UK Tram

Briefing Paper
Costs of Light Rail Schemes

15 October 2012	Paul Griffiths	Version 4 for issue	Geoff Inskip
28 August 2012	Paul Griffiths	3rd draft for UKTram board review	
12 June 2012	Paul Griffiths	2nd Draft to reflect comments from F&A	
26 April 2012	Paul Griffiths	1st Draft	
Date	**Author/Reviewer**	**Document**	**Approved**

Acknowledgements

Richard Higgins, Arup

Steve Warrener and Daniel Satizabal, Transport for Greater Manchester

Roger Harrison, Keolis

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Alastair Richards, AMRT Consult Limited

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Executive Summary

This report seeks to examine the costs of light rail schemes in the UK, Europe and North America over the last 20 years to determine:

- the availability of information,
- any differences in costs between the various nationalities involved,
- the reasons for cost differentials, and
- how costs might be better collated for future schemes.

The availability of actual detailed scheme cost information is very poor. This is as a result of lack of focus on collating and retaining the data – as generally, in the UK at least, there is little need to report this information, certainly beyond the end of construction. The sporadic nature of UK light rail development has further complicated this situation.

Where costs are available the format is not standard, unlike in the US where a cost breakdown structure and the collection of data is mandated by the Federal Transit Authority.

Typical unit cost information is now available which allows the development of scheme cost estimates at a high level. The Little Black Book of Light Rail Costs published by Franklin and Andrews is a good example of this. It should be noted that this data is general and additional work will always be needed to develop this to a scheme specific level.

Contrary to the perceptions of many, it would appear (at least on the basis of a cursory look) that the UK is not necessarily any more expensive than either European or North American light rail. There are however a large number of variables in making this assessment and it is only with more comprehensive data that proper assessments will be able to be made. The key difference between the UK and European schemes in particular is the reliance on heavy rail conversions rather than street running tramway. This has a major impact on cost.

Whilst lower cost schemes such as Portland Streetcar and the Besançon light rail scheme appear to offer cheaper solutions, questions remain to be

answered. The Portland scheme has lower construction costs than those typically achieved, but the cost of their vehicles is high on a per passenger basis. The Besançon scheme is yet to be completed and it will be a number of years before it is known whether the lower costs sought have been achieved either in terms of construction or whole life costs. Notwithstanding it is important that the techniques that can be best adopted for the delivery of future UK schemes at lower cost are monitored and where appropriate adopted in the UK.

The key issue in understanding costs is the future collection of data in a standard format. As such it is recommended that:

1. **The collection and maintenance of cost information should be mandated by DfT as a condition of funding.**
2. **The management of this and the format of the data should be delegated to UKTram in order that data can be made readily available to all appropriate parties.**
3. **Lifecycle costs should be considered in addition to the capital costs, to ensure value for money exists over an extended period of time.**

Introduction

UK Tram is an organisation that represents the promoters and operators of tramways and light railways in the United Kingdom. It is a limited company owned in equal parts by Transport for London, the Passenger Transport Executives Group, the Confederation of Passenger Transport and the Light Rapid Transit Forum. Its main purpose is to carry out research into a variety of aspects of light railway design, construction and operation. It publishes the results in the interests of improving understanding of the factors involved in the development of light railways and uniformly raising standards throughout the industry. It is supported in its activities by the Department for Transport.

In October 2011, the Department for Transport at the instigation of Under Secretary of State for Transport, Norman Baker MP, published its report Green Light for Light Rail. Subsequently DfT and UK Tram jointly hosted the Tram Summit on 30 November 2011. The report focuses largely on how to make future light rail schemes more affordable. A number of workstreams were discussed and developed from the summit are being developed in advance of the next summit to be held in June 2012. A list of the workstreams is provided in Appendix A.

This workstream has focused on understanding what cost information is available from UK, other European and North American light rail schemes for use in:

- Informing promoters of new schemes as to the order of magnitude of light rail scheme costs for different types of light rail e.g. street running tram, heavy rail conversion etc.
- Providing a comparison with the cost of light rail in other countries.
- Use as a benchmark for the work being done by DfT and UK Tram in trying to make light rail cheaper.

Additionally the report considers what can be done to facilitate improved cost data collection in the future, so as to better support the above.

Background – Cost Data Collection

The PFI procurement route adopted for the first phase of modern UK light rail schemes has not aided the process of collecting cost data for use by promoters and central government as the costs are typically those associated with a long term concession and as such visibility of the capital cost of individual elements may be low. In addition concessions were typically awarded to consortia consisting of several separate entities; this has further obscured the costs.

There is no requirement on UK scheme promoters to report on scheme costs in a detailed and methodical manner. Along with issues such as the natural attrition of team members from project delivery teams, often to move to other light rail projects (from both the promoter and contractor teams) there is often a rapid loss of knowledge once a scheme is completed.

As such there is a general lack of reliable as-built cost information available. Much of the information in the public domain is of poor quality e.g. it lacks detail as to what is included within the costs and is seldom complete in the picture it provides.

Existing Schemes

The availability of data relating to completed light rail schemes is low. This is a result of a number of factors:

- Procurement route
- Turnover of staff
- Lack of data collection in appropriate formats
- Commercial confidentiality preventing release of data

Data collection has been hampered by all of the above.

The true costs are further obscured by promoters each collecting data in different formats which makes comparisons at a detailed level more difficult to achieve.

The table below sets out update data relating to those schemes first published in The National Audit Office's report of 2004 which considered the costs of light rail schemes at that time.

Table 1

NAO Capital Costs as updated by DfT in Green Light for Light Rail

System and Date Opened	Date Opened	Length (km)	Cost (£m)	Cost per km (£m)
Tyne and Wear Metro	1984	59.1	727	12.3
Manchester Metrolink Phase 1	1992	31.2	227	7.3
Sheffield Supertram	1995	29.1	361	12.4
Midland Metro	1999	21.1	191	9.1
Croydon Tramlink	2000	28.2	260	9.2
Manchester Metrolink Phase 2	2000	8.0	208	26.0
Tyne and Wear Metro - Sunderland Extension	2002	18.7	121	6.5
Nottingham Express Transit	2004	14.3	210	14.7
			Average (light rail)	**12.2**
Docklands Light Railway	1987	13.0	162	12.5
Docklands Light Railway - Bank Extension	1991	1.6	455	284.4
Docklands Light Railway - Beckton Extension	1994	8.0	387	48.4
Docklands Light Railway - Lewisham Extension	1999	4.0	289	72.3
			Average for DLR	**112.7**
		Average for DLR (excluding tunnelled sections)		**30.4**

Notes:

1. Costs are based upon the concession cost - this may not have reflected the actual construction costs, vehicles costs etc.
2. Costs are not available to allow separation of vehicle, infrastructure, depot costs etc.
3. DLR costs have been separated as this is considered to be a ligh Metro system rather than light rail/tram.
4. DLR costs are provided to separate those sections which are largely at grade/on viaduct from those for the largely tunnelled sections.
5. The high costs associated with Metrolink Phase 2 relate to the large number of structures on the extension including elevated sections though Salford Quays, Manchester Ship Canal Crossing etc.

In updating the costs in the table above to reflect inflation since the construction, indices have been applied to give a current data cost basis (1Q 2012). The methodology applied is set out in Appendix 2. The updating of costs on this basis is not necessarily straightforward; as such the costs can only be treated as an approximation. In order to make the process manageable all figures have been increased using the same indices - this ignores issues such as regional inflation effects.

It is important to note in considering the costs of these schemes, that the majority of these projects were largely conversions of former or existing heavy rail alignments with the add on of street running sections and a more intensive timetable in order to increase patronage. It is noticeable that Manchester Metrolink Phase 2, an entirely new alignment through a regeneration area utilising a large number of structures has significantly higher costs.

An elevated section of the Phase 2 Metrolink alignment at Pomona – showing the major structures which added to the scheme cost

The Docklands Light Railway (DLR) is another example of how costs can vary significantly between schemes that are nominally light railway. As DLR is a segregated, elevated railway it is considered to be closer in nature to a light metro rather than a light rail/tram system. As such the cost data skews the average for light rail schemes as a whole.

Data to break down the above costs into more closely defined areas is not available for the reasons noted previously.

Since the 2004 report there has not been significant spend on delivering new light rail in the UK until recently. As such there is not a large collection of actual cost data available. Whilst there are now extension schemes preparing for delivery e.g. Midland Metro and Nottingham, the only costs available are estimates.

Whilst cost estimates are not considered to be as valuable as actual cost data Franklin and Andrews[1] have recently published a guide to light rail costs utilising the information they have gathered working on light rail schemes in the UK, Europe and North America. This data provides a range of values for various elements of the cost of a light rail scheme. Whilst a detailed estimate will still be required this guide provides useful material for a promoter to develop a first 'ballpark' estimate for the cost of a scheme, or to provide a test against a scheme estimate.

Schemes where data is available are set out in Table 2 below.

Table 2

UK Light Rail Costs 2004 - Present

Scheme	LRVs		Track				Depot	
	Gross cost per vehicle	Cost per passenger	Street running track	Per km	Railway conversion	Per km	Depot costs	Depot costs per vehicle
UK								
Manchester Metrolink Phase 3	£2,300,000	£11,616				£16,100,000		
Midland Metro BCCE	£1,900,000	£9,500						
Edinburgh	£2,200,000	£9,649						
Blackpool	£2,264,000	£11,320	£29,088,192	£3,636,024	n/a	n/a	£20,804,000	£1,300,250
Croydon additional vehicles	£2,710,000	£13,550	n/a	n/a	n/a	n/a	n/a	n/a
Averages	£2,274,800	£11,127						

Globally there is significant growth in construction of light rail schemes. The same issues exist with regard to data and updating costs to current cost bases, however there is the additional difficulty of adjusting to reflect currency exchange rates (which themselves vary with time). In addition there is the difficulty that inflation rates may be different for different currencies. As such the costs of schemes when undertaking comparisons can only be considered as approximations.

Table 3 below sets out the costs of a selection of light rail schemes in Europe that have been delivered over the period 1994 to 2009.

[1] Franklin and Andrews, Little Black Book of Light Rail Costs, 2012.

Table 3

European Scheme Costs

System	Date Opened	Length (km)	Cost (£m)	Cost per km (£m)
Bordeaux 1	2003	22.2	513.16	23.1
Bordeaux 2	2006	18.6	361.20	19.4
Grenoble 3	2006	15.2	308.70	20.3
Le Mans	2006	15.4	231.96	15.1
Lyon	2000	18.7	343.19	18.4
Marseille	2006	16.0	331.14	20.7
Montpellier	2006	19.0	376.26	19.8
Montpellier 1	2000	15.2	322.06	21.2
Montpellier 2	2006	19.8	364.68	18.4
Mulhouse	2005	19.0	301.64	15.9
Nantes Phase 2	1994	13.9	272.28	19.6
Nice	2006	8.5	232.20	27.3
Orleans	2000	17.9	278.56	15.6
Paris	2002	3.0	78.69	26.2
St. Etienne	2005	8.0	121.70	15.2
Strasbourg	1994	12.6	283.11	22.5
Strasbourg 2	2006	13.5	345.72	25.6
Toulon	2009	18.3	399.90	21.9
Valenciennes	2006	9.4	215.46	22.9
			Average	19.5

It should be noted that in many instances the costs of diverting the statutory undertakers utility apparatus will not be included in the above costs as the cost of diverting these are understood to be the responsibility of the undertaker on many French schemes.

The USA appears to have the most rigorous system for collection of light rail costs, through the Federal Transit Authority, which maintains a database of all scheme costs for which it has provided funding.

Table 4, below, sets out a sample of scheme costs from the FTA database as well as those of the Portland Streetcar schemes. Whilst the FTA database provides data at a higher level of detail than that provided here is has not been reproduced as there is no corresponding level of detail available for UK or European schemes.

Table 4

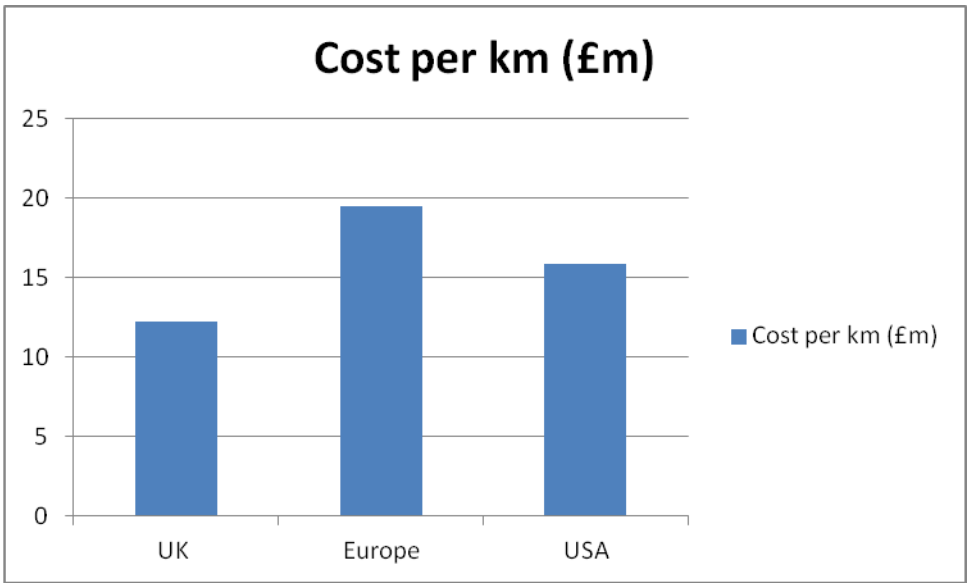
US Scheme Costs

System	Approx date	Length (km)	Cost (£m)	Cost per km (£m)
Denver Southwest Corridor	1999	13.7	174.90	12.8
Hiawatha Corridor, Minneapolis	2002	18.7	580.52	31.0
Pittsburgh Stage 2	2003	8.7	319.03	36.7
Portland Interstate MAX	2002	9.3	296.30	31.9
Portland/Westside/Hillsboro MAX	1996	28.5	1035.42	36.3
Portland Streetcar 1 & 2	2001	3.9	52.31	13.6
Portland Streetcar River Place	2005	1.0	11.93	12.4
Portland Streetcar Gibbs Extension	2006	1.0	11.29	11.7
Portland Streetcar Lowell Extension	2007	0.6	9.87	15.3
Sacramento Folsom Corridor	2002	20.8	231.64	11.1
Sacramento South Corridor	2002	10.1	193.22	19.1
Salt Lake North South Corridor	1998	24.3	300.40	12.4
San Diego Mission Valley East	2003	8.9	416.35	46.8
Southern New Jersey LRT	2002	45.0	603.14	13.4
VTA Tasman West	1999	12.1	355.43	29.4
			Average	15.9

As with the data for the UK and European schemes there is a wide range of costs encompassed by the light rail banner and it is only through understanding the detail of individual schemes that true comparisons can be made. The European schemes are the most consistent in cost; this perhaps reflects the similarity of approach in delivering high quality street running tramways, often accompanied by significant public realm improvement. The US schemes by comparison reflect a wider range of approaches from ‘starter schemes’ such as the Portland Streetcar to light metro and tunnelled schemes.

On the basis of the above datasets it would appear that the UK has on average actually delivered light rail schemes for lower cost than both European and US schemes, as shown in Figure 1 overleaf.

Figure 1



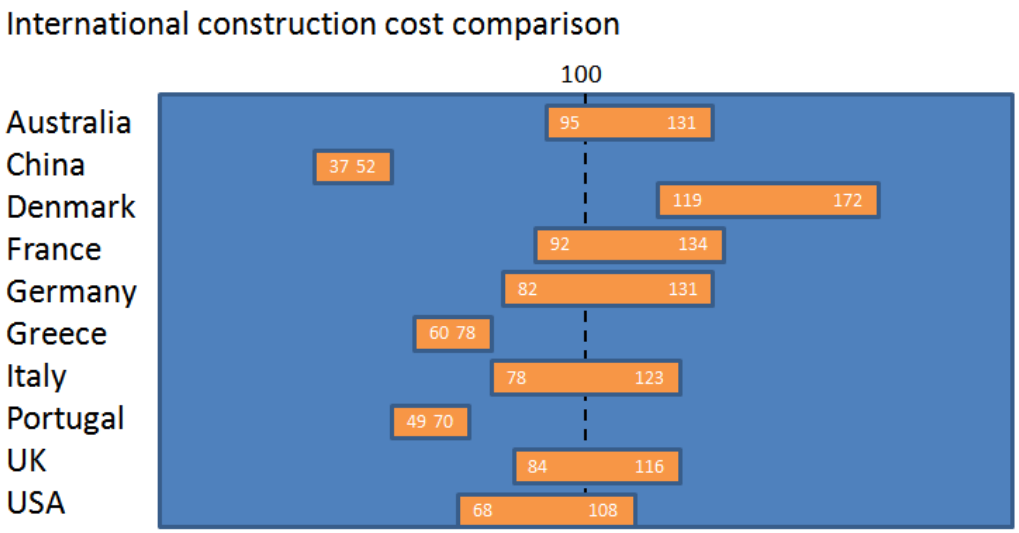
International construction costs may account for a part of this differential. Data published by EC Harris suggests[2] that the UK construction market is 10th most expensive in Europe and 14th most expensive globally, cheaper than France, but more expensive than the USA.

The picture is however complex, with a range of costs existing for each country making it difficult to draw proper comparisons. The picture in the USA is particularly complex with wide ranges between different states; for example the industrialised North East is more expensive than the more rural South. The range and overall cost of construction is illustrated in the diagram in Figure 2 overleaf. Even across the UK there are pricing differentials between the south east and other areas.

On average construction prices in France and Germany are higher than those in the UK by 13% and 7% respectively. This must then explain some of the difference in light rail scheme costs.

[2] EC Harris International Bulletin, Summer 2011

Figure 2



Note: 100 equals typical cost is South East England; orange bars provide the approximate range for each country.

Whilst the cost of construction is a factor, a major reason for the differential between UK first phase construction costs and those of the French schemes considered may well be the extent to which UK schemes utilise old heavy rail alignments which in most cases provide at least a cleared path for the tram without significant utility and other obstructions. The approximate extent of street running on the current UK tramways is set out in Table 5 below:

Table 5

System	Length	Approximate segregated length
Croydon	28	60
Midland Metro	21	90
Metrolink Phase 1	30.4	93
Metrolink Phase 2	7	30
Metrolink Phase 3 (to date)	2.6	100
Nottingham Tramlink	14.5	63
Sheffield Supertram	28.8	75

Note: Blackpool is not considered as its alignment is a first generation tram system.

As can be seen there is very extensive segregated proportion to all of the systems which in all cases makes use of old rail alignment. It is only in the case of Metrolink Phase 2 where there is no rail alignment utilised and it is noticeable that the costs of this scheme were significantly higher.

With regard to the French schemes there is much less of a focus on reusing rail alignments than there has been in the UK. Taking the example of Montpellier; the first line was entirely within the city centre, whilst the first extension to the system did utilise 2.5km of rail alignment, this represents a much smaller percentage than that of any of the UK systems. On the basis that the construction of street running tramway is more expensive than a segregated light railway, this may be a significant factor in accounting for the cost differential.

The reasons behind differences in costs are considered further in the following section of the report.

Comparison Between UK, European and US Scheme Costs

The complexities of considering and comparing scheme costs exist at a number of levels; international variances, national approaches and standards and local issues. These must all be considered in an attempt to compare costs.

International

As noted in the previous section of the report there are variations in cost internationally as a result of such issues as cost of living and business related costs. As such construction in emerging markets is far cheaper than the UK, whilst there are still significant variations across the European Union.

The complexities of international currency exchange rate variations make comparisons more complicated.

National

At a national level there are significant variations in how tramways are owned, operated and constructed.

The type of procurement route adopted is a clear driver for the costs. Whilst the integrated single procurement adopted in the Public Private Partnership appears to provide a straightforward route to procuring and operating a light rail system in reality it hides a number of tensions that may lead to higher costs than those deliverable through piecemeal procurement. For example a typical design, build and operate concession may feature a constructor, rolling stock/systems provider and an operator. The constructor does not necessarily share the long term aspirations of the other partners and as such may seek to reduce the overall cost and quality of the construction element, leaving a need for costly replacement or higher long term operating costs. This has certainly been an issue in UK tram system with fundamental items required for the operation of a system, such as the wheel lathe, left out to reduce capital cost. The long term operational costs associated with reduced capital cost are an area which requires future consideration by UKTram to understand the impacts.

PPP schemes can also create tensions as to how risks are dealt with which in turn can lead to the private sector financiers building in additional risk premiums. This sub-optimal risk transfer can lead to the cost of the scheme to the public purse being increased without additional benefit.

The size of procurements has a very significant impact on costs. Any contract will require a set up cost and this is more effectively spread across a larger contract. This is particularly relevant in the case of rolling stock where there may be, even in the event of selecting a relatively standard vehicle, significant costs to undertake system specific design, establish production lines and produce the vehicle.

In France there has been a very clear local drive to deliver light rail schemes. These projects, often spearheaded very publically by a local major, are seen as a matter of civic pride. As a result there has been in many cases a relatively quick delivery of schemes and often subsequent extensions once the initial service has been proven to be popular. This has had a positive impact in driving through the work needed to obtain funding (helped by a sympathetic view at national government level). As a result the gestation period of these schemes has been shorter, as can be seen from the multitude of tram schemes delivered in France in the last 20 years, than that in the UK; where for example it has taken over 15 years to get the Manchester Metrolink phase 3 routes to the stage of opening and even there the construction will continue for several more years. This is despite Metrolink being hugely successful and delivering both public transport growth and modal shift from the private car. The many iterations of the scheme faced by the Metrolink promoters have only added to the costs, often abortive, of developing and procuring the works.

Conversely the level of ‘civic pride’ attached to the French schemes may in its own way increase the cost of schemes. It is very clear from visiting any of the major French tram systems that there has been significant expenditure incurred in ensuring that the public realm alongside the tramway is of an appropriately high standard.

Montpellier Tramway showing the extensive work undertaken to the public realm

In addition there have been instances where extra steps have been taken to ensure that the tramway does not impact the environment and visual amenity of various city centres e.g. the use of Alstom's APS system, which provides power to the tram through an electronically sectioned third rail system, through the centre of Bordeaux and other cities[3]. This adds considerably to the cost of the system.

It may be as a reaction to this type of expenditure that the objectives for the Besançon light rail system have been set. The budget has been set on the basis of delivering a tramway that will not have any of these additional costs and provides a no frills operational infrastructure. The scheme is still in the delivery phase and it will not be known for some time whether the capital cost targets are achieved and if so whether a sustainable light rail system is delivered with a realistic whole life cost and reliable service.

[3] Refer to UK Tram Working Group Technology Briefing Paper – Catenary Free Tram Operation.

The external environment and route choice can have a very severe impact on the costs of a light rail scheme. Those schemes that rely upon large scale structures to support the track e.g. Metrolink Phase 2 or Docklands Light Railway are far more expensive than those that are street running or on old rail alignments. Whilst there are occasions where this may be appropriate the scheme promoter needs to clearly understand the magnitude of cost that this will entail from an early stage of the scheme. Similarly where tunnels need to be employed the costs will rise e.g. the Lewisham DLR extension.

Bordeaux tram operating using the APS system through the city centre

The approach to statutory undertakers' equipment and the diversion of this utility equipment out of the path of the tramway is often quoted as a reason for cost differentials between UK and French schemes in particular. In the UK it is a scheme related cost to divert these and despite a small element of discount on the cost utility diversions is often a significant element of the cost of the scheme. In France it is usually the statutory undertakers' cost to provide the diversion. Whilst there have been efforts in the UK to minimise the cost of

diversions through retaining the infrastructure under the tramway, this is never entirely practical as there are always instances such as manholes, which cannot remain in situ.

There has not been until very recently any attempt to align light rail standards across national boundaries. This has left tramway promoters locally to develop standards using what is available to them, in most cases the local heavy rail standards, adapted to make them more suitable for tramway/light rail operation. In many cases the reliance on heavy rail standard has been a contributory factor in making light rail more expensive[4]. Germany has been perhaps the most advanced country in terms of defining standards through the work of VDV. This has led to a wealth of material on design of light rail that has helped to provide a common and appropriate standard[5].

Work has over the last two years been progressed via the EU and CEN/CENELEC to review and adopt a set of European wide standards for light rail. The relevant standards have now been prioritised for presentation to the EU standards writers in order to address safety and cost advantages. The work is now at the stage where it has been presented to the individual national standards bodies for ratification prior to adoption. It is only as systems are produced to a common standard across Europe that there will be a direct ability to compare like for like costs.

[4] Refer to UKTram Workstream 1 – Lower Cost Schemes, Lessons from Elsewhere.

[5] Refer to Local and Regional Railway Tracks in Germany, Association of German Transport Undertakings (VDV), Dusseldorf, 2007.

Low Cost Schemes

The Portland Streetcar scheme has in recent years been used as an example of a means of delivering lower cost light rail. The report Green Light for Light Rail refers additionally to the light rail scheme in Besançon, France.

Considering the costs of the Portland schemes it is clear that the Portland Streetcar does achieve a low cost for a fully street running system. The approach adopted of utilising a lightweight track slab and minimising the utility diversions is obviously one that is generating savings on construction cost. These ideas are already permeating the UK market and it will be interesting to determine whether these yield savings here on forthcoming schemes.

Portland Streetcar Vehicle

One of the means of reducing the overall cost of the Portland schemes has been the smaller streetcar vehicles utilised. It is clear however from examination of the costs that these are close to being comparable to European/UK vehicles prices and when considered on a per passenger capacity basis are actually more expensive. This may be for a number of reasons the most obvious is the Buy America legislation which requires light rail vehicles to have a US component, including manufacturing/assembly in

the USA. This may actually increase costs and may also cause manufacturing set up costs to be applied to schemes. Hence whilst the smaller vehicles may provide a slightly cheaper fleet when patronage is low, may in the event that the scheme is successful increase costs through the need to increase fleet size.

The local government, in planning the Besançon scheme has set out that the scheme will cost €228m at 2008 prices with a maximum 5% contingency. This equates to a cost of €16m per km or approximately £14.5m per km at current prices. This would put the costs of the scheme below that of the other French schemes and at the lower end of scheme costs internationally. Whilst the aspiration to deliver lower costs is recognised, there is as yet little evidence to suggest whether the scheme will achieve this.

The only element of the costs to date fixed is that of the vehicles which have been procured through CAF. Whilst these are relatively low cost the actual cost of passenger capacity is relatively high, probably as a result of the shorter vehicle configuration which does not provide for a high capacity.

Visualisation of the Besançon tram to be supplied by CAF

Additionally it should be considered that not all capital cost savings will lead to long term operational cost savings. An example might be the very minimal depot specification reportedly proposed for Besançon. This could lead to similar problems to those experienced in the early operational period of

Midland Metro where as a result of cost saving measures the PFI contractor had not provided what would now be considered key operational equipment such as a wheel lathe which led to significant additional operating costs.

Besançon currently has a bus network, 'Ginko', that will be partially replaced by the tram system. It may be that some of the costs of the tram network have already been absorbed through the construction of the bus network, artificially reducing the real cost of the scheme.

It is only when the scheme is completed that a judgement will be possible on whether the scheme has actually delivered real reductions against a standard light rail implementation.

Portland has recently announced that it has finalised the funding for an extension to the conventional light rail system in the city. The costs are at the high end of the normal range for light rail with Siemens light rail vehicles at approximately £2.5m each and the 11.3km scheme costing approximately £73m per kilometre (albeit that this includes a major bridge over the Willamette River which will also cater for buses and cycles, the scheme will also provide cycle and pedestrian facilities along the route. This points to an important point – that even in cities where low cost light rail has been very successfully delivered it is not the solution for everything. What Portland recognise is that the Streetcar solution is the correct one for the city centre core area where passengers are making shorter journeys and numbers are such that smaller vehicles, better able to be fitted into the cityscape are able to cope with demand; however they are also catering for the more demand intensive radial and commuter routes which need to cope with a greater peak demand.

It is recommended that UKTram establishes monitors the ongoing delivery of the Besançon scheme to determine whether the cost goals are achieved, whether there is the opportunity to learn from this scheme and whether these lessons are transferable to the UK.

Reference should be made to the report produced by Workstream 1 which is considering means of reducing the costs of light rail in the UK.

Future Scheme Data Collection

In compiling this report it is clear that the lack of readily available and comparable data is a fundamental problem in comparing any two or more schemes.

The US Federal Transit Authority (FTA) maintains a standard cost breakdown system of Scope and Activity Line Item Codes for collating costs. This is utilised in the USA as a means of collating all relevant costs. The FTA maintains this in a simple database for the purposes of analysis of scheme costs. The database format allows searches on differing types of scheme, cost elements and the automated generation of reports from the data.

A similar database facility could readily be replicated for UK use.

The current UK dataset is not large enough to draw general conclusions on costs (particularly as many of the examples utilised have not yet been completed or are still in the procurement phase) and future focus should be given to widening the dataset available.

Cost capture is essential to monitor the efficiency of the capital costs of Light Rail schemes. Not only does a standardised method of cost capture facilitate the comparison of tender costs, it also allows the future planning and funding of schemes to become more certain. The industry as a whole will benefit through cost certainty in key areas and the subsequent benefits of any contingency against genuine project risk as opposed to perceived pricing risks and cost uncertainty. This will help to reduce required contingency, and subsequently reduce tender costs. While this is essential, and a firm economic foundation from which the industry as a whole can grow, care must be taken to not simply focus upon driving capital costs down.

There is a direct link between the capital costs and the lifecycle costs of civil engineering projects in general, maintenance costs are usually higher later in the project life if a less substantial and subsequently cheaper construction is utilised at the outset. The same applies with transportation projects, and care should be taken to fully understand the impact of driving down the capital costs of Light Rail projects to the detriment of the lifecycle costs of the scheme.

Reduction in specification can be very effective in providing an affordable no-frills light rail system, but the specification items that should be down-scaled should not be key components that will increase future maintenance costs. As an example, if a low level specification track form is used, the initial capital costs could be significantly reduced, but the warranty period offered by the contractor may well be reduced as a result. The maintenance costs associated with this track-form will very possibly increase the overall lifecycle costs, and the maintenance costs will occur sooner in the project life possibly to the detriment of the business case and cash-flow of the provider.

A fine balance between sensible capital costs and efficient maintenance costs must therefore be sought. In order to find this balance, it is recommended that in addition to detailed capital cost analysis of all Light Rail schemes, Lifecycle cost analysis over 20, 30 or 60 year periods is carried out as a matter of course for all future projects.

It is recommended that it should be a condition of funding for future schemes that cost data is provided for collation by UK Tram in a standard format. A draft format is provided in Appendix 3.

Conclusions and Recommendations

Examination of the data available suggests that closer examination is needed for a number of widely held views about the cost of light rail:

UK light rail is more expensive than European and North American schemes

There has been a belief for some time that light rail in the UK is not delivered as cost effectively as in other locations (mainland Europe and North America are often quoted as being able to deliver cheaper schemes). There has been a widely held view that UK requirements for diversion of statutory undertakers apparatus as well as the large scale rebuilding of the public realm where schemes are undertaken in city centre locations has helped to push costs higher. The cost comparisons show that not only is this assertion not correct, in some cases the UK has provided much cheaper schemes. Reasons for this may include the fact that whilst UK schemes typically rebuild the streetscape, this is not uncommon in other countries – French cities also typically use light rail as a driver for regeneration and urban renewal. In addition, UK Light Rail schemes have in several instances, utilised old heavy rail corridors previously mothballed by the Beeching cuts of the 1960's. This has resulted in much of the expensive infrastructure works not needing full construction from new, and land purchase costs being reduced as the corridors are 'set aside' and in the ownership of the Local Authorities, this makes these routes ideal for Light Rail schemes. As many of the major contracting and supply organisations in the market now operate across Europe or even globally it is perhaps not surprising that prices are similar across national boundaries. There are however a number of complicating factors which make the development of conclusions with regard to cost relatively difficult. For this reason it is necessary to collect cost data in a more reliable and comparable way in the future.

Some schemes have discovered how to provide light rail at a lower cost

Portland Streetcar is often quoted as the example of how to deliver low cost, but effective light rail in an urban environment. Whilst Streetcar is undeniably popular it is arguable that despite the 'no-frills approach' and pared down infrastructure design, in reality the cost is not hugely different from that achieved elsewhere – although the means of achieving the costs of track construction should be investigated further under Workstream 1. Indeed the vehicle costs quoted are at least comparable to those achieved in the UK. In the event that a scheme develops in popularity there is the very real issue that the vehicles would have to be upgraded.

The Besançon scheme will deliver the way forward for cheaper light rail in the future

The Besançon scheme whilst not yet constructed has been referred to as the way forward for delivering more cost effective light rail in the future through the careful control of the scope of the scheme and through ensuring that the functionality of the scheme is limited to that required. Whilst the infrastructure elements of the scheme are yet to be delivered, the vehicles have been procured. The cost of these vehicles, whilst low per vehicle, is high per passenger. In fact the 'per passenger' cost is higher than the cost of all recent UK procurements. The vehicles procured are shorter than a standard tram (three sections) and as such will be adequate whilst patronage is low however once demand increases it is likely that the vehicles will need to be modified to incorporate additional sections in order to provide greater capacity and increase revenue. The total cost of vehicles will be higher than for a standard vehicle. At this stage in the project it is too early to be certain as to whether the methodology adopted for the Besançon scheme will offer real savings.

The recommendations set out below should be pursued as part of UKTram's ongoing work programme.

1. ***It is recommended that UKTram establishes monitors the ongoing delivery of the Besançon scheme to determine whether the cost***

goals are achieved, whether there is the opportunity to learn from this scheme and whether these lessons are transferable to the UK.

2. ***It is recommended that it should be a condition of funding for future schemes that cost data is provided for collation by UK Tram in a standard format.***

References and Further Reading

Delivering a ‘No Frills’ Tram, Railway Gazette International, Pascal Gudefin, Communaute Urbain De Grand Besançon, April 2011

Green Light for Light Rail, DfT, September 2011

Improving public transport in England through Light Rail, National Audit Office, 2004.

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Global Economy Worries Affect investor Confidence and Push Back Recovery in Tender Prices, Market View UK, Spring 2012, EC Harris Research

Unit Price Regional & Escalation Analysis, High Speed Rail Feasibility Study, Rocky Mountain Rail Authority, March 2010

Local and Regional Railway Tracks in Germany, Edited by Prof. E.h. Gunter Girnau & Dr. Friedrich Kruger, Association of German Transport Undertakings (VDV), Dusseldorf, 2007

Appendix 1

UKTram Working Groups

The original UK Tram Activity Working Groups are listed below:

Activity 1 - Protection and Diversion of Utilities

Activity 2: Tram Design Standards and DDA / RVA issues

Activity 3: Signing of Tramways and Highway Interface

Activity 4: Noise and Vibration

Activity 5: Network Rail Interface

Activity 6: Trackform Design

Activity 7: Benefits included in the Appraisal Process

Activity 8: Commercial Structure

Activity 9: Operational Performance Measures

Activity 10: Tender Documentation

Activity 11: Wheel / Rail Interface Study (HMRI Study Phase 2)

Activity 12: Traction Power Supplies

Activity 13: Proposed British Tramways' Board (BTB)

Further to the DfT/UKTram Summit of 30 November 2011, the following workstreams were established:

Workstream 1 - Lower Cost Schemes – lessons from elsewhere

Workstream 2 - Standard Implementation Plan and Centre of Excellence Support

Workstream 3 - Utilities and Light Rail Interfaces Consultation Exercise

Workstream 4 - Ultra Light Rail and PRT

Workstream 5 - Future Technologies (Infrastructure and Operation)

Workstream 6 - Heavy Rail Conversions

Appendix 2

Price Inflation and Exchange Rates

In order to account for inflation it is necessary to utilise an index figure to inflate historical costs for comparison purposes. Whilst there are numerous indices available to do this, the indices do not necessarily follow the actual cost of light rail scheme construction.

A large portion of light rail scheme costs are construction costs. These typically do not follow standard indices such as the Retail Price Index and in 'boom' years tend to increase ahead of general inflation as wages rise and material costs increase, but also the market prices in the shortage of resource through increasing profit margins. The other major element of light rail schemes is the cost of vehicles which are governed more closely by the cost of materials as well as overall manufacturing output.

In addition to the above there are both regional and national variations in inflation. The USA for example shows very wide differences of inflationary index across states, at least on the basis of individual years.

In inflating costs for the purposes of this report a single index has been used to inflate prices as set out below. Whilst it is recognised that this will not be wholly accurate, it is considered that it would be inappropriate to attempt to apply a greater level of detail as this would potentially imply a greater level of accuracy to the figures than is actually the case.

Year	Price Index	Multiplier
1990	130	1.62
1991	129	1.63
1992	120	1.75
1993	120	1.75
1994	122	1.72
1995	125	1.68
1996	128	1.64
1997	132	1.59
1998	138	1.52
1999	142	1.48
2000	151	1.39
2001	158	1.33
2002	163	1.29
2003	175	1.20
2004	182	1.15
2005	191	1.10
2006	201	1.04
2007	210	1.00
2008	229	1.09
2009	225	0.93
2010	212	0.99
2011	210	1.00
2012	210	1.00

Note: For reasons of accuracy cost data for schemes prior to 1990 has not been used.

Current exchange rates have been used in undertaking conversions from US Dollar and Euro. The Euro was not introduced until 2002, so older schemes have already been converted from their national currency. The £ was worth approximately 1.75 US Dollars in 1990 (on average) and was worth 1.5 US Dollars in 2000, so today's figure of 1.6 US Dollars is a mid-point for this period.

The € has been converted at a current rate of 1.2:1.

Appendix 3
Draft Cost Breakdown Structure for Future Light Rail Schemes

LEVEL 1 - PROJECT STAGE	LEVEL 2 - COST ASSET	LEVEL 3 - COST SUB-ASSET	LEVEL 4 - COST ACTIVITY
1 Development	1 Planning	1 Route development costs	
		2 Consultation	
	2 Powers	1 Powers application development	
		2 TWA costs	
	3 Funding	1 Outline business case	
		2 Full business case	
2 Implementation	1 Land and Property	1 Land acquisition	
		2 Relocations	
		3 Alterations / refurbishments	
	2 Rolling Stock	1 Engineering and Design	
		2 Procurement	
		3 Purchase	
		4 Refurbishment	
		5 Lease	
		6 Trial Running	
	3 Track	1 Trackbed and rail	
		2 Bridges and support structures	
		3 Tunnels	
		4 Public realm	
		5 Public art	
		6 Track Drainage and attenuation	1 Engineering and Design
			2 Procurement
			3 Construction
			4 Refurbishment
	4 Power	1 Supply	
		2 Sub-stations	
		3 OLE	1 Engineering and Design
			2 Procurement
			3 Construction
			4 Refurbishment
	5 Systems	1 Signalling	
		2 Telecoms	1 Engineering and Design
			2 Procurement
			3 Construction
			4 Refurbishment
	6 Stops	1 Civil works	
		2 Shelters and furniture	
		3 Customer information / protection equipment	1 Engineering and Design
			2 Procurement
			3 Construction
			4 Refurbishment/conversion
			5 Park and ride provision
			6 Customer information / protection
	7 Support Facilities	1 Administration buildings / control centre	
		2 Maintenance sheds	
		3 Tram storage sheds	
		4 Tram storage yards (incl sidings etc)	1 Engineering and Design
			2 Procurement
			3 Refurbishment
			4 Construction
			5 Maintenance equipment
			6 Support vehicles

- 3 Indirect Costs
  - 1 Programme and Project Management
    - 1 Internal management cost
    - 2 External management support
    - 3 Stakeholder & publicity
  - 2 Statutory undertaker equipment
    - 1 Diversions
    - 2 Upgrades
  - 3 Highway costs
    - 1 Highways changes
    - 2 Bus facilities
    - 3 Cycle facilities
      - 1 Engineering and Design
      - 2 Procurement
      - 3 Construction
      - 4 Refurbishment
  - 4 Staff training
    - 1 Maintenance
    - 2 Operations