Office of the PPP Arbiter

1 June 2009

International benchmarking of the costs and performance of maintaining and renewing metro systems: Additional Data Study report, BSL, May 2009

In January I published a study by BSL which compared the cost and performance of Tube Lines and Metronet with international metros and identified potentially transferable practices, strategies and approaches.

Click here to access the January report and covering note.

As an extension to this report, to broaden the evidence base of this comparison and compare the findings with the original data, I have commissioned BSL to source existing data from other metros that could be compared to the original data.

The report on this Additional Data Study is attached.

I have commissioned BSL to undertake a second round of the original study which will add two further years of data and cover some additional areas of cost information. I expect to publish this later in the year.

I expect to draw upon this work and developments of it in the Periodic Review of Tube Lines' PPP Agreement now underway. However, I recognise that the interpretation of any benchmarking study is dependent on a number of factors including the relevance of the external comparators, the robustness of the methodology adopted and the quality and quantity of the underlying data.

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Office of the PPP Arbiter

International Benchmarking Study – Additional Data

Final Report

London/Hamburg, 12th May 2009

Content

1. Executive Summary

The Office of the PPP Arbiter (OPPPA) is continuing its assessment of whether the London Underground Infrastructure Companies ("Infracos") are carrying out their activities in an overall economic and efficient manner and in accordance with Good Industry Practice.

BSL Management Consultants – a member of the Lloyd's Register Group – has been appointed to compare the findings of its 2007-08 international benchmarking study of the Infracos against comparable international metros (Peers). This was through cross-comparison with other available data from six international urban rail companies, whose fundamental characteristics were broadly comparable to the previous sample. At least four additional data sets from the six companies selected from prior BSL studies were added to the earlier benchmarking results for track, rolling stock and signalling. This data was harmonised to price levels of a comparable base year and normalised using the same normalisation factors used in the earlier benchmarking study. In addition, output from another benchmarking project (CoMET/Nova) was analysed.

For track, data from the added peers confirms low failure rates and low numbers of in-house staff as found at the "good performers" in the earlier benchmarking. Track maintenance costs turned out to be lower than the weighted average of previous peers, but above the "benchmarking range". For track renewal, the cost range of the earlier international peers was confirmed. The high spread between Infracos and other peers, which suggests fundamental differences in the way that renewals are undertaken by the peers, was also observed in the CoMET/Nova data.

Rolling stock availability for the added peers turned out to be lower than at the Infracos. The comparatively high availability of the Infracos' cars was also confirmed by the CoMET/Nova data. Rolling stock maintenance costs at two of the added peers were within the earlier "benchmarking range", while costs of the other two new peers were higher, each for specific reasons. CoMET/Nova also shows rather high rolling stock maintenance costs at Infracos compared to most international peers.

For signalling, costs of all added peers were within the "benchmarking range" while their average performance was, with one outlier, similar to the weighted average of the earlier peers.

Altogether, data from the added peers generally confirms most of the results from the previous benchmarking. Thus, the established "benchmarking ranges" for costs and performance of track, signalling and rolling stock were further substantiated.

2. Project Approach

2.1 Selection of additional peers

BSL has reviewed its extensive data stock and has added at least four additional data-sets, for each asset group, to the previous study; these were taken from a sample of six companies.

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	Added Peers					
Asset groups	Company 1	Company 2	Company 3	Company 4	Company 5	Company 6
Track	X	X	X	X		
Rolling Stock	X	X	X		X	X
Signalling	X	X	X	X		

Figure 1: Added peers by asset groups

The data has been sourced from other BSL consultancy studies and is presented anonymously. The description of these peers by code letters is mixed in the figures of this report for confidentiality reasons.

In addition, data from another benchmarking project (CoMET/Nova, provided by OPPPA) has been incorporated. Peers of this benchmarking are the metros of Berlin (BVG), Hong Kong(MTRC), *London (LUL)*, Mexico City (STC), Madrid (Metro de Madrid), Moscow (MoM), *New York (NYCT)*, Paris (RATP Metro/RATP RER), Santiago (Metro de Santiago), Shanghai (SMOC), São Paulo (MSP), Buenos Aires (Metrovías), *Barcelona (TMB)*, Bangkok (BMCL), Delhi (Delhi Metro Rail Corporation), Glasgow (SPT), *Hong Kong (KCRC, East Rail/West Rail)*, Lisbon (Metropolitano de Lisboa), Milan (ATM), Montréal (STM), Newcastle (Nexus), Naples (Metronapoli), Rio de Janeiro, Singapore (SMRT), Sydney (City Rail), Taipei (TRTC) and *Toronto (TTC)*. Since these data were provided anonymously to BSL, duplication with the peers from the BSL-benchmarking (as marked in *italics*) could not be eliminated.

Due to lack of transparency and lack of detailed knowledge about the definition of the CoMET data it has not been possible to make robust comparisons between the CoMET data and the current findings.

2.2 Characteristics of the additional peers

The new data is from operators in mainland Europe, whose main characteristics are comparable to the previous peers:

- Metro or light rail systems
- Tunnelled and surface track
- Similar network sizes
- Sophisticated train control and signalling infrastructure in the majority of their network
- Comparable fleets

BSL has been involved with the restructuring and modernisation of the added peers. Most companies have started the implementation of related activities, while some have already completed the initial stages but have plans for additional major improvements in the future. The data used in this report was obtained for most peers after some initial restructuring had been completed, but all peers have further stages of restructuring to implement.

The share of internally resourced maintenance works and subcontracted services is similar for the additional peers.

In comparison to Metronet and Tube Lines, the added peers have much "younger" networks. This is mainly due to a significant quantity of tunnelled tracks, which were built in the 1950s/1960s as substitute for, and/or extension to existing tram systems (that had been constructed from the end of the 19th century), with a subsequent change-over to light rail systems. Substantial expansion of the networks took place – in many cases - from the 1970s onwards and covered suburban areas, interconnecting rural areas and the cities.

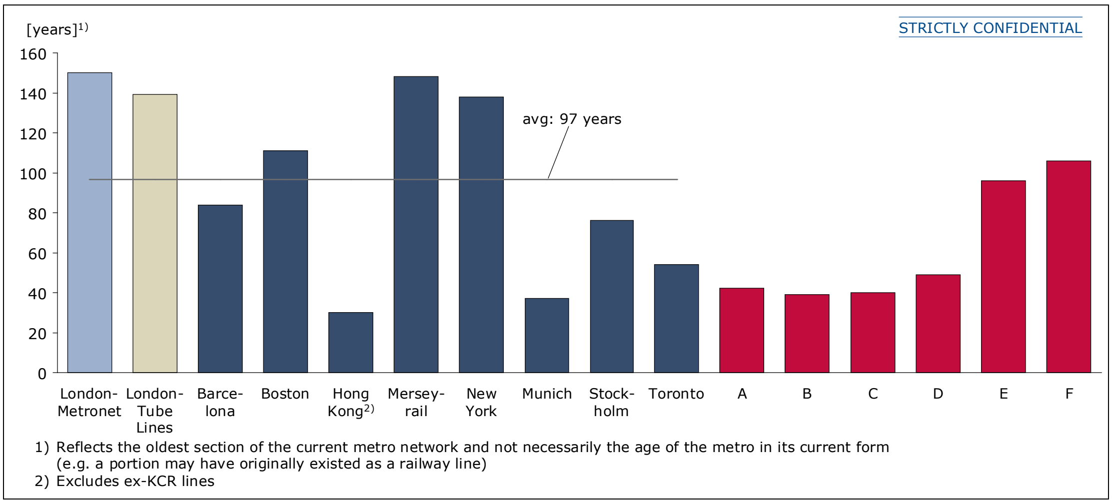

Figure 2: General network characteristics – age of oldest section

However, for comparisons of costs and performance the average age of rail (see figure 25), which is determined by renewal rates, is much more relevant than the age of the original network.

The network sizes of the additional peers are generally comparable to the previous sample but are towards the lower end of the sample, which can have some cost-influencing implications.

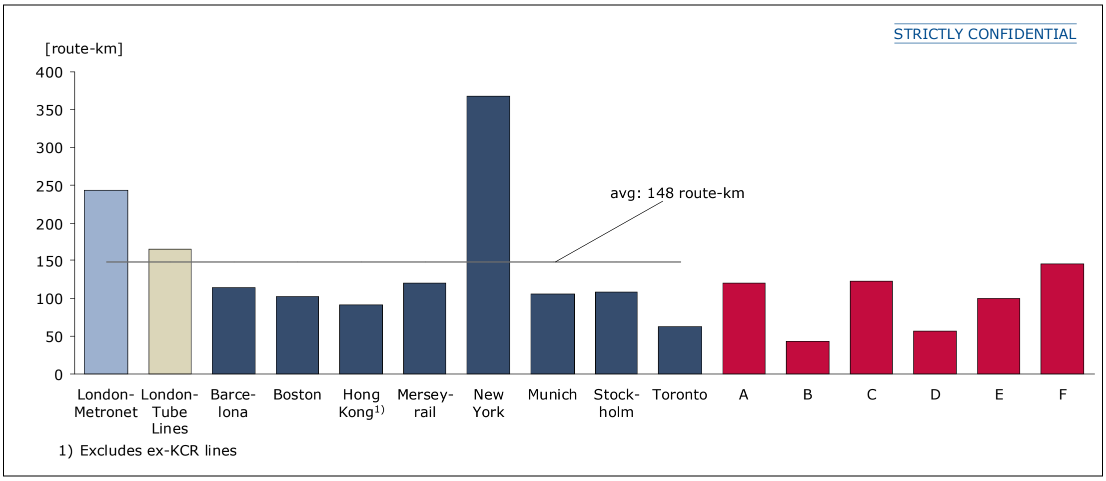

Figure 3: General network characteristics – network size

Short access times (depending on number of work bases), shared on-call services during nights and weekends or high centralization of interdepartmental functions may be cost-advantageous.

Small-scale machinery utilisation, provision of minimum staff/capacity (especially of planning or administrative staff), lower "buying power" (bargaining) or less synergy in general may provide cost-disadvantages.

Ridership figures for the added peers are at the lower end of the previous range.

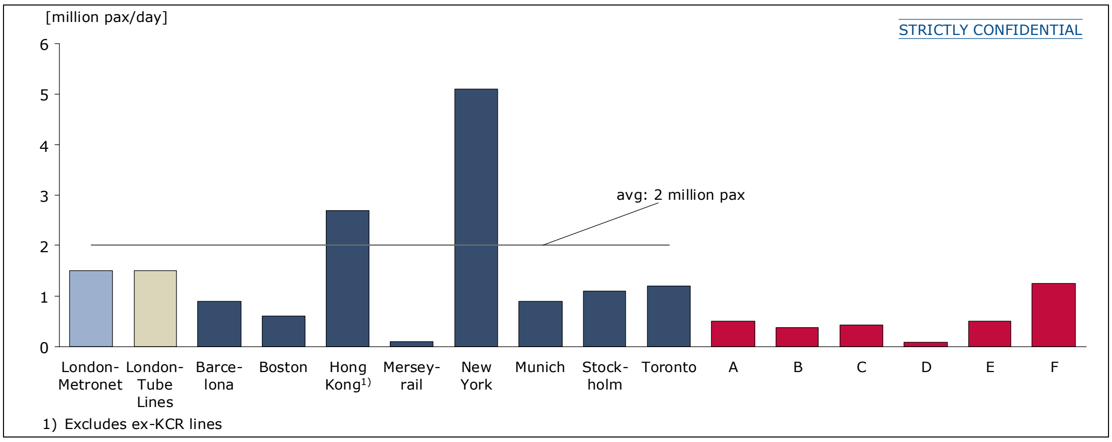

Figure 4: General network characteristics – daily ridership

Whilst lower ridership should generally result in less utilization, no proportional correlation between ridership and number of trains or cars was found at the peers. The data was based on total fleet size including spare cars.

Lower ridership per day at comparable network sizes might be an indicator for comprehensive networks with lower utilization and greater free capacity, e.g. in the outskirts, depending on intervals of train services.

Network utilisation is considered to be much more relevant for cost and performance comparisons than ridership, since asset depreciation is driven more by train frequencies and characteristics than by passenger loads.

As shown in figure 5, the added peers are comparable to the previous sample or were made comparable by harmonisation with respect to most of the indicators, which have the highest impact on cost structures. Thus, added data is suitable to further extend the sample.

	Comparability towards previous peers[1)]											
Peers	**No 2.2**	**System compara-bility[2)]**	**Fig. 2**	**Age of oldest section**	**Fig. 3**	**Network size**	**Fig. 4**	**Daily ridership**	**Fig. 7**	**Track utilisation**	**Fig. 8**	**Distance between stations**
Note: The composition of the peers varies due to confidentiality reasons.	A	high	A	low	A	high	A	medium	I	low	N	low
	B	high	B	low	B	low	B	low	J	low	O	low
	C	high	C	low	C	high	C	low	K	low	P	low
	D	high	D	low	D	low	D	low	L	medium	Q	high
	E	high	E	high	E	low	E	medium	S	high	R	low
	F	high	F	high	F	high	F	high	T	high	S	low
Overall comparability[3)]		high		low		medium		low		medium*		low*
Cost relevance of comparability indicator		high		low		medium		low		high		high

*high comparability after harmonisation

1) Measured by relating the deviation of added peer data against the previous average towards the average spread within the previous sample:
- >25% higher deviation than previous spread: low comparability
- up to 25% higher deviation than previous spread: medium comparability
- lower or equal deviation than previous spread: high comparability

2) All peers are metro or light rail systems with main basic structures (as train-control, fleet)

3) Average value of low(0)/medium(1)/high(2) comparabilities ≤0,7=low, >0,7 but ≤1,3=medium, >1,3 high

Figure 5: Overview of the comparability of the added peers

2.3 Methodology

Data from the added peers was collated in order to establish a data base which could be reasonably compared with the existing international benchmarking data. The validity of comparisons was considered and data was harmonized where required.

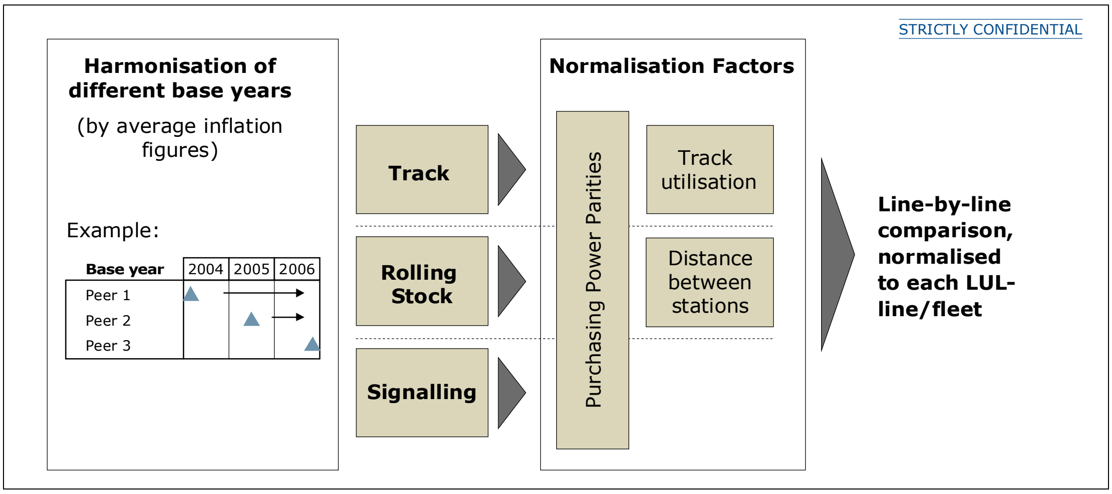

Figure 6: Overview of the methodology

Harmonisation of different base years

Peer data from earlier BSL studies were originally related to different financial years. All costs in this report have been inflated to average 2007 prices in accordance with the practice developed for the previous international benchmarking exercise.

PPP normalisation

Different countries have different currencies and price levels. Purchasing Power Parity (PPP) normalisation takes account of this and corrects cost data to ensure comparability.

As in the previous international benchmarking, PPP figures were used to create Comparative Price Levels (CPL) that converted the cost data to GBP currency and UK price levels.

Normalisation of track data by utilisation

Track maintenance cost data of the added peers was normalised by utilisation figures, as was done previously. The normalisation factor – which was defined as weighted average of the peers' track utilisation ("virtual metro") – was left unchanged because:

- Additional peers were added for cross-comparison. A full integration into the peer group was not intended; and
- Changes of normalisation factors would also result in variations in the normalised cost of the previous peers. This could cause confusion and thus has been left unchanged.

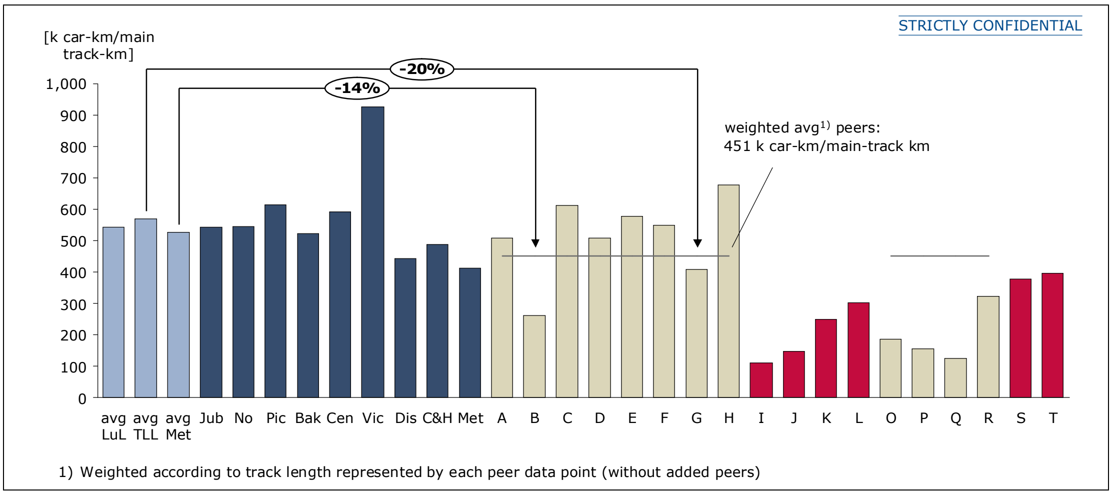

Figure 7: Track utilisation

As expected, the utilisation of track for the added peers is below the "virtual metro" average. Thus, normalised cost of all new peers shows an increase compared to the original costs. However, the added figures are similar to the track utilisation of five previous peers and fit well into the sample.

Normalisation of rolling stock data by distance between stations

As in the previous benchmarking, rolling stock maintenance cost data from the added peers was normalised by average distance between stations. Again, the previous normalisation factor ("virtual metro" weighted average) was left un-changed.

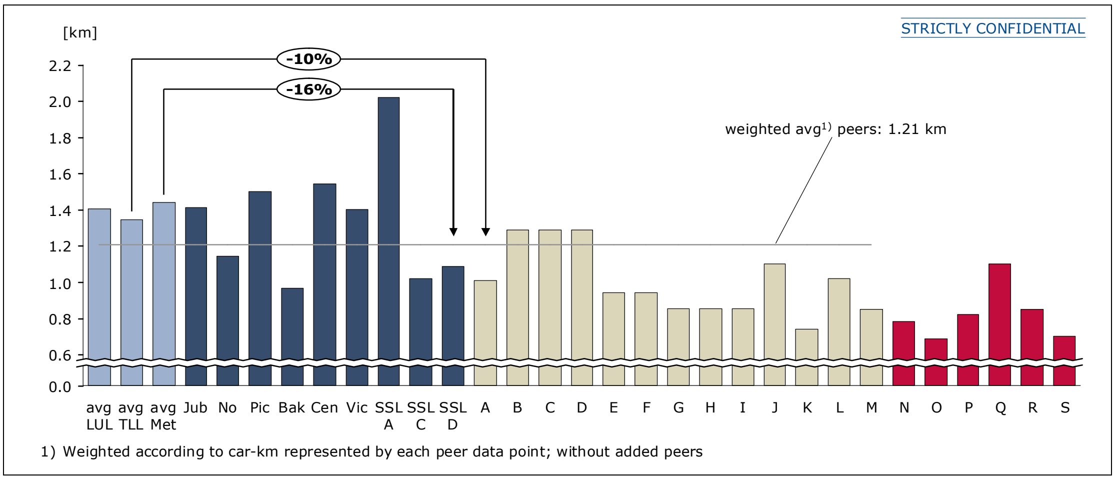

Figure 8: Average distance between stations

Average distance between stations of the added peers are below the "virtual metro" average. This means, that normalised rolling stock maintenance costs of all new peers show a decrease when compared to the original costs.

3. Extended Data Sets

3.1 Track

Maintenance Cost

Track maintenance costs of the added peers are above the "benchmarking range".

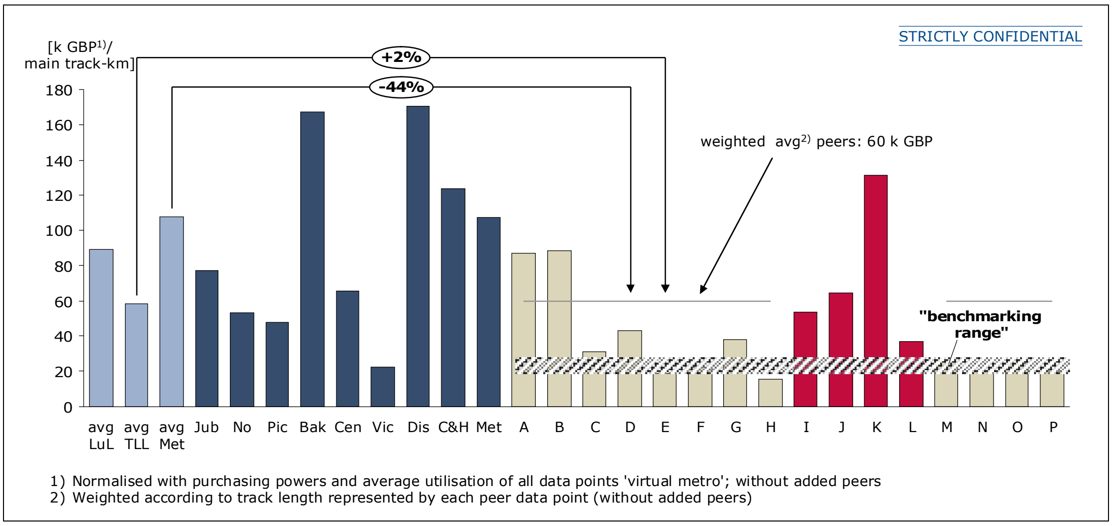

Figure 9: Normalised track maintenance cost

However, as noted in chapter 2.2, some of the added peer data was evaluated at the beginning of their restructuring processes giving target-costs well within the band of the benchmarking range. This is particularly true for peer K, who intends to cut costs significantly. At the other peers, initial restructuring programs are completed. However, further major improvements are planned while will give target costs well within the band of the benchmarking range.

These will focus on various improvements:

- Efficiency of point maintenance (inspections, cleaning and lubrication)
- Strategy for grinding and welding in the context of corrugation problems
- Optimisation of team structures and streamlining of processes, e.g. for on-site services
- Balanced corrective maintenance (especially welding) against renewal; and
- Optimised share of maintenance works during non-operational times.

Track access

Track access conditions can play a significant role in understanding costs.

Some of the networks of the added peers are partly equipped with catenary instead of third rail. Thus, there is better access for maintenance works such as welding, grinding, tamping and inspections, while access for visual track inspection, monitoring trains etc. is less affected.

The tunnels of the added peers are larger in diameter than those of the original peers in some cases. This could lead to cost advantages compared to the Infracos. For instance, less maintenance works may need to be carried out during non-operational times.

For some added peers, major parts of the network are at surface level. This may cause cost advantages. However, tracks are in part close to road traffic lanes, which may make maintenance works more costly. Later on it will be shown that no clear correlation between maintenance costs and the proportion of track in tube was found (see figure 29).

Staff

Staff numbers (FTE) of the added peers are consistent with the good practice range for track maintenance, which was previously only exhibited by one peer.

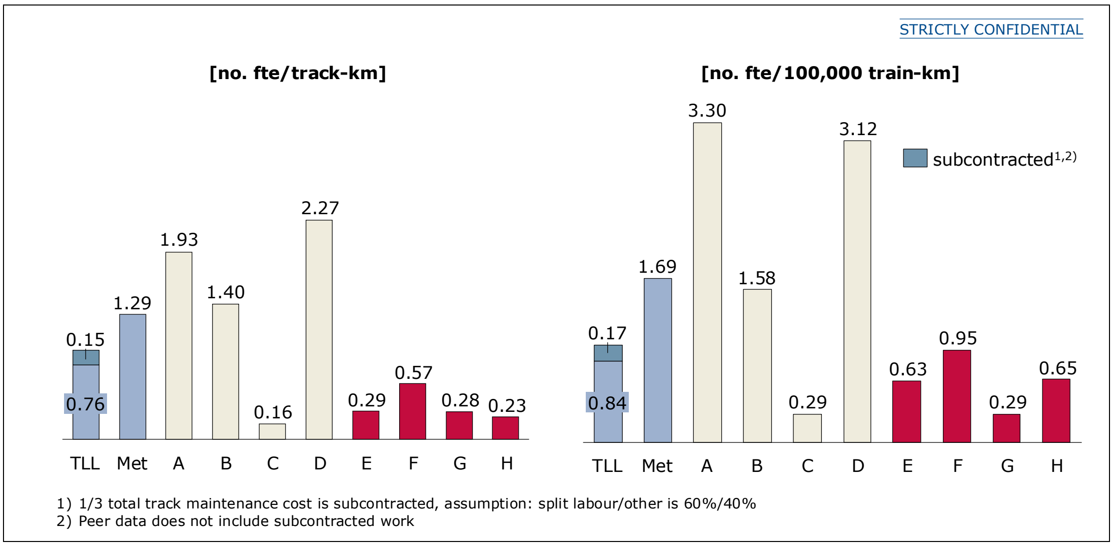

Figure 10: Track Maintenance Staff

As stated in the earlier international benchmarking report, staff figures may be influenced by outsourcing ratios. This cannot be analysed further from the data available to us.

For the added peers, outsourcing in track maintenance applies not only for simple or unpredictable work but also for work with machinery, for which contractors can realise economies of scale.

Generally, half of track maintenance costs of the added peers cover internal maintenance services (including material/machinery), while the other half consists of contracted services (about 50-60% labour cost).

Since restructuring processes usually start with measures to increase staff productivity, these figures had already been greatly increased at most of the added peers before the data was evaluated. This had led to extensive staff reductions without increasing subcontracted work and may, among other reasons, explain the figures as provided in figure 10. Measures included:

- Reductions of workshop times for cleaning/repairing or maintenance activities;
- Streamlining of shift regimes; and
- Optimising for on-duty services.

As a consequence, the ratios changed towards relatively more contracted work. Nevertheless large proportions of maintenance work are still executed with in-house staff, such as maintenance of points and (partly) tracks.

Performance

Figures from the added peers show low track related failure rates. These are comparable to good performers from the previous peer group.

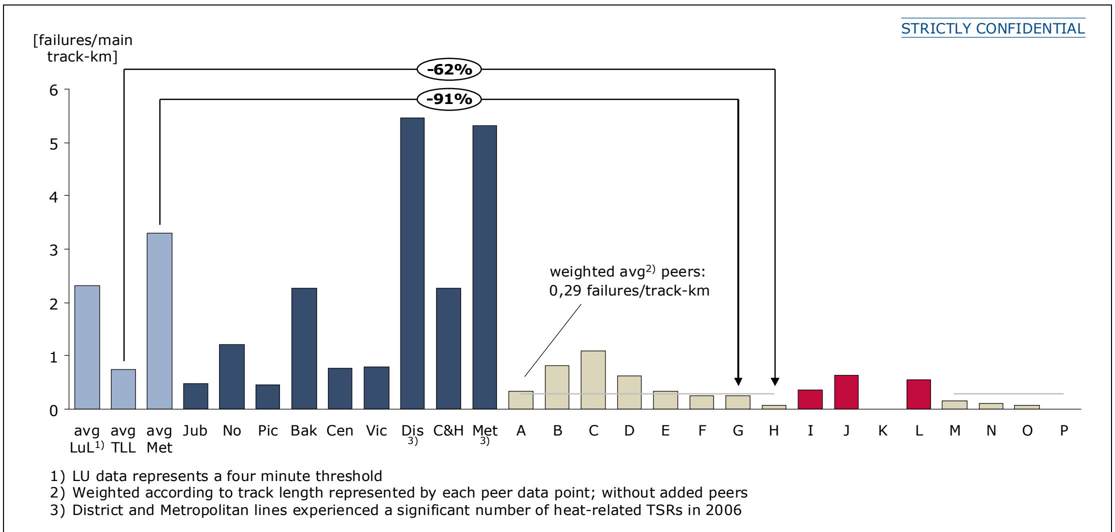

Figure 11: Train affecting failures

All of the new peers have high standards of safety, quality and performance. Lower maintenance costs for the new peers in comparison to the Infracos do not result in lower availability or higher failure rates.

It was found that the "duration" of failures, which affect the number of trains being delayed, is managed by agreed response times, access conditions and available staff for fault repair. All new peers have on-call services outside normal shift times. Response times of about 45-60 minutes (maximum) after failure reports are obtained.

Most failures occur with points; a less prominent factor is broken rails.

Renewal cost

Track renewal costs of all the peers including the added ones are much lower than those of the Infracos.

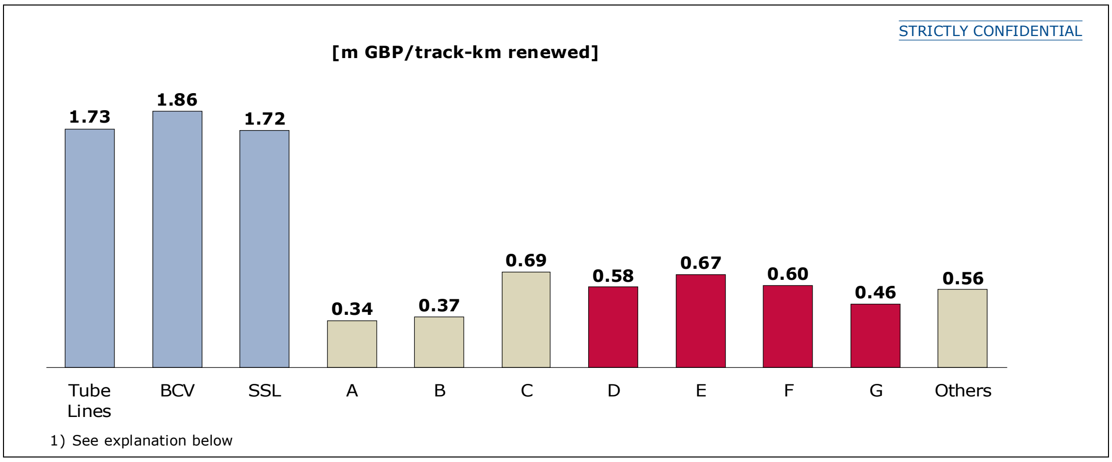

Figure 12: Ballasted track renewal costs

For further comparison, additional data was taken from another benchmarking study (CoMET/Nova), which was provided by OPPPA. Since BSL has no insight into which costs were exactly covered by this data, the outcome has only been analysed within the CoMET/Nova sample and not directly compared with costs from the BSL benchmarking.

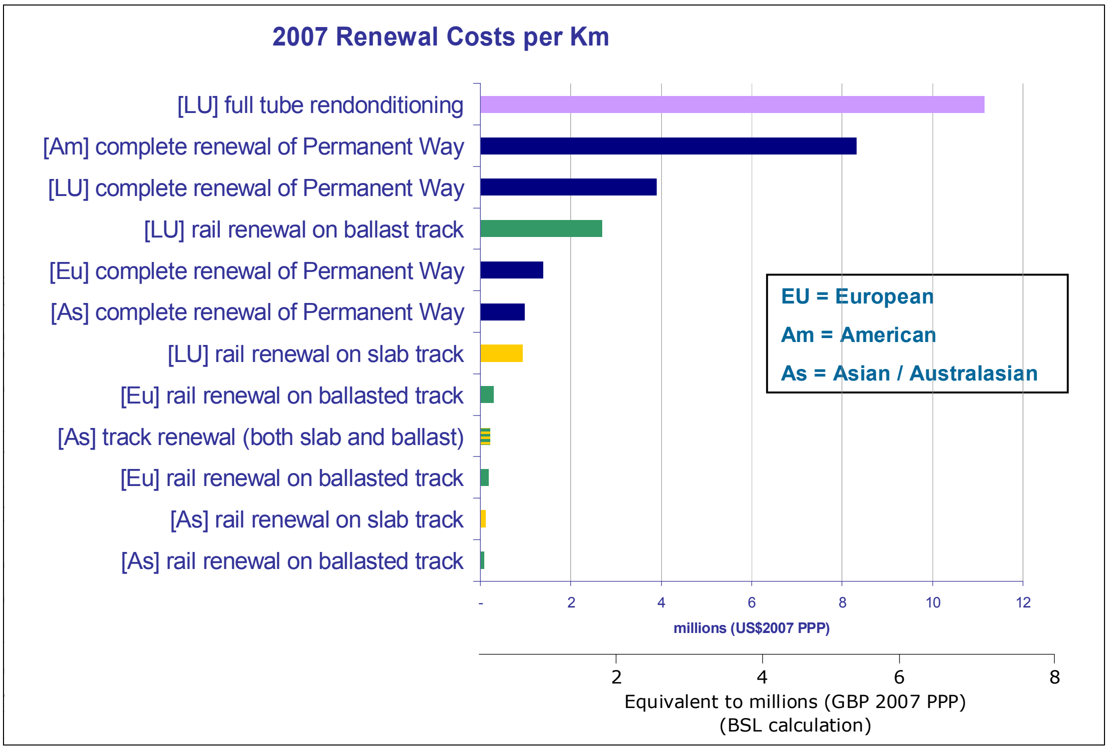

Figure 13: CoMET/Nova Permanent Way Renewal Cost

Cost levels for rail renewal on ballasted track show a benchmarking range of the European peers about six to ten times below costs for London Underground. This confirms and even reinforces the findings of the earlier benchmarking.

For complete renewal of permanent way, two peers indicate cost levels being three to four times lower than costs for London Underground, while one American peer shows costs twice that of London Underground.

As with the earlier BSL benchmarking, the spread of cost levels suggest fundamental differences in the way that renewals are undertaken between the peers.

3.2 Rolling Stock

Costs

The added data on rolling stock maintenance costs indicate a wide spread. This applies both by car-km and per car-basis.

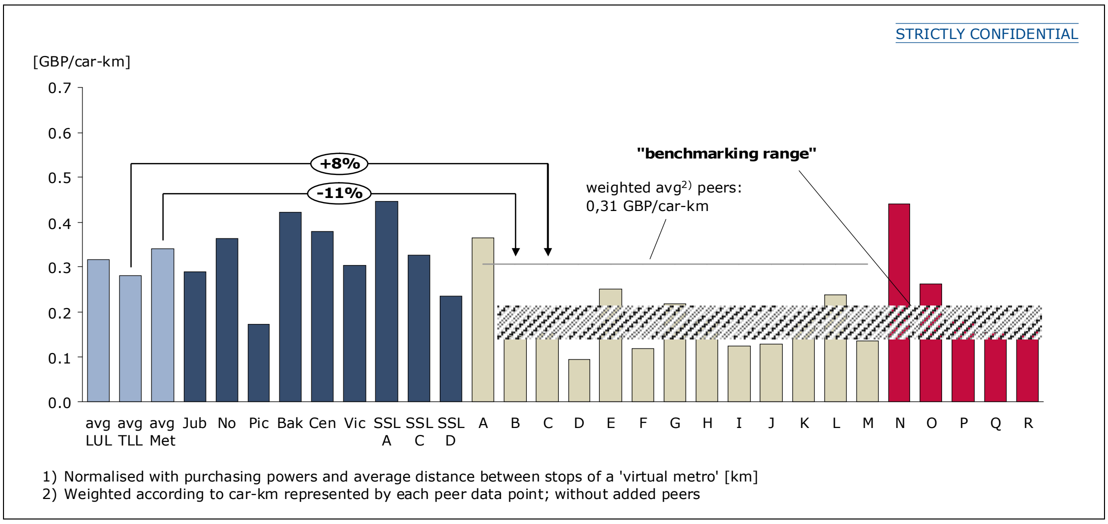

Figure 14: Rolling Stock Maintenance Cost (car-km basis)

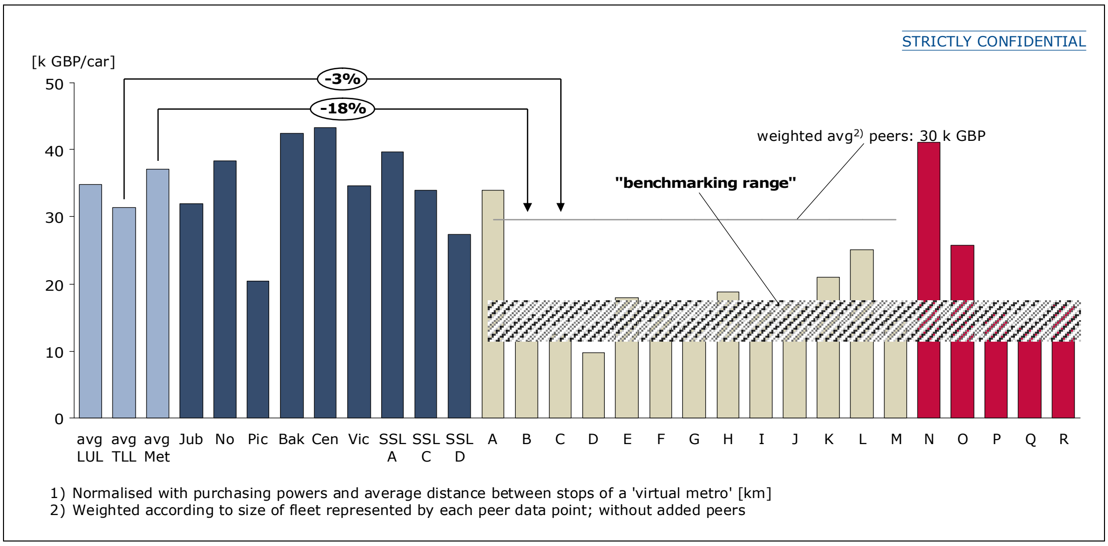

Figure 15: Rolling Stock Maintenance Cost (per car basis)

At the time of the data origin, peer N was at the beginning of a holistic restructuring process, through which a significant decrease of cost was expected.

Data from the other added peers underpins the conclusion that rolling stock maintenance cost for most of the Infracos are quite high.

Again, a further cross-comparison was made with the data from CoMET/Nova.

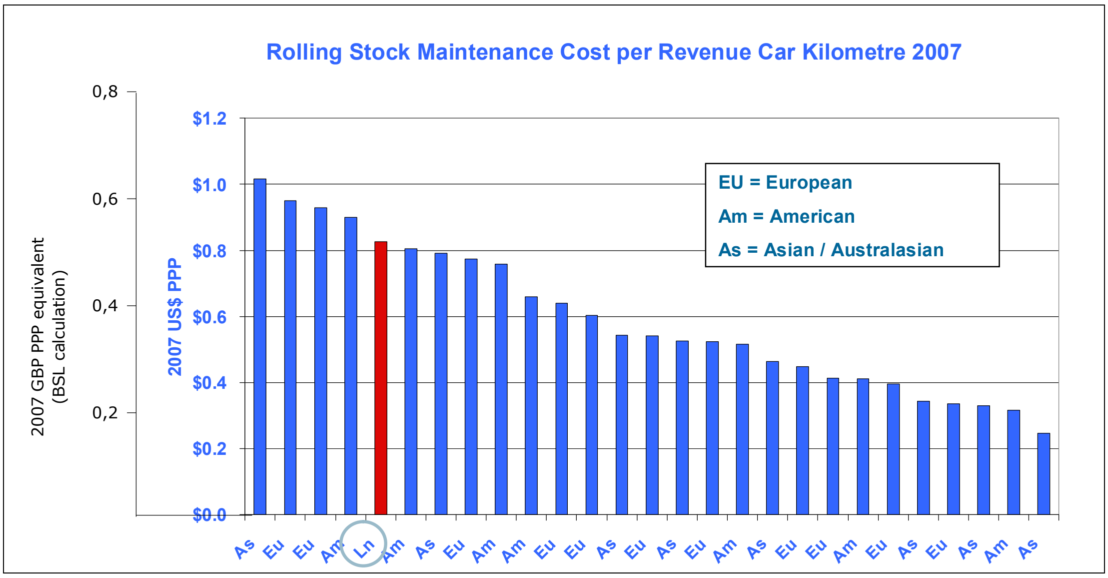

Figure 16: CoMET/Nova Rolling Stock Maintenance Cost (car-km basis)

CoMET/Nova data – which was available for car-km basis only - shows a similar spread between the peers as in the BSL benchmarking and confirms a cost level of good performers being almost half that of the Infracos'.

Performance

Rolling stock reliability for the added peers is lower than that found for the Infracos and the previous peers.

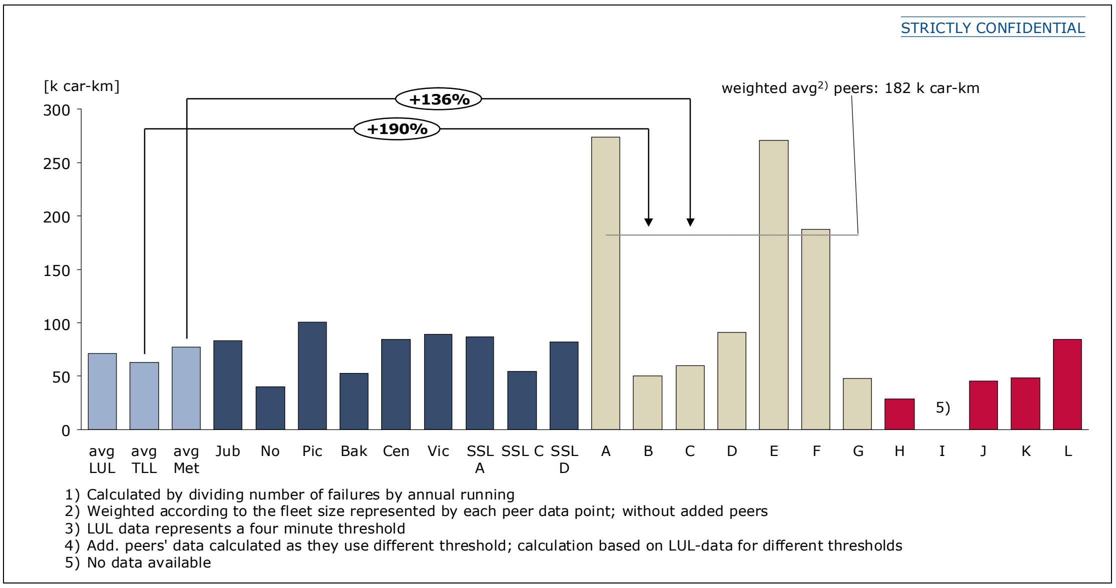

Figure 17: Rolling Stock Performance (Mean Distances between failures)

Fleet availability for the added peers is at a medium level but generally lower than for the Infracos.

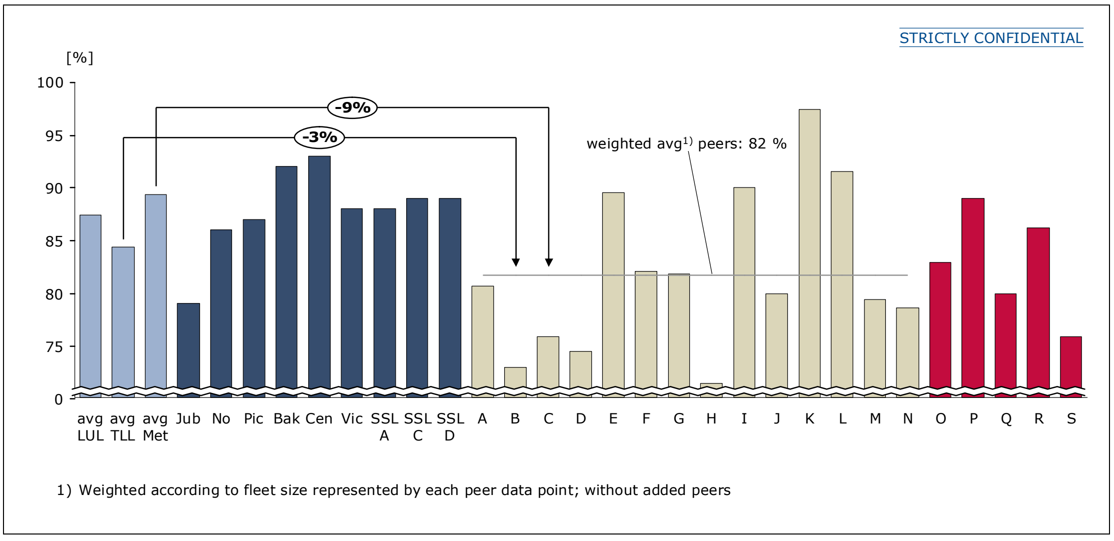

Figure 18: Rolling Stock Availability

All the added peers have identified targets and measures to increase their fleet reliability. The targets are availability figures of 85-90%.

In part the data for the added peers was influenced by specific technical problems with certain vehicles (motors, wheels, brakes), which are beginning to be solved by purchasing new trains and changes in the maintenance strategy and duty rosters.

After the benchmarking data was collected, one peer has reduced its fleet size significantly. Since older and less reliable vehicles were eliminated, the average reliability figure has been greatly increased.

None of the additional peers pursued a strategy of deliberately accepting lower fleet availabilities in order to reduce maintenance cost. All companies intended to improve their availability by cost-efficient means.

Once again, additional data was derived from the CoMET/Nova benchmarking.

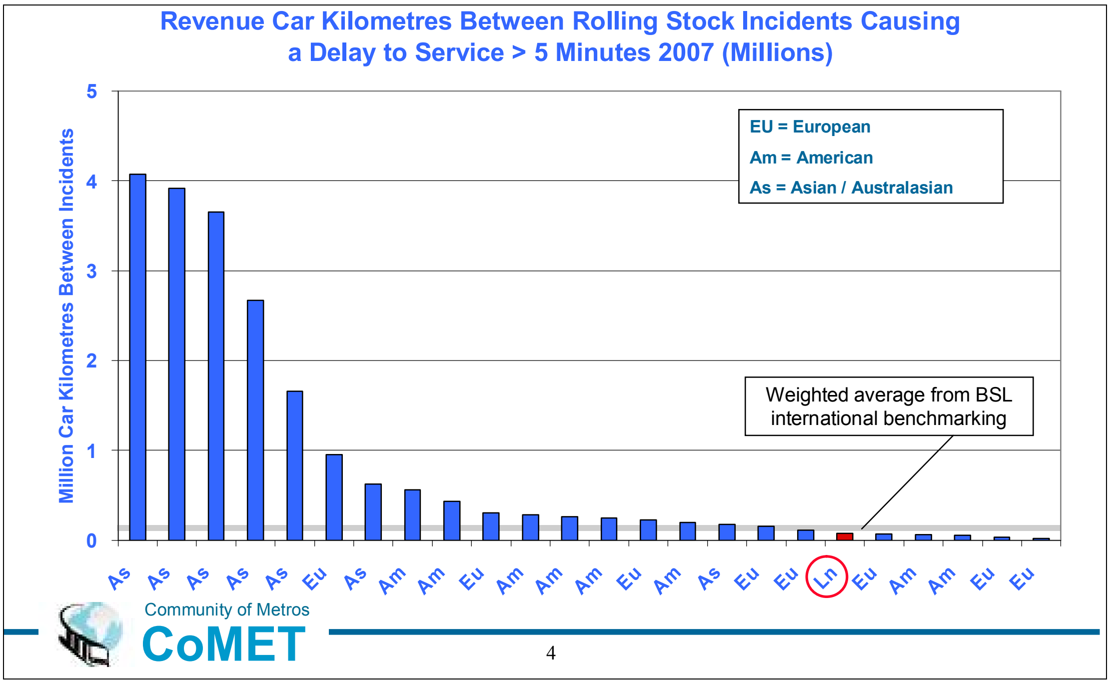

Figure 19: CoMET/Nova Rolling Stock Reliability (mean distance between failures)

This data shows an extremely high spread. While figures from 15 CoMET peers are in a range as evaluated in the BSL benchmarking (on average one failure per 129k car-km - marked in grey in figure 19), for eight mostly Asian peers much higher performance levels are shown. Cars of these "best performers" seem to run over 4 million kilometres without a failure. Since BSL has no insight into the background of this data, this outcome cannot be interpreted any further in this report.

3.3 Signalling

Costs

The previous benchmarking range for signalling maintenance cost is confirmed by data from the added peers.

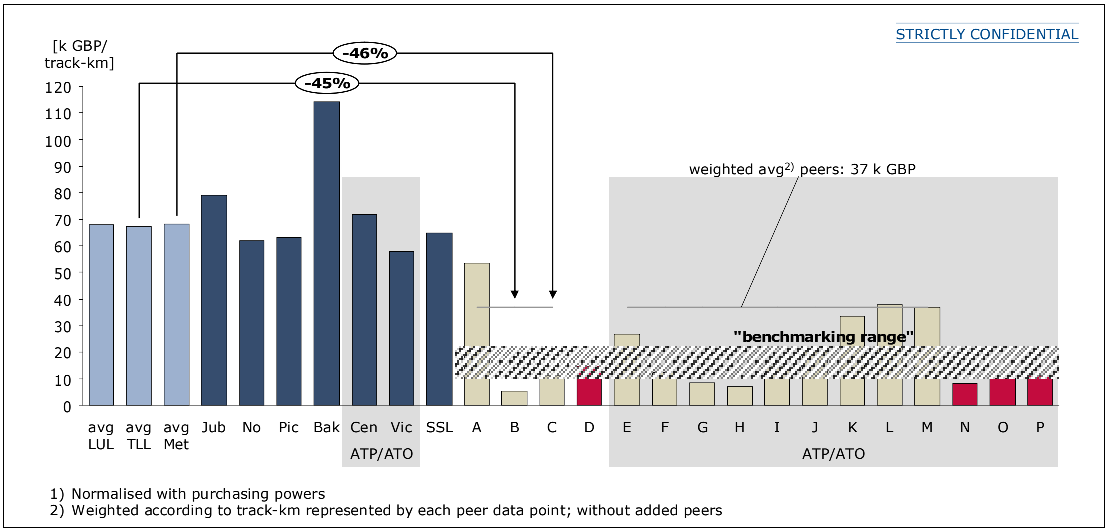

Figure 20: Signalling Maintenance Cost (track-km basis)

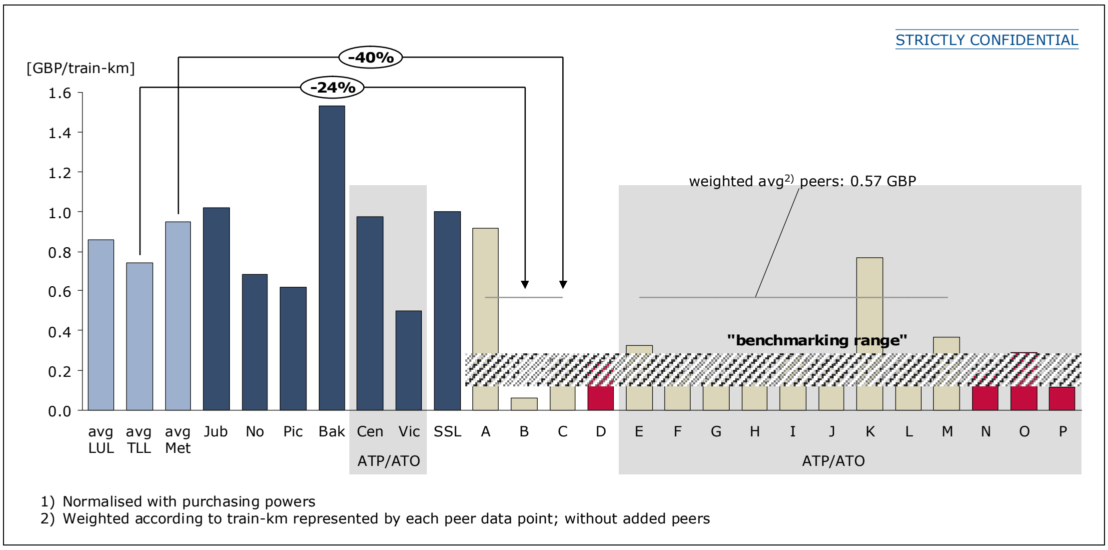

Figure 21: Signalling Maintenance Cost (train-km basis)

Data from the added peers is all within the benchmarking range. This is probably due to:

- Little preventive maintenance activity in favour of corrective maintenance. For instance, inspection frequencies at the added peers are four times a year for point machines, twice a year for automatic speed control installations and lineside equipment rooms and once a year for other equipment like axle counters;
- Less work undertaken outside normal hours and therefore lower shift payments and allowances;
- Comparatively good access conditions for many signal maintenance services (intervals of running trains between 5 - 20 minutes, which facilitates working on operating tracks);
- High productivity through good personnel management (technicians, foreman) and motivated/young staff; and
- Small working groups often without flagmen.

Looking to the future, newer and still increasing numbers of installations will probably lead to additional costs, while higher technical standards and remote control may lower follow-up costs.

Staff

Signalling staff numbers substantiate a good-practice level, which was previously found at one performer only.

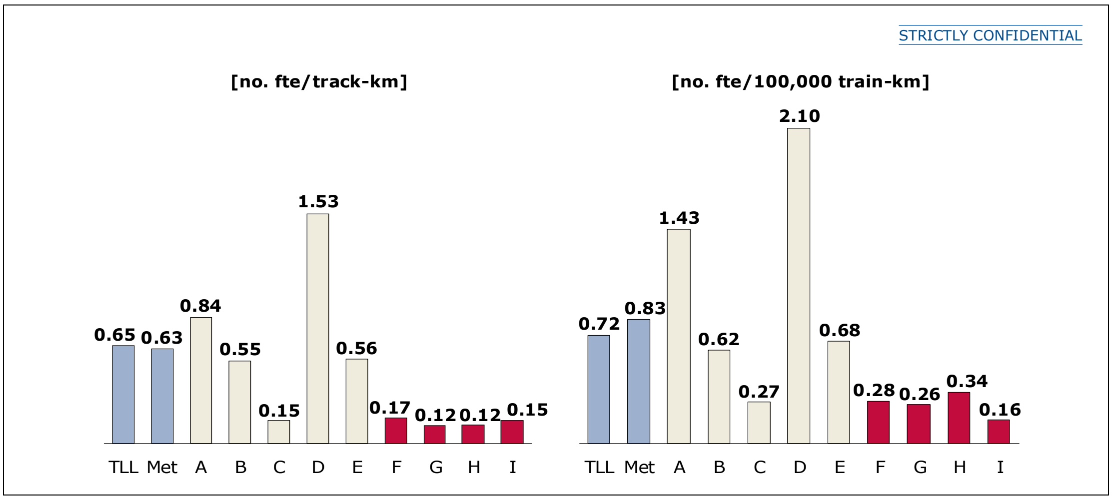

Figure 22: Signalling Maintenance Staff

As already stated in the international benchmarking study report, staff figures may be influenced by outsourcing ratios. This cannot be analysed further based on the available data.

Outsourcing rates in signalling maintenance are quite high for the added peers. This covers maintenance of high end installation (e.g. operations control system), networks and computers.

Generally, 50 to 60% of signalling maintenance costs at the added peers cover internal maintenance services, while 40 to 50% consist of contracted services (approx. 60% labour cost).

In line with the restructuring processes, staff productivity has been much increased at added peers before the data was evaluated. This has led to extensive staff reductions without increasing subcontracted work and may, among other reasons, explain the figures as provided in figure 22. Measures included reduced access times (starting work on-site), streamlining shift regimes and modified/mixed team structures (less staff, and more multifunctional).

As a consequence, ratios have moved towards relatively more contracted work. Nevertheless, a considerable share of maintenance works is still executed with in-house staff, with maintenance of lineside equipment rooms and open-line installations as well as fault repair.

Performance

Also at the added peers, a high spread between good and bad performers was found for signalling-related train affecting failures.

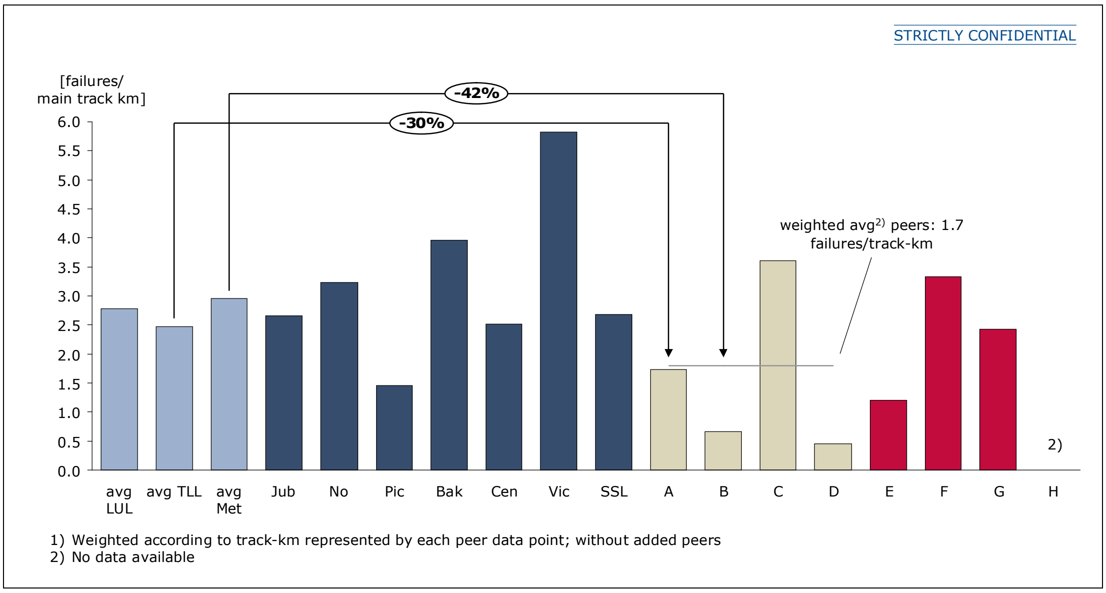

Figure 23: Signalling Failure Rates (track-km basis)

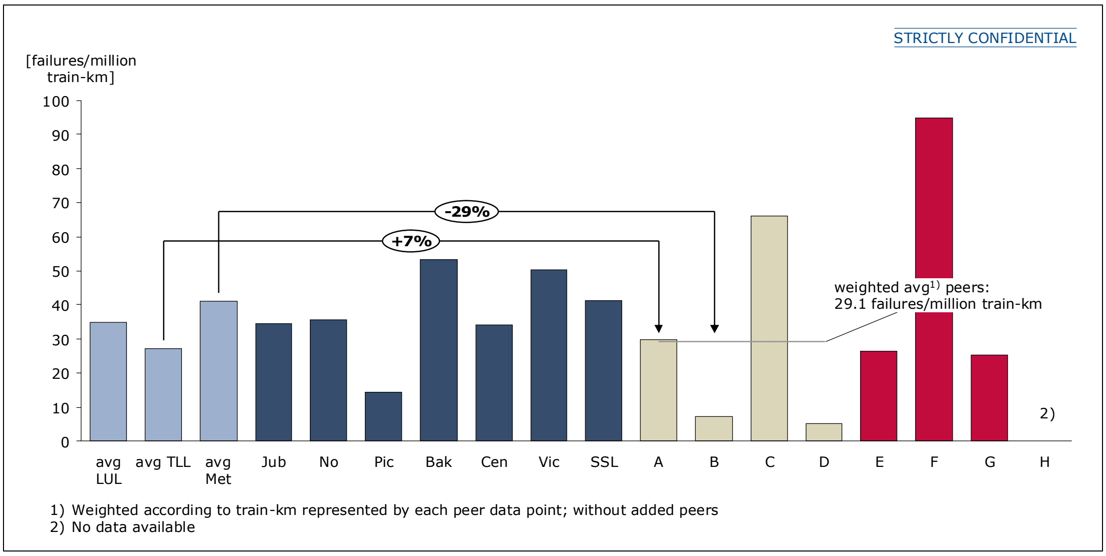

Figure 24: Signalling Failure Rates (train-km basis)

Failure rates at peers E and G are below the average level of the international benchmarking, but much higher than the best performer both among the Infracos and internationally.

Peer F has the highest signalling failure rate within the sample. There is no clear explanation for the reason for this.

This outcome is in accordance with the strategies of the added peers to limit preventive maintenance activities in favour of corrective maintenance. Their performance targets are set by owners or internally. Most of them are output-orientated and define quality of operations rather than failure rates of assets. Thus, efforts on asset reliability and on minimising effects on operation, e.g. by quick reaction times, can be balanced by the management. Short response times of 30-45 minutes, good access conditions and available staff on-call helps to limit the effects of these failures on operations..

4. Updated Explanatory Factors

4.1 Track

Labour rates for the added peers are mainly below the average of the previous peers. Thus, labour rates of the Infracos are validated as an explanatory factor for the cost differences.

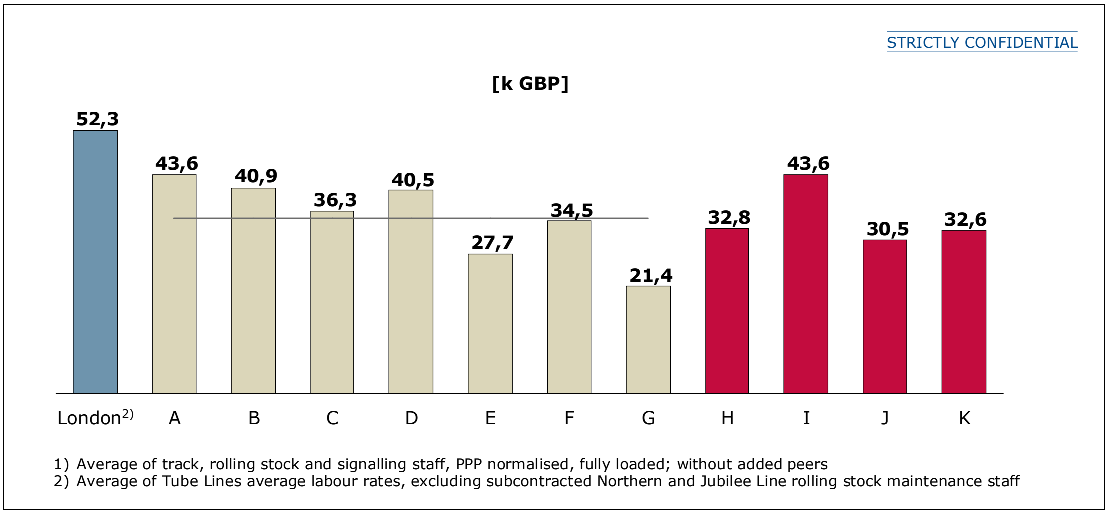

Figure 25: Average labour rate per "blue-collar" FTE per year

This outcome needs interpretation, since on the first sight rather high labour costs would have been expected due to high wage levels in mainland Europe. More detailed analysis shows that few additional labour costs (allowances) apply at most added peers because their labour force works:

- Fewer overtime hours (normally compensated by time in lieu, not paid out)
- Fewer regular late or night shifts; and
- Limited work shifts at weekends.

On-call or on-duty services are streamlined at the added peers (service hours and available staff), and workers are compensated on a lump-sum basis.

Even the age structure of staff and seniority can influence labour costs, but this was not compared in detail here.

As a second explanatory factor for differences in track maintenance costs (as outlined in the previous international benchmarking), inspection frequencies were validated.

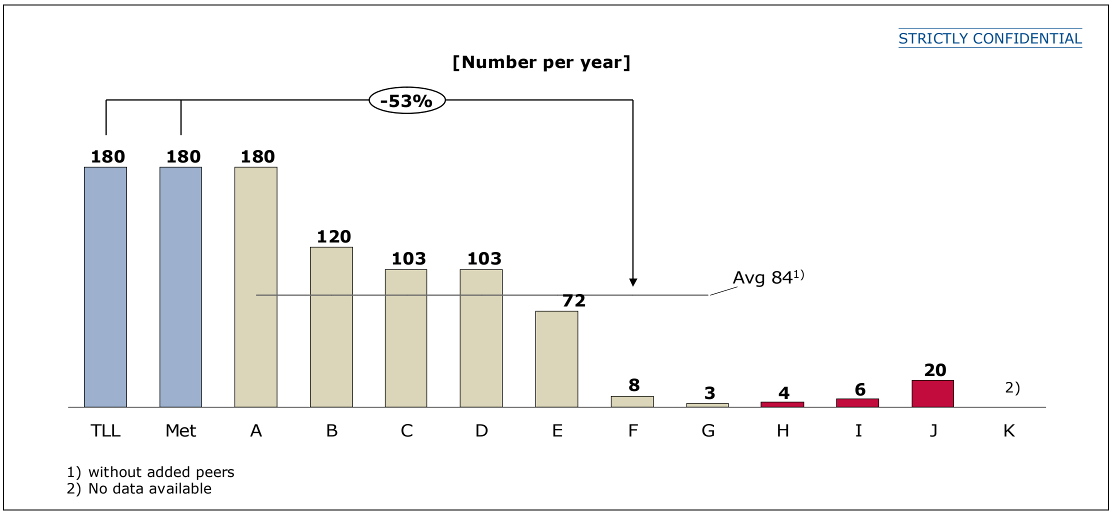

Figure 26: Complete main track visual inspections

Throughout the added peers a low number of main track visual inspections were found, which was similar to the lowest inspection figures of the original peers.

The relatively higher number of inspections at peer J is currently planned to be significantly reduced.

Inspection frequencies are set by the chief operating managers within the framework of legal regulations, for example BOStrab in Germany, and are also influenced by internal requirements or findings from previous inspections. In addition monitoring trains are used for track inspections, and staff members, including drivers or track workers, are instructed to report any failures or abnormalities.

Further, added peer data confirmed the age of rails as a third explanatory factor.

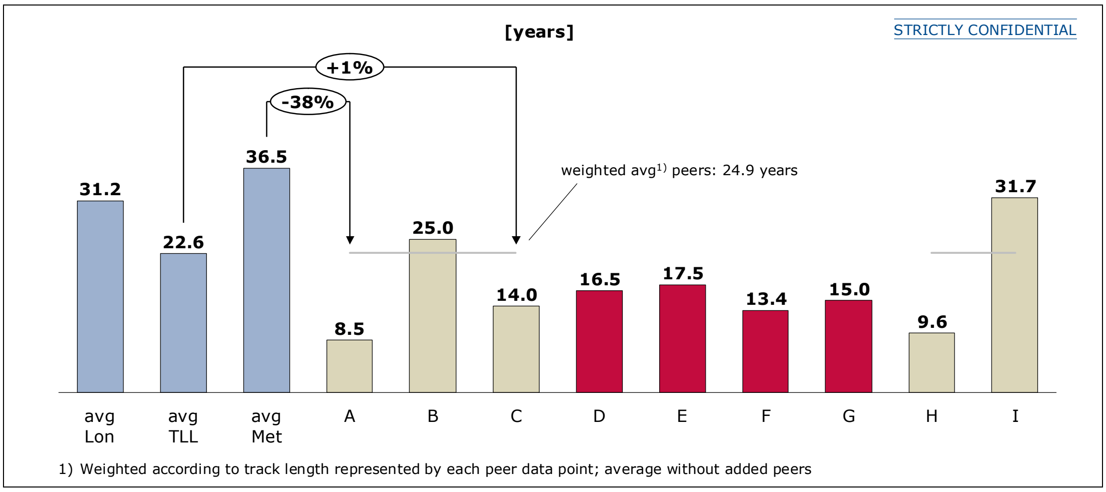

Figure 27: Average age of rail

Rail age of the added peers corresponds well with BSL's good practice experiences for economic use (30-35 years depending on location and utilisation; track side life time up to 40 or 45 years).

The advantages of "younger" networks include, among other things:

- Reduced maintenance expenditures (as lower follow-up costs or better accessibility) due to more recent construction methods/designs and up-to-date materials;
- Higher performance (lower failure rates) of assets due to state-of-the-art equipment or better failure management options (remote control etc.);
- The ability to draw upon experts' knowledge of other long-standing operators and lessons learnt from tram services; and
- Optimised costs of rolling stock maintenance (modern workshops and depots).

However, some of the added peers are currently starting to complain about the beginning of investment bottlenecks (lack of funds). They are afraid that extending the age of the rail may lead to increasing expenditures on maintenance (e.g. welding) and less availability, e.g. broken rail or switch blades (as switch tongues).

Strategic decisions to extend the life of rail are taken in recognition of the available funds. This can influence the allocation of maintenance and renewal costs, either towards more corrective maintenance/reconditioning and less renewals or towards higher renewal rates and less reconditioning (leading to a lower average track age).

As a fourth explanatory factor for track maintenance cost, the duration of non-operational times was reviewed in the international benchmarking.

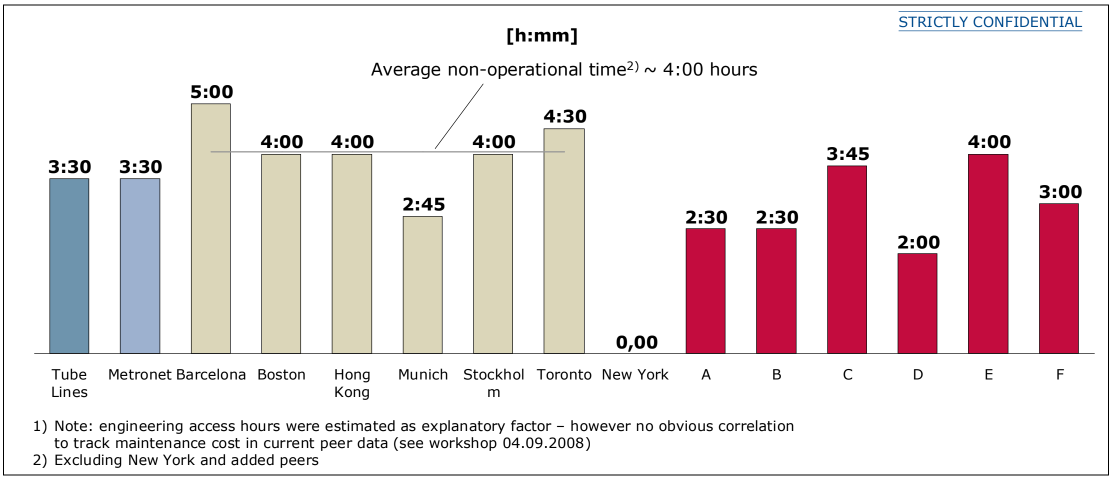

Figure 28: Typical non-operational time per day

The added peers have very short non-operational times and partly non-stop operation at weekends. The limited closure times of lines are not only used for maintenance, but also for transport of large goods (e.g. for materials) to construction sites and for comprehensive refurbishments and renewals.

This outcome substantiates the premise that the length of non-operational times does not necessarily explain higher maintenance costs of Infracos.

Finally, the share of track in tube was checked as a factor in track maintenance cost.

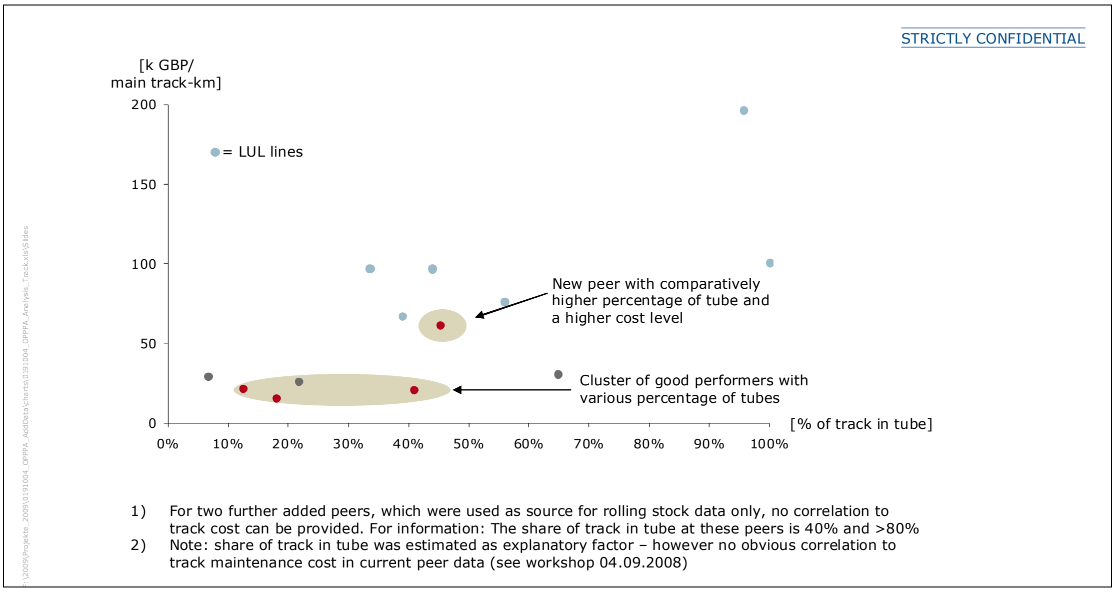

Figure 29: Share of track in tube and total track maintenance cost

As found in the previous international benchmarking study, the additional peer data does not substantiate a correlation. While the peer with the highest specific track maintenance cost (from the additional ones) has a high share of track in tube, it has also comparatively high cost levels over all studied assets – therefore it is likely, that its track costs are driven by other factors than its specific share of track in tube.

4.2 Rolling Stock

Costs differences for rolling stock were partly explained by different maintenance intervals which, for the added peers, are almost equal to the Infracos.

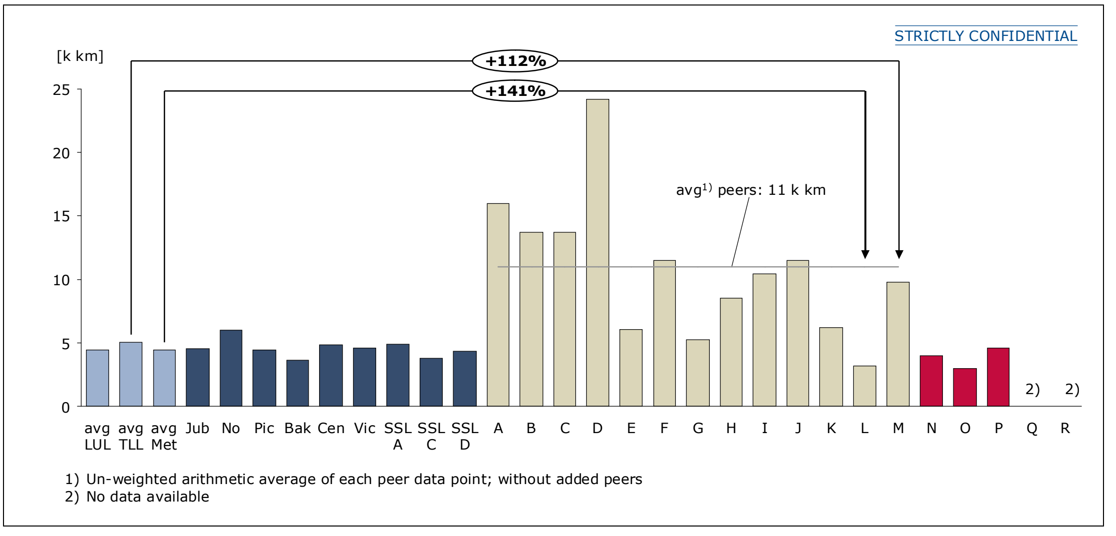

Figure 30: Rolling stock minimum maintenance intervals, distance basis

Again, interpretation of data requires further analysis:

One of the added peers is pursuing a new mileage-based maintenance strategy, since the data was evaluated, which will significantly increase its minimum maintenance interval. This will be done using a step-by-step approach, during which performance indicators (failure rates) will be carefully monitored.

Another peer has started a condition based maintenance strategy on a component basis since the data was evaluated. Hence, preventive maintenance is split into component-specific tasks, considering interdependencies between different elements (e.g. if component A is to be replaced, which other components should be replaced concurrently?). This is also expected to extend maintenance intervals, although quantitative evaluations are not available to us yet.

Altogether, the data from the added peers indicate that comparatively low minimum maintenance intervals usually lead to higher maintenance cost, while specific features of these intervals and of the overall maintenance strategies may influence this correlation.

Labour rates were a further explanatory factor for differences in rolling stock maintenance cost in the previous international benchmarking – see chapter 4.1 for data from added peers.

4.3 Signalling

Cost differences for signalling maintenance were partly explained by the average signal head maintenance interval. Although head maintenance itself provides only a limited proportion of the total signalling maintenance costs, it was used as an indicator for maintenance frequencies in general in the previous international benchmarking.

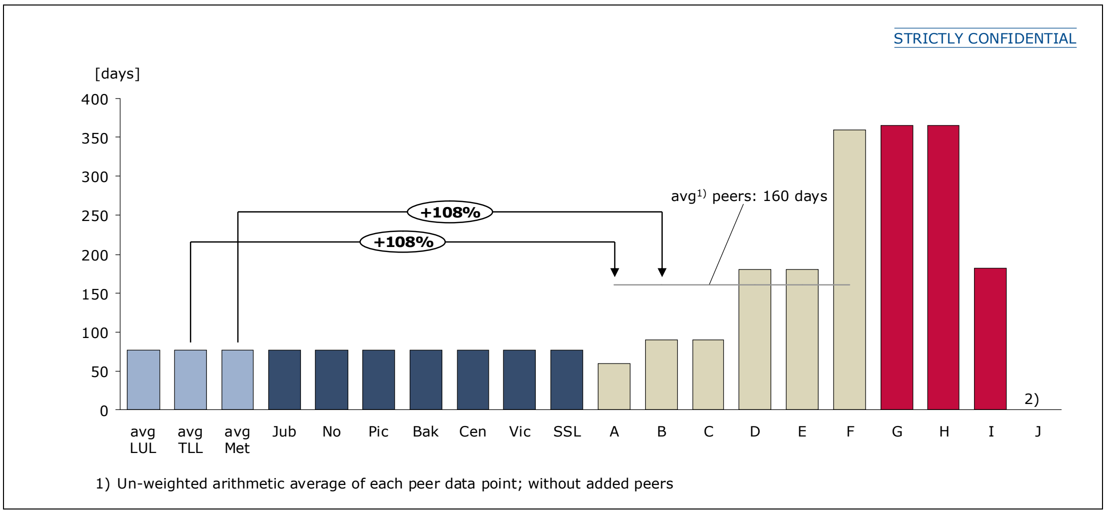

Figure 31: Average signal head maintenance interval

Data from added peers confirms that head maintenance is usually carried out much less frequently than at the Infracos. This is still considered as an important cost driver.

Further analysis also shows lower inspection intervals at interlockings and connected open-line installations for the added peers.

Labour rates were a further explanatory factor for differences in signalling maintenance cost in the previous international benchmarking – see chapter 4.1 for data from added peers.

5. Results

Data from the additional peers generally confirms most of the results from the previous benchmarking.

Some emerging findings required further interpretation. These were particularly:

- An outliner for track maintenance cost (figure 9, peer K);
- An outliner for rolling stock maintenance cost (figures 14/15, peer N);
- Rolling stock availability levels (figure 18, peers P and R); and
- Signalling failures (figures 23/24, peer F).

It was found that these values could be explained by specific features of the relevant peers, particularly the stage of their restructuring processes. Thus, the benchmarking outcome is not changed by these data-sets.

However, there are still aspects remaining which merit further analysis.

These items include:

- The influence of outsourcing on staff figures;
- An explanation for the high spread of track renewal costs between Infracos and peers;
- Further analysis of signalling failure rates; and
- Further discussion of the data from CoMET/Nova, which show better standards for track renewal cost and rolling stock performance but increased cost for rolling stock maintenance, while the spread within their peers is generally very high.