Britain would indicate an elasticity of below 10%[7]. That said, it could be that the variable is picking up other factors excluded from the model.

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[7] For summaries and underlying research on the econometric results, and comparisons with the engineering approach underpinning current track access charges in Great Britain, see, for example: Wheat, P.E., Smith, A.S.J. and Nash, C.A. (2009), CATRIN D8 Rail cost allocation for Europe. University of Leeds; Smith, A.S.J., Wheat, P.E., Walker P., and Marti, M. (2016), Modelling railway infrastructure maintenance cost in France: Overview of estimates, Final Report for SNCF Réseau; and Smith, A.S.J. and Nash, C.A. (2018), Track access charges: reconciling competing objectives: Case Study – Britain, published by CERRE.

The maintenance delivery unit (MDU) level analysis is similarly promising. It contains a richer set of variables, and also the model specification includes input prices. However, this only covers 70% of Network Rail's maintenance, and does not include renewals. There are 37 MDUs, and two years data for this study, which is still a rather limited dataset (particularly in that the existence of only two years of data limits the extent to which panel data techniques can usefully be applied). As in the route-level study, the elasticity with respect to traffic is again very high. There may also be issues regarding the elasticity on track-length, which suggests very significant economies of scale, thus warranting further consideration. From discussion with ORR staff, we understand that there is a suggestion that there might be a minimum efficient scale for an MDU, and some may be currently undersized, which would be consistent with a scale effect detected in the modelling. At the same time, it is not necessarily efficient for an MDU to cover an excessively large geographic area.

Whilst the analysis is therefore very promising and appears to have been subject to reasonable sensitivities, the fact that the document itself dissuades against its use because of data quality and quantity issues makes it difficult to argue for this work to be used in any more than a supporting / cross-checking role. A key criterion in evaluating the appropriateness of econometric work in regulatory environments is not just the quality of the econometric work, but also the process that has been followed. In the current case it would not seem appropriate to place greater weight on a document that has previously been published as supportive evidence only, and which has not been subject to formal peer review.

4. BOTTOM-UP ASSESSMENT OF POTENTIAL EFFICIENCIES

In this section, we have undertaken a bottom-up assessment of whether:

- Network Rail's CP6 baseline has been adequately adjusted to remove inefficiencies from CP5 and any further efficiencies expected during the remainder of CP5; and
- there is scope for more challenging efficiency targets during CP6.

The assessment is based on our analysis of material sent to ORR by Network Rail as part of their PR18 Strategic Business Plan (SBP) submission.

4.1. MAINTENANCE COSTS

In the following analysis, we have made extensive use of Network Rail's Activity Based Planning (ABP) process and tool to gauge the scope for efficiency during CP6 and to assess the extent to which the CP6 core adequately removes inefficiencies inherent in CP5. However, although the ABP tool is a positive development in terms of transparency of estimates, there are areas where there is insufficient detail to fully assess whether Network Rail's assessments adequately adjust for inefficiencies during CP5 and are sufficiently challenging in terms of efficiency targets for CP6, particularly as our project scope did not allow time to engage with Network Rail.

We identified significant variation both in the level of detail provided by different routes in terms of costs and proposed headwinds/tailwinds[8] and efficiencies, and in the scale of ambition for maintenance efficiency. As we have insufficient sight of CP5 exit costs and CP6 core costs, we are however unable to separately estimate the potential for efficiency gains for each of the unquantified savings that ORR has asked us to consider. However, we have been able to quantify an overall envelope for efficiency savings in maintenance expenditure.

We have identified potential savings of approximately £440 million over CP6 - £310 million from reducing norm times (the typical time taken to complete a standard task) to rates closer to the national average; and £130 million from replicating the reduction in non-time-on-tools found in more ambitious route plans, across all the route businesses. This represents savings of 6% of pre-efficient CP6 costs that are in addition to the 4% in net efficiencies identified by Network Rail in its SBP. There also remains the potential for saving in other costs areas, which we have been unable to quantify due to the lack of transparency in the data made available to us by ORR. Our quantified analysis did not include all areas of cost, covering 48% of expenditure on ABP maintenance which equates to 36% of total maintenance spend.

Our estimates are highly uncertain and may not be deliverable during the time period concerned, however, they provide a broad and indicative estimate of what might be achievable. We consider that the level of savings that could be identified from a more forensic analysis of the underlying calculations are likely to be greater than those we provide here.

We set out below further details of the analysis that we have undertaken to achieve the estimates set out above.

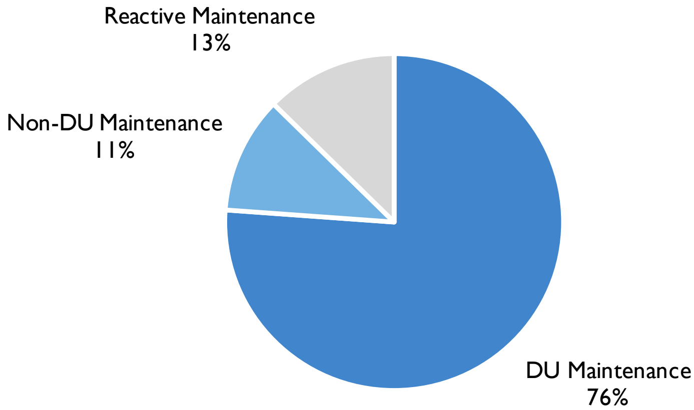
[8] Headwinds/tailwinds are exogenous factors tending to increase/reduce costs respectively. Since headwinds identified greatly exceed tailwinds identified, we will refer to these just as headwinds.

4.1.1. Types of maintenance expenditure

Each of Network Rail's routes is made up of regionally specific maintenance delivery units (MDUs) that carry out maintenance activities across the route's assets. Certain routes also have separate works delivery units (WDUs) who operate more flexibly across the routes and deliver both maintenance activities and smaller scale capex. Each route has between two and eight of these delivery units.

Figure 4.1 shows the proportion of maintenance costs by the type of spend. The majority of this is expenditure that delivery units have estimated using the ABP process and tool. The remaining expenditure is made up of non-ABP maintenance, typically activities that have been outsourced and not carried out by the delivery units; and reactive maintenance, short notice repairs to assets when a need for work has been identified.

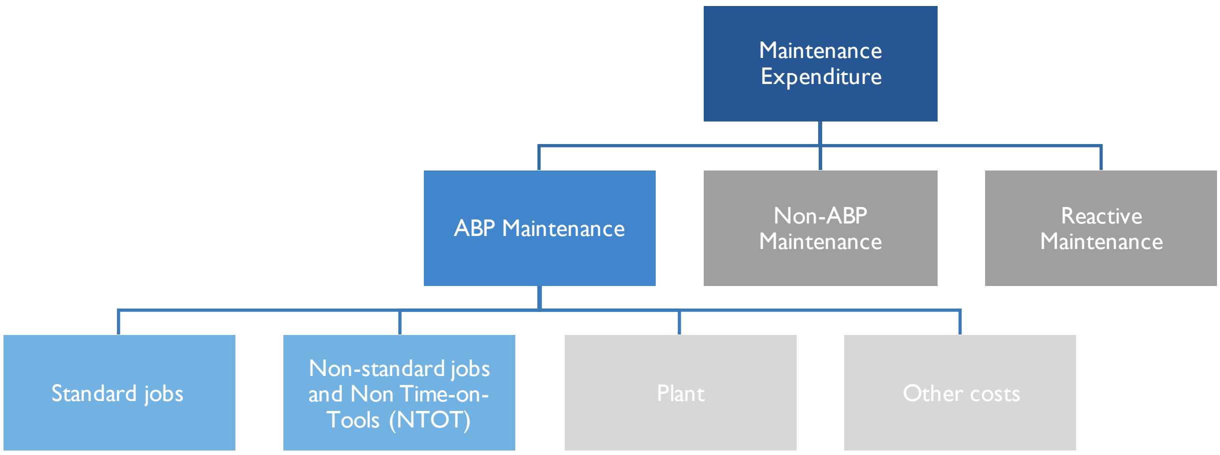
Figure 4.1: Proportion of delivery unit maintenance expenditure by spend type during CP6



In our analysis we focus only on ABP activities as they make up the largest component of maintenance spend. The proposed ABP spend was detailed in an ABP tool completed separately by each delivery unit.

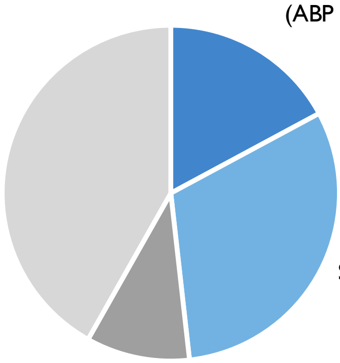
The ABP tool covers four broad cost sections, outlined in Figure 4.2. Figure 4.3 shows the relative proportion of the four cost components for maintenance costs.

Figure 4.2: Maintenance expenditure



Note: Cost sections highlighted in blue are the ones that are considered in detail in our analysis

Figure 4.3: Proportion of ABP maintenance expenditure by spend type during CP6 (post-efficient)



The first section of the tool allows delivery units to calculate the labour cost of delivering a certain volume of standardised maintenance activities. The resourcing requirements are calculated from the bottom up based on planned work volumes for each ‘standard job’. There are approximately 600 standard jobs, defined as the most frequent maintenance activities undertaken by the delivery units’ directly employed workforce. They collectively account for more than 90% of time spent on maintenance.

In the tool, each standard job has an estimated figure for the time taken to complete the task (‘norm times’) and an associated hourly labour cost, both of which vary by delivery unit. The norm times used in the estimates for Network Rail’s SBP were derived from norm times during the financial years 2015/16 and 2016/17, as recorded by individual delivery units. Whilst maintenance efficiency has been of less concern than renewals efficiency, during the first three years of CP5 Network Rail had underperformed maintenance spend by approximately £0.3 billion (in 2016/17 prices)[9]. As such, we would expect these norm times to be adjusted to remove any inefficiency from CP5 and to incorporate efficiency initiatives expected during the remainder of CP5. This would be in addition to any expected efficiencies during CP6.

However, it is not clear whether such adjustments have been made. In the majority of ABP spreadsheets we analysed, only post-efficient labour costs for standard jobs were presented. As such it is unclear by how much the historical norm times have been adjusted. This is a key area of concern noted in ORR’s draft determination for the 2018 periodic review. Five routes presented only aggregate figures for the headwinds and efficiencies expected during CP6 and have not provided details on how they have been calculated. For two routes however, Scotland and London North West, the norm times were manually adjusted to capture expected efficiencies. This typically meant matching the national average norm time or applying a percentage reduction to the delivery unit specific norm time based on what a local engineer considered achievable.

If, as it appears, the remaining routes have not made any adjustments to the norm times, there is significant scope for more challenging efficiency targets. This is considered further later in this section.

The second section of the ABP tool considered the direct labour cost of non-standard jobs and includes the labour costs of non-productive time, or Non Time-on-Tools (NTOT). NTOT adjustments reflect that not all time is spent directly working on maintenance activity, due to restrictions on access to the track, travel times, weather delays etc. The labour cost of non-standard jobs is calculated by uplifting the cost of

[9] *2018 periodic review draft determination: review of Network Rail’s proposed costs*, ORR, June 2018

standard jobs using historical ratios between the two. NTOT adjustments are a percentage uplift that is exogenously input by each delivery unit.

No adjustments have been made to the historical ratio of standard to non-standard jobs for CP6. The NTOT adjustments on the other hand, are only broadly guided by historical rates and are instead driven by offline spreadsheets. As the NTOT adjustments have only been presented on a post-efficient basis, we have been unable to scrutinise the basis on which they were formed. Based on commentary included in the spreadsheets, it appears that NTOT adjustments have been estimated using assumptions such as the level of access restriction and differences between required labour time and available time.

The next section of the ABP tool estimates plant costs using a similar bottom-up approach to the labour costs. Each delivery unit estimates the number of shifts required by activity type. This is then multiplied by figures for the 2016/17 average volume per shift to get overall volumes, and then by shift rates to get overall costs. From the sample of routes analysed, it does not appear that many delivery units have made adjustments to the figures for the average volume per shift. However, as plant costs make up a relatively small proportion of overall maintenance costs and the scope for efficiency gains is likely to be small.

The final section of the ABP tool comprises all other costs, largely consisting of materials, indirect staff costs, income from NTOT recoveries when staff are working on other non-maintenance work, and other plant expenditure not specific to individual activities. Most routes have not included calculations for these estimates, though these other costs make up a significant proportion of the proposed expenditure. We suspect there may be, but cannot quantify, significant scope for efficiency saving in these other cost categories.

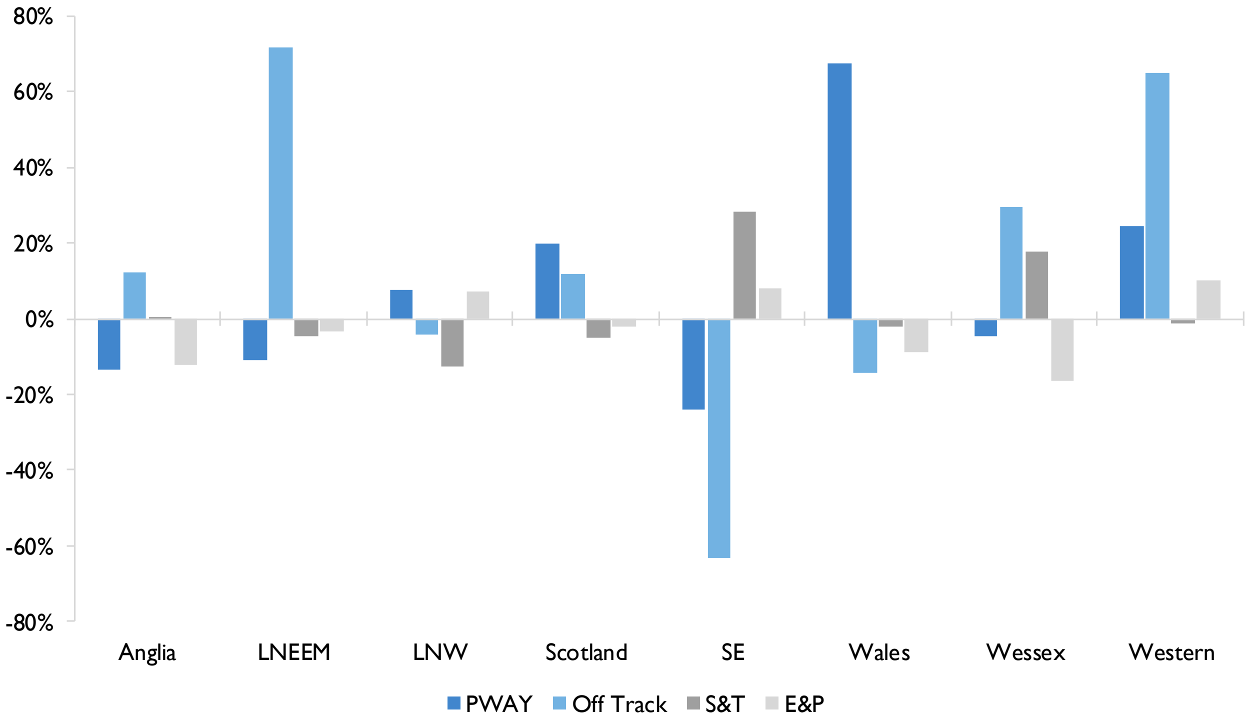
4.1.2. Scope for efficiencies

Having identified areas of potential saving we now attempt to quantify the scope for efficiency gains in ABP expenditure. To obtain an understanding of how maintenance efficiency varies by route, we compare unit labour rates for direct productive time. Figure 4.4 shows how average post-efficient unit rates differ from the national average (weighted by volume of activity) by discipline[10], taking into consideration only direct labour costs. As can be seen, there is significant variation between routes, even when looking at average rates across disciplines.

This will partially be driven by differences in the volume of activity where greater volumes allow delivery units to achieve economies of scale. It will also be partially driven by differences in the use of contractors, which are excluded from calculation of unit rates. However, this is unlikely to fully explain the variation in unit rates.

[10] The relevant "disciplines" are i) permanent way, referring to activities on track; ii) off-track, including activities such as fencing and removing vegetation; iii) signalling and telecommunications; and iv) electrification and plant.

Figure 4.4: Percentage difference of post-efficient unit rates from national average (direct labour costs only)



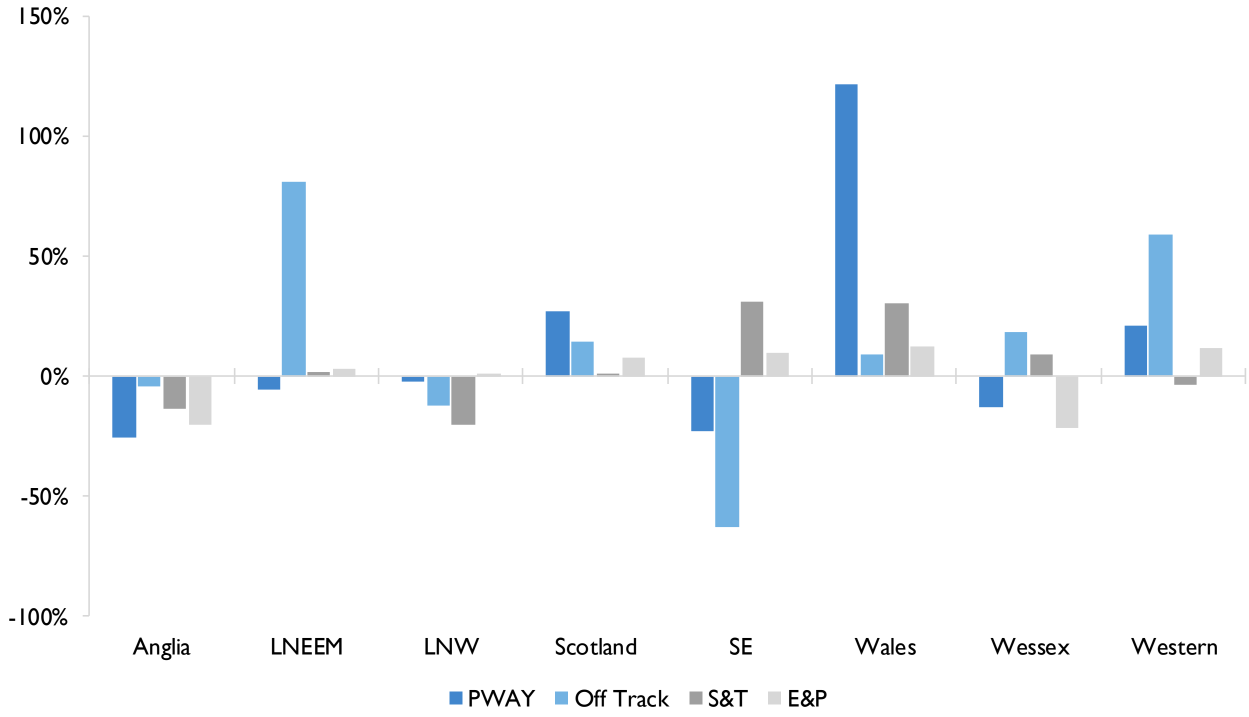
As stated previously, on most routes it is unclear the extent to which efficiencies expected during the remainder of CP5 have been incorporated, and how headwinds and efficiencies expected during CP6 have been included. The variation in post-efficient unit rates suggests to us that there are still significant efficiencies to be realised.

In order to provide an indication of the scale of efficiencies potentially achievable, we have reduced the variation in norm times. As such, where norm times exceed the national average by 20% or more we have reduced them to 120% of the national average. This leads to efficiency savings of approximately £110 million in direct labour costs for standard jobs, rising to £310 million when we include a broad approximation of non-standard jobs and NTOT. These figures equate to approximately 4% and 12% of post-efficient labour costs (sections one and two above) respectively. The estimates could therefore be considered a proxy for both the removal of residual inefficiency during CP5 and of more ambitious efficiency targets for CP6.

We must caution however, that this is a very indicative estimation of the efficiency potential. Some of the variation in norm times will be due to differences contracting strategies, as spend on contractors is captured separately within the ABP tool. There will also be the inevitable uncertainty surrounding whether these norm times are deliverable within the control period.

Figure 4.5 shows the variation of unit rates when including the proportion of NTOT. As can be seen the relativity of unit rates does not vary significantly. However, this masks significant differences in what different delivery units have assumed around how NTOT changes over CP6.

Figure 4.5: Percentage difference of post-efficient unit rates from national average (direct labour costs and NTOT)



Routes have provided some explanation for the assumed proportion of NTOT time, though we did not have access to any underlying calculations. Most routes show the proportion of NTOT staying relatively constant throughout CP6, with the notable exception of London North East and East Midlands (LNEEM). LNEEM are assuming gradual reductions in NTOT throughout CP6 by introducing a more structured maintenance regime. Certain routes have assumed increases in NTOT due to more difficulty gaining access or due to other upgrades that make maintenance more complex (such as electrification).

The analysis shows that some routes have been more ambitious in attempting to reduce NTOT. As an indication of what might be achievable if other routes took a similar approach, we have replicated the reductions in NTOT by LNEEM across the remaining seven routes. Doing so reduces costs by approximately £130 million over the five-year control period, which makes up approximately 5% of post-efficient labour costs (sections one and two costs). This provides a helpful estimate of the scale of efficiencies that may be achievable during CP6, though it does not explicitly consider any inefficiencies from CP5. Again however, there is uncertainty around the deliverability of such reductions in NTOT.

When considering other costs (i.e. not direct labour and plant costs from undertaking maintenance activity), planned expenditure is relatively constant throughout CP6 though there is an increase of approximately £40 million per annum between the final year of CP5 (2018/19) and the first year of CP6 (2019/20). This is largely driven by increases in planned volumes of activity but also by a substantial increase in planned expenditure on contractors (with the exceptions of Anglia and Wessex). On the sample of routes and ABP jobs we examined in further detail, the increase in contracting spend was consistent with adjustments made to the relevant norm times.

Comments in the worksheets suggest most routes have incorporated efficiencies into their estimates of the other costs. However, there is little transparency around how efficiencies have been estimated and what the pre-efficient costs were. It does appear that most routes are expecting to deliver larger volumes of activity with the same number of indirect staff, rather than proposing to reduce headcount. In preparation for the next periodic review, Network Rail should improve its bottom-up, activity-based estimates of other costs, which would allow for more accurate and robust planning.

4.2. APPROACH TO ESTIMATING RENEWALS COSTS

For CP6, Gleeds was commissioned by ORR to review the basis of Network Rail's pre-efficient renewals cost plans. We have reviewed the Gleeds report and also separately examined Network Rail's costing methods for the renewals programmes, in order to assess the level that they are costed at, and the efficiency improvement that is provided for.

The cost data provided has the following characteristics:

- The renewals programme has substantially been costed separately by each route.
- It includes a complete work programme for each route,[11] with a "pre-efficient" cost shown for every project in the work programme, which is used to calculate a build-up for a total pre-efficient cost.
- This is then adjusted to an "efficient" cost with a quantification of headwinds and efficiencies, which are shown at a less granular level. In principle there are also tailwinds, exogenous factors tending to reduce cost, but these are very limited. They are shown by year, discipline[12] and route, but cannot be matched individually to projects in the workplan. We can however see the classes of efficiency applied in each year, even if they are aggregated across projects.
- A variety of additional detail on project costings has also been provided, though far from comprehensively, and rarely comprises a transparent costing methodology. However, it is generally clear that standard Network Rail costing tools have been used for track and signalling projects, where such costing tools are quite detailed and in common use.
- We have information on project costs matched to output volumes (e.g. linear track metres, SEUs – signalling equivalent units, etc) according to standard categories of project within each discipline. This enables some comparison of unit costing between CP5 and CP6. For CP5, the costs are actuals for the first three years, and RF06 projections in the last two years. CP6 costs are pre-efficient costs. There is some simple inflation correction.[13] Since volumes are not broken down by year, but into criticality groups, for each five-year period, we can only calculate average unit costs across that five-year period, and not see trends, noting that the basis of costing is different in different years of CP5. However, given the variability in unit cost discovered, it is unlikely we would have been able identify trends in annual data.

From this examination, we draw the following conclusions.

[11] The breakdown has eight rather than ten geographical routes: LNE and EM are paired into LNEEM, and Kent and Sussex are paired into SE.

[12] The "disciplines" applicable to the geographical routes are track, signalling, structures, earthworks, buildings, EFP (Electrification and fixed plant) and drainage. The non-geographical routes have a variety of other disciplines, mainly in telecoms and a variety of "other" categories.

[13] Using a constant 2.2% inflation rate across CP5.

- The efficiencies and headwinds are applied to a base unit costing generally representing mid-CP5 or average CP5 level (signalling is an exception), which is typically higher than the end-CP5 costing level; the application of efficiencies should therefore include late CP5 cost reductions as well as on-going reductions in CP6[14]
    - In many cases (routes/disciplines) a substantial efficiency level is being applied in the first year of CP6. This indicates that in many cases there is an implicit recognition that the pre-efficient cost for CP6 Yr1 is overstated by using a cost level from mid-CP5 to represent it, and the application of the identified efficiency techniques in late CP5 will deliver material efficiencies by Yr1 of CP6: but this is not uniform and some routes show lower efficiencies in earlier years as if they require to take time to achieve them. However, those routes/disciplines showing high efficiencies in Yr1 often do not have materially higher efficiencies in later years, so different assumptions are being made over the build-up of efficiencies.
- The manner in which different routes have applied efficiencies varies
    - Some have a growing efficiency profile whereas others have relatively even efficiency expectations over time
    - Some have much higher efficiency amounts in early years than others
    - There appears, although we have no transparency on this, to be a distinction between routes applying a material range of efficiencies to all or most of a discipline, whereas others being much more selective by project over where they believe such efficiencies will arise. For example, there is a large efficiency in just one year for Scotland signalling projects, which might be related to one or two particularly large signalling renewals occurring at that time, against a background of lower levels of efficiency at other times.
    - The average level of efficiencies differs materially across the routes. This is not closely related to the relative inefficiency levels identified in ORR's econometric benchmarking. For example, some routes identified in that analysis as relatively inefficient are proposing relatively low levels of efficiency gain going forward. The most extreme example is in Wales.
- The unit costs of similar tasks vary substantially by route.
    - Routes are permitted to cost using local factors and adjustments, and the variations in costs arising, and differences in how cost vary from CP5 to CP6, suggest different levels of discretion have been applied.
    - Scope is clearly an important driver of cost, and the implication of our analysis is that scope of typical renewals tasks is varying substantially on average and regionally. Scope is an area where significant and potentially unnecessary cost can be added in the absence of a detailed review of project scope; a check of the validity of scope on a sample of projects might lead

[14] Quantifying this would require a detailed analysis of the costing methods and parameters used by the various routes/disciplines and obtaining a detailed understanding of the reasons for their selection of particular scope and parameters to represent the cost forecasts.

to a better understanding of what is driving these differences. Such an analysis is however outside the scope of this project.

We conclude that it seems likely that some routes, or some disciplines within routes, have been less testing in how they have costed their renewals than others. Especially if it is in future intended that each route has a separately regulated budget, then more detail on how costing has been carried out, and benchmarking of costs by discipline would be justified and could be a means by which to drive significant efficiency. The average efficiencies identified by routes on renewals are 8%, and this is on a cost base that substantially replicates the peak costing of the CP5 period. Later in our analysis we make a cross-check with the econometric benchmarking results to suggest that rather higher efficiencies could be achieved.

4.2.1. Efficiencies applied by year, route and discipline

The extended table (4.1) below shows efficiencies that each route has applied to its pre-efficient costing of renewals, broken down by year, route and discipline. The final costing is obtained by adding "headwinds" – reasons why cost will increase such as input cost increases. We have concentrated on efficiencies, since ORR has analysed the headwinds in more detail in its draft determination. Overall, we see that the average efficiency amount applied by routes is 8.0%.

A large part of this average efficiency applied is generally delivered in the first year. There is a then clear step to the CP6 Yr1 delivery cost efficiency of 6.6%. This is applied to the base cost levels used to forecast the "pre-efficient" cost levels to which the efficiencies are applied. This is largest in track and buildings, where CP6 Yr1 cost levels have a 9% efficiency applied to them on average. But this varies from route to route, and there may be some differences in the basis of costing the "pre-efficient" level of costs.

Efficiencies applied by the routes increase by about 0.6% a year from there, to result in an efficiency applied in Yr5 of 8.9%. There is however material variation in the levels of efficiency applied by route. The average efficiency amount applied to renewals varies from an average of 6.5% in Wales to 10.8% in Anglia. Yet according to the ORR's benchmarking report, the least efficient routes are Kent, Wales and Western, and the most efficient are Scotland, East Midlands and Wessex. In general, there seems to be a poor match between the benchmarking results and efficiency ambition reflected in route plans.

Table 4.1: Efficiency amounts applied by Network Rail's routes to pre-efficient renewals costings by route, discipline and year

EFFICIENCIES %	SBP Base Plan					
Discipline & Route	Year					
	19/20	20/21	21/22	22/23	23/24	CP6 total
Tot Renewals	**-6.59%**	**-7.44%**	**-8.45%**	**-8.59%**	**-8.91%**	**-8.01%**
Ang	-8.64%	-9.54%	-11.60%	-12.31%	-11.17%	-10.78%
LNEEM	-7.77%	-7.39%	-7.19%	-5.89%	-6.14%	-6.90%
LNW	-9.85%	-9.37%	-9.12%	-10.29%	-12.59%	-10.21%
Scot	-6.77%	-6.74%	-11.61%	-7.97%	-9.70%	-8.54%
SE	-5.22%	-7.72%	-9.41%	-8.93%	-11.00%	-8.47%
Wales	-5.25%	-7.95%	-6.58%	-6.03%	-6.54%	-6.53%
Wessex	-6.49%	-6.29%	-10.65%	-12.44%	-16.91%	-10.58%
Western	-4.60%	-9.53%	-8.89%	-12.33%	-9.99%	-9.07%
Track	**-9.14%**	**-11.47%**	**-11.18%**	**-11.89%**	**-12.14%**	**-11.16%**
Ang	-9.43%	-9.43%	-9.43%	-9.43%	-9.43%	-9.43%
LNEEM	-13.58%	-14.06%	-15.00%	-12.05%	-11.93%	-13.29%
LNW	-15.29%	-15.60%	-15.14%	-14.33%	-16.05%	-15.25%
Scot	-7.45%	-8.61%	-8.69%	-9.51%	-10.80%	-9.07%
SE	-6.10%	-11.35%	-11.65%	-12.16%	-12.64%	-10.59%
Wales	-1.18%	-4.24%	-3.77%	-6.00%	-6.15%	-4.24%
Wessex	-6.93%	-11.54%	-11.70%	-13.24%	-12.49%	-11.22%
Western	-3.17%	-11.03%	-7.99%	-15.59%	-13.31%	-9.32%
Signalling	**-4.34%**	**-5.25%**	**-8.23%**	**-7.32%**	**-7.80%**	**-6.74%**
Ang	-8.71%	-9.32%	-12.73%	-11.81%	-6.06%	-10.28%
LNEEM	-4.40%	-3.21%	-2.55%	-2.36%	-2.55%	-3.00%
LNW	-5.32%	-4.08%	-3.99%	-4.90%	-6.57%	-4.91%
Scot	-6.26%	-3.96%	-23.37%	-6.38%	-12.75%	-9.99%
SE	-2.86%	-6.35%	-9.57%	-6.98%	-12.26%	-8.03%
Wales	-7.57%	-14.20%	-7.73%	-5.28%	-5.40%	-7.99%
Wessex	0.00%	0.00%	-11.49%	-13.90%	-28.31%	-11.40%
Western	-3.42%	-10.05%	-14.55%	-14.86%	-10.10%	-10.50%
Structures	**-8.25%**	**-7.77%**	**-8.53%**	**-7.90%**	**-8.02%**	**-8.09%**
Ang	-12.22%	-11.00%	-12.11%	-13.52%	-14.06%	-12.69%
LNEEM	-5.46%	-7.52%	-9.36%	-4.69%	-5.22%	-6.80%
LNW	-10.78%	-8.60%	-9.95%	-9.17%	-9.25%	-9.54%
Scot	-6.77%	-7.79%	-7.53%	-7.88%	-7.28%	-7.46%
SE	-5.78%	-6.28%	-5.67%	-4.00%	-2.96%	-5.10%
Wales	-7.65%	-7.28%	-7.51%	-7.62%	-7.90%	-7.57%
Wessex	-12.32%	-8.21%	-8.37%	-13.66%	-13.52%	-10.83%
Western	-7.20%	-7.60%	-7.60%	-7.60%	-7.60%	-7.51%

EFFICIENCIES %	SBP Base Plan					
Discipline & Route	Year					
	19/20	20/21	21/22	22/23	23/24	CP6 total
Earthworks	**-7.54%**	**-8.25%**	**-10.68%**	**-11.29%**	**-11.84%**	**-9.75%**
Ang	-12.22%	-11.00%	-12.11%	-13.52%	-14.06%	-12.69%
LNEEM	-5.46%	-7.52%	-9.36%	-4.69%	-5.22%	-6.80%
LNW	-10.78%	-8.60%	-9.95%	-9.17%	-9.25%	-9.54%
Scot	-6.77%	-7.79%	-7.53%	-7.88%	-7.28%	-7.46%
SE	-5.78%	-6.28%	-5.67%	-4.00%	-2.96%	-5.10%
Wales	-7.65%	-7.28%	-7.51%	-7.62%	-7.90%	-7.57%
Wessex	-12.32%	-8.21%	-8.37%	-13.66%	-13.52%	-10.83%
Western	-7.20%	-7.60%	-7.60%	-7.60%	-7.60%	-7.51%
Buildings	**-9.06%**	**-9.07%**	**-8.16%**	**-10.43%**	**-12.49%**	**-9.47%**
Ang	-9.95%	-8.65%	-9.01%	-8.77%	-9.07%	-9.01%
LNEEM	-11.10%	-10.70%	-10.82%	-10.74%	-10.04%	-10.81%
LNW	-5.82%	-14.58%	-7.71%	-14.01%	-21.20%	-11.68%
Scot	-7.42%	-6.78%	-6.87%	-9.18%	-13.34%	-8.06%
SE	-7.34%	-8.05%	-7.38%	-10.13%	-9.28%	-8.31%
Wales	-6.55%	-5.94%	-6.22%	-4.84%	-4.95%	-5.87%
Wessex	-17.03%	-11.75%	-14.52%	-17.69%	-9.02%	-14.10%
Western	-8.30%	-5.23%	-5.33%	-6.29%	-6.68%	-5.92%
Electrification & Fixed Pl	**-4.60%**	**-6.83%**	**-7.62%**	**-10.05%**	**-10.66%**	**-8.09%**
Ang	-0.01%	-9.95%	-12.95%	-18.78%	-19.69%	-13.82%
LNEEM	-2.66%	-2.88%	-3.07%	-3.10%	-2.99%	-2.97%
LNW	-7.38%	-7.58%	-8.76%	-13.20%	-12.33%	-9.73%
Scot	-7.49%	-11.08%	-10.62%	-6.94%	-6.79%	-8.71%
SE	-4.82%	-6.79%	-7.09%	-10.91%	-9.64%	-7.81%
Wales	-5.99%	-5.32%	-6.00%	-6.00%	-5.88%	-5.78%
Wessex	-6.00%	-4.37%	-5.26%	-5.13%	-5.76%	-5.25%
Western	-9.08%	-11.89%	-7.51%	-6.92%	-7.77%	-8.22%
Drainage	**-4.97%**	**-5.02%**	**-7.51%**	**-8.18%**	**-12.75%**	**-7.51%**
Ang	-0.90%	-0.72%	0.00%	-3.69%	0.00%	-0.81%
LNEEM	-2.70%	-3.09%	-3.36%	-3.58%	-3.37%	-3.18%
LNW	-7.32%	-6.70%	-13.40%	-11.80%	-26.86%	-12.96%
Scot	-5.34%	-5.34%	-5.34%	-5.34%	-5.34%	-5.34%
SE	-5.01%	-5.24%	-9.21%	-11.65%	-12.76%	-8.11%
Wales	-7.36%	-7.29%	-7.71%	-6.57%	-7.18%	-7.20%
Wessex	-4.09%	-3.22%	-2.40%	-1.90%	-1.89%	-2.47%
Western	-4.61%	-4.62%	-3.89%	-4.65%	-5.31%	-4.57%
Telecoms	-10.48%	-14.29%	-16.63%	-19.06%	-20.70%	-15.80%
Other	-3.06%	-2.57%	-2.31%	-2.23%	-1.94%	-2.41%

4.3. Scope for Efficiency

In the following table, we show the average efficiency improvement levels applied by each of the routes and compare it to the benchmarked level of inefficiency resulting from ORR's econometric analysis noting that this is only relative inefficiency between the routes, and not total inefficiency relative to an external comparator. The overall renewals efficiency proposed by Network Rail over CP5 is 8% in comparison to 16% identified in the benchmarking exercise. Clearly the benchmarking study is only indicative, but a comparison of the relative efficiency of the routes and the ambitions of routes to reduce cost shows little alignment.

If all the routes were required to deliver at least the proportion of catch-up to the benchmark efficiency level as the 3rd best route (the upper quartile) amounting to 77% catch-up, then the overall level of efficiency target would rise from 8% to 12.7% (weighted average by quantity of CP6 renewals by route). Earlier in this report we indicated that the benchmarking study should be used as a cross-check, not a primary driver, but nevertheless it suggests that there is substantial additional potential, arising from the different levels of ambition of the various routes.

Table 4.2: Renewals efficiencies by route if all routes attempted at least as much as the benchmarked relative inefficiency level as the 3rd best route – illustrative calculation[15]

EFFICIENCIES %

Route	SBP	Benchmarking Potential	How much of potential	All raised to at least 77%
Tot Renewals	**-8.01%**	**-16%**	**50%**	**-12.7%**
Ang	-10.78%	-14%	77%	-10.8%
LNEEM	-6.90%	-12.5%	55%	-9.6%
LNW	-10.21%	-21%	49%	-16.2%
Scot	-8.54%	-8%	107%	-8.5%
SE	-8.47%	-19%	45%	-14.6%
Wales	-6.53%	-21%	31%	-16.2%
Wessex	-10.58%	-10%	106%	-10.6%
Western	-9.07%	-22%	41%	-16.9%

A significant issue on what efficiencies should be applied to obtain the costing for Yr1 of CP6 is the precise definition of "pre-efficient" unit costs that has been used to cost the programme before efficiencies. This varies by discipline and by route, so overall efficiencies is not clean number; it aggregates efficiencies assessed in different ways because the base cost is not uniformly defined.

We have examined three disciplines in detail, track, signalling and structures.[16]

[15] Since the benchmarking exercise was over a larger number of routes than represented here, we have taken a simple average of the benchmarked inefficiency results where the routes in the SBP are made up of two routes in the benchmarking exercise.

[16] Structures are generally bridges, tunnels, retaining walls and culverts, as there are separate disciplines for buildings, earthworks and drainage.

Track

Relatively high levels of CP6-Yr1 efficiencies are applied in the track discipline, 9.1% as opposed to the 6.6% average across disciplines. This might be consistent with the use of a higher pre-efficient unit cost for track than other disciplines. It is notable that a consistent track renewal costing model is used by the routes, so it is possible that similar unit costs are being used by the routes, although in fact the commentary we have does not precisely support that. Most track renewals, particularly major ones, are in practice delivered by the IP, and thus ought to be to a consistent cost. The LNW track costing sheets clearly states that basis of "pre-efficient" costing is 16/17 cost levels, which is generally taken as the highest level of cost in CP5. LNW takes a particularly large CP6-Yr1 efficiency of 15.3%. Anglia says it has a PWC model which has predicted unit costs, but the base level is not stated. LNEEM states it is using IP delivery rates notified to it, and it also has high CP6-Y1 efficiency of 13.9%. However, several other routes, Wales, SE, and Wessex, say something similar, and have rather lower efficiency levels. Scotland says it is using CP5 outturn rates, though it is not clear whether this means at a specific date or an average. There would appear to be scope here in principle for assessing more clearly the basis of costing and applying efficiencies in a more uniform way.

The very much lower track costing efficiencies applied by the Wales route stand out, and we do not find anything to justify this, nor indeed the variety of efficiencies shown. Maybe there are good reasons for this given the specific nature of the projects carried out, but we have no information on this. There would appear to be notable lack of ambition by several routes in relation to track costs, and therefore there is scope for identifying further efficiency.

Signalling

In the case of signalling, several routes comment that the rates used are ICM rates, (ICM is a signalling costing model used by all the routes) or national rates which we assume means the same thing, though a minority of routes are silent on the source of rates. A paper has been provided to us on the unit costing of signalling work for CP6[17] but we do not have a clear statement that the rates derived there reflect the rates that are in the ICM. Given that it seems that routes are largely using the same signalling rates, it might be expected that they might find similar opportunities for efficiencies. It might be argued that certain types of work package scope are more amenable to some of the efficiencies than others, and this might be the cause of differences. We observe for example that Scotland takes a very large efficiency on signalling renewals of £15m in just one year, all to the same cause. We do not have information relating this large sum to specific projects, but it is possible that it relates to one or two large signalling projects whose expenditure is partly or mainly in that year. Nevertheless, it does raise questions on the application of efficiencies to specific projects and whether there is consistent ambition between routes for similar projects, and similar application to similar projects. Scotland is roughly intermediate in the efficiencies applied on average by the routes within the signalling discipline, but a large part of it is contributed by that one large sum in that one year. This would appear to merit further detailed examination.

Overall, we note the levels of signalling renewals efficiency applied by LNEEM and LNW, which are relatively high. Maybe there are reasons for this in relation to the specific nature of projects carried out by those routes, but we have no information on this. It is suggestive that others could be more ambitious if

[17] IP Signalling, CP6 Unit Rates Review for RF6, July 2017

challenged, given it seems all are using the same model and unit costs, but some kind of investigation of the reasons for this by signalling project would be required.

The note we have been given on signalling unit rates suggests that a new much higher unit cost is being used than was the case for costing CP5 signalling. It starts from the CP5 forecasting cost, adds inflation, several upward adjustments for scope items now generally required and apparently not included in the older unit cost, and also a doubling from 5% to 10% of an upward adjustment for “abnormal” projects. The effect results in a very substantial increase in signalling unit costs. This is not necessarily the same as the CP5 delivery cost in any single year, so the efficiencies applied are not necessarily comparable to those other disciplines where CP5 achieved costs, or something like them, seems to be quoted. Rather it suggests that one substantial reason for the increase in delivery cost is that signalling delivery generally now requires a wider scope of works than previously and that “abnormal” projects require greater adjustment than has been the case in the past. There is some logic in smaller initial efficiencies within the signalling discipline, because the starting basis of the unit cost is the CP5 forecasting cost, plus an adjustment for increased scope. A separate issue is whether that substantially expanded scope is necessary. Nevertheless, some large individual efficiencies are being applied in areas in the signalling program, and it would be useful to understand why.

Structures

Pre-efficient unit rates for structures are generally stated by most routes to be CP5 achieved rates or similar, though not all routes say this precisely or at all. This would suggest, as is shown in the 8.3% CP6-Yr1 efficiency applied, a substantial down-step of cost for CP6-Yr1 because of efficiencies being delivered in the latter part of CP5. Thereafter we observe no growth in efficiency during CP6. Indeed the CP6 average is lower than the CP6-Yr1 figure by a small amount. Again we note a diversity of levels by route which are at odds with the efficiency potential indicated by benchmarking. There may be good reasons for this, but we have no information to assess it.

Overall, some disciplines do seem to be a showing a substantial step down in cost for CP6-Yr1 because they are using a high cost basis for a pre-efficient cost. But not all disciplines are using the same basis of costing, and indeed practice also varies among routes. There are substantial variations in the both the initial efficiency amount, the pre-efficient basis, and the course of efficiencies through CP6, to suggest that a detailed examination would locate clear differences in ambition and practice in costing. This would tend to suggest that such a detailed examination of costing practice by route, discipline and project could locate the potential for material additional efficiencies within specific routes and specific disciplines. This view is also reflected in the Gleeds report, which noted that the lack of granularity of the data prevented a more thorough assessment of the cost plans.

4.3.1. Unit costing of renewals items

The unit costing of renewals is likely to be ‘noisy’ because of the varying mix of renewals projects, and their scope. For example, as we note above in relation to signalling projects, the scope of such projects has tended to increase. We nevertheless tried to obtain some useful information from a unit cost analysis. We note that some of the categories have a very small quantity of work within them, in some cases comprising nothing more than a negative balancing item, thus reference back to source is necessary to ensure that the size of the population the average is measured over is large enough. The number of categories for which volume information is kept has increased from CP5 to CP6, so we have deleted a number of categories, or sub-categories, for which CP5 information is not available. Going forward to CP7, it will be possible to report these results in more detail than is shown here. It can also be seen that not all routes have a number in every reported category. In some cases this is because the volume is zero, in other cases because the volume is not recorded in the source we have.

Unit costs are averaged across the full five years of the control period. Volumes are not recorded by year, so we aggregate across the period. Typically, delivery periods are in any case extended, so timing issues particularly around period ends can potentially distort volumes and costs and we have no visibility of how that has been handled. The planning, contracting and delivery periods of many such projects is extended, particularly for larger items in the work bank, and this adds to timing issues.

The CP6 unit costs are all pre-efficient costs. The efficiency amounts applied that we have been provided with are not broken down in a way that allows the efficiency amounts to be categorised in this way.

As with the previous section, we have examined a sample covering track, signalling and structures.

Track

Table 4.3: Unit costing of track renewals

TRACK COSTS PER LINEAR METRE CP5

Cost Headers	Tot	Ang	LNEEEM	LNW	Scot	SE	Wales	Wessex	Western
Total Track									
Plain Line	**499**	627	443	674	399	528	379	500	530
New Build									
Replace - Full	**1,451**	1,346	1,452	1,716	1,235	1,715	1,256	1,465	1,416
Replace - Partial	**501**	507	688	439	411	337	503	327	602
Re-Rail	**319**	346	824	264	218	249	276	211	329
Re-Ballast High Output	**611**	474	638	542	530	1,430	603	467	685
Re-Rail, Re-Sleeper Conventional	**617**	835	377	801	743	-	714	583	453
Re-Rail, Re-Sleeper High Output	**893**	820	734	879	1,068		956	679	1,608
Re-Rail, Re-Ballast	**982** -	1,577 -	2,395	-	595	-	-		4,800
Refurbishment	**258**	376	897	1,213	144	301	135	437	96
Heavy Refurb (PL)	**1,513**	711	1,047		2,057	954	787	1,677	4,945
Medium Refurb (PL)	**91**	29	709	257	48	64	54	122	54
Slab track	**49,965**				24,103	925			
S&C	**262,522**	423,763	213,086	413,620	245,475	205,646	172,644	303,736	350,088
New Build									
Replace - Full	**895,431**	861,997	830,014	2,281,810	772,421	689,333	662,792	831,648	788,285
Refurbishment	**120,701**	59,280	361,366	116,222	134,188	70,671	43,544	95,747	175,356
Abandon	**178,225**	284,173	272,162	193,068	146,260	179,406	111,702		167,992
Off Track									
Fencing	**46**	34		42	23	77	51	46	23

TRACK COSTS PER LINEAR METRE CP6

Cost Headers	Tot	Ang	LNEEEM	LNW	Scot	SE	Wales	Wessex	Western
Total Track									
Plain Line	**451**	468	379	527	500	417	368	328	637
New Build									
Replace - Full	**1,411**	1,318	1,355	2,032	1,291	1,333	1,259	1,347	1,148
Replace - Partial	**493**	468	416	536	512	300	531		794
Re-Rail	**255**	328	218	255	202	241	321	290	357
Re-Ballast High Output	**664**	478	631	626	474		587		1,007
Re-Rail, Re-Sleeper Conventional	**758**		690	796	769		891		772
Re-Rail, Re-Sleeper High Output	**826**	647	776		1,068	804			925
Re-Rail, Re-Ballast	**1,109**				1,109				
Refurbishment	**93**	56	100	80	49	161	91	105	55
Heavy Refurb (PL)	**189**	174	102			704		865	286
Medium Refurb (PL)	**83**	40	455	71	58	113	78	46	50
Slab track	**4,215**		10,000	11,250		1,000			
S&C	**270,291**	350,181	239,458	177,349	292,090	296,527	236,492	365,913	269,793
New Build									
Replace - Full	**848,317**	944,141	742,460	1,164,706	734,615	869,452	822,000	930,000	792,683
Refurbishment	**60,125**	68,816	72,320	52,915		51,100	59,800	50,000	51,415
Abandon	**162,770**	155,170	90,000	200,000	216,667	286,000		245,000	172,000
Off Track	**79**	64	55	141	43	171	88	136	135
Fencing	**44**	35	37	52	33	78	59	71	54

TRACK COSTS PER LINEAR METRE CHANGE

Cost Headers	Tot	Ang	LNEEEM	LNW	Scot	SE	Wales	Wessex	Western
Total Track									
Plain Line	**-10%**	**-25%**	**-14%**	**-22%**	**25%**	**-21%**	**-3%**	**-34%**	**20%**
New Build									
Replace - Full	**-3%**	**-2%**	**-7%**	**18%**	**5%**	**-22%**	**0%**	**-8%**	**-19%**
Replace - Partial	**-1%**	**-8%**	**-40%**	**22%**	**25%**	**-11%**	**6%**		**32%**
Re-Rail	**-20%**	**-5%**	**-74%**	**-3%**	**-8%**	**-3%**	**16%**	**38%**	**8%**
Re-Ballast High Output	**9%**	**1%**	**-1%**	**15%**	**-11%**		**-3%**		**47%**
Re-Rail, Re-Sleeper Conventional	**23%**		**83%**	**-1%**	**3%**		**25%**		**70%**
Re-Rail, Re-Sleeper High Output	**-8%**	**-21%**	**6%**		**0%**				**-42%**
Re-Rail, Re-Ballast	**13%**				**86%**				
Refurbishment	**-64%**	**-85%**	**-89%**	**-93%**	**-66%**	**-46%**	**-32%**	**-76%**	**-43%**
Heavy Refurb (PL)	**-88%**	**-75%**	**-90%**			**-26%**		**-48%**	**-94%**
Medium Refurb (PL)	**-9%**	**38%**	**-36%**	**-72%**	**19%**	**75%**	**43%**	**-62%**	**-8%**
Slab track	**-92%**					**8%**			
S&C	**3%**	**-17%**	**12%**	**-57%**	**19%**	**44%**	**37%**	**20%**	**-23%**
New Build									
Replace - Full	**-5%**	**10%**	**-11%**	**-49%**	**-5%**	**26%**	**24%**	**12%**	**1%**
Refurbishment	**-50%**	**16%**	**-80%**	**-54%**		**-28%**	**37%**	**-48%**	**-71%**
Abandon	**-9%**	**-45%**	**-67%**	**4%**	**48%**	**59%**			**2%**
Off Track									
Fencing	**-5%**	**3%**		**24%**	**44%**	**2%**	**15%**	**55%**	**136%**

The tables indicate that the cost of track renewals per linear metre is planned to fall by around 10% from CP5 to CP6, before the application of efficiencies. This is initially somewhat unsurprising given that the basis of costing is generally a CP5 high point or average cost, or similar. But this reduction is probably due to the introduction of the new refurbishment technique of rail milling which is being introduced, or substantially expanded. This increases the measured quantity of refurbishment output substantially, representing about half the linear metres of refurbishment. If rail milling were excluded from these unit cost, not just refurbishment but the total plain line unit costs, the average unit cost of plain track work would change from CP5 to CP6 by +11% rather than reduce by -10%. The efficiencies the routes are applying are tending to get the track renewal cost back to the CP5 level on a cost per linear metre, rather than reduce below it. This suggests that although track renewal projects have been costed at a CP5 unit cost level, what is happening is that the costing model allows for scope differences, and the scope of such renewals is tending to increase.

The most interesting number is perhaps "replace – full", because it is a more standard job than the partial replacements. It is perhaps not surprising that LNW and LNEEM have the highest costs, they have the highest proportion of high-speed track. Perhaps more worrying is the substantial underlying increase being indicated by LNW. This may be a scope issue, but it would require much more detailed study on data we do not have.

Signalling

Switch and crossings work is showing more benign cost changes. The technique of fabricating switches and crossings in factories, installation largely comprising dropping them into place and joining them in, is well-developed. It is possible that with a relatively large part of the value of these renewals being carried out off site allows costs to be more replicable.

Table 4.4: Unit costing of signalling renewals

SIGNALLING COSTS PER SEU CP5

	Tot	Ang	LNEEEM	LNW	Scot	SE	Wales	Wessex	Western
Total Costs (Signalling + Level Crossings)									
Signalling Major Works	**410,233**	817,505	439,790	297,632	312,066	511,011	274,473	784,893	315,255
Partial	**284,534**		931,387	194,899	305,058	307,341			268,099
Refurb	**1,535,371**	3,554,126	447,497	1,035,020	787,256	661,078	4,585		
Level Crossings	**1,535,871**	3,537,664	1,200,969	1,740,942	1,454,202	1,045,050	1,706,517	2,250,798	1,295,152

SIGNALLING COSTS PER SEU CP6

	Tot	Ang	LNEEEM	LNW	Scot	SE	Wales	Wessex	Western
Total Costs (Signalling + Level Crossings)									
Signalling Major Works	**526,545**	542,664	481,139	443,119	388,238	762,260	371,330	481,338	469,184
Partial	**463,727**		349,422	417,899	457,888	666,257	436,361		
Refurb	**507,356**	374,965	669,726	332,144	321,898	1,023,977	315,134	694,232	434,056
Level Crossings	**717,721**	1,426,135	1,077,511	4,626,001	386,366	86,128	1,394,314	1,275,089	2,229,096

SIGNALLING COSTS PER SEU CHANGE

	Tot	Ang	LNEEEM	LNW	Scot	SE	Wales	Wessex	Western
Total Costs (Signalling + Level Crossings)									
Signalling Major Works	**28%**	**-34%**	**9%**	**49%**	**24%**	**49%**	**35%**	**-39%**	**49%**
Partial	**63%**		**-62%**	**114%**	**50%**	**117%**			
Refurb	**-67%**	**-89%**	**50%**	**-68%**	**-59%**	**55%**	**6773%**		
Level Crossings	**-53%**	**-60%**	**-10%**	**166%**	**-73%**	**-92%**	**-18%**	**-43%**	**72%**

The unit used to measure signalling work, the SEU, is recognised to have its shortcomings, being very crude because of the size of signalling projects. Nevertheless, having such a volume measure, crude as it is, might enable some trends to be identified. The unit for level crossing signalling work is number of level crossings, a similarly crude unit.

Signalling works show a substantial increase in unit cost from CP5 to the CP6 pre-efficient level. As noted above, this is likely to be related to the use of unit costs that reflect the increased scope of signalling projects that is being recognised. Nevertheless, the signalling costing tool which has been used in all cases, and which permits scope differences between individual tasks in the works programme to be reflected, is producing quite large swings between different routes. It would clearly require a detailed examination of the scope of tasks to obtain much sense from this, and to assess whether the specified scope for work packages is necessary scope. The basic pre-efficient CP6 average cost per SEU in the unit costing document we have been shown builds up to a cost per SEU of £330,000. The actual average cost per SEU for major works shown here of £527,000 indicates that the projects typically have substantial additional scope or difficulties in relation to that apparently average unit cost. It is unexplained why partial works and refurbishment cost a large fraction of major works, and in some routes more than major works.

Clearly, again a detailed study of the scope of the projects and the costing of them would be required to fully understand these results.

Table 4.5: Unit costing of structures renewals

STRUCTURES COSTS PER SQ METRE CP5

	Tot	Ang	LNEEEM	LNW	Scot	SE	Wales	Wessex	Western
Total Structures									
Tunnels	**1,058**	18,044	454	1,287	1,515	1,116	1,074	1,236	3,424
Overbridges	**4,033**	4,058	5,371	3,565	3,805	2,289	4,323	3,709	6,637
Underbridges	**2,011**	3,964	1,894	1,602	1,484	3,506	1,964	3,049	2,440
Footbridges	**4,861**	3,344	4,257	15,328	2,792	4,460	5,352	6,895	10,888
Retaining Walls	**1,511**	4,247	1,355	1,407	956	448	1,650	15,864	3,461
Culverts	**2,729**	1,528	1,932	4,748	4,481	1,352	5,496	1,117	3,147

STRUCTURES COSTS PER SQ METRE CP6

	Tot	Ang	LNEEEM	LNW	Scot	SE	Wales	Wessex	Western
Total Structures									
Tunnels	**1,303**	10,220	660	1,389	1,049	28,105	1,476	1,783	4,000
Overbridges	**3,875**	7,532	4,233	3,098	3,299	2,152	3,653	13,986	4,238
Underbridges	**2,879**	5,455	2,250	3,239	1,916	4,131	2,264	7,438	2,955
Footbridges	**7,004**	10,550	9,079	12,661	2,294	4,696	4,727	9,009	8,313
Retaining Walls	**2,159**	18,759	6,891	1,950	1,121	2,044	1,471	4,824	6,171
Culverts	**7,307**	25,550	4,487	4,462	5,071		3,000	1,962	9,449

STRUCTURES COSTS PER SQ METRE CHANGE

	Tot	Ang	LNEEEM	LNW	Scot	SE	Wales	Wessex	Western
Total Structures									
Tunnels	**23%**	**-43%**	**45%**	**8%**	**-31%**	**2418%**	**37%**	**44%**	**17%**
Overbridges	**-4%**	**86%**	**-21%**	**-13%**	**-13%**	**-6%**	**-16%**	**277%**	**-36%**
Underbridges	**43%**	**38%**	**19%**	**102%**	**29%**	**18%**	**15%**	**144%**	**21%**
Footbridges	**44%**	**215%**	**113%**	**-17%**	**-18%**	**5%**	**-12%**	**31%**	**-24%**
Retaining Walls	**43%**	**342%**	**409%**	**39%**	**17%**	**356%**	**-11%**	**-70%**	**78%**
Culverts	**168%**	**1572%**	**132%**	**-6%**	**13%**		**-45%**	**76%**	**200%**

Structures

Obtaining a sensible unit cost in structures is clearly particularly difficult. Network Rail has chosen to quantify this work in both per item and square metres, but only the latter provides a comparison between CP5 and CP6. Clearly it is not appropriate to add up the volumes of the different types and produce an overall estimate. Similarly, it is also clear that exceptional structures can have quite different costs. Tunnels works may result in exceptional costs, and are relatively uncommon, and this may explain the particularly large diversity of tunnel costs by route.

Nevertheless, if there is any validity to this method of quantifying structure works, it is suggesting quite large increases in the pre-efficient unit costs. Though with so much variability in the route-based costs, it is difficult to lend much credence to it. It is suggestive that an examination of project scope would be necessary to understand if in fact the scope of structures work in CP6 is on average more extensive than in CP5 to warrant this increase in unit cost.

5. CONCLUSIONS

5.1.1. Efficiency levels assumed in the draft determination

In its Strategic Business Plan, Network Rail identified net efficiencies (efficiencies minus headwinds) of an average of 8% on pre-efficient costs over CP6. Maintenance net efficiencies were approximately £300 million over CP6, equating to an average of 4% of pre-efficient maintenance costs. Renewals efficiencies on the other hand, were assumed to be approximately £1.6 billion or 9% of pre-efficient costs, once headwinds were taken into account.

In the draft determination however, the ORR identified areas where they considered that:

- Efficiencies had not been fully factored into individual route plans;
- Inefficient costs from CP5 were included in estimates of the CP6 Core (i.e. pre-efficient costs); and
- Headwinds had been over-estimated or lacked a clear justification.

Whilst the ORR was unable to quantify the expected savings from the above two issues, it did quantify the savings from reduced headwinds by applying factors for the various headwinds that were deemed to be double-counted or over-estimated. This represented savings of £659 million. The ORR used this estimate as an indication of the potential scale of efficiency savings from the above issues, and as a result increased the target net efficiency level from 8% to 10%.

5.1.2. Maintenance

Our assessment of the top-down evidence on organisational change illustrated the efficiencies that could potentially have been achieved by Network Rail through its route devolution. Given Network Rail began devolving activities to route businesses in 2011 and largely completed the exercise by 2016, we would expect to see such a reduction in maintenance costs from at least 2016 onwards, including the remaining two years of CP5. In our assessment, we identified potential reductions in maintenance costs ranging from 0.9% per annum to 11.2% per annum. As a result, we would expect to see efficiencies of at least 1.8% over 2017/18 and 2018/19.

As stated by ORR and confirmed by our bottom-up review of Network Rail's ABP analysis, it is unclear whether any efficiencies expected after 2016/17 have been incorporated into Network Rail's estimates of CP6 Core costs. ORR's adjustment to Network Rail's efficiency target, seems a fair reflection of the scale necessary to account for this. It is also likely to be a conservative estimate, given other top-down evidence suggested larger efficiencies than 0.9% per annum, and given the ORR identified a number of areas where the SBP underestimated the potential for efficiency.

When considering ORR's benchmarking of the efficiency of maintenance delivery units, the results suggested average inefficiency levels of 16%. This is significantly larger than the efficiency target proposed by Network Rail and the one proposed by ORR in its draft determination.

Our bottom-up analysis of Network Rail's route business plans supports the ORR's conclusions regarding the areas where Network Rail seems to have underplayed the efficiency potential. This was primarily done through analysis of the activity-based planning worksheets. There remains significant variation in post-efficient unit rates between different delivery units and routes, and there is wide variation in the level of ambition for efficiency between different routes. We have identified indicative additional savings of £440 million, from reducing the variation in time taken to complete routine tasks, and from adjusting individual plans to match the targets of more ambitious routes. Our bottom-up review mostly covers the maintenance activities covered by the APB activities. As such, it is likely that there is further potential for efficiency when undertaking a more thorough review of Network Rail's plans for non-ABP jobs.

We acknowledge that there is significant uncertainty around our additional savings envelope, both in terms of the quantum and its deliverability within the control period. Nevertheless, the savings we have identified only cover 36% of maintenance spending, and both the results of ORR's benchmarking exercise and the top-down evidence on organisational change suggest that there is much greater scope for maintenance efficiency. As a result, we believe that the ORR's efficiency target of £158 million is a conservative estimate of the scope for maintenance efficiency during CP6. A more forensic analysis of Network Rail's underlying calculations would be necessary to further refine the efficiency target.

5.1.3. Renewals

Our case studies of organisational transformation did not provide a specific benchmark of for cost changes for renewals. In the one organisation where we had some information, National Grid's renewals of gas mains, costs increased both in total and at unit level. This was due at least in large part to increased output and input cost increases. This is in contrast to operating costs that generally reduced in our case studies.

ORR's internal benchmarking of routes suggested a relative internal inefficiency level of 16% in maintenance and renewals combined. Since it also found 16% in maintenance alone, and renewals are about 70% of total maintenance and renewals costs, this tends to imply the inefficiency in renewals was also around 16%. This is only inefficiency relative to the most efficient route, there may be further inefficiency relative to a fully efficient comparator.

In our illustrative exercise comparing renewals with the results of ORR internal econometric benchmarking, by route, if all routes were at least as ambitious as the third-best route in delivering their benchmarked relative inefficiency (the kind of analysis other regulators do setting efficiency targets for regional regulated utilities) then there would be a 12.7% target for overall renewals efficiency. Our analysis suggests that this benchmark can be used as a cross-check so this should not be seen as a primary recommendation. Nevertheless, as a cross-check it suggests that increasing the present 8% efficiency ambition of Network Rail's routes in delivering renewals, generally from a high mid-CP5 cost base, to 10% is a conservative adjustment. The exception perhaps is Scotland, which is one of the most ambitious routes in terms of catching up its benchmarked efficiencies.

We have also shown that there are substantial and unexplained differences in efficiency ambitions and unit costs across all broad areas of renewals and between routes. This is strongly suggestive that a detailed examination would expose material differences in ambition, and costing practices. The general tendency for unit costs to increase relative to CP5 in many cases tends to suggest, based on the methods used, that the typical work bank renewal has more scope than in the past. There might be a good reason for this. But it is also suggestive that a detailed examination of the scoping of work-bank projects used for costing purposes might expose unnecessary or inefficient scope which can be removed. We have also seen that there is little consistency in costing methods, or clarity in their basis and so some specific scope for improvement in plans for future review periods.

APPENDIX A NETWORK RAIL DEVOLUTION: CASE STUDY SELECTION NOTE

The case studies will aim to draw out similarities and differences with Network Rail's circumstances and describe the period over which the change took place and the broad effect of the change on company costs. The idea being to give context to the quantified results (where available) such that ORR can consider how the resulting ranges might be appropriately applied to Network Rail.

The premise here is that Network Rail is delivering a transformational change programme that will deliver efficiency not least through greater comparability between regions/routes that enable benchmarking. The question is how much efficiency might reasonably be expected to arise out of such a change?

At a high level, the result of Devolution is that the Routes have **greater discretion and autonomy but must continue to operate within the overall framework set by the Centre**, e.g. around safety rules.

A.1. CHANGE UNDERTAKEN

Company/ industry	Change in business	Analysis
BP	**2005 Texas City explosion** This study focuses on the changes in BP's maintenance and renewals costs over time following the 2005 Texas City Refinery explosion as this provides for a longer time series than the 2010 Gulf of Mexico oil spill.	Safety was a key component - BP was under pressure to ensure that it is not cutting maintenance costs (i.e. pursing profit) at the expense of other important objectives such as employee safety. BP's approach highlights the dangers of failing to achieve a balance between safety, quality and maintenance/renewals expenditure and of enforcing corporate policy across the business irrespective of the asset condition within particular business units.
General Motors	**Recovery from Chapter 11 re-organisation in 2009** The U.S. Treasury bailed out the company and a 'new GM' was established in mid-2009. It has continued to restructure its operations, by cutting wages, linking bonuses to performance and selling off brands with low sales.	Transport sector company Large unionised workforce Capital intensive Operations restructure Following their restructure, have continued to make significant cost savings
IBM	**IBM witnessed a threat from more efficient, lower priced competitors in the late 1980s and the early 1990s. Threat of bankruptcy in early 2000s** By late 1980s IBM employed more than 400,000 staff. IBM had to choose between devolving into smaller more efficient units or to centralise into one large, but more efficient unit, and it went for the latter.	Able to cut its expenses as a percentage of revenue very significantly and continue to find efficiencies, while strengthening its annual revenue Undertook the opposite of devolution Competitive industry Following their restructure, have continued to make significant cost savings Reduced internal autonomy – opposite of Network Rail
Infrabel	**Devolution of Belgian rail operator which led to the creation of Infrabel**	Infrabel is Network Rail's counterpart in Belgium and hence a direct comparator

Company/ industry	Change in business	Analysis
	The national railway company of Belgium known as SNCB (Société Nationale des Chemins de fer Belges), managed rail transport in Belgium until 2005, when it was split into two different companies – Infrabel and SNCB (both owned by a parent company, SNCB Holdings) – under liberalisation requirements set by the EU.	Transport sector Large network Non-competitive industry Strong unionised labour force Safety focused Split into two – not clear whether this is similar to Network Rail's devolution
National Grid Gas	**Split into distribution licence areas (2005/06)** National Grid Gas plc (formerly Transco plc) is a gas transmission and distribution company. For the purposes of our case study we focus on the distribution side of the National Grid Gas (NGG) business. NGG operates a significant proportion of the UK gas distribution network, with it owning four of the eight gas distributions networks in the UK. In June 2005, National Grid was required to sell four of Transco's gas distribution networks (for £5.8 billion), as part of an industry reorganisation designed to break up National Grid's monopoly of the gas networks. National Grid retained its distribution networks in London, East England, the Midlands, and North West England.	Works in an environment without competition Regulated Large network National Grid Gas' four distribution licenses came into existence after the forced split of TransCo gas distribution network into eight distinct licence areas. TransCo (which was renamed NGG) was then required to sell four of these licences, thus reducing its size. Overall in terms of improving operating cost efficiencies, the sale of four distribution networks in 2005 has seemingly had a greater impact to date in driving efficiencies in the networks which were sold (which might argue for devolution of business units). Split into smaller parts, able to keep half of them – now have four distribution licence areas to manage, similar to Network Rails' routes
SSE	**Merger in 1998** In 2005 SSE was part of a consortium which purchased two gas networks from National Grid (Scotland Gas Networks and Southern Gas Networks). This gas distribution network company – Scotia Gas Networks (SGN) – became the second largest in the UK, with a value of just under £3bn at acquisition (it is now valued at approximately £4bn in nominal terms as of March 2010).	SSE has undergone two major organisational changes over the last 15 years Regulated Large networks Purchased additional networks – more than one part to the organisation Diverse network spread
Tube Lines (TLL)	**Split of internal structure** TLL was taken over by LUL in 2010 after Transport for London (TfL) concluded that the network would be better managed as a whole i.e. without the interfaces created by the PPP Agreements. TLL now operates as a semi-autonomous company within TfL.	Transport sector Highly unionised Safety focused Carry out similar activities to Network Rail Somewhat devolved within TfL, has some autonomy Non-competitive industry Large network The Tube Lines data has detailed breakdown of opex costs
United Airlines	**Filed for bankruptcy in 2002**	Transport sector

Company/ industry	Change in business	Analysis
	The reason for the structural change in labour costs around 2002 and United's strategy is the focus of this case study. In 2001 America was facing an economic downturn which meant that airlines in general were not performing well, however the 9/11 attacks which involved two United aircraft created a crisis for the airline industry. There were 22 bankruptcies in the airline sector during this period, including United. With only a few companies able to restructure their costs in time to avoid administration.	Unionised labour Safety important Transformed its cost structure to improve efficiency and compete effectively Following their restructure, have continued to make significant cost savings Competitive industry United's restructuring resulted in it consolidating the routes that it operated United's proportion of maintenance expenditure attributable to outsourcing increased dramatically, from 16.7% in 2002 to 45.7% in 2007, as in-house staff were replaced by external contracts
Veolia Water Central (formerly Three Valleys Water)	**Merger: VWC merged with North Surrey Water in October 2000** VWC may have some organisational complexities because it is part of the Veolia Water group - a multinational water company with €12.6 billion of revenue in 2011. Being part of such a large organisation, this may reduce the autonomy of VWC to make changes but should create some economies of scale.	Regulated Large network Formed through a number of mergers over the last 20 years Reduced autonomy is opposite of Network Rail devolution
Wessex Alliance	**Deep alliance between Network Rail and South West trains** which utilised a joint business plan and join management team. The main objective of the Alliance was to align incentives in order to improve performance and reduce costs. In effect, the Alliance seeks to address the basic conflict between the network operator (which needs track access to perform maintenance) and the TOC (which needs to run train services).	Closer working between NR and TOCs is a driver of benefit from devolution. Note that financial information was difficult to obtain
Devolution of London Underground	**Establishment of PPP contracts** and the payment and incentive regime that was included within that.	A devolution process governed by contract (so going further than current devolution at NR) for which we have some evidence of financial benefit. The scale of the reorganisation within London Underground for the PPP's dwarfs devolution in Network Rail, but was clearly undertaken for different reasons which required complete legal separation of the entities and reliance on a contractual structure which had to work from day one.
Governance changes at Heathrow for the CAA	**Imposition of sharing of control over governance** of the £4bn capital programme between HAL and airlines introduced for the current control period	A recent change to governance where Airlines gain greater control over works. Some parallels to routes and relationship with NR centre Gives the airlines greater say in the capital investment programme. Airlines now have to sign

Company/ industry	Change in business	Analysis
		off expenditure at the Airport and HAL is expected to show that its plans represent value for money.
Review of specific processes	Improved possessions management	What can be achieved through better access planning

A.2. COSTS ANALYSED

The table below illustrates that data that was used in the previous studies and also, highlights those case studies where data access/availability was more difficult. As quantification of efficiency is an important part of the study, it is important to consider those comparators that appear to have a greater quantity of cost data available.

Company	Support and operations	Maintenance and Renewal
Veolia Water Central	✓	✓
National Grid Gas	✓	✓
Scottish and Southern Electricity	✓	✓
Tube Lines	✓	✓
Infrabel (Belgian Rail)		✓
United Airlines	✓	✓
General Motors	✓	
BP		✓
IBM	✓	

APPENDIX B TUBE LINES CASE STUDY

B.1. BACKGROUND

Tube Lines (TLL) was established to provide infrastructure services to London Underground (LUL) under a Public Private Partnership (PPP). The PPP was proposed as a way of enabling longer term budgetary certainty compared with the public sector, and to encourage more efficient management of investment. This would allow full devolution of London Underground infrastructure management, governed purely by a contract between the concessionaires and LUL.

TLL signed a PPP contract in 2002 lasting 30 years, with two others let to Metronet. LUL would retain responsibility for operating trains and managing the PPP contract, whilst TLL's remit covered the provision of maintenance, renewal and enhancements to the Jubilee, Northern and Piccadilly lines.

Given the length of the PPP contracts, they incorporated a review mechanism which could be managed by the parties independently or referred to the third-party Arbiter who would then take control of the review process under powers analogous to a regulator in a price control.

During the first periodic review, in 2010 LUL bought TLL from its shareholders. This brought the management of maintenance and investment for all London Underground lines back in-house. The rest had previously been brought back inhouse in 2008 when Metronet entered administration.

TLL now operates as a separate business within Transport for London (TfL). Until 2012, TLL largely operated as a separate entity with its own board and management structure, but it has since become more integrated into LUL, and the management of infrastructure investment has become significantly more centralised than was the case during the PPP.

B.2. APPLICABILITY TO NETWORK RAIL DEVOLUTION

TLL's business activities closely match those of Network Rail's devolved routes, with both firms operating in similar markets and carrying out similar work. They both operate in a safety critical environment and have highly unionised workforces.

There are however, a few differences between the experience of TLL and Network Rail. The first is the degree of devolution in the two examples, with Network Rail retaining some centralised controls. Additionally, whilst TLL was a private company for a large duration of period covered in this case study, Network Rail and its devolved units remain public sector organisations. Network Rail's devolved units carry out route operations and some customer service, whereas this was always retained inhouse by LUL and was not part of the remit of TLL.

Finally, the devolution of Network Rail is likely to create a closer relationship between track maintenance and rail operation than was previously the case, whilst the TLL PPP increased the separation between London Underground maintenance and operation.

Overall, the experience of the TLL PPP provide a useful comparator against which to assess the potential efficiency gains from Network Rail's devolution. However, it is likely that the efficiencies gained by TLL are on the upper end of what can be achieved, given the more limited devolution in Network Rail and it public sector status.

B.3. EFFECT OF DEVOLUTION ON COMPANY COSTS

B.3.1. Summary

Maintenance: TLL delivered its maintenance programmes in line with its plans and at a level of cost that was slightly below the Arbiter's expectations for the first review period. International benchmarking showed its costs (along with those of Metronet) to be comparatively high, though TLL made significant progress in reducing its costs towards a 'benchmark range' over the 4 years of the international study. Service performance improved by broadly 50% over the period in question (measured by reduction in delays to passengers using the tube network)

Support: Administration costs reduced by c.20% over the 7.5 year review period and were judged to be consistent with best practice in certain areas e.g. finance, accommodation and facilities. In some areas a change of strategy delivered early costs savings – moving HQ to a less expensive location. In other categories there was early investment to deliver longer term savings e.g. IT or a continuous improvement programme over the first contract period e.g. procurement costs.

Operations: Not covered by this case study. Activities analogous to Network Rail Operations e.g. signal control and customer services were retained by LUL under the PPP arrangements

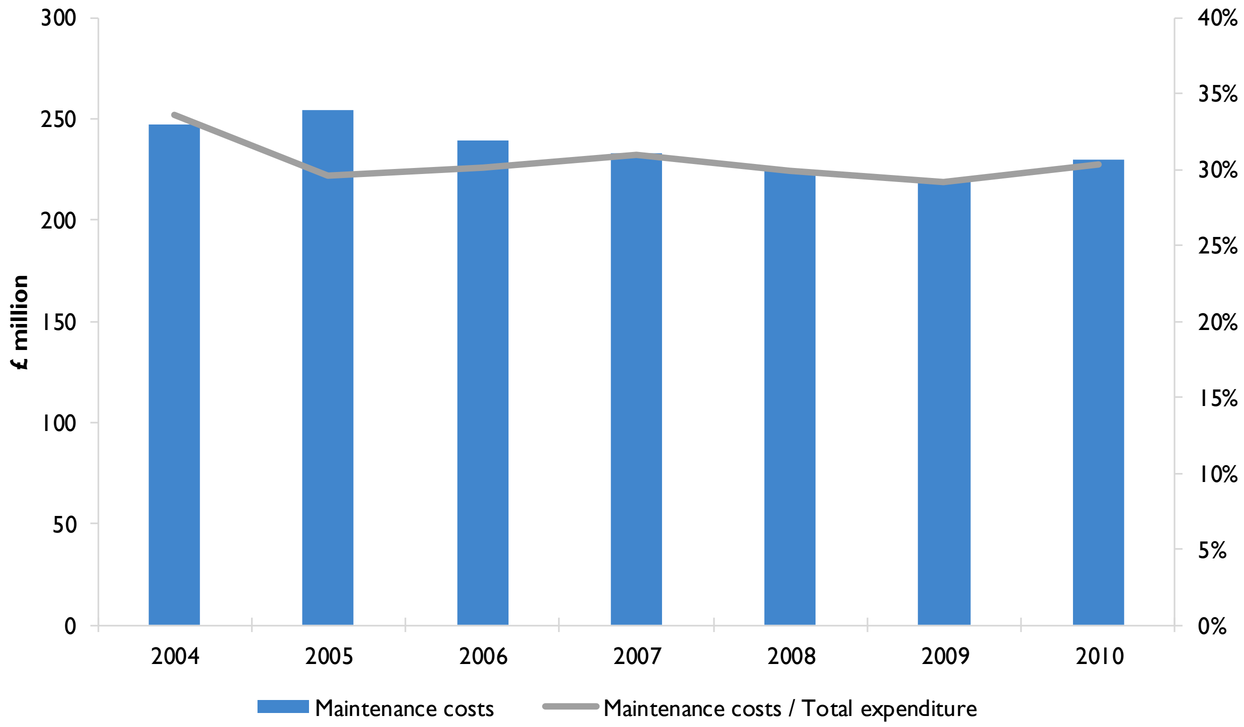
B.3.2. Maintenance and renewals

The design of the first PPP contract period was to give TLL the incentive to reduce maintenance costs for track, signalling and rolling stock, whilst at the same time improving day to day performance. In this regard, Tube Lines had some success as shown in Figure A-B.1. TLL first reported costs for maintenance and renewals in 2003/04 after being awarded the contract in 2002. After a small increase in costs during its first year (of 3.1%), TLL reduced its costs by 13.9% to 2008/09 before seeing an increase in costs (of 4.8%) in 2009/10.

After making a reduction of 11.9% in its maintenance costs as a proportion of total expenditure in its first year, TLL's maintenance costs as a proportion of total expenditure remained relatively constant to 2010. Although it was not always possible to confirm the volumes of work delivered in key areas such as track maintenance it delivered ahead of the volumes predicted in its bid. In others such as lifts and escalators it delivered less work than was originally expected. We also note that the capital works programme was rapidly expanding in this period creating more assets and more complex systems to maintain.

Performance was not adversely affected by the reduction in maintenance expenditure, with TLL generally exceeding the performance benchmarks set for it. In all cases performance measured by failures rates and mean distances between failures, improved alongside cost performance. Additionally, these cost and performance improvements were made despite TLL having higher rates of pay than Metronet and most external peers.

Figure A-B.1: Tube Lines' maintenance costs (2010/11 prices)



In terms of maintenance costs for specific areas of activity:

- Between 2006 and 2009 TLL reduced track maintenance costs by 30%, leaving a gap to the benchmark range determined by the PPP Arbiter of approximately £7.5m p.a. At a normalised level TLL reduced costs from £87k per track kilometre to £81k, which compares favourably with the 2009 cost of £132k per track kilometre for lines not maintained by TLL. We do note though that costs rose in the benchmarking exercise carried out by TfL after TfL took control of Tube Lines.
- Signalling maintenance costs fell by 4% over the same period, which remained high relative to TLL's peers and left a gap to the benchmark range of approximately £7.5m p.a. The reduction in maintenance costs is low compared to track because the opportunities to deliver more significant savings in signalling would only arise once new common signalling was fitted across all of the TLL Lines.
- TLL reduced the costs of rolling stock maintenance to a level close to the benchmark range leaving a gap of approximately £6.3m p.a. Maintenance of the Piccadilly Line stock which was serviced in house was within the benchmark range.

These successes were delivered through a range of activities e.g. a move toward risk-based maintenance for some activities, a greater focus on the effective use of engineering hours and the revising of maintenance standards. TLL also undertook internal work with Network Rail and MTR (Hong Kong Metro) to review its approach to various aspects of maintenance.

Following the purchase of TLL by LUL, the company continued to deliver more efficient cost levels as a separate company within TfL than the ex-Metronet lines, though noting that costs increased from the levels seen in 2009. Since 2012 however, the company has become more closely integrated with the rest of LUL and its costs are no longer separately benchmarked.

B.3.3. Support and operations costs

While TLL was awarded the contract for the Jubilee, Northern and Piccadilly in 2002, data for support and operations costs are only available from 2004. TLL was able to rapidly reduce its support and operations costs from 2004 to 2006, with costs reduced by over 47%. Although at a much slower rate, costs continued to decrease over the rest of the period covered.

TLL was able to maintain a similar pattern in its administration and other costs as a proportion of total expenditure as it does for its non-normalised costs i.e., a sharp decrease in costs in the first two years (51.1%), followed by a relatively flat profile over the remaining period covered.

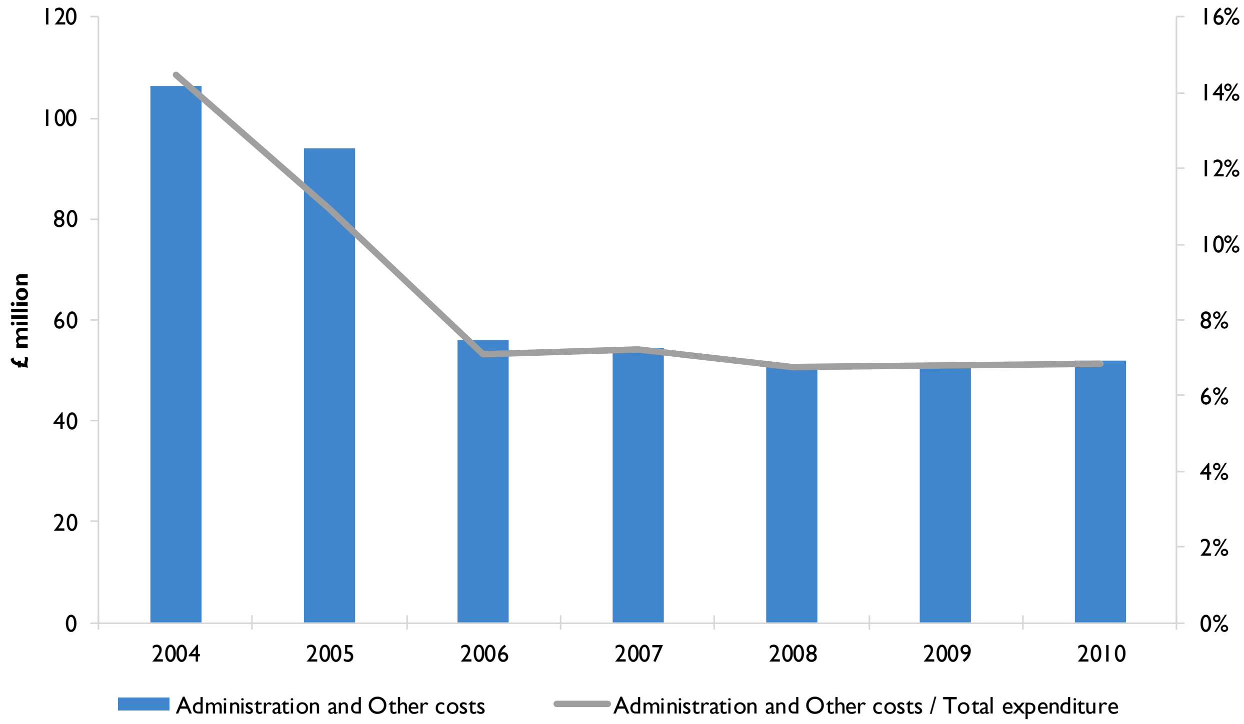
TLL spent the first-year post contract award (2003/04) consolidating and combining the plans that it had developed in bidding with those of the Shadow Infraco[18] and created joint plans which it then implemented. TLL managed to reduce its administration costs by circa 51% over six years and were judged to be consistent with best practice in certain areas e.g. finance, accommodation and facilities. In reducing costs:

- it took opportunities such as those offered by a break in the London Underground lease on buildings in Canary Wharf to negotiate improved deals;
- for the first three years of operation TLL's administration and other costs increased as it invested in, for example, IT equipment; and
- TLL also spent heavily on internal communications which delivered a strong sense of corporate identify – separate from London Underground

By the middle of the first review period costs fell markedly. The third year saw the biggest overall reduction in costs with the majority of areas delivering significant savings in year. Thereafter costs reductions were more incremental. Figure A-B.2 shows TLL's administration/other costs and maintenance costs, shown both in absolute terms and relative to TLL's total expenditure.

[18] LUL created three companies which were let under the PPP arrangements. LUL staff were TUPE transferred and assets leased into the Infracos

Figure A-B.2: TLL administration and other costs (2010/11 real prices)



B.3.4. Pace of change

In our previous analysis, we considered the pace at which companies were able to reduce their costs during the period studied. In the case of TLL, the pace in which it reduced its costs varied between maintenance, renewals and support activities. The design of the PPP contract was to incentivise cost reduction across all areas of activity during the first period. TLL was also expected to demonstrate that it had operated at a level that was consistent with good practice. Although there no process to claw back inefficiency at a review, cost levels for the subsequent period were set by reference to good practice not at the level delivered by the company in the previous period.

During the period we have explored, TLL delivered a relatively steady reduction in maintenance costs. As Figure A-B.1 shows, there was a rise during the first year mostly because of increases in rolling stock costs, whilst the following four years saw steady and continuous reductions. These cost reductions in part arose from a move to risk-based approaches for some elements of maintenance and a greater focus on what could be achieved within each track possession.

For support and operations costs, there was a large reduction in the first three years with costs staying relatively constant after. The largest single reduction in administrative costs came from TLL moving its headquarters to a cheaper location.

B.4. ANALYSIS OF COST CHANGES

The experience of Tube Lines suggests that substantial cost efficiencies are achievable in the context of Network Rail devolution. TLL have managed to reduce costs without any obvious reduction in safety or wider quality performance and have manged to improve efficiency while simultaneously ramping up the capital programme.

The reductions in maintenance costs were achieved within approximately five years of the PPP contract being signed. These cost reductions came from actions that may be more achievable in the context of Network Rail where decisions on maintenance and renewals are made closer to the day to day operations of the network. However as with TLL, it may take a year or two from the point at which route devolution is complete, before these efficiencies are realised given the time taken for changes to be bedded in.

Some reductions in administrative costs are unlikely to be achievable by Network Rail; for example, Network Rail began moving its headquarters from London to Milton Keynes in 2012 and as such, a further move is unlikely to create efficiencies. However, Table 5.1 below shows that other support and operations costs are achievable over a relatively short period.

Table 5.1: Tube Lines' cost reductions related to Network Rail's cost categories (real price changes)

Activity	Cost reductions and pace of change
Maintenance	Track maintenance costs reduced by 30% over three years (11.2% per annum). Signalling maintenance costs reduced by 4% over three years
Renewals	
Human Resources	Costs decreased by 24% over 7.5 years (3.6% per annum).
IT	IT costs decreased by 9% over 7.5 years (1.2% per annum). Communications costs decreased by 26% over 7.5 years (3.9% per annum).
Finance and accounting	Costs decreased by 52% over 7.5 years (9.3% per annum).
Procurement, property and corporate	Accommodation and facilities costs decreased by 51% over 7.5 years (9.1% per annum). Procurement costs decreased by 52% over 7.5 years (9.3% per annum). Legal services costs decreased by 40% over 7.5 years (6.6% per annum). Planning management and regulatory, and commercial costs rose.
Operations and other	Costs decreased by 33% over 7.5 years (5.2% per annum)

APPENDIX C NATIONAL GRID GAS DISTRIBUTION CASE STUDY

C.1. BACKGROUND

Cadent Gas Ltd, formerly known as National Gas Grid Distribution Ltd, is a gas distribution company. Cadent Gas operates a significant proportion of the UK gas distribution network, owning four of the eight local gas distributions networks (GDNs) in the UK. Following the privatisation of British Gas in 1986 there were several changes in ownership that would eventually result in the creation of Cadent Gas Ltd:

- In 1994 British Gas was divided into five Business Units, one of which was Transco, responsible for gas transportation and storage, including the distribution businesses.
- In 1997 British Gas was demerged into two companies: BG plc and Centrica. BG took ownership of Transco and the international gas production business, whereas Centrica, trading as "British Gas", became mainly a retail supply and trading business, retaining some of the local gas production businesses around Britain.
- In 2000, a demerger from BG plc resulted in Transco plc becoming part of the Lattice Group.
- In 2002, the Lattice Group merged with National Grid.
- In June 2005, National Grid sold four of Transco's gas eight local GDNs, retaining the other four and the national gas transmission business.
- In October 2005, the National Grid's Transco division became known as National Grid Gas plc, containing the national gas transmission business, with its distribution business known as National Grid Gas Distribution Ltd, which owned the four retained GDNs.
- In March 2017, National Grid sold a 61% stake in its gas distribution business to a consortium of investors, with the resulting company called Cadent Gas.

Current figures indicate that Cadent Gas has approximately 10.9m customers connected to its four GDNs. Cadent Gas, or more accurately its four GDNs, are currently regulated by Ofgem through its RIIO-GD1 price control. Each GDN has its own licence and price control.

C.2. HISTORY OF DEVOLUTION

Prior to 2004, all of Transco's gas distribution networks (GDNs) were regulated under a single licence and price control. In April 2004, Ofgem made the decision to separate the price control into eight regional price controls, one for each GDN. This allowed Ofgem to improve benchmarking between the GDNs and provided Transco greater focus for managing its distribution activities.

The cost for domestic gas users had gone up by 36% over the period 2003-05, with a fifth of the total bill due to gas distribution. As a result in 2005 the devolution went a step further, with National Grid being required to sell four of Transco's gas distribution networks (for £5.8 billion in cash and approximately £130m of assumed liabilities), as part of an industry reorganisation designed to break up National Grid's monopoly of the gas networks. For the retained GDNs, there was greater separation between Transco's transmission and distribution activities. National Grid retained its distribution networks in London, East England, the Midlands, and North West England.

Ofgem estimated that National Grid selling four of its gas distribution networks in 2005 would generate £325 million of potential benefits for customers over the period 2008 to 2023. On an annual basis, this equates to efficiency benefits of 1.13% per annum, which would be in addition to the 3% per annum ongoing efficiency targets.

The first Gas Distribution Price Control (GDPCR1) was the first full price control following creation of separate controls for each of the GDNs and the sale of National Grid's four GDNs in 2005.

C.3. SIMILARITIES/DIFFERENCES WITH NETWORK RAIL DEVOLUTION

The separation of the gas distribution networks into eight business units has key similarities with Network Rail's devolution. The distribution networks moved from a more centralised structure all covered by a single regulatory settlement, to eight separate GDNs units each with their own management structures and own price controls. The subsequent sale of four of Transco's GDNs created more separation between the transmission and distribution sides of Transco's business.

The devolution of Transco's retained GDNs took place alongside other large-scale changes such as the sale of four other GDNs, which may be less helpful when considering the devolution of Network Rail. However, comparing the experience of the retained GDNs against the four sold GDNs where there was arguably even greater separation, may be useful to illustrate the degree of efficiency gains that could be achieved from devolution rather than full divestment.

The GDNs operate in a different market to Network Rail and have a somewhat different range of business activities within that. However, as both firms still operate in an industry with significant maintenance and replacement expenditure and are both monopoly local network businesses with captive customers, we believe that the experience of NG is relevant to the consideration of Network Rail's devolution.

C.4. EFFECT OF BUSINESS CHANGE ON COMPANY COSTS

C.4.1. **Summary**

As the following sections set out, there is mixed evidence on the performance of NG since it sold four of its gas distribution networks in 2005. The key points are:

- In terms of replacement expenditure (repex), costs per unit of gas demand have increased significantly since 2003/04 (at around 7% per year). This is largely due to the requirements imposed on gas distribution networks since 2002 under the HSE iron mains replacement programme, which is to an extent outside of NG's control.
- NG has reduced its controllable operating costs by c.15% since 2005/, which includes support, operations and maintenance costs. This is most likely due to rationalisation and standardisation processes undertaken by NG to reduce support and operations costs, and to a recent reduction in maintenance costs.
- However, gas demand across all four of NG's retained networks has fallen by even more than costs, in part due to energy efficiency measures by its customers. This means that NG's controllable operating costs per unit of gas demand have risen very slightly over time.
- More importantly, although it might be argued that a high level of fixed cost impacts on the ability of the company to respond to a reduction in demand, when NG's costs are benchmarked against the other four GDNs, NG's networks are relatively inefficient based on Ofgem's methodology.

- Overall in terms of improving operating cost efficiencies, the sale of four distribution networks in 2005 has seemingly had a greater impact to date on the networks which were sold, which might argue for divestment rather than devolution of business units. The separation of the GDNs has benefitted Ofgem however, by enabling them to make better comparisons of performance between them.

C.4.2. Important note on data limitations

We have been able to source some good data for NG's replacement expenditure and controllable operating costs over time. However, obtaining a further breakdown has been more difficult, such that we have only been able to identify business support costs from 2006/07 onwards and maintenance / repair costs from 2008/09 onwards.

For reference, LECG report on NG's business costs in 2007 stated some similar issues involved in data collection:[19]

- There was "a lack of detailed and consistent information".
- The industry restructuring that occurred over 2005 and 2006 "influenced data availability/ consistency", as GDN owners were asked to provide detailed cost information for businesses that they had owned for a relatively short period.
- Before the GDN sales by NG in 2005, the GDNs were all part of a single entity, and so financial information was not publicly reported for each GDN separately.

To summarise, LECG state that "the lack of available historical information has impeded our assessment of the level of efficiency achieved over the current price control period." Therefore, we think it is worth noting this at the outset as a caveat to our analysis.

A further relevant point is that in January 2011 National Grid was fined £8m by Ofgem for reporting inaccurate information in relation to mains replacement expenditure.[20] This included double claims for work on mains pipes for the period 2005-06 to 2007-08 and creates the possibility that expenditure figures for these years in particular may have been inflated over their true value. Although it is impossible to speculate on the extent to which data may or may not be representative of NG's true costs, it may be beneficial to treat the analysis of results with some additional caution.

C.4.3. Maintenance and renewals

There is mixed evidence on the performance of National Grid's retained GDNs following the creation of separate price controls in 2004 and the sale of the other GDNs 2005.

In terms of maintenance and repair expenditure, NG reduced its annual expenditure by 10% between 2008/09 and 2012/13 (an average of 1.9% per annum) and generally underspent its revenue allowance. NG has claimed these are due to efficiencies in its workforce management and measures it had undertaken to reduce its workload. However, it must be noted that National Grid undertakes maintenance expenditure at company wide level rather than separately for each GDN.

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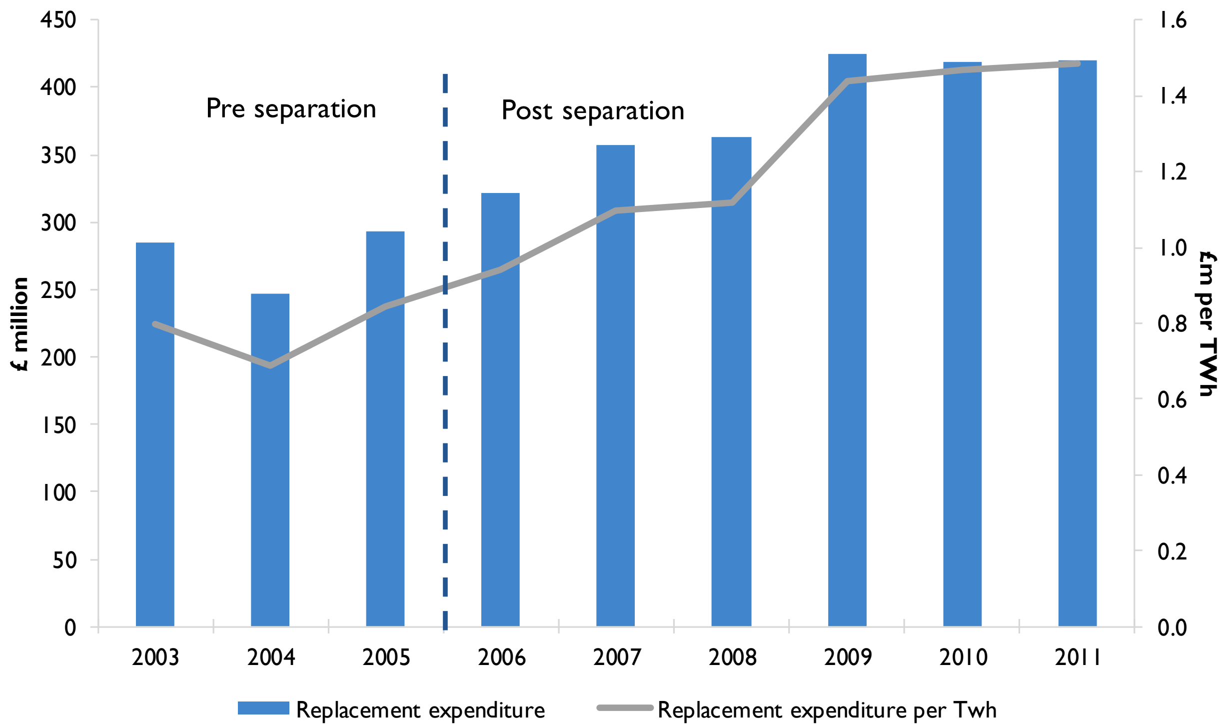
[19] *Benchmarking National Grid Gas Distribution's business support services*, LECG, April 2007

[20] BBC, January 2011

In terms of replacement expenditure (repex), costs have increased significantly since 2003/04 (at around 6% per year). NG's replacement costs show a steady increase following the separation of the gas distribution licenses. Over the six years following the separation replacement costs increased by over 43%. This is largely due to the requirements imposed on gas distribution networks since 2002 under the HSE iron mains replacement programme, which was to a large extent outside National Grid's control. Replacement costs excluding mains replacement increased by 26% over the same six-year period. In 2007, a report from PB Power for one of NG's networks shows that repex costs per unit of mains replaced were tending to increase at around 2% per year at that time, above inflation, due to real increases in direct labour, materials and contractor costs. This does not enable any assessment of whether efficiency or inefficiency was contributing to the increase in costs observed.[21]

In addition, NG's replacement costs per unit of throughput (TWh) exhibit the same pattern as its non-normalised costs. Figure A-C.1 below shows NG's replacement expenditure per TWh of throughput. Over the six years following the separation normalised replacement costs increased by over 75.8%. This has in part reflected the fall in gas demand over time, which means that even if total repex costs had stayed the same, per unit repex costs would have increased. However, some of this has been driven by additional safety requirements, which have led to an increased rate of renewals, and increased output. As noted above, there appears to be

Figure A-C.1: National Grid's replacement expenditure (2010/11 prices)

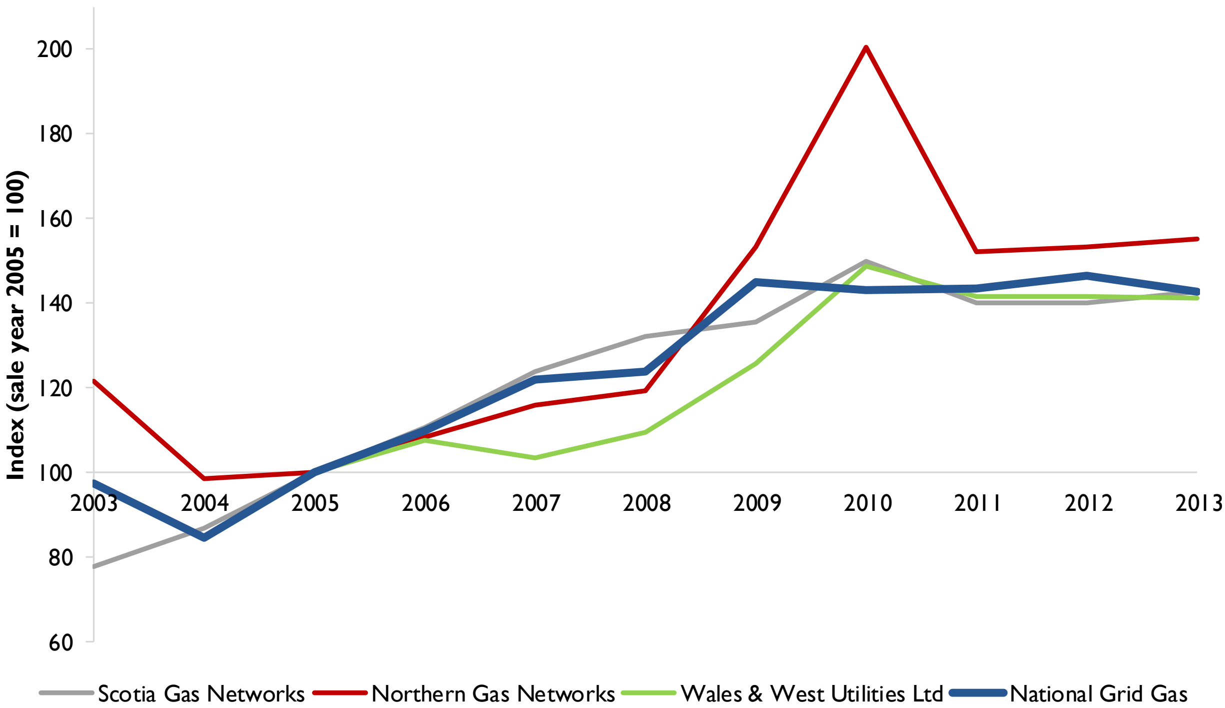


As Figure A-C.2 shows, when comparing National Grid's performance following separation against the four other GDNs, the replacement expenditure does not look significantly different. Following separation, costs increased for all of the GDN groups, supporting the view that the requirements from the HSE iron mains replacement programme explain to a large extent the increase in costs. Given that there has been such an

[21] *GDPCR Capex/Repex Report for East of England GDN*, PB Power, June 2007

increase in replacement output, which is driven by factors outside the company's control, and we do not have an index of the quantity of replacement to assess the unit cost of output, and further there were real price effects on mains replacement, we cannot observe whether there has been any change in efficiency separate from that which has contributed to the unit cost of mains replacement, which would be a more relevant measure of efficiency than total cost or cost per TWh.

Figure A-C.2: Index of replacement expenditure across gas distribution networks



However, when National Grid's costs were benchmarked against the other four GDNs by Ofgem, NG's networks were considered relatively inefficient. This does mask significant variation between individual GDNs owned by NG.

Table A-C.1 shows that in terms of efficiency of replacement expenditure for the three years following separation, one of NG's networks (West Midlands) was considered relatively efficient whereas another (London) was considered relatively inefficient. Since then, the repex cost efficiency has changed substantially with NG's least efficient GDN becoming at the end of the price control the most efficient within the grouping and the second most efficient across all eight GDNs. West Midlands on the other hand had become the least efficient out of all eight GDNs. This suggests that whilst devolution has the potential to improve efficiency and the effects can be substantial (as evidenced by the change in rankings for London), the effects may not be felt universally across a business.

Table A-C.1: Repex efficiency rankings

GDN	2008/09	2009/10	2010/11	2011/12	2012/13
East of England	4	4	4	6	7
London	6	3	5	4	2
North West	5	5	6	5	4
West Midlands	2	7	8	8	8
Northern	1	1	1	1	1
Scotland	7	8	3	2	3
South	8	6	7	7	6
Wales and West	3	2	2	3	5

Source: End of Period Review of the First Gas Distribution Price Control (GDPCR1), Ofgem, 2014

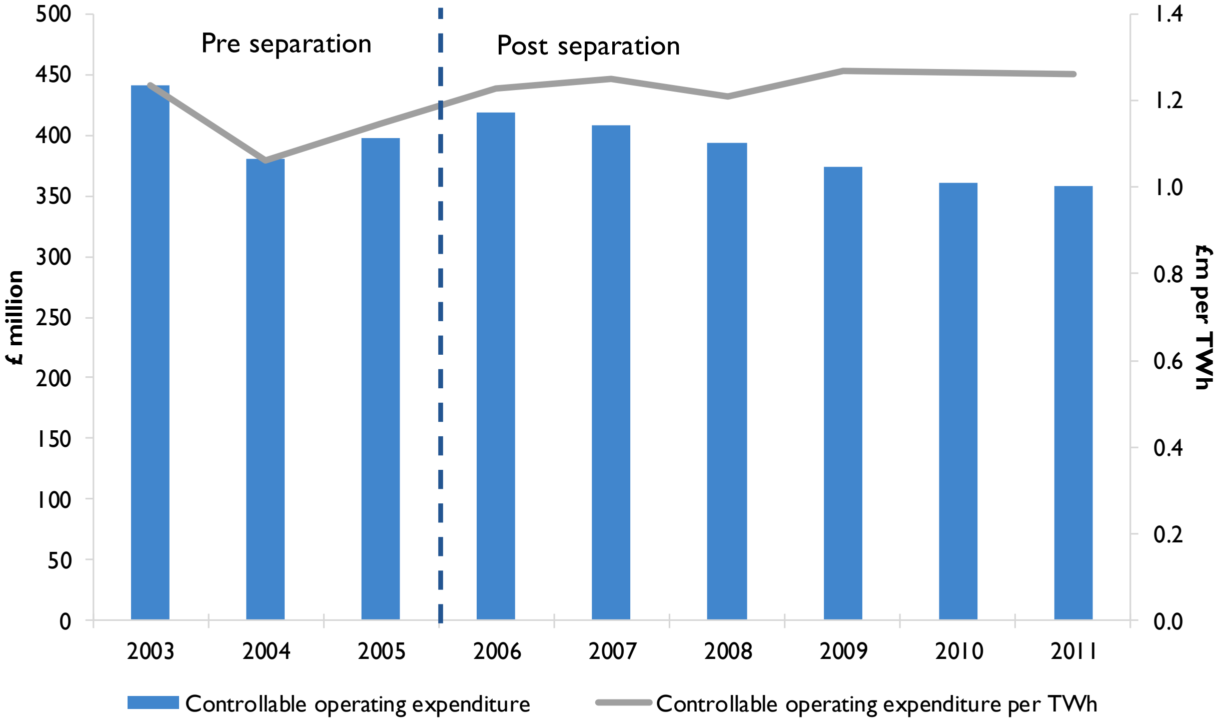
C.4.4. **Support and operations costs**

National Grid experienced a slight increase in controllable opex during the year preceding and the year following the separation of gas distribution into eight licence networks (2005), of which NG kept four. This was likely a result of the restructuring of its business during this period. Since then NG managed to reduce its controllable opex reasonably steadily with is costs reducing by 10.2% from 2006 to 2011. It took NG three years to reduce its costs to below the level prior to the separation of the distribution licences.

In contrast to its non-normalised costs, NG's per unit costs (TWh) increase from 2005 to 2011 by 10.1%. TWh is not an ideal measure for controllable opex costs as they are unlikely to be a direct driver of these costs. However, this is the best measure we have available as revenue and customer numbers for only NG distribution networks is unavailable pre-2005. Figure A-C.3 below shows NG's controllable operating expenditure per TWh of throughput. NG's controllable opex costs have been falling since 2006 (one year after the split of distribution licences), however on a per unit basis they are increasing as gas demand has been falling since 2004.

While it would be expected that reducing the size of a company may lead to the loss of economies of scale NG has managed to reduce its costs in real terms since the split. The approximate 15% cost savings that NG has managed to achieve since 2005/06 appears to be largely driven by rationalisation and standardisation processes undertaken by NG to reduce support and operations costs.

Figure A-C.3: National Grid's operating expenditure (2010/11 prices)



For controllable operating costs, Ofgem have undertaken a benchmarking analysis of costs over time. Their analysis shows that NG's four GDNs have consistently been ranked towards the bottom half of the ranking table for 2006/07 - 2009/10.

C.4.5. **Pace of change**

Renewals costs at National Grid increased for four years following the divestment both in absolute and normalised (cost per unit of output produced) terms. The costs then stayed relatively constant from 2008/09 onwards. The increase in per unit repex over time has primarily occurred because of the HSE's iron mains replacement programme, which commenced in 2002 with the aim of decommissioning all cast iron mains within 30 metres of property in 30 years. Over the longer term however, there has been some improvement in repex efficiency at some of National Grid's retained GDNs as shown in Table A-C.1, though this has not been universal across the business.

In terms of operating expenditure, Figure A-C.3 above shows that costs increased for the first year following the sale of four of NG's GDNs, but then steadily and consistently reduced throughout the period we analysed in our previous case study. However, more importantly, NG's costs per unit of output have remained broadly flat and the retained GDN's efficiency as benchmarked by Ofgem has been consistently lower than the four GDNs that were divested (as shown in Table A-C.2). Our previous report highlighted analysis by Rune Associates which identified IT spend as a large component of continuing inefficiency between the four retained GDNs and the divested GDNs. Network Rail also highlighted the cost of supporting the divested GDNs during the period immediately following the sale.

Table A-C.2: Opex efficiency rankings

GDN	2008/09	2009/10	2010/11	2011/12	2012/13
East of England	6	6	6	6	7
London	8	8	7	8	8
North West	7	7	8	7	6
West Midlands	3	3	5	4	3
Northern	1	1	3	5	5
Scotland	4	5	4	1	1
South	5	4	2	2	2
Wales and West	2	2	1	3	4

C.5. ANALYSIS OF COST CHANGES

The relatively poor performance of National Grid's retained GDNs, particularly in relation to renewals expenditure could be due to several factors, one of which is genuine inefficiency in certain areas. Ofgem's efficiency benchmarking suggests however that this inefficiency is not universal across the business. NG believe there are additional reasons for their relatively high costs, which include constraints imposed by the legacy of supporting the other companies prior to and following the sale of distribution networks, e.g. IT systems.

In terms of improving operating cost efficiencies, the sale of four distribution networks in 2005 has seemingly had a greater impact to date in driving efficiencies in the networks which were sold, which might argue for devolution of business units.

Overall, the experience of National Grid suggests that efficiencies are achievable in the context of devolution at Network Rail with Table 4.2 showing the extent of cost reductions. However, it also suggests that cost reductions are not guaranteed and may not be felt across all devolved business units.

Table 4.2: National Grid's cost reductions related to Network Rail's cost categories (real price changes)

Activity	Cost reductions and pace of change
Maintenance	Controllable opex costs fell by 15% from 2005/06 to 2010/11. Of this, maintenance and repair costs fell by 10% over the five years (1.9% per annum). However, during this period maintenance was largely centralised.
Renewals	43% increase in replacement expenditure over six years (6.2% per annum increase). However, this is driven substantially by a required increase in output, and we cannot say whether the unit cost of output has increased or reduced.
Human Resources	Controllable opex costs fell by 15% from 2005/06 to 2010/11. Human Resources make up approximately 5% of controllable opex (3.2% per annum).
IT	15% reduction in controllable opex over five years. IT makes up approximately 33% of total controllable opex (3.2% per annum).
Finance and accounting	15% reduction in controllable opex over five years. Financing & accounting makes up approximately 12% of total controllable opex (3.2% per annum).
Procurement, property and corporate	15% reduction in controllable opex over five years. Procurement, property and corporate makes up approximately 43% of total controllable opex (3.2% per annum).

Operations and other	15% reduction in controllable opex over five years (3.2% per annum).

APPENDIX D SSE CASE STUDY

D.1. BACKGROUND

SSE, formerly Scottish and Southern Energy, is a British electric utility company involved in various aspects of the energy industry in the UK, including electricity (generation, transmission, distribution and supply), gas (distribution and supply), the operation of telecoms networks, and other energy-related services (gas storage, contracting, connections and metering).

Following the UK electricity market privatisation in the 1980s, SSE (then named Scottish and Southern Energy) was then formed in 1998 following a merger between Scottish Hydro-Electric and Southern Electric.

In 2005 SSE was part of a consortium which purchased two gas networks from National Grid (Scotland Gas Networks and Southern Gas Networks), and so SSE added a gas distribution operation business to its portfolio. Upon acquiring these two companies, SSE and its consortium of buyers brought them under the same name - Scotia Gas Networks (SGN). This gas distribution network company became the second largest in the UK, with a value of just under £3bn at acquisition.

D.2. APPLICABILITY TO NETWORK RAIL

The acquisition of the Scotland and Southern gas networks led to the two gas distribution networks (GDNs) moving from a more centralised structure under National Grid Gas to a more independent structure partially owned by an energy company. Whilst Scotia Gas Networks retained its own board and management, the 50% stake acquired by SSE allowed the firms to share management best practices and identify opportunities for efficiencies through economies of scale and synergies in business support functions.

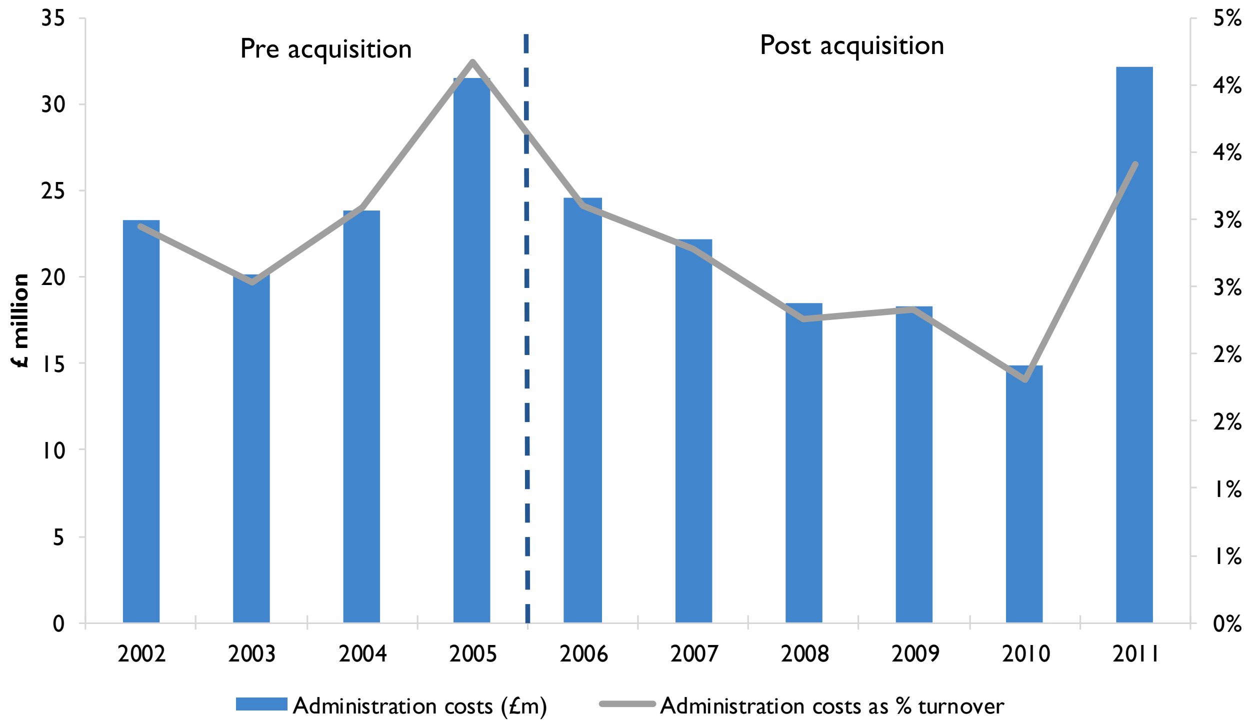
The experience of SEE and SGN may offer useful lessons on the areas where centralised support functions can offer efficiencies over more devolved functions.

D.3. EFFECT OF ACQUISITION ON COMPANY COSTS

D.3.1. Support and operations costs

In terms of relative efficiency of operating costs in relation to SSE's gas distribution business, our previous study showed that following its purchase of SGN in 2005 SSE, was able to reduce is administration costs, relative to its size, across the group. Corporate administration charges are allocated across each of SSE's network companies, the corporate administration charge to SSE distribution and transmission is shown in Figure A-D.1 below. We previously considered that the increase in administration costs in 2010/11 relate to some form of 'one-off' cost.

Figure A-D.1: SSE's corporate administration cost (2010/11 prices)



When considering SGN specifically, SGN reported that their two network companies had risen to 1st and 3rd in Ofgem's rankings by 2007/08, having been 7th and 8th respectively at the time of their sale.

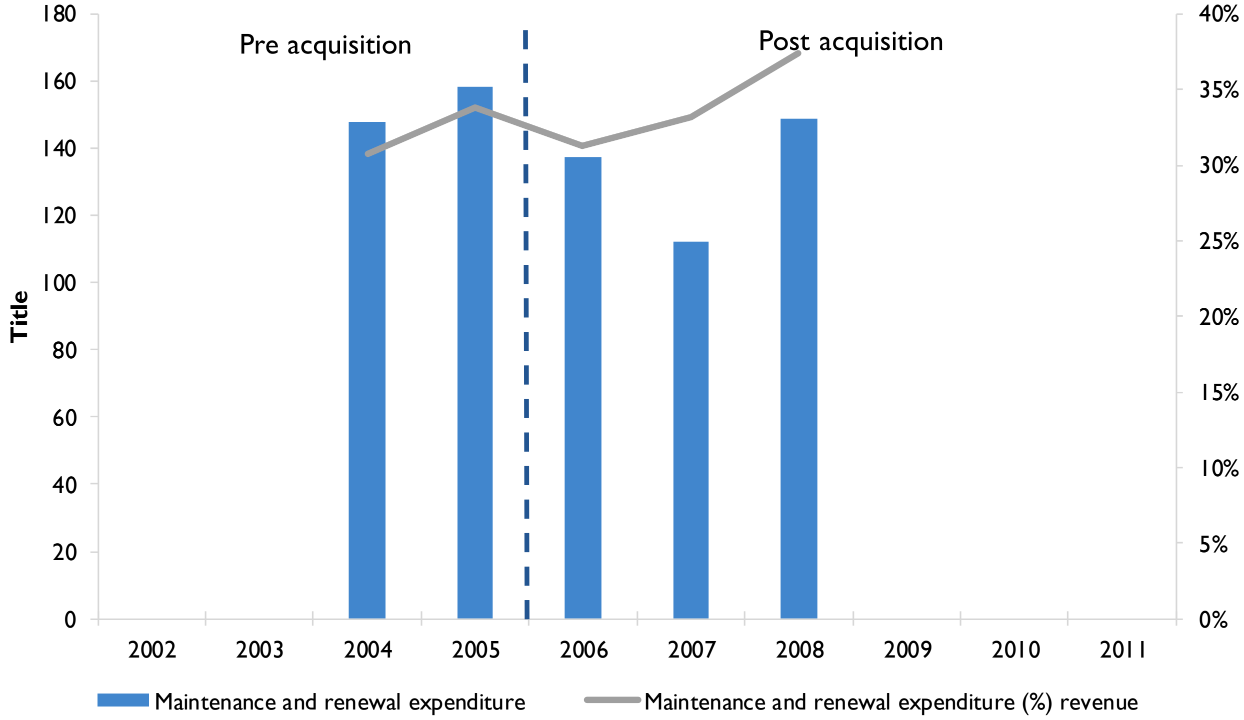
However, Ofgem's opex efficiency rankings are based on statistical benchmarking of cost data, which can obscure some qualitative factors. For example, during Ofgem's GDPCR consultation in 2007, two GDNs noted that SGN had benefited from purchasing some services at marginal cost by acquiring them directly from SSE (its parent company). This reduced the operating costs that SGN had to pay, and consequently had a distorting effect on the opex benchmarking rankings.

D.3.2. **Maintenance and renewals costs**

In terms of efficiency of replacement expenditure, SSE's costs have not increased significantly. However, as we noted in our previous study, SSE's maintenance activities were relatively cyclical and therefore year-on-year fluctuations in expenditure are to be expected.

From a quality perspective, as measured by the Ofgem quality of service incentive, SSE has improved its performance e.g. in relation to customer minutes lost and it has reduced the number of interruptions experienced by its customers. Figure A-D.2 below shows SSE's maintenance and renewals expenditure.

Figure A-D.2: SSE's maintenance and renewals expenditure



When considering SGN, the Scottish and Southern GDNs were considered 7th and 8th respectively in 2008/09 in terms of repex efficiency, three years after their sale. By 2012/12 however, this had improved with the two GDNs being ranked 3rd and 6th respectively. During the same period, Scottish and Southern GDNs continued to see improvements in their relative efficiency of both capex and opex.

D.3.3. **Lessons learned**

SSE have identified a number of areas where they believe their strategy has contributed to efficiency improvements in SGN and SSE's performance. These include sharing of depots, equipment and vehicles between SGN and SSE, common training centres, economies of scale in procurement strategies, and synergies in back office functions.

APPENDIX E CAA CAPEX GOVERNANCE CASE STUDY

E.1. BACKGROUND

Heathrow Airport Limited (HAL) is economically regulated by the Civil Aviation Authority (CAA). The charges HAL levies on airlines to use the airport are regulated by the CAA using an average per passenger price cap.

For the Q6 price control for HAL, the CAA has adopted a new approach to governing HAL's capital expenditure. The changes include giving airlines greater oversight over HAL's scoping, costing and performance of its capital programme. This was done through the creation of a Capital Portfolio Board (CPB), which meets monthly and is comprised of representatives from HAL and the airlines, with an observing role for the CAA. The CPB is responsible for managing the portfolio and monitoring the Q6 capex allowance envelope set at the beginning of the price control period.

Additionally, the CAA has built the use of an Independent Fund Surveyor into the price control process, analogous to the independent reporter used in rail and previously in water. This seeks to provide additional assurance that capex is scoped efficiently and delivered at efficient cost.

E.2. APPLICABILITY TO NETWORK RAIL

Both Network Rail and HAL are economically regulated and undertake significant capital expenditure that are frequently at risk of scope changes and cost overruns. However, HAL's capital programme tends to consist of substantially bespoke items whereas Network Rail's maintenance and renewals expenditure are largely made up of more routine activities, although clearly there can be element of bespoke scope in certain renewals. This means HAL's capital programme is more similar to Network Rail's enhancement programme.

It also means that gives us no objective measure of the cost efficiency of HAL's capital programme, because there is no way of making comparisons to learn whether something is being done more cheaply than before. Further, since the airport business is notable for the unevenness of capital expenditure from one year to the next, for example it will increase if a new terminal is being built, the total capital expenditure from one year to another, or the expenditure per passenger, is no suitable basis either. Thus we have not been able to assess whether this change has produced any change in cost efficiency except on some basis of qualitative perception. Airlines have told us they are more content than they used to be, thus on the basis of that perception there may have been an improvement.

Another kind of important efficiency change is whether the scope of projects, even at the same cost, is more suited to airline's business requirements, and thus offers increased value for money to them. This again is not measurable. As previously, we understand that the airlines perception is that they are more content than they used to be with HAL's capital expenditure as a result of the process.

Another key difference is between the competitive pressures faced by airlines compared with train operating companies, and the identity of who ultimately funds such capital expenditure. It is clear that airlines have to pay in full through the regulated charges for the net cost to the airport of such capital expenditures. The degree of competition between airlines is such that airlines are limited in their ability to pass on higher airport charges on to passengers. Train operating companies are exposed to fewer competitive pressures in that respect, and are able to recover higher costs imposed on them by Network Rail to a certain extent via the franchising process. In effect, the government funds the net effect of Network Rail's capital programme. This gives airlines a much stronger interest in assessing whether the cost of airport investments offers value for money to their businesses than TOCs do. Freight operating companies do have more exposure to Network Rail's charges than TOCs, and therefore may have a greater incentive to engage with the route supervisory boards.

Nevertheless, the new governance process implemented by the CAA for Q6 has interesting parallels for Network Rail. It created closer alignment between airlines and HAL, and gave airlines a greater say over HAL's capex plans and delivery through the CPB, akin to the route supervisory boards being set up by Network Rail.

E.3. LESSONS LEARNED

During our previous review of the new capex governance process, one of our key insights was that airlines had limited capacity to scrutinise HAL's capex programme. This was due to both the volume and technical complexity of material airlines were required to digest in order to effectively understand and respond to the capex programme. The role of the Independent Fund Surveyor was crucial in this context as a way of reducing this resource burden, though this did not fully resolve the issue.

In relation to Network Rail's devolution and in particular the use of the route supervisory boards, a key determinant in its success will be the extent to which train operating companies have the resource and expertise to engage effectively with the devolved route units. It is not unreasonable to assume however that greater resource dedicated to engagement with Network Rail's devolved business units would likely generate savings in excess of the resource costs. However, a risk would be that greater engagement between TOCs and Network Rail over the capex programme would increase the ability of TOCs to encourage change in the scope of programmes to their convenience with relatively little concern as to whether the cost of that scope change represented value for money to the ultimate funder.

Another insight was that the capex envelope set in the CAA's determination often became the de facto target cost for the portfolio. When there has been pressure on delivery of the portfolio within the capex envelope, this has been managed through an element of de-scoping or deferrals to ensure that the de facto target is met. What was less clear is whether the portfolio following deferrals or descoping was continuing to deliver value for money for passengers.

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