Finance and Policy Committee

Date: **14 October 2014**

Item 9: **Benchmarking and Financial Planning at TfL**

This paper will be considered in public

1 Summary

1.1 This paper presents an overview of how TfL is using benchmarking to inform projected operating costs and to provide assurance for both the level and pace of cost reductions. The analysis has been reviewed with the Independent Investment Programme Advisory Group (IIPAG).

2 Recommendations

2.1 **The Committee is asked to note that:**

(a) TfL's existing efficiency plans, once fully secured, should bring the costs of operating London Underground into line with other efficient and comparable metros;

(b) TfL's repeatable activities in Surface Transport, notably road maintenance/renewal and bus operations are the subject of benchmarking that demonstrates TfL delivers good value for money; and

(c) TfL is sharing best practice across the organisation and broadening the scope of benchmarking as the scope of its investment programme and activities (especially in Surface Transport) increases.

3 Rail and Underground Operating Costs and Productivity Trends

3.1 Rail and Underground (R&U) spends approximately £2.9bn per annum operating the railway (including corporate overheads). These operating costs will increase to £3.2bn in 2020/21, including Crossrail services.

3.2 R&U is on target to deliver total cost reductions of £8.1bn (between 2009/10 and 2020/21, after deducting implementation costs). This is split between operating cost reductions (£5.8bn) and capital projects savings (£2.3bn). These efficiencies have been included in the Business Plan and the analysis presented in this paper applies benchmarks to operating costs after the deduction of all planned efficiencies.

3.3 R&U uses *operating cost per passenger kilometre* as the primary measure of overall efficiency. This metric is expressed in real terms, i.e. excluding general price inflation (RPIX).

3.4 Real operating costs per passenger kilometre (pkm) were £0.22/pkm in 2013/14. This is 26 per cent lower than 2008/09; the majority of the reduction is due to increased passenger numbers. Although significant operational cost reductions have already been delivered, these have been partly off-set by the costs of introducing new timetables with greater service levels.

3.5 Real unit costs for R&U, including future projections for Crossrail, are forecast to reduce by a further 26 per cent by 2020/21. Excluding Crossrail, real unit costs are forecast to reduce by 23 per cent by 2020/21; R&U will deliver 15 per cent more passenger kilometres and the remaining improvement is due to underlying cost reductions.

3.6 R&U has compared its unit cost forecasts to two separate benchmarks:

(a) **Comparison with regulated utilities:** The first is an estimate of productivity improvement rates from regulated utilities. This was provided by the economists NERA in 2010 (as part of the periodic review with Tube Lines). NERA observed that a regulated utility would take 10 years to "catch-up" with the most efficient peer organisation, improving productivity by around 5.2 per cent per annum (the "catch-up" phase). After that, the rate of improvement would continue, but at the slower rate of 1.4 per cent per annum (known as "frontier shift"); and

(b) **Comparison with mainline rail:** The second benchmark is based on the findings from the 2011 Rail Value for Money Study (the McNulty report). This report suggested that costs of UK rail were 30 per cent higher than in other countries. This informed strongly the Office of the Rail Regulator's most recent price settlement for Network Rail. The Office of Rail Regulation settlement for Network Rail for Control Periods 4 and 5 (2009/10 to 2014/15 and 2014/15 to 2018/19) include efficiency targets of 23.5 per cent and 19.4 per cent respectively. This combines to a total target of 38 per cent over ten years.

3.7 R&U's real unit operating cost forecasts (including Crossrail) fall close to or below the trajectory derived from each of these comparators. This is shown in the following graph.

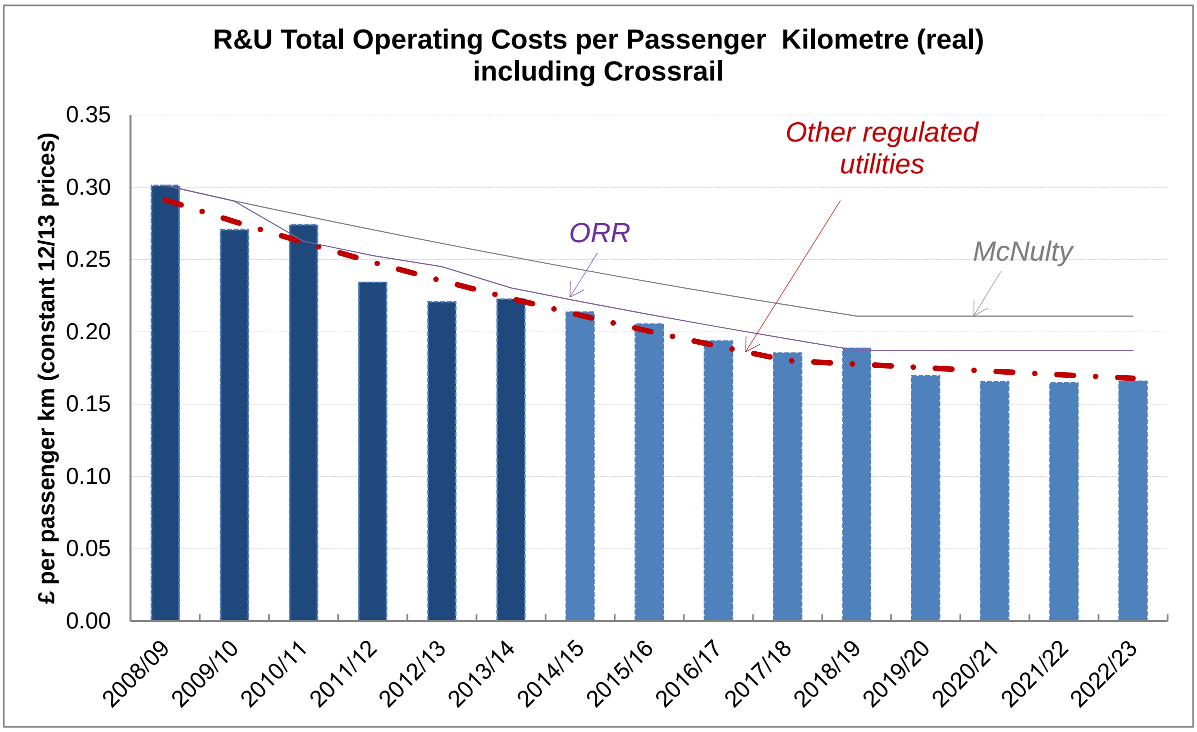

Figure 1 – R&U Real Unit Operating Costs, per passenger kilometre (2008/09 to 2020/21)

3.8 The base year chosen for the comparison is 2008/09 (when R&U's initial efficiency plans were drafted and two of the three large PPP contracts came in-house). Capital expenditure is not included. The small increase in 2018/19 reflects costs of Crossrail; there is a short timing lag between the provision and up-take of new services.

3.9 The projected unit operating costs are shown after deducting planned cost reductions. R&U regularly assesses the delivery status of its efficiency programme; of the £5.8bn of operating cost reductions, £4.6bn (85 per cent) have been secured, with £1.2bn (15 per cent) to go. The unsecured cost reductions represent approximately 10 per cent of annual operating expenditure. R&U's current assessment shows that there is significant risk attached to almost half (£0.5bn) of the unsecured cost reductions. Risk relates to both level of cost reduction and the pace at which changes can be agreed with staff.

4 Comparison of London Underground With Other Metros

4.1 London Underground (LU) regularly compares itself with other metros across a range of metrics – cost and cost recovery, productivity, reliability, safety and sustainability. The comparison is carried out through the Community of Metros (CoMET). CoMET and its sister organisation of smaller metros (Nova) forms a group around 30 metros from around the world, which regularly report key performance data via Imperial College. LU's most recent report, prepared in conjunction with IIPAG, was presented to the Rail and Underground Panel in April this year[1]. The report highlighted the rapid pace of improvement achieved by LU in recent years, particularly in cost efficiency and reliability.

4.2 Compared to international metros, LU's unit costs are undergoing one of the most significant reductions of all members – 3 per cent in 2012/13 (the most recent year for which comparisons are available) compared to an average reduction across all other metros of less than 1 per cent. LU is delivering more for less, as the investment in line upgrades has enabled the introduction of new timetables, which deliver more car kilometres.

4.3 In absolute terms LU performs relatively less well on this measure – it was the third most expensive CoMET metro in 2012/13.

[1] http://www.tfl.gov.uk/cdn/static/cms/documents/rup-20140411-part-1-item08-rail-and-underground-international-benchmarking-report.pdf

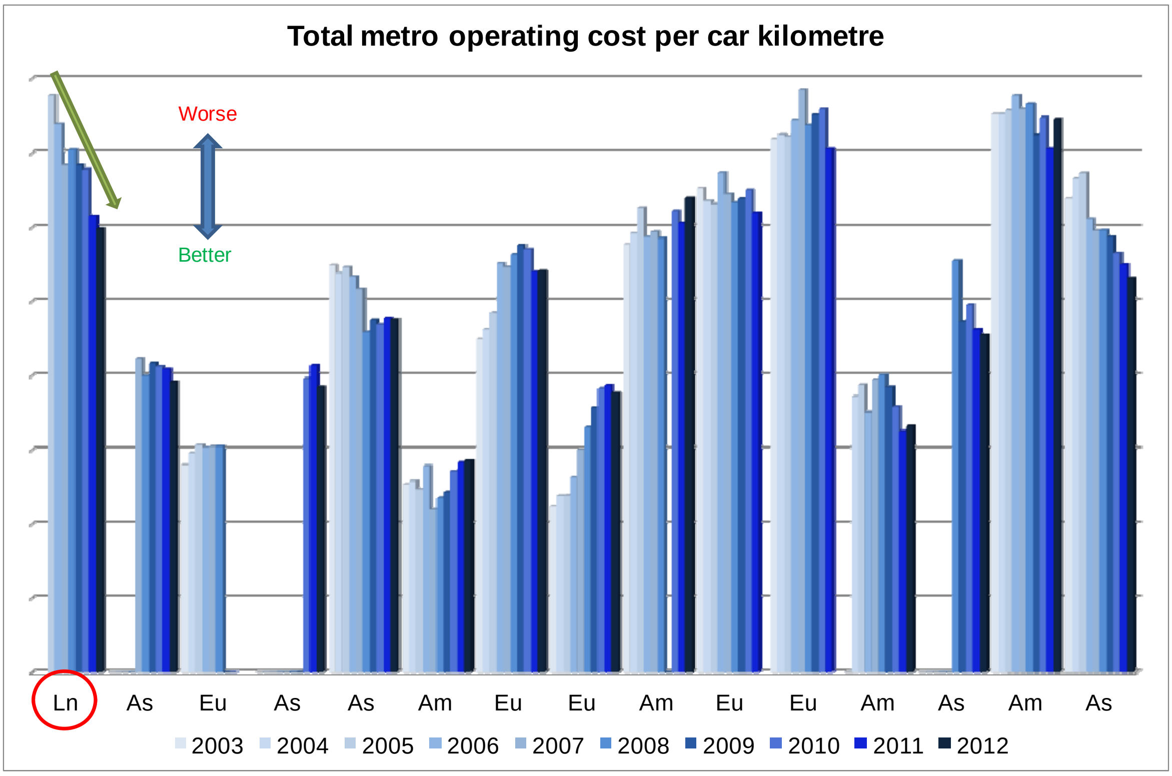

Figure 2 – LU Total Unit Operating Cost trends compared to other metros (2003/04 to 2012/13, US$ PPP normalised[2])

4.4 LU's total operating cost per passenger kilometre in 2012/13 was 30 per cent higher than the average for peers in other Western European and North American Metros. LU has explored this difference and now has a complete view of the causes of the gap:

(a) current cost reduction plans will reduce annual spend in 2020/21 by approximately £370m (or 12 per cent) compared to 2012/13;

(b) in addition, LU will deliver 18 per cent more passenger kilometres by 2020/21, improving overall efficiency by a further 8 per cent;

(c) this is partly off-set by costs of new timetables. LU will run 16 per cent more car kilometres by 2020/21;

(d) approximately 9 per cent of LU's costs are accounted for by factors which impact on London to a different extent (both adversely and favourably) than other metros, including wage factors. This has been estimated from detailed analysis carried out by Imperial College and is described in more detail below; and

(e) just 2 per cent of the 30 per cent gap remains unexplained. This equates to around £60 - £65m per annum out of an annual budget of £3.2bn. The gap may in part be explained by service policy choices in London that drive high customer satisfaction levels (for example the commitment to staff every station).

4.5 This is summarised in the following graph.

[2] Data reported by CoMET is presented in US dollars and has been normalised to reflect the Purchasing Power Parity (PPP) in each country. PPP normalisation is based upon a basket of comparable goods and so adjusts for variations in underlying economic conditions.

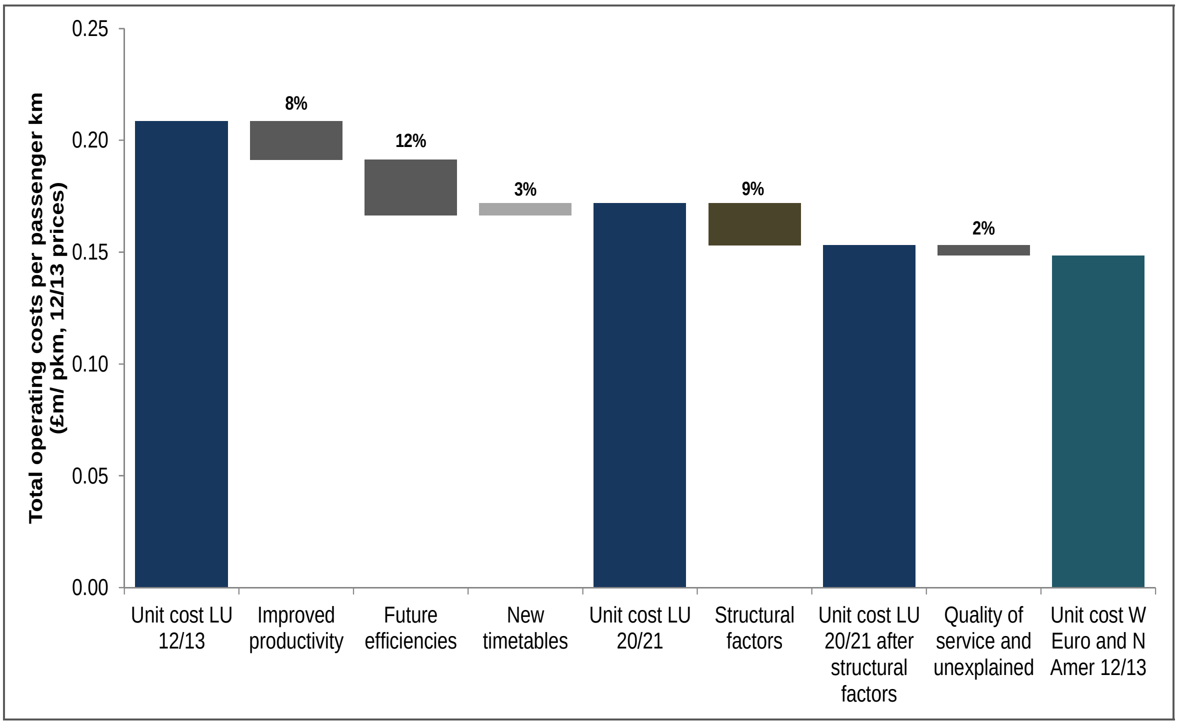

Figure 3 – LU Total Unit Operating Cost trends compared to Western European and North American metros (2003/04 to 2012/13, US$ PPP normalised)

4.6 The average unit cost for Asian and Far Eastern metros is approximately half that of Western Europe and North America. The following graph shows that post-efficiency unit costs in London are approximately 55 per cent higher than the Asian average. Just under half of this is accounted for by structural factors that have been identified so far with the remainder still to be explained.

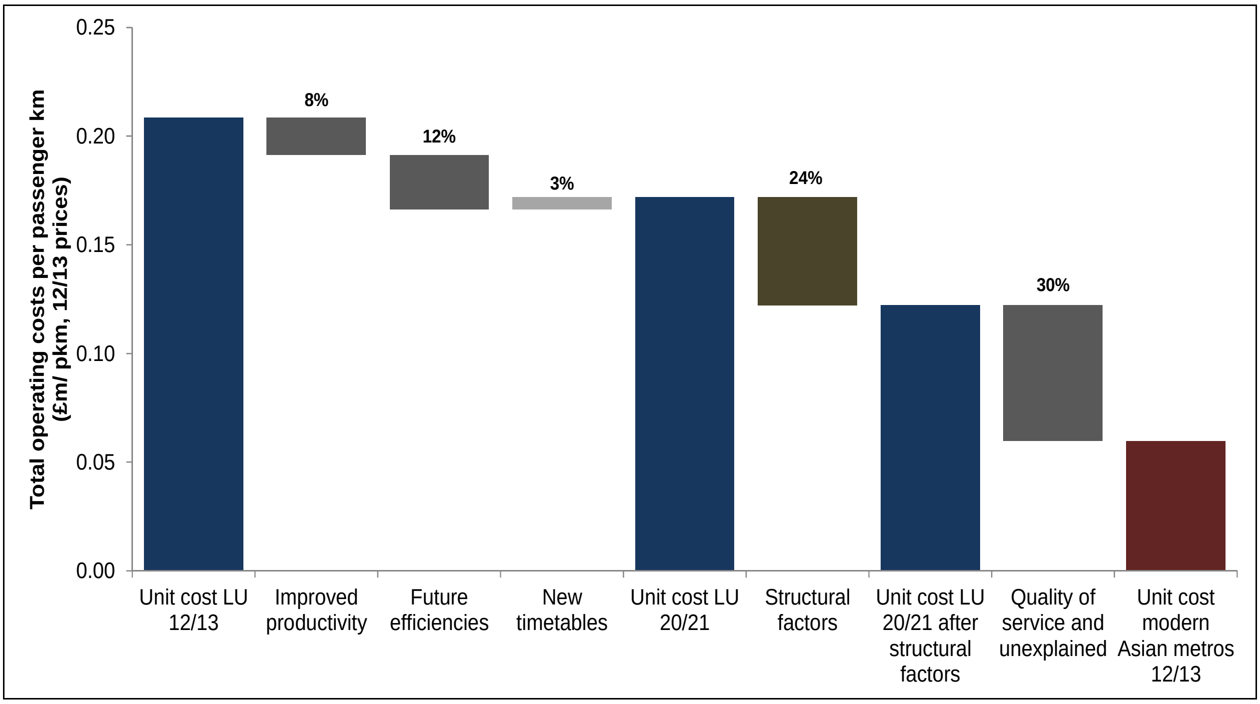

Figure 4 – LU Total Unit Operating Cost trends compared to modern Asian metros (2003/04 to 2012/13, US$ PPP normalised)

4.7 There are two key differences between Asian metros and the Western European and North American peer group. The first is the relatively low wages. The second relates to the characteristics of the Asian networks; which are designed on more efficient principles. For example, operations are delivered with higher levels of automation, rolling stock is more energy efficient and maintenance is more productive as a result of broader tunnels, sidewalks, segregated traction power, etc.

4.8 More detailed analysis is currently being carried out to more fully understand how London compares to the best class metros.

5 London Underground: More Detailed Analysis

Research carried out by TfL

5.1 Compared to other metros, LU’s service operations costs are broadly in line with the CoMET average (measured per car kilometre). However, infrastructure maintenance costs, which include track and signalling, are 64 per cent higher than the average of other metros and its station facilities maintenance costs are 44 per cent above the average of its peers. LU’s rolling stock maintenance costs are, by contrast, just below the average of other metros.

5.2 In response to these observations, TfL carried out detailed studies into track and signalling maintenance and now has an enhanced understanding of the factors and opportunities to improve.

5.3 The findings include:

(a) City-wide wages in London are around 80 per cent higher than the average for cities where other CoMET and Nova metros operate. This factor alone accounts for 40-50 per cent of the difference between London’s cost of track and signals maintenance and those of low cost metros;

(b) metros with a 3rd (or 4th) rail power system are more expensive than those with an overhead catenary. This is partly an accounting issue: the cost of maintaining power rails is typically included in the track budget, while the cost of maintaining catenary power lines is not. Nonetheless the power rails are close to the running rails and impede track maintenance, making the work harder, more time consuming and costlier;

(c) traditional track form (jointed bull head rail on wooden sleepers) is more expensive to maintain than modern designs of track form (typically continuous flat bottom rail on concrete sleepers). LU has four times the CoMET average of traditional track form and around 20 per cent of track maintenance cost difference is due to this factor. LU is replacing jointed track and so would expect this cost driver to reduce over time;

(d) metros that have built an incident response organisation to resolve faults more swiftly have higher signalling costs. The London lines perform better than the rest of the study group, with only Hong Kong achieving a comparable Mean Time to Repair (MTTR). There is a wide range of MTTR and London is on average eight minutes faster than other modern metros; and

(e) lines with a higher density of line-side assets (such as LU) have higher signalling maintenance costs.

5.4 The findings have provided assurance that TfL's existing efficiency programme will bring infrastructure costs in line with other high performing metros (taking into account local structural factors). A comprehensive cost reduction programme for tube maintenance has already delivered over £0.4bn of cost reductions, with action taken to secure a further £1.2bn to 2020/21.

5.5 The planned cost reductions for signalling include changes to maintenance cycles, i.e. reductions on the Bakerloo and Victoria lines following a review of safety and performance implications. There are also cost savings (achieved and planned) on the Victoria and Sub-surface lines that take advantage of the signalling upgrades. These include a reduced programme of relay changes and the separation of incident and maintenance activities. A further review of the Jubilee and Northern line signalling will be undertaken now that the new signalling systems have bedded in.

5.6 For track, changes to maintenance regimes, such as reduced inspection and cleaning frequencies, will bring them in line with new standards that promote risk-based assessments for inspection intervals, which will lead to a reduction in work volumes. In addition, revisions to the organisation structure and working practices have also contributed to a reduction in unit rates.

5.7 The Automated Track Monitoring System is planned to be fitted on all rolling stock fleets by 2015. This will automatically monitor track quality, dramatically improving the visibility in deterioration rates in track condition and will drive timely, proactive maintenance. As a result, reliability will improve as fewer temporary speed restrictions will be required.

5.8 LU continues to research lessons from other metros and these are actively informing its future strategies and improvement initiatives. A list of recent and current studies is attached in Appendix 1.

Imperial College's econometric assessment

5.9 TfL's own analysis shows that simple unit cost comparison between metros does not tell the full story. Local factors such as city-wide wage levels, the age of assets, service quality commitments and electricity market prices vary between metros and these do significantly influence costs.

5.10 In 2012, TfL commissioned the Railway and Transport Strategy Centre (RTSC) at Imperial College to undertake more in-depth research to help TfL improve its understanding of the factors which impact most on LU's costs. Using the rich data set gathered from over 20 metros internationally, RTSC's research uses multivariate regression analysis to estimate the *expected costs* for the five main areas of metro operation – train and station services, rolling stock, infrastructure and station maintenance.

5.11 The preliminary findings compare LU's actual costs (for 2012/13) with an "expected cost" derived from the statistical analysis. This comparison is summarised in the following graph.

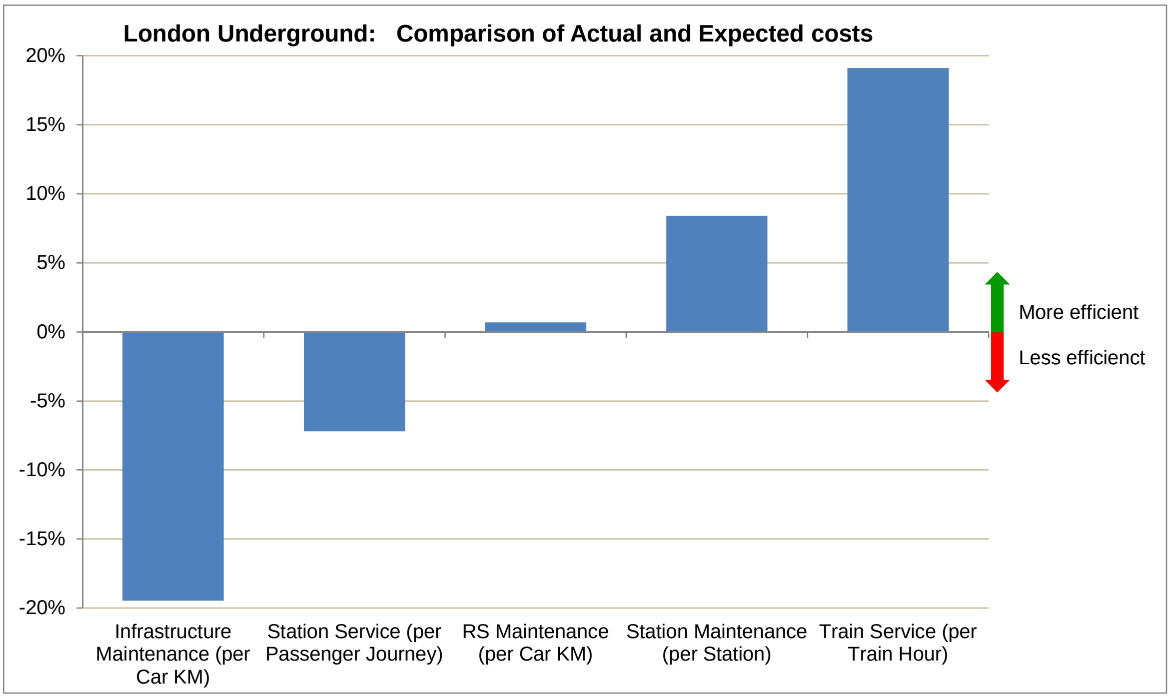

Figure 5 – Preliminary findings from RTSC cost efficiency research

5.12 If expected costs exceed actual costs, LU is more efficient, and vice versa. The graph above shows the relative efficiency as a percentage, where positive results indicate greater cost efficiency and negative results indicate inefficiency.

5.13 In 2012/13, train service costs (including the costs of traction electricity), rolling stock maintenance costs and station maintenance costs are efficient compared to the expected level. However, station service costs and infrastructure maintenance costs are less efficient than expected.

5.14 As with any benchmarking, these preliminary results are indicative rather than definitive. However, TfL is now considering the implications for its efficiency programme.

(a) **Train services**: LU's relative efficiency in this area may be partly due to the relatively long distances on some of its lines (particularly Metropolitan, Central and Piccadilly lines) compared to other cities where services are concentrated in the central districts. Notwithstanding this finding, LU is considering opportunities to enhance productivity in this area. (Note, as very few of the comparator metros included in the analysis are fully automated the level of automation has not significantly influenced the expected cost of LU's train services.)

(b) **Station services**: Staffing levels in London are considered moderate compared to other metros. However, when city wage levels are taken into account, LU is only one of three high wage metros that provide moderate to high levels of station staff. Under the Fit for the Future Stations Programme, LU has committed to staff every station during train services and will at the same time achieve cost reductions of around £50m per annum. LU's analysis indicates that successful completion of the proposed Fit for the Future Stations will bring LU's station service costs in line with levels expected based on international norms.

(c) **Rolling Stock maintenance**: LU continues to look for efficiency improvements in rolling stock maintenance; LU has already delivered cost reductions of £40m per annum in fleet maintenance, with stretch targets to secure further reductions of £13m per annum.

(d) **Infrastructure maintenance**: the detailed benchmarking was described in section 3 above. LU has already delivered cost reductions of £61m per annum in infrastructure maintenance. In addition, the infrastructure team has been set stretch targets to reduce costs by a further £40m per annum. These savings will be delivered through a range of initiatives, including introduction of mechanised maintenance, increased automated inspection and changes to maintenance regimes in response to the introduction of modern assets. Overall, by 2020/21 the unit cost of track and signalling maintenance is planned to reduce by 16 per cent (in real terms and measured per track kilometre).

(e) **Stations maintenance**: LU has already delivered cost reductions of £47m per annum in stations maintenance. In addition, the stations maintenance teams have been set targets to further reduce costs by up to £11m per annum, primarily through improved contract terms as cleaning and maintenance contracts are renewed.

5.15 The preliminary findings reveal important factors that affect metro costs within and outside operator control. Work is continuing with RTSC to understand why metro cost performance varies between different cities, including line-by-line comparisons for LU. LU is also exploring in more detail the variations between London and the best in class metro. This requires a holistic view of operating cost, investment and performance. An example of the operating cost analysis is presented in Appendix 2.

5.16 Based on historic cost efficiency improvements across all metros, Imperial's analysis also indicates that the potential trajectories for the future efficiencies are in the range 1.5 per cent to 3.0 per cent per annum. R&U's current business plan exceeds this target.

6 Surface Transport Operating Costs and Productivity Trends

Buses

6.1 TfL spends around £2.2bn a year on bus services (£0.1bn capital, £2.1bn operating costs). These operating costs include the cost of bus operators purchasing, maintaining and renewing vehicles.

6.2 All TfL bus routes are competitively tendered every five to seven years. This provides an on-going view of market pricing and is one indicator that TfL is obtaining good value for money.

6.3 Tender returns alone would not indicate if TfL's specifications or business practices drive uneconomic costs; for this and many other reasons TfL was a founding member of the International Bus Benchmarking Group (IBBG) ten years ago. As with CoMET, this group is administered by Imperial College. It contains 14 members from 13 cities.

6.4 The 2014 IBBG report finds that:

(a) London has the second lowest subsidy requirement among its peers;

(b) operating cost per vehicle km (the analogue for buses of Figure 2 above) is the third lowest and in the best quartile; this has happened while ridership and customer satisfaction levels have increased; and

(c) operational efficiency (measured through lost vehicle kilometres due to internal reasons and excluding mileage lost due to traffic congestion) is in the second best quartile and fifth best in the group.

6.5 TfL works closely with the IIPAG to share IBBG data and reports. IIPAG's Annual Benchmarking report for 2014 recommends that "*The current approach to delivering bus services is maintained".*

6.6 The combination of tender returns and IBBG data provide TfL with confidence that its bus services represent internationally-leading value for money. TfL continues to work with operators to reduce costs while improving service, such as the recent introduction of cash free buses.

Other operating expenditure

6.7 TfL plans to spend £0.8bn on non-bus operating costs this year, including road operating costs, walking cycling and safety operations, policing and enforcement, taxi, private hire and dial-a-ride and river services. TfL's road operating costs are principally delivered through the London Highway Alliance Contract (LoHAC) and the Traffic Control Maintenance and Related Services (TCMS) contract. Comparison of the rates of work on LoHAC with the previous Highway Maintenance Works Contract shows reductions in unit rates of between 12-35 per cent. The comparison of TCMS2 (which goes live in October 2014) with its predecessor indicates operational savings will be greater than 12 per cent. This is the result of highly competitive tendering and dialogue throughout the bidding process. The dialogue process allows TfL to explore with potential contractors the price impact of various elements on the specification.

6.8 The IIPAG's draft annual benchmarking report 2013/14 notes that the LoHAC costs to date are broadly in line with the initiative's business case, reaffirming TfL's financial estimates. TfL will actively monitor the LoHAC contract to ensure it delivers the best value for money and are directly engaged with IIPAG on a continuing programme of road-asset benchmarking.

6.9 TfL sits on the board and is an advocate of the Highways Maintenance Efficiency Programme (HMEP). HMEP is facilitated by the Department for Transport and its purpose is to support the UK highways sector on its journey to transform its services – delivering service improvements and substantial efficiencies. HMEP includes a programme to share and promote good practice, including cost and performance information, across the sector. TfL's work on LoHAC was highlighted as a case study in HMEP's 2014/15 annual plan.

6.10 TfL uses customer satisfaction surveys to inform highway operations. The annual National Highways and Transportation (NHT) survey provides comparators with over 50 other UK highway authorities across topics like carriageway, lighting, drainage and management of road works. As well as providing a comparison with other highway authorities, from 2014 the survey has been designed to also support comparison between the four LoHAC areas.

6.11 TfL also carries out a Transport for London Road Network (TLRN) customer satisfaction survey. Prior to 2014 this was an annual survey – from April 2014 it is quarterly. The TLRN survey can be analysed by user type, for example, motorist, pedestrian, cyclists, HGV driver and so on. The customer satisfaction information is being used to inform and target service improvements.

6.12 TfL also compares and benchmarks a range of asset and service measures with London's 33 boroughs, through the London Technical Advisors Group. The metrics include carriageway condition, bridge condition, response to defects and so on. The information shared is used to identify, promote and share areas of good practice across London.

7 Capital expenditure

7.1 TfL plans to invest around £2.0bn on its infrastructure in 2014/15.

7.2 R&U plans to spend £1.8bn, including £1.1bn upgrading trains, signalling and stations. R&U now has a comprehensive programme of recording and tracking the unit costs of defined repeatable work items (RWI) covering around two-thirds of planned expenditure. The IIPAG's separate benchmarking report on this has also been provided the Committee.

7.3 Excluding buses, Surface Transport plans to spend around £0.3bn, the vast majority of which is in road renewal and cycling infrastructure. LoHAC applies to both maintenance and renewal works; the efficiency delivered by LoHAC thus also applies to road capital renewal and to many elements of cycling infrastructure.

7.4 The growing Surface Transport element of TfL's investment programme sees a greater volume of expenditure across a greater variety of projects. TfL is transferring the experience gained from its R&U projects to the newer Surface Transport investment. One of many such examples is that of cost estimating. Across projects delivered through the Project and Programmes Directorate (PPD) a set of RWI has been developed, based on the process employed for Tube investment.

7.5 RWI examples include the cost per metre of kerbing, or the cost per metre squared of cycle lane. These provide a common currency to compare different schemes, and as importantly a common method to collect, store and request data from contractors. This allows TfL both to compare unit costs for schemes and to improve the accuracy of estimates during the project lifecycle.

7.6 The ongoing collection of RWI data is already being used to refine financial forecasts for projects and provides the data to expand benchmarking.

7.7 TfL continues to develop its benchmarking strategy and is working with the IIPAG to identify ways to continuously improve the scope of activities for which benchmarking is undertaking. The focus continues to be to benchmark activities where this can drive business value, especially for expenditure that is soon to be re-tendered.

8 Conclusions

8.1 TfL is using benchmarking to look at its cost efficiency targets from several different perspectives, summarised below.

(a) Overall productivity trends (using real unit operating costs as the primary metric) show that the **pace of cost reduction** achieved and planned by R&U is in line with levels that might be expected by regulated utilities or mainline rail;

(b) Unit operating costs reported by LU are high compared to other metros. These conventional comparisons, however, do not take into account local cost drivers. They have, however, prompted useful further investigation;

(c) LU's own studies into how other metros carry out track and signalling maintenance have revealed a wide variety of approaches and costs. The principal cost pressures in London can be attributed to local wage levels, the greater age and more traditional form of the assets, as well as higher service quality objectives. By incorporating existing efficiency plans into the analysis, R&U is now assured that these plans will bring LU's costs in line with international norms;

(d) Independent research by RTSC, using a statistical approach, is helping LU to gain a better understanding of its cost drivers and to identify opportunities to improve further; and

(e) LU's existing cost reduction plans are extensive, tackling all aspects of operations, both directly managed activities and those sourced from external suppliers. To achieve the current targets – particularly across maintenance and stations operations – LU is undertaking lengthy and detailed engagement with staff. At the same time, LU continues to deliver new and upgraded trains and signals to meet the ever increasing demand. Therefore, LU currently has limited capacity to undertake any further cost reduction initiatives.

8.2 Overall, the findings from these different approaches provide assurance that R&U's existing plans should, over time, be sufficient to achieve a step-change in cost efficiency and bring costs in London in line with international norms. R&U continues to set stretch targets for its delivery and support teams in order to achieve this position.

8.3 TfL's work with external benchmarking bodies demonstrates that the major components of Surface Transport expenditure (buses and road maintenance and renewal) are delivering industry leading value for money. TfL is transferring the R&U benchmarking best practice to Surface Transport and is currently reviewing how to further broaden the range of expenditure that can be fruitfully benchmarked.

List of appendices to this report:

Appendix 1: Recent and current best practice studies carried out by R&U

Appendix 2: Example of more detailed benchmarking analysis

List of Background Papers:

IIPAG Benchmarking Report 2013/14

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Appendix 1

Recent and Current Tube Best Practice Studies

Topic	Status	Study objectives
RELIABILITY & CUSTOMER SERVICE		
Dwell-time management (two studies, one by CoMET and a second by ISBeRG)	Ongoing	To understand the operational methods used by metros to manage dwell time and improve service regularity
Driver-only operation (a study by ISBeRG)	Complete	To understand the operation of sub-urban trains with driver-only operation.
Managing Major Events (study by Nova)	Draft	To capture best practice from Nova members that have successfully delivered major events, and produce a best practice guide for all members to use in the future.
Customer service excellence (a study by ISBeRG)	Complete	To understand the approaches taken by sub-urban railways to deliver improved customer service.
Predictive and Preventative Maintenance 1: Remote condition monitoring	Complete	To understand the approaches taken to implementing predictive and preventative maintenance practices by other best practice infrastructure maintainers (metros, railways, utilities and others)
Predictive and Preventative Maintenance 2: How other infrastructure organisations manage Data Analytics	Ongoing	Study for Predictive and Preventative Maintenance: How other business's use and apply data analytics, and to understand the business benefits of a data analysis function. ToR agreed and in process of agreeing target organisations
Maintaining reliability during upgrades	Ongoing	What are the techniques, competences and processes required to avoid service delays during long periods of intrusive upgrade works?
Using Delay and Incident Data to Improve Service Quality (study by CoMET)	Ongoing	1. Increase the accuracy and consistency of train delay and incident data 2. Identify best practices for using delay and incident data to improve service quality, reliability, and capacity
International Customer Satisfaction Survey (Study by CoMET)	Draft	The first customer satisfaction survey for metros; 18 participated including LU and DLR; Over 40,000 responses received between 28th April and 25th May across all metros, of which LU and DLR customers have contributed nearly 7,000.
SAFETY		
HSE management	Ongoing	How other organisations provide HSE support to their business, and the effect that this support has on HSE performance. (Note, ISBeRG is also conducting a study of HSE practices in suburban railways).
EFFICIENCY		
Fraud / fare evasion (a study by ISBeRG)	Complete	To understand sub-urban metros experience of fraud and fare evasion and approaches to managing this issue.
Improving rolling stock maintenance practices (a study by ISBeRG)	Complete	To understand rolling stock maintenance of sub-urban railways
Rolling Stock Overhaul	Complete	To understand the frequency, scope and costs of rolling stock overhauls.
Track maintenance & use of mechanisation	Complete	To understand the maintenance regimes and costs of track maintenance in other metros internationally
Signalling maintenance	Complete	To understand the maintenance regimes and costs for signalling maintenance in modern Asian metros
Train Operations engagement	Complete	Study for Trains Strategy: How other metros manage and engage with their train operators, to understand if there are any practices that could be beneficially imported to LU
Communicating with	Complete	Communications with passengers: To benchmark the winning

Topic	Status	Study objectives
Customers (Study by CoMET)		strategy for managing communications with customer, understand how new technologies and social media are being used.
Service Control	Phase 1 complete	As LU explores the potential for increased automation and integration in both train operations and service control systems, what is the impact of such developments on the service control system? In addition, the study will also cover experiences of metros using automatic train regulation and the relationship between timetable recovery margins and service dependability.
Station Management and Mobile Technology (a CoMET study)	Ongoing	A study co-sponsored by LU (with Hong Kong) to understand the change strategies other metros are developing or implementing with respect to the control and operation of stations, in particular a focus on improving customer service and the greater use of technology to support staff.
CHALLENGING CONVENTIONAL WISDOM		
Night Tube	Ongoing	Contacting most of the world's metros that run late night or 24 hour services to understand the issues they face. Focus will be on customer experience and stakeholders.
NEW TUBE FOR LONDON & LINE UPGRADES		
Best practice procurement 1: Rolling Stock	Complete	To understand lessons learned by other metros, railways and fleet operators who have procured new fleet in recent years.
Best practice procurement 2: Railway Control Systems	Complete	To understand lessons learned by other metros, railways and users of complex control systems who have procured new control systems in recent years.
Cost of railway control systems	Complete	To provide a benchmark range for the core contract costs of procuring new CBTC railway control systems.
Human Operational Support in Automated lines (CoMET study)	Complete	A study co-sponsored by LU (with Hong Kong and Taipei) to understand the lessons from implementing automated services. This study was supplemented by a series of visits by the New Tube for London team to automated metros, including brown-field conversions. The visits included approaches to obstacle detection.
Platform Screen Doors	Ongoing	To understand how other metros have implemented PSDs in brownfield locations, the costs of doing so and the asset performance achieved.
Railway Control Systems	Ongoing	To complement the signalling procurement study, this research is to understand from other metro operators the functionality of the CBTC control systems they have implemented and how these systems support service recovery.
CAPITAL PROGRAMMES		
Decision strategies for metro asset renewal (a CoMET study)	Complete	A study to share best practice and tools for whole life asset decision-making.
Asset information systems and applications (a Nova study)	Complete	To share knowledge on current asset management systems. This was supplemented by workshops with the members of the IUK Infrastructure Benchmarking group
Impact of new lines, extensions and major investments on the metro (a Nova study)	Complete	To understand the strategies of metros that have recently implemented line extensions or opened new lines.

Example of more detailed benchmarking analysis

Appendix 2

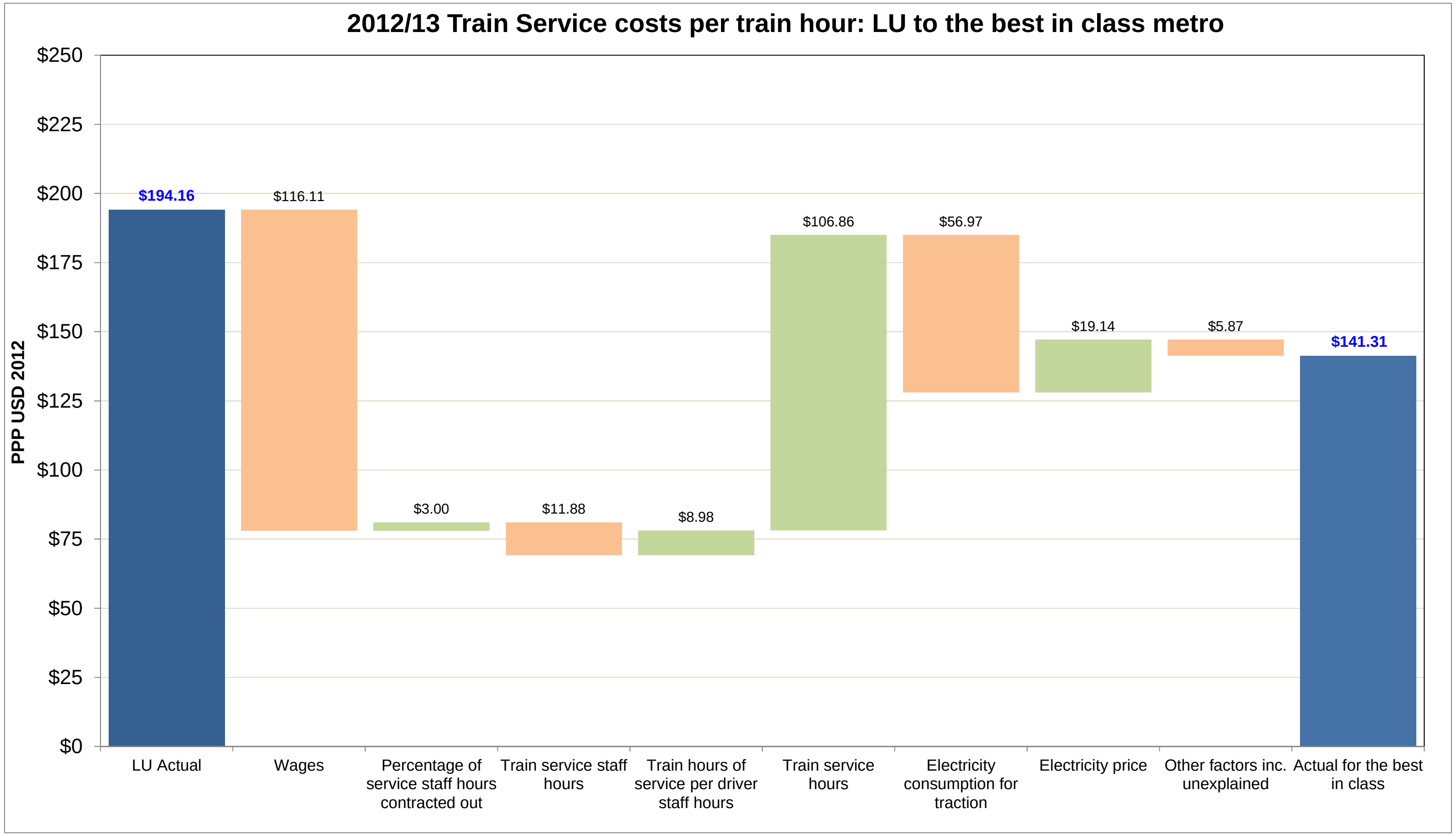

Figure 6 – London Train service costs compared to best in class metro – based on econometric analysis

The graph above presents the main differences between the cost of delivering train services in London compared to the best in class metro included in Imperial College's econometric analysis. Unit costs in London are 37 per cent higher than the lowest cost metro. London's high cost is chiefly due to relatively high local wage rates. London, however, benefits from economies of scale because it delivers a higher number of train hours and so recovers fixed costs over a greater output. Traction electricity usage is also relatively high on London's older design trains, but this is off-set by lower electricity prices.