Why does new transport infrastructure seem to cost more in Scotland and Great Britain than in other northern European countries?

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1 Introduction and objectives

There is huge demand for new transport infrastructure as local and national government try to deal with congestion, increase social inclusion or regenerate local economies. A question that is rarely asked, however, is why we are paying more than our continental European counterparts to build such schemes. Initial work carried out by the authors shows striking differences in headline costs for these kinds of schemes. For example (using an exchange rate of €1.3 to £1; or 12SEK to £1):

- 2.2km of on-street tram extension in Berlin, completed 2014, £9.4 million/km for the tracks, stops and overhead wiring, and a further £10.6 million/km for associated reconstruction of the street and pavements alongside. These costs appear to be typical of other German urban tram extensions. This compares to the estimated cost for the Edinburgh tram extension to Newhaven of £30.9 million per km.
- 9km busway in Malmö, Sweden, including tram-type bus stops and signal priority, completed 2014: £7 million (infrastructure cost only). This compares to Glasgow Fastlink (8km) global cost of £40 million.
- Re-construction and re-opening of 12km of single railway line plus refurbishment of 19km of single track freight line, 3 modernised and 2 new stations and 3 passing loops, resignalling, refurbishment of 2 tunnels and reconstruction of 2 major and several minor overbridges, Hessen, Germany, £26.4 million (2015 prices) (see www.korbach-frankenberg.de). This compares to Borders Rail at £294 million (2012 prices) for 48 km.
- Construction of 21km of 18.5m wide (2 plus 1 lane) high speed bypass and associated structures, plus pedestrian and cycle improvements on existing road, on E22 trunk road in southern Sweden between Linderöd and Sätaröd. £69 million at 2011 prices (£3.3 million/km). A9 dualling 118km in 11 projects with an estimated total cost of £3 billion (£25.4 million/km).

The list above is of course of headline global costs and such global cost figures will almost certainly mask differences if compared from country to country, due to what is excluded and included in the headline total as well as different topological characteristics (e.g. how many bridges or tunnels are involved?). For example, are planning and project management costs included; and, where a project is planned and project managed by an in-house organisation (typical for tram schemes in Germany, for example), when does the “clock start ticking” in counting the planning and management costs of a specific project, as opposed to the general work of the agency? There is clearly a need, then, if a more meaningful comparison is to be carried out, to obtain more disaggregated cost information and some information about how the project was planned and procured.

The purpose of this paper, then, is to present some more detailed results from an ongoing research project that has so far gathered somewhat disaggregated cost information on one busway, five tram schemes and two rail reopenings in Germany, Austria, France and Sweden. It also discusses why some transport infrastructure providers in the UK have not been willing to provide similarly detailed cost information for comparable schemes, and considers any evidence that other agencies have sought to undertake the kind of benchmarking that this paper would like to do, were the data from Great Britain to be made available. In the absence of detailed comparator data, it discusses some of the reasons why costs are seemingly lower in our northern continental European counterpart countries. It draws some conclusions and makes recommendations for further research.

2 Previous research on this issue

A literature review revealed almost no previous academic research on this issue. Academic interest has focused instead on cost and time overruns in large infrastructure projects, driven particularly by the work of Flyvberg, a Danish professor. Flyvberg's work (Flyvberg et al 2002; Flyvberg et al 2003a; Flyvberg et al 2003b; Flyvberg and COWI 2004; Flyvberg 2005a; Flyvberg 2005b) has shown that key reasons for cost overruns include:

- Systematic underestimation of costs in order to secure project approval.
- Higher cost inflation in infrastructure construction than in other sectors.
- Poor specification of the original project.
- Project specification changing part way through the project, sometimes several times.

However, his work did not indicate that certain countries were more prone to these problems than others, with the exception of his paper in 2008, which compared metro schemes around the world. Here he identified outliers, of which the only UK scheme considered in detail, the London Underground Jubilee Line Extension, was seen to be an upper cost outlier. He identified a number of reasons why schemes that were brought in at low cost achieved this, summarised in the following way in relation to the Madrid metro scheme that he studied, which was the cheapest of the European examples:

- "General reasons, which account for savings of 15-20 million US$/km. These general reasons include strong political commitment, a highly experienced project management team, and contract procurement not based on the cheapest bid.
- Specific reasons related to civil works, accounting for savings of up to 10 million US$/km. These include the use of a twin track single tunnel and the Earth Pressure Boring Method (EPBM), strong geotechnical supervision, monitoring and standardised station designs.
- Specific cost reduction in equipment, accounting for up to 10 million US$/km savings. These are explained by no air conditioning at stations, limited uninterrupted power supply systems, overhead rigid rail or catenary for trains, ATP (automatic train protection) and ATO (automatic train operation), tested technology for signalling and telecommunications, and conventional steel wheels.
- Specific cost reduction in design, supervision and management accounting for savings of 1 to 5 million US$/km, including short construction time, small project management team, limited technical assistance and the possibility of exploiting scale economics." (All four bullet points quoted directly from Flyvberg, Silelius and Wee (2008:10.))

De Jong, Annema and van Wee (2013) carried out a systematic review of the literature in this area, finding 28 relevant studies. Once again, these focused on reasons for cost overruns in projects; the paper looked at projects from across the world and draws some geographical comparisons, but only at the inter-continental level. The conclusion from this review of the literature is that key factors that need to be managed, if cost overruns are to be controlled, are as follows: (1) better early appraisal of project costs and benefits, (2) identifying and then limiting the risks involved, and (3) increasing accountability and transparency within the project and (4) keeping the scope and objectives as clear as possible and keeping "scope creep" to a minimum. However, there was no insight into whether or not these factors are better controlled in some *countries* (as opposed to continents) than others.

Nijkamp and Ubbels (1999) are authors who did carry out an international cross-comparison, in this case between the Netherlands and Finland, but again they were looking at reasons for cost and time overruns in each country, rather than explanations for differences in absolute costs (if any) for similar projects in the two countries.

The authors also carried out a search for articles in the German-speaking technical press that have presented cost data for schemes and cost differences between German-speaking countries. However, this search revealed little detailed cost data. Generally only headline figures were provided with a huge range of costs; some limited data were available on planning and management costs. There were also articles that argued that construction costs in Germany are higher than Netherlands or France, in Austria higher than in Germany, and in Switzerland higher than anywhere else. A general view from the articles reviewed was that costs are not comparable and from a PhD study on the topic that costs were almost impossible to compare internationally because of the different ways that they are calculated in different countries.

The European Investment Bank (EIB) carried out some benchmarking of headline costs of individual tram schemes in Europe and the US. It only considered two UK schemes, of which one was the highest of the whole sample, and the other closer to the EU average. It did not disaggregate costs nor give detailed reasons for any differences. (EIB, n.d., cited in UK Treasury/NIC 2010b but not properly referenced.)

As the publication cited previously suggests, the issue of cost differences between UK and continental European infrastructure has attracted the attention of the UK Treasury (Finance Ministry) and its National Infrastructure Commission. In 2010 they conducted an in-depth study of reasons for cost differences in infrastructure generally (not just transport infrastructure, although there was some detailed benchmarking relating to tunnelling and high speed rail) (UK Treasury/NIC 2010a, 2010b). This included interviews with many industry and government staff working on infrastructure delivery in different EU countries, although primarily France, Spain, Netherlands and Germany. This study is important as it identifies a number of reasons why costs are lower in these continental EU comparator countries than in this country. The reports concluded that cost savings of at least 15% could be achieved in the UK if some of these factors are changed or acted upon. There are clear parallels between some of these factors and those identified in the literature on cost overruns (unless otherwise specified, the factors listed below exist to a greater extent in continental EU countries than in the UK):

- Long term political commitment to schemes and their funding.
- Regular national and sometimes regional infrastructure plans.
- Codified (not Common Law) legal systems bring greater certainty and less need to constantly reinterpret regulations.
- UK environmental, health and safety and procurement regulations are applied differently in different schemes. Greater uncertainty about the legal situation drives up risk and cost in the UK.
- Competent skilled knowledgeable in-house public sector teams are more common elsewhere.
- Letting projects in smaller tranches to stimulate competition.
- Within the private sector contracting industry, there is greater willingness to collaborate and compete at same time.
- Engineers in Spain, France, Germany and Sweden study for longer and have better appreciation of all aspects of building a project, not just its technical aspects. They are encouraged by remuneration and industry culture to stay with the same employer, so staff turnover is lower.
- Use of standard not bespoke designs for, for example, bridges and metro stations.
- In the UK there is a tendency to have higher specifications. For example, gantries on UK motorways are crash proof; signs on UK A roads are lit; construction lifetime for UK motorway structures is 120 years and in the Netherlands 80 years; and so on.
- Projects start only once design is sufficiently complete.
- Role of client, funder and delivery agent is clear.
- Aiming in budgeting for the lowest cost for required performance rather than a target quoted cost.
- Budget including contingencies is not seen as the available budget.

- In the UK, competition processes not always effective in producing lowest outturn costs – fear of legal challenges makes procurement cumbersome.
- In the UK we may pay more for basic materials and/or the same inputs.

Aggravating all of this is the fact that UK working hours in construction are the longest but labour costs the cheapest.

It should be noted that with respect to the transport infrastructure schemes examined by the UK Treasury study, there was a preponderance of data from France and Spain, which clearly have some very significant differences in construction standards and legal systems compared to the UK. In the authors' study of tram and rail schemes we have collected data mainly from Germany, Austria and Sweden because these countries are considered more similar to the UK in terms of public consultation, application of health and safety standards and construction standards. Nonetheless, the list of cost drivers identified in the UK Treasury study is highly instructive and will be returned to in the discussion and conclusions of this paper.

From the review of the limited literature in this field, then, it is clear that academics have focused primarily on cost overruns. The findings are helpful insofar as they point to factors that need to be controlled to keep cost overruns in check, but there are almost no comparisons between countries, and there is no literature that considers why projects that are on time and within budget may cost more for apparently the same thing in one country compared to another. As de Jong et al (2013) point out, there is a need for more data on projects that have gone to plan, rather than only on those that have gone over budget. Some benchmarking studies have been carried out but these have not presented detailed disaggregated costs and no studies appear to have benchmarked tram and local rail reopening schemes in detail. There is therefore a clear need for more research and data in this area.

3 Methodology

Essentially, the methodology is a secondary data gathering exercise, but it was important to be clear about what secondary data was required and try to apply some structure to this. The process was as follows:

- Select comparable schemes e.g. similar locations, ground conditions, terrain, mix of structures.
- Gather info on design standards, maintenance regimes, planned traffic levels and axle weights.
- For rail and tram, attempt also to get some information on how planning, management and contracting is organised.
- If possible, obtain as built not planned costs.
- Costs broken down in as much detail as possible, but at a minimum to specify major structures, groundworks, drainage, track, stops and overhead line separately.

German and Swedish road and rail design standards were obtained along with examples of construction cross sections from German tram schemes.

A Google search returned moderately detailed costs for tram extension schemes in several German cities but in order to obtain relevant information about the nature of the scheme and the contract type it was clear that face to face contact was required; and it was not possible to find rail scheme costs from Germany or Sweden disaggregated to any level from an internet search. Therefore a German consultancy company was employed to obtain more detailed information on two rail reopening schemes and one tram extension scheme.

Ultimately, however, it was possible to obtain moderately disaggregated costs for the following schemes:

- Innsbruck, Austria, tram extension (via consultants in Germany), partly complete, partly under construction and in tendering.

- Lund, Sweden, new tram (personal contact), partly under construction, partly in tendering.
- Kassel, Germany, new tram (personal contact), completed.
- Dijon and Besancon, France, new trams, completed (secondary sources via personal contact).
- Germany, both schemes completed (via consultants in Germany).
- Sweden, a busway in Malmö (personal contact), completed 2014.

Network Rail and Transport Scotland (Head of Rail) were provided with the disaggregated costs of one of the German rail schemes and asked, respectively, for costs for a recent Scottish scheme at a similar level of disaggregation. Network Rail said that they would look at the request but are as of the date of writing of this paper (27th March 2017) still considering "whether this information is readily available in the format that you expect and what quantum of activity would be required to compile it, and to provide assurance that the data quality is valid and provides meaningful comparisons" (email correspondence with NR, 24th March 2017). Via an FOI request Transport Scotland said that they had not carried out any benchmarking studies of continental European rail schemes. City of Edinburgh Council tram extension team were supplied with the continental tram scheme costs listed above and were asked for the costs of the planned Newhaven tram extension at a similar level of disaggregation. They turned down this request on grounds of commercial confidentiality although are keen to carry out a visit to at least one of the sites to understand whether or not these costs would be in any way achievable in Edinburgh. Their decision not to provide disaggregated costs of the Edinburgh extension has been reported to the Information Commissioner but their view is not yet available.

4 Costs of the schemes for which data are available.

This section reports these costs, scheme by scheme, beginning with the tram schemes, then rail, then busway. In the absence of detailed costs for UK schemes, the reader is referred to the headline costs in the introduction to this paper.

4.1 Tram scheme costs.

4.1.1 Besancon and Dijon, France

These trams opened in 2014 and 2012 respectively. No information is available about the form of contract or project management structure, nor the split between on- and off-street. Source: Technical University of Berlin, 2015.

	Asset	Besancon (14.5 km) Total	Per km	Dijon (18.9 km) Total	Per km
1	Planning/Studies	1,190,717	82,118		
2	Project management 1	11,159,649	769,631	7,000,000	370,370
3	Project management 2	13,649,718	941,360	19,200,000	1,015,873
subtotal 1-3		**26,000,084**	**1,739,109**	**26,200,000**	**1,386,243**
4	Property acquisition	5,000,100	344,835	14,000,000	740,741
5	Relocation of facilities	2,150,000	148,276	23,000,000	1,216,931
6	Preparation	8,823,850	608,541	12,100,000	640,212
7	Civil engineering works	18,776,200	1,294,910	10,100,000	534,392
8	Route construction	8,495,725	585,912	18,400,000	973,545
9	Track construction	39,074,100	2,694,765	41,500,000	2,195,767
10	Guideway design	10,437,175	719,805	7,400,000	391,534
11	Streets and places	13,785,800	950,745	41,000,000	2,169,312
subtotal 8-11		**71,792,800**	**4,951,228**	**108,300,000**	**5,730,159**
12	Furniture of public spaces	8,185,200	564,497	14,900,000	788,360
13	Traffic lights	3,241,125	223,526	4,300,000	227,513
14	Stations	2,201,600	151,835	6,000,000	317,460
15	Electrification (high)	20,521,750	1,415,293	24,700,000	1,306,878
16	Electrification (low)	10,504,900	724,467	17,400,00	920,635
subtotal 12-16		**44,654,575**	**3,079,626**	**67,300,000**	**3,560,847**
17	Depot and maintenance	13,112,702	904,324	24,500,000	1,296,296
18	Vehicles	35,296,094	2,434,213	73,600,000	3,894,180
18	Induced measures	2,393,595	165,076	3,500,000	185,185
	Total	**228,000,000**	**15,724,138**	**362,600,000**	**19,185,185**

Table 12: Cost Comparison between Besancon and Dijon, France in €[77]

4.1.2 Lund, Sweden

This scheme is under construction, and due to open early 2018. It is 5.5km long, with 9 stops. Approximately 1 km of it is on street, 2km on an existing busway, and 2.5km off-street, with two major bridge structures. Costs exclude depot. There is early contractor involvement, partnering contracting method, heavy contractor involvement in detailed design and the council has no existing in-house design or project management team for a project of this nature and scale. Source: summarised from City of Lund, 2016

Main item	**Cost in million Swedish kr (11kr = £1)**
Planning and management costs	82.3
Track	137.3
Trackbed	38.6
Electrical equipment – catenary etc	90
Signals	17.0
Drainage	23.3
Groundworks and stops	52.3
Streets and bridges (construction and modification)	166.5
Relocation of utilities	54.1
Contingency (14% of total costs)	95.5
Grand total	**776.0**

4.1.3 Kassel, Germany

This case is of a 4.2km double track extension to Vellmar Nord in the City of Kassel, opened in 2011. The contracting method unknown but likely to have been detailed design carried out by local tramway company and then a variety of small contracts let to build individual elements of tramway (e.g. stops; track; OHLE).

	Section 1	**Section 2**	**Total**
Planning and management costs	2,076,657 €	897,875 €	2,974,532 €
Major structures	423,031 €	288,648 €	711,679 €
Preparing track bed	6,508,087 €	2,888,401 €	9,396,488 €
Track			7,537,000 €
Stops	652,684 €	382,863 €	1,035,547 €
Overhead wires for electricity	1,535,810 €	853,652 €	2,389,462 €
Street reconstruction costs associated with the tram project (for example, putting in new bike lanes on the same street as the tram was built on)	7,071,939 €	2,030,378 €	9,102,317 €
Costs for moving utilities in the street	2,463,001 €	904,952 €	3,367,953 €
Costs of any new traffic signals required	804,666 €	380,542 €	1,185,208 €
Length in m directly on-street	428 m		
Length of route running off-street (but immediately adjacent to street in most parts)	2.345 m	1.353 m	4.125 m

4.1.4 Innsbruck, Austria.

This route is almost all on-street and consists of:

- A new line within city limits 11.92km of which 9.1km is finished.
- Reconstruction of 9 km of existing Lines 1 and 3, completed.
- A further 3km in total of new construction outside the city limits to Völs and Rum, to be completed by 2020.

Detailed design is carried out by the public sector tram company. The project divided into smaller sections of a few km for tendering purposes. There is a process of pre-qualification then full bids, with up to five bidders per contract at second stage. Total costs as follows:

	Contribution from Land of Tyrol (m €)	Contribution from City of Innsbruck (m €)	Sum (m €)
Common infrastructure	57.37	114.73	172.10
Urban infrastructure (100% City of Innsb.)		24.98	24.98
Regional infrastructure (100% Land of Tyrol)	42.27		42.27
Vehicles	56.87	83.20	140.07
Depot	8.65	8.65	17.30
Total	231.56	165.16	396.72

More information about the project is available (in German) at http://www.ivb.at/de/aktuelles/bauprojekte/tramregionalbahn/projektbeschreibung.html and http://worldofporr.porr-group.com/index.php?id=5383#/page/5. Detailed costs are available below.

Cost estimation "RegionalStadtbahn Innsbruck"			
Estimation of 2016 values include an annual increase of 2.5% (valorisation)	**2009**	**2016**	**price per**
Tracks			
Single track (or first track when doubled) including overhead line	1,880.00 €	2,234.73 €	serial metre
Second track when doubled including overhead line	1,780.00 €	2,115.86 €	serial metre
Damping of track	500.00 €	594.34 €	serial metre
Overhead-line: First Track (projected velocity <50 km/h)	350.00 €	416.04 €	serial metre
Overhead-line: Second Track (projected velocity <50 km/h)	250.00 €	297.17 €	serial metre
additionally: Overhead-line, catenary equipment: First Track (projected velocity >50 km/h)	350.00 €	416.04 €	serial metre
additionally: Overhead-line, catenary equipment: Second Track (projected velocity >50 km/h)	250.00 €	297.17 €	serial metre
Single track, ballast bed, no vibration-proofing, with overhead line	850.00 €	1,010.38 €	serial metre
Second track when doubled, ballast bed, no vibration-proofing, with overhead line	800.00 €	950.95 €	serial metre
Single track, ballast bed, with vibration-proofing, with overhead line	1,150.00 €	1,366.99 €	serial metre

Second track when doubled, ballast bed, with vibration-proofing, with overhead line	1,100.00 €	1,307.55 €	serial metre
Vibration-proofing ballast bed	350.00 €	416.04 €	serial metre
Point-Works			
Grooved rail (including control/driving system)	118,400.00 €	140,740.39 €	unit
Vignol rail (including control/driving system)	83,400.00 €	99,136.39 €	unit
Grooved rail with special set of switches (including control/driving system)	139,400.00 €	165,702.79 €	unit
Simple crossing	55,000.00 €	65,377.72 €	unit
Diamond crossing with double slip	245,000.00 €	291,228.01 €	unit
Stops			
Stop 30m platform	56,000.00 €	66,566.40 €	each
Stop 60m platform	110,000.00 €	130,755.43 €	each
Stop 80m platform	150,000.00 €	178,302.86 €	each
Demolition costs infrastructure			
Demolition of extant infrastructure (including rails, point-works, concrete, bitumen)	193.60 €	230.13 €	serial metre
Slitting of concreted surface	11.00 €	13.08 €	serial metre
Pavement and margins			
Demolition of curbstone	22.30 €	26.51 €	serial metre
Demolition of drainage depression	10.50 €	12.48 €	serial metre
Relocation of curbstone	92.10 €	109.48 €	serial metre
Material costs curbstone	24.00 €	28.53 €	serial metre
Installation of drainage depression	62.50 €	74.29 €	serial metre
Mesh wire fence, height: 1.5m; 5kg/metre	28.00 €	33.28 €	serial metre
High kerbs and guardrails			
Guardrail	75.00 €	89.15 €	serial metre
High kerb (0.5m x 0.4m)	30.60 €	36.37 €	serial metre
Covering layers / Substructures			
Driving lane surface (bitumen including, bulldozing and shaping)	40.65 €	48.32 €	m²
Renewal surface	11.60 €	13.79 €	m²
Driving lane surface in side roads (bitumen, including bulldozing and shaping)	25.85 €	30.73 €	m²
Sidewalk (melted asphalt, including shaping)	57.75 €	68.65 €	m²
Cycle path/Sidewalk without melted asphalt/Service road, including shaping	22.05 €	26.21 €	m²
Traffic lights			
Modification	30,000.00 €	35,660.57 €	unit
Rebuilding	120,000.00 €	142,642.29 €	unit
Level crossing with heavy rail	200,000.00 €	237,737.15 €	crossing
Bridges			
Grenobler Brücke: length= 145m, width=13.9m	2,000.00 €	2,377.37 €	m²
Innbrücke Völs: length= 137m, width=5	2,000.00 €	2,377.37 €	m²
Bridge over Motorway Völs: length= 78m, width=5m	2,000.00 €	2,377.37 €	m²
Bridge over Gießenbach: length= 14m, width=5m	1,000.00 €	1,188.69 €	m²

Underpass crossings			
Pedestrian underpass Haller Straße: length= 30m, width=4m	1,500.00 €	1,783.03 €	m²
Ramps for pedestrian underpass including retaining walls: length= 276m, width=1m	1,000.00 €	1,188.69 €	m²
Pedestrian underpass underneath railway: length= 20m, width=1m	5,200.00 €	6,181.17 €	m²
Pedestrian and cycling underpass Sillpark underneath railway: length= 40m, width=1m	5,200.00 €	6,181.17 €	m²
Underpass Fischerhäuslweg: length= 14m, width=10m	1,500.00 €	1,783.03 €	m²
Underpass beneath roundabout Cyta Völs: length= 55m, width=5.3m	1,500.00 €	1,783.03 €	m²
Underpass M-Preis in open building method: length= 94m, width=5.3m	2,600.00 €	3,090.58 €	m²
- there of ramp with retaining walls: length= 40m	3,000.00 €	3,566.06 €	m²
Underpass M-Preis/HBf in open building method: length= 80m, width=7m	2,600.00 €	3,090.58 €	m²

More detailed costs for the Grenobler bridge are also available. The graphic below shows an artist's impression of the new bridge, now under construction

4.2 Rail schemes

4.2.1 Lindern-Heinsberg

This is a former freight-only line in Germany that was electrified and reopened to passenger traffic in 2013 (previously passenger services had run until 1980). It is 12.2km long with 8 stops (single track with currently only one passing loop). Two of the stops count as stations in German rail regulations and six as halts. Two stops were completely new for the reopening whilst the other six were rebuilt. There is one major structure, a bridge over the River Wurm. The majority of the track was serviceable and in situ but 2.7km of track and trackbed had to be completely relaid and renewed. The railway is owned ultimately by the state government but via various companies and a special infrastructure company, Rurtalbahn, was created to plan and manage the reopening. The works were designed in detail by this company and let as 8 different tenders. The line operates only an hourly frequency of lightweight passenger EMUs.

	Cost / €	% of total costs	Unit cost /€	Comments
Planned costs in 2008	**17,674,419**			
Actual costs in 2013	**19,000,000**	100%		7.50%
> including planning and management costs	**2,850,000**	15.0%		
Property acquisition	755,000	4.0%		
Ground preparation Oberbruch-Heinsberg (2.7km)	324,000	1.7%	120	Price per metre
New Wurm bridge	720,000	3.8%		
Electrification	2,900,000	15.3%	238	Price per metre
Station facilities (platforms, etc.)	2,650,000	13.9%		
> Heinsberg-Randerath	420,000	2.2%	4.941	Price per platform-metre
> Heinsberg-Horst	200,000	1.1%	2.353	Price per platform-metre
> Heinsberg-Porselen	210,000	1.1%	2.471	Price per platform-metre
> Heinsberg-Dremmen	290,000	1.5%	3.412	Price per platform-metre
> Heinsberg-Oberbruch (station)	470,000	2.5%	3.241	Price per platform-metre
> Heinsberg-Kreishaus	460,000	2.4%	5.412	Price per platform-metre
> Heinsberg (Rheinl) (station)	600,000	3.2%	4.138	Price per platform-metre
Signal systems for Oberbruch and Heinsberg stations	1,700,000	8.9%		
18 level crossings	5,600,000	29.5%		

4.2.2 Bentheimerbahn

This is a 28km freight line in Lower Saxony near the Dutch border that reopened in late 2016 to hourly diesel powered passenger services. It has five stations and is mainly single track but with three passing loops. Track was in place but had to be replaced in parts. In addition, stations needed to be rebuilt and their accessibility improved; and the line had to be fully signalled. A project management company managed the project on behalf of the infrastructure owner, a private company called Bentheimer Eisenbahn. They carried out detailed design and then let the contracts for the works.

Type of measures	Related costs	Share of total costs
Superstructure (track, switches, sleepers)	6,430,690.00 €	29.4%
- of which sleepers	*2,855,600.00 €*	*17.3%*
Stop equipment (sheds, platforms)	1,378,500.00 €	8.4%
Utility diversion	158,100.00 €	1.0%
Control and command technology (interlocking)	4,432,620.00 €	26.9%
Integration of level crossing in interlocking system	1,580,000.00 €	9.5%
Demolition	294,000.00 €	1.8%
Expenses for preparation of building sites	2,424,226.18 €	14.7%
Planning and management costs	1,361,994.25 €	8.3%
Total costs	**16,480,130.43 €**	**100.0%**

4.3 Busway scheme

City of Malmö, Sweden, opened a cross-city busway on its most heavily-used bus route in 2014. The route is 16.5km long (both directions) and 10.5km of this is provided with bus lanes, mostly in the centre of the road. Tram-like stops were built in 3 locations, bus signals and bus priority incorporated into 7 signalled junctions, several bus stops were lengthened, and the road was resurfaced and strengthened in the bus lanes. The tram-like stops cost about £280,000 each; removing and relaying 56,000 square metres of asphalt to a depth of between 50mm and 140mm cost around £3.2 million; and the project as a whole about £7.7 million.

5 Discussion: why do costs differ?

Given the absence of disaggregated data, the discussion of why costs differ is somewhat problematic. However, there is indicative evidence from the cost data to support some of the points made in UK Treasury/NIC (2010a and 2010b).

5.1 Projects started before design is sufficiently complete; and role of client, funder and delivery agent blurred

The German and Austrian schemes reviewed here develop detailed designs produced by a project manager/project planner. This function is usually assumed by in-house staff, although a consultant is sometimes used. Contracts are not put out for tender until these designs are complete. This reduces risk to the bidders because they are clear as to what they are supposed to build; there is less potential for confusion as to where the responsibility for design lies; and this makes it easier for more companies to bid for the work.

5.2 Competition processes in the UK are not always effective in producing lowest outturn costs

Related to the previous paragraph, detailed design prior to tendering in Austria and Germany enables the project to be split into several smaller sections and contracts, with clarity as to what is to be delivered. This then encourages more bidders, which helps to keep down costs through more competition. It of course requires a skilled competent in-house organisation, or similar, to do the detailed design and tendering.

5.3 Over-specification and using bespoke solutions

It is clear for tram that the UK uses a track construction system that is different, more complex and more expensive than that used in most other parts of the EU. Essentially, on-street track in the UK is more often than not laid on a concrete slab whilst in other parts of the EU track is more simply held together by tie bars and laid on a conventional ballast bed with the road surface then refilled in around the track. Off-street track is conventionally sleepered and laid on a ballast bed. This is shown in the figures below.




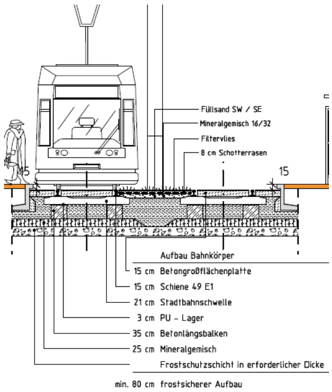

Figure 1a off-street tram track, Edinburgh (source: http://www.edinburghtrams.info)
Figure 1b on-street tram track under construction, Edinburgh (source: Wikipedia)
Figure 1c on-street tram track under construction, Zurich (source: http://photo.proaktiva.eu)
Figure 1d on-street track cross-section, Bremen (source: City of Bremen)

This can also be seen in the specification of the stops and the main structure in the rail reopening example from Germany, as illustrated below. They are clearly standard designs developed to provide what is required in the scheme but nothing more. A further point from the rail example is that the scheme incorporates a number of level crossings. Given the low-frequency and low speed (max 80kph) of the service, the railway was permitted to be reopened with level crossings; they would be very unlikely to be permitted on any new scheme in Britain and over- and under-bridges would be required, driving up the cost.


F***igure 2a: Wurm bridge, the largest structure on the Lindern-Heinsberg railway, cost €720,000 (single track). Figure 2b (above left) and 2c (below): New Heinsberg-Oberbruch station showing waiting facilities, passenger access via level crossing and new OHLE (source of both photos: author's own).***

5.3.1 Inputs cost more in this country

It is only one case but the Malmö busway costs result in a cost per square metre of asphalt – laid to a standard to take heavy triple-articulated buses – of £57. This is around the same price as strengthening of main roads costs in standard capital road maintenance in the City of Edinburgh, in a lower labour cost environment. It is also likely that the standard used for the busway is higher than for a capital road maintenance scheme on a standard UK urban road. Anecdotally, Spanish staff working on trunk roads schemes in Scotland report input prices orders of magnitude higher than in Spain.

5.3.2 Other reasons for cost differences

Due to lack of data from both the UK and continental schemes it is not possible to discuss with specific reference to the schemes the other possible reasons for differences in costs that were identified in general by the UK Treasury/NIC (2010a and 2010b).

6 Conclusion

This paper, as noted in the introduction, reports ongoing research. It fails somewhat at present as a benchmarking study, however, given the lack of UK data. It is clear however from the headline costs presented that there are major differences between the UK and continental Europe and the more detailed continental data has not revealed anything to suggest that there is not broad comparability in cost headings and it has confirmed, for example, that aspects such as planning and project management are included in headline figures. The lack of willingness from UK agencies to release data is rather predictable but also disappointing; especially disappointing is the apparent lack of interest on the part of Network Rail and Transport Scotland (Rail) to engage in this discussion. It may be that the cost levels achieved in the continental schemes presented here are not achievable in the British context; however, the authors have not been able to obtain any academic or industry study that has conclusively demonstrated that in the case of rail reopenings and tram schemes the potential 15% cost savings highlighted in UK Treasury/NIC (2010a and 2010b) cannot be achieved. In the absence of such evidence, the discussion and research seems worth continuing.

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