A topographic map of Central Oxfordshire, England, overlaid with a proposed tram network. The map shows contour lines, roads, and various towns. The tram network consists of several circular nodes, each with radial lines extending outwards, connected by a central spine. The nodes are located in areas such as Killington, Sunnymead, Headington, Cowley, Rose Hill, Blackbird Leys, Littlemore, Marsh Baldon, Abingdon, and Kennington. The central spine runs north-south through the heart of Oxford. The map also shows the Vale of White Horse to the west and south, and Cherwell to the north.

Trams for Oxford

Could light rail improve our historic cities?

Summary of the findings from a seminar on the introduction of trams in Central Oxfordshire.

UCL,
March 12th 2015





Grenoble



Grenoble

1. Introduction

This report is from a series of Oxford Future workshops and follows on from one in Keeble College in November on Transport Options (www.oxfordfutures.org.uk)

Modern Light Rail Transit (LRT) could be the saviour of historic cities such as Oxford. This conclusion emerged from a seminar organised by URBED and the Sintropher project group at UCL on March 12th.

A series of papers were discussed by an audience representing a range of interests from Oxford City as well as experts from the tram world around the UK. This short report brings out the main messages with relevant illustrations and the full presentations are available on the Oxford Futures web site: www.oxfordfutures.org.uk

List of main contributors:

- Dr. Nicholas Falk, URBED
- Dr. Chia-Lin Chen, UCL
- Dr. Fiona Ferbrache, University of Oxford
- Peter Headicar, Oxford Brookes University
- Pete Redman, Trade Risks
- Dr. Robin Hickman, UCL
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 March 2015



Grenoble



Nottingham Tramlink

2. Challenges for Oxford

Dr. Nicholas Falk: Founding Director of URBED

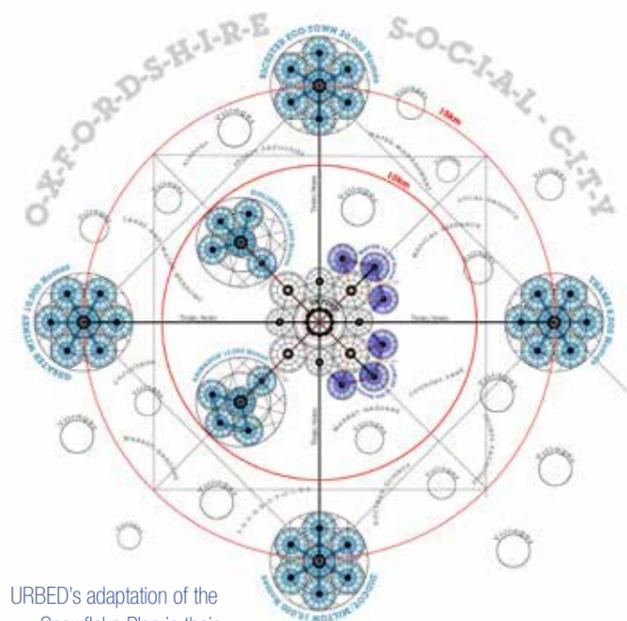
Opening the seminar, Dr. Nicholas Falk, founding director of URBED, drew on work for Oxford Futures (a collaboration with Oxford Civic Society), and subsequently the 2014 Wolfson Economics Prize winning submission for Uxcester Garden City www.urbed.coop. Over the last three decades the UK has lagged behind other European countries like France and Germany in the number and extent of its light rail systems. Cities like Grenoble, Oxford's twin town, show how historic cities can benefit from investing in new tram systems. The *Connecting Oxfordshire* report from the Leader of Oxfordshire County Council first raised the idea of reintroducing a tram down the road that runs out to Kidlington and Oxford Airport.



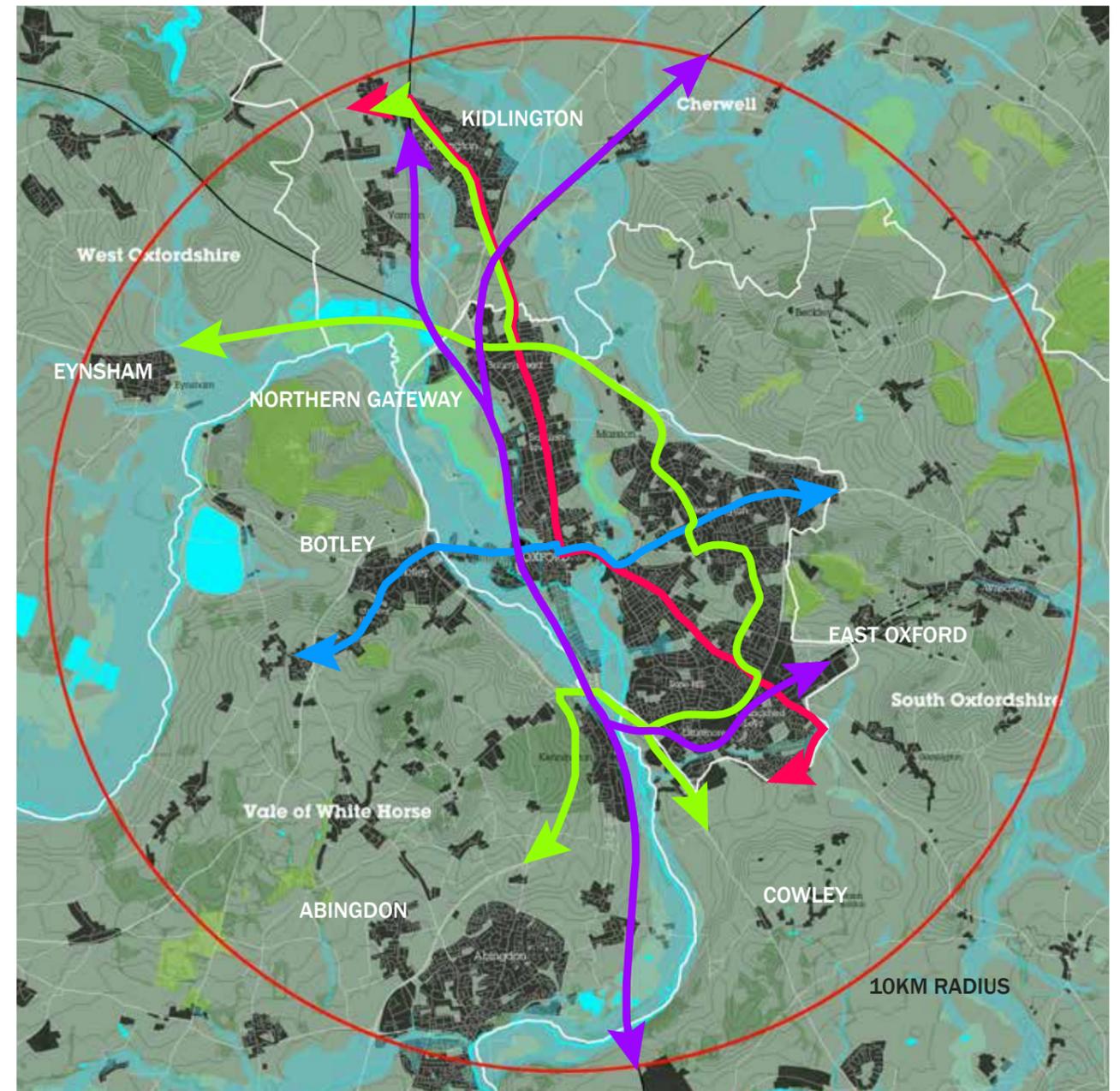
Visualisation of London Oxford Airport Tram stop
Source: Oxfordshire County Council www.oxfordshire.gov.uk

URBED's Wolfson report showed how a tram could be funded from the uplift in land values from extending Oxford at the edges. A new plan, opposite, shows how what Nicholas calls the **Oxford Metro** could be developed in stages. The best place to start is with the upgrade on the line that will connect Oxford with Marylebone in London via Bicester. It should be relatively easy for Chiltern Railways to run through to Cowley and Didcot, possibly with tram trains, connecting up the expanding employment areas on the edge once Oxford Station is rebuilt. A second route could be one of the Bus Rapid Transit (BRT) lines proposed in the draft Oxford Transport Strategy to provide faster links to Witney and Abingdon. The third line would be the first new street running tram in an English historic city.

It would connect the Botley Park and Ride on the A34 with the main railway station, shopping centre, and down



URBED's adaptation of the Snowflake Plan in their Wolfson submission to the situation in Oxfordshire



Possible **Oxford Metro** Plan (illustrative only)

Key:

- Line 1
- Line 2
- Line 3
- Line 4
- Proposed Neighbourhood
- Existing Neighbourhood

the High to the hospital complex and Oxford Brookes University in Headington. This would be funded through new housing at 'Greater Barton' the other side of the A40. Line 4, a North South link, would reinstate the line that once ran down part of the Banbury Road and connect up with new housing in Kidlington and an expanded Oxford University Business Park at Begbroke.

precedents, such as the historic university city of Freiburg, where car use has been held constant, to show how cities can expand through 'smarter growth' without reducing the quality of life for the residents. This involves providing quieter and cleaner places in the centre, as well as affordable new homes on the edges. But there are also major barriers to making progress where research may hold the answers.

There are plenty of European

3. What can we learn from Europe?

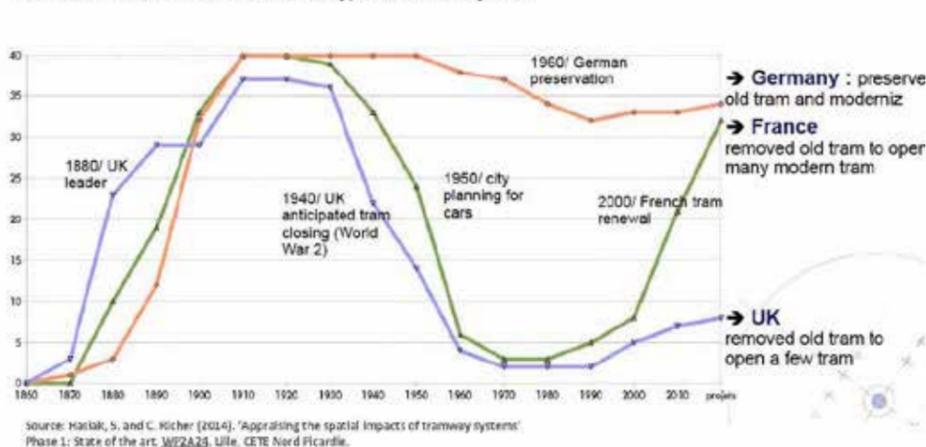
Dr. Chia-Lin Chen: Senior research officer at the Sintropher project, UCL

Dr. Chia-Lin Chen, senior research officer on the Sintropher project, used the comparison between new trams in Valenciennes on the French border with Belgium and Blackpool in France to explain how the French succeeded where the UK had failed. The French focussed on the regeneration benefits and the impact on a city's image whereas we concentrated on transport efficiency. Also they had a different approach to design and procurement which helped cut costs. So the Valenciennes tram economised by having a single multi-directional line on its second route with passing loops, which cut the costs by a third.

Key points:

- ▶ Sintropher is about trams in peripheral regions, with a focus on tram trains
- ▶ It is tackling technology, appraisal, interchanges and marketing
- ▶ The UK has built little because of the narrow focus on profit or efficiency compared with other European countries
- ▶ Valenciennes is an interesting example of a run-down border city where the major employers are motor and rail manufacturers
- ▶ The tram has only cost 15 Euros a km for the double track section and 10 Euros for the single track line with passing loops
- ▶ The secret has been integrating transport and land use planning
- ▶ The result has been to transform the city's image e.g. greening the streets
- ▶ The versement transport or transport charge on the payrolls of firms employing more than 10 brought in 150 million Euros by the time the first line opened
- ▶ The upgrade in Blackpool, which cost £100 million, has quadrupled usage in three years.

Number of urban areas (more than 200,000 inhabitants, about 40 cities in UK, France and Germany) with a tram system



Valenciennes

4. Where might a tram fit in?

Dr. Fiona Ferbrache: Transport Studies Unit, University of Oxford

Dr. Fiona Ferbrache (Transport Studies Unit, University of Oxford) drew on her recent research for UK Tram to examine the wider economic impacts that light rail transit has the potential to bring about in Oxford. She then drew from information in the Oxford Local Transport Plan 2015-2031 to compare key factors differentiating a light rail system from more bus-based forms of mass transit (e.g. Fixity versus flexibility; and modal shift). While the Oxford Local Transport Plan distinguishes three types of bus transit, light rail transit has not been addressed in the same detail.

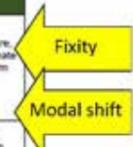
Key points:

- ▶ Oxford is trailing Cambridge in certain aspects of transport infrastructure and housing provision
- ▶ Improved transport capacity can help to stimulate inward investment and widen labour market catchment areas
- ▶ Light Rail Transit (LRT) has been instrumental in transforming city centres into pedestrian-friendly spaces e.g. Grenoble, Nice
- ▶ To realise the benefits, LRT needs to be combined with appropriate land use planning and traffic management strategies
- ▶ The fixity associated with LRT can give passengers and businesses confidence and hence stimulate modal shift
- ▶ Bus Rapid Transit (BRT) has not achieved modal shift in the same way that LRT has
- ▶ Any new policies need to be assessed against multiple criteria

LRT v BRT

Oxford Local Transport Plan 2015 - 2031
https://consultations.oxfordshire.gov.uk/consult/ti/CO_LTP4/consultationHome

System	Conventional bus	Guided Bus	Bus Rapid Transit	Light Rail Transit/Tram
Strengths	Lowest cost of infrastructure and vehicle technology. Increases in capacity deliverable immediately. Vehicle size enables access throughout the road network.	High degree of priority bus sections. Can be used for other services. Flexibility	Greater operating flexibility. Mixed running with traffic. Significantly lower capital and operating costs than LRT. Suited to disperse urban form.	Permanence of infrastructure, vehicles and operators create confidence and aid long term locational decisions. High capacity services.
Weakness	High volumes of buses already add to congestion issues in the city centre and along the radial routes. The status quo is unlikely to encourage mode shift.	Sections of parallel guided kerb limit the scope for other traffic to cross the corridor. Width constraints make delivery within the ring road unfeasible. Shared use with cyclists not possible.	Opportunities for additional priority over existing situation limited. Construction cost (£2m to £5m per km) is higher than standard bus prioritisation methods. Vehicles and technology are more expensive than conventional buses.	Space unavailable to allow complete segregation within ring road. On road operation with other traffic or roads would be closed to traffic. Inability to divert should problems be experienced on the road network.
Opportunity	Timed slot booking at stops will reduce bunching. Bus stop departure charges could raise revenue. Operators already implementing low emission technology.	High existing demand on radial routes within the city. Higher speeds from neighbouring towns would encourage modal shift.	Can be incrementally implemented - priority/stops/vehicles. Higher capacity vehicles to be introduced to reduce total volume of buses and deal with additional demand.	Connecting denser urban areas. High existing demand of corridors will be increased with growth.
Threat	Population and patron growth are expected to be so high that excessive numbers of buses will lead to congestion, noise and pollution.	High existing demand on radial routes within the city. Higher speeds from neighbouring towns would encourage modal shift.	Increases in traffic flow caused by growth creates so much congestion that BRT is not effective where road space is shared.	Very high construction cost (£20m+ per km of route), vehicle and operating cost. Failure to deliver necessary patronage will require subsidies. Technological advances could render scheme obsolete.

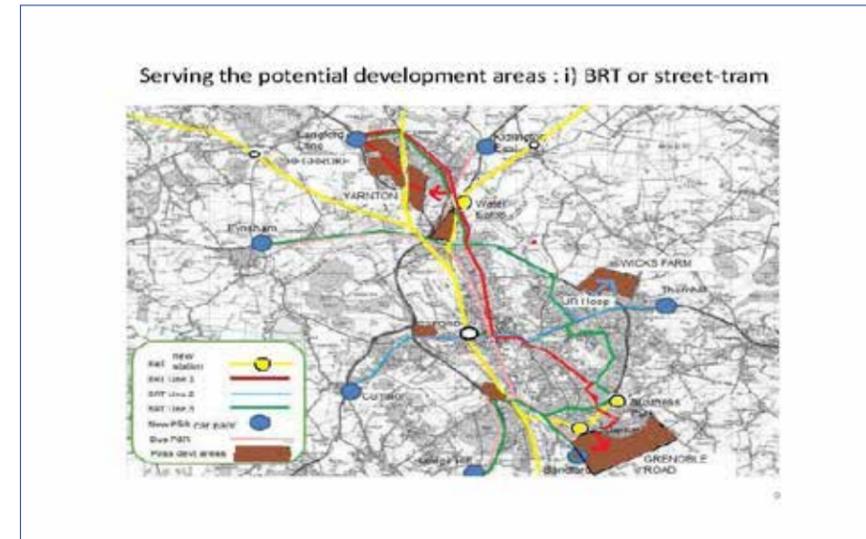
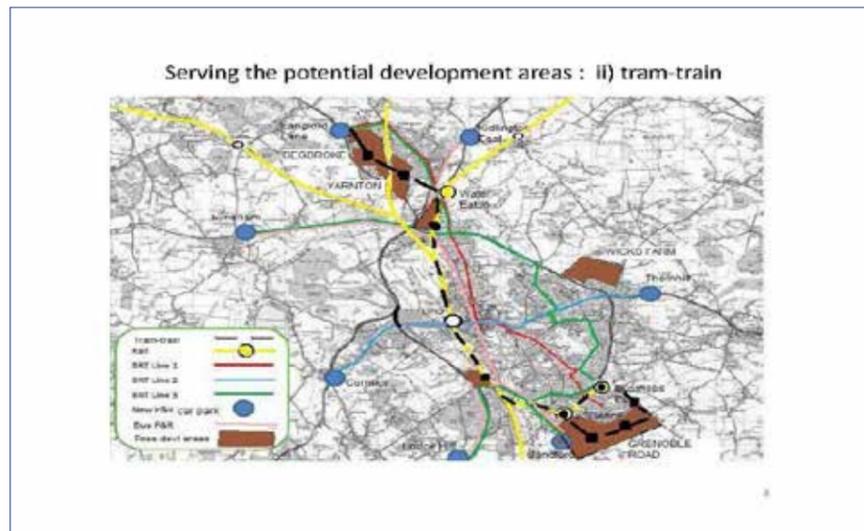
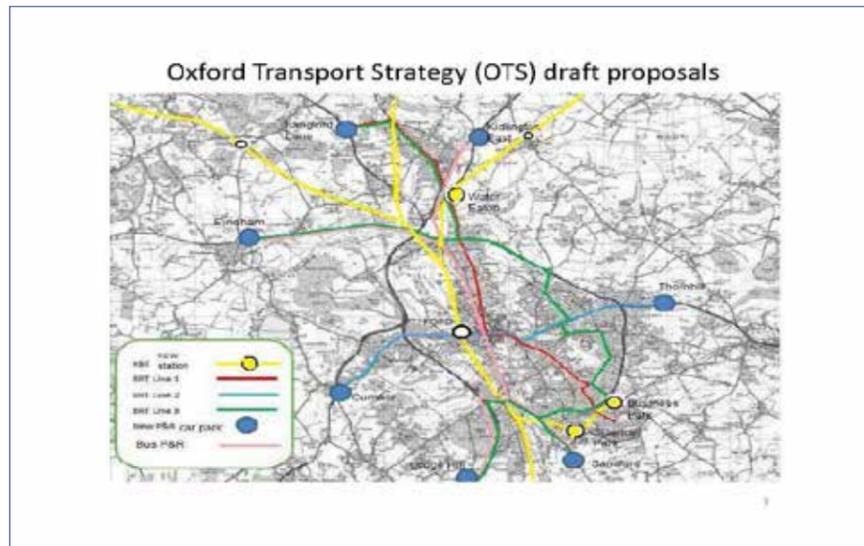


4. Where might a tram fit in?

Peter Headicar: Oxford Brookes University (OBU)

Peter Headicar from OBU then explored the opportunities and constraints involved in introducing trams in the Oxford area. At present the public transport system is almost entirely bus-based with separate categories of frequent urban services, inter-urban services and limited stop services from five park and ride sites around the edge of the city.

Although extensive bus priority measures had been introduced on the main radial corridors within the city and in the city centre services remained slow and subject to unreliability due to traffic congestion. Several outlying towns on which residential development had been concentrated in recent decades had their rail services withdrawn in the Beeching era.



Key points:

- ▶ Tram services could be developed in one or both of two ways:
 - 1) on-street along the principal radial corridors within the city (by utilising and adding to the existing bus priority measures) and/or
 - 2) by utilising the existing rail corridor to operate tram train services north-south across the city with new spurs to serve peripheral development areas
- ▶ The draft Oxford Transport Strategy envisages a mass transit network without any light rail or tram element, but with an improved rail service along the Bicester-Didcot 'knowledge spine'
- ▶ The core of this network is to be provided by a set of bus rapid transit routes along the main city radials and via the orbital Eastern Arc
- ▶ These routes have as their termini seven P&R sites located well outside the Oxford Ring Road, all but one of which are replacements for the existing sites
- ▶ The OTS does not identify potential development areas close to the city; the opportunity for these to contribute to the funding of tram lines appears not to have been acknowledged
- ▶ The most likely candidates for such development (if agreed in principle) are Grenoble Road to the south, Yarnton/Begbroke to the north-west and Wicks Farm ('Greater Barton') to the north-east.
- ▶ All three could readily be served by extension or spurs off the proposed transit routes and the first two by spurs off existing rail routes
- ▶ In addition to objections on grounds of cost and inflexibility in implementation trams have to overcome the following obstacles compared with BRT:
 - providing paths which enable overtaking of cyclists and stopping buses over all or most of a route (in order to achieve a 'rapid' service)
 - achieving direct routes across the city centre (in the face of current proposals for complete pedestrianisation)
 - potential public opposition as concentration of investment and services on a few tram routes implies reduction in bus frequencies to some other suburban termini.

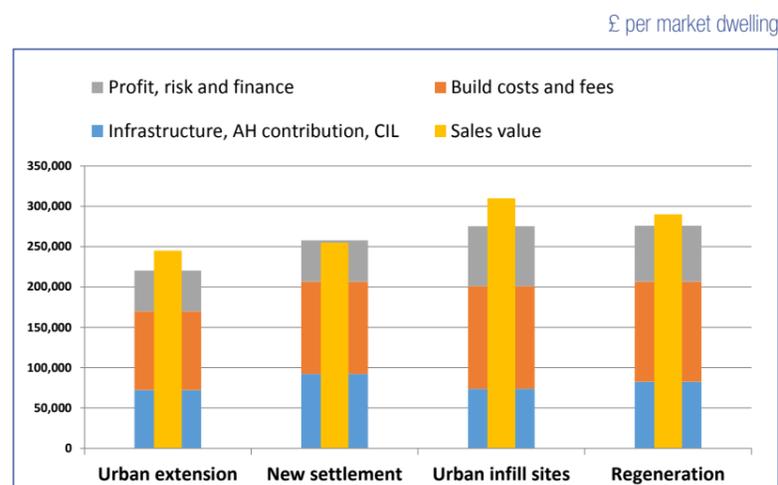
5. Where will the money come from?

Pete Redman: Research Director at Trade Risks

Pete Redman, research director at Trade Risks, who have raised over £4-billion for local authorities and housing associations over the last five years, used his research for the URBED Wolfson submission to explain how a new light rail system could be funded. As the capital costs are incurred up front they need to be phased, and so buses would be used in the first five years. But there is enough in the uplift in land values resulting from planning permission to fund a wide range of infrastructure, of which transport is the most expensive. A cocktail of sources would enable Oxford to greatly improve its environment. He had used Nottingham tram figures, and suggested starting with a figure for available investment and then asking which options would produce best value.

Key points:

- ▶ Local infrastructure, such as transport, should be funded locally
- ▶ At present developers make a very small contribution (less than 6%)
- ▶ Urban extensions offer much better returns than isolated new settlements (though infill brownfield sites are best of all)
- ▶ Oxford could be doubled in size without encroaching into flood plains or Areas of Natural Beauty, and this would only take 5% of the Green Belt
- ▶ If land can be obtained at existing use value plus compensation there would be almost £900 million available for transport alone – more than enough to rebuild the potholed roads!
- ▶ A ‘smarter’ cash flow can be produced by concentrating development in the right locations, tapping the uplift in land values, and ploughing it back in local infrastructure
- ▶ There is a mass of money available but a lack of good propositions
- ▶ The initiative could come from the Local Enterprise Partnership, which is managing a budget for strategic planning.



6. Does the current appraisal approach help?

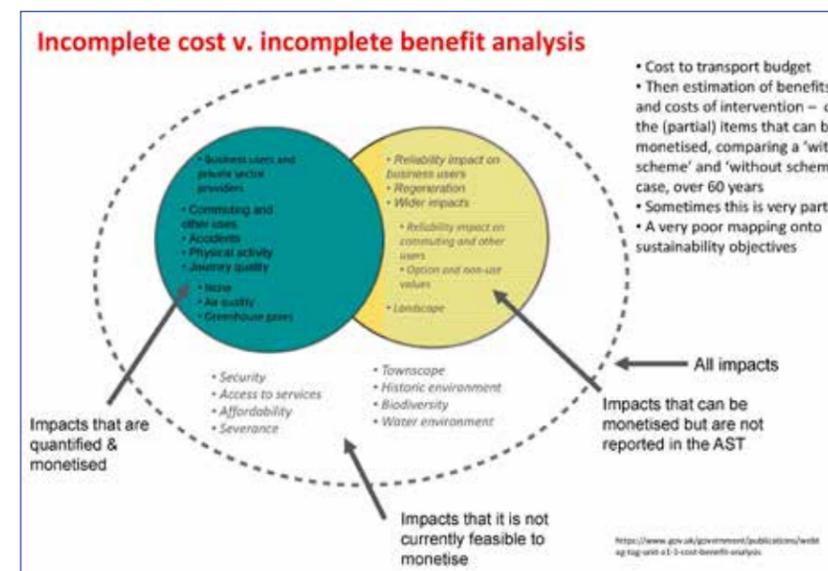
Dr. Robin Hickman:

Sintropher Project Leader, University College London

Dr. Robin Hickman, who now leads the Sintropher project at UCL, examined the current system for assessing projects, which gives most consideration to Cost Benefit Analysis, and concluded it was fundamentally flawed. Both the costs and benefits are subject to major uncertainties, and many cannot be calculated at all. It ignores equity issues. Instead of ranking projects by spurious simple numbers judgements were needed on what should be done, taking account of a range of factors. This requires a more localised approach.

Key points:

- ▶ Many affects are not properly considered, particularly where there are trade-offs
- ▶ Some impacts are ‘priceless’ or intangibles such as townscape
- ▶ We need to consider choices and reflect the values of different actors
- ▶ This is vital in historic cities which form part of the national heritage like Oxford
- ▶ We talk for years without getting anywhere
- ▶ The process is not transparent and gives excessive weight to travel time savings (which favour roads)
- ▶ The European approach considers the impact on the whole city and urban fabric
- ▶ We are starting with very run-down roads many of which need to be rebuilt (often due to buses with power-steering)



7. How can we apply the lesson?

Roger Harrison: Chairs both Light Rail Transit Forum and Tramlink in Nottingham

Roger Harrison, who is Chair of the Light Rail Transit Forum and also Chair of Tramlink in Nottingham, brought the event to a close. He drew on direct experience of both the latest tram extensions as well as extensive knowledge of the French system. He showed how six new trams had been built since 2006 in cities roughly the size of Oxford. The benefits include designing better cities, reducing car usage, and connecting up disadvantaged parts of cities (or social inclusion). This was helped by having a franchise for all modes for six or seven years (not the deregulated 'free for all' we have in the UK). The French also have regional Local Transport Plans and an obligation to save energy and emissions, as well as greater local leadership. The latest scheme in Besançon, a city of only 117,000 population, had cut costs in many ways, such as using bus shelters and open maintenance depots. Anger and Dijon had commissioned their systems together. The results typically were costs of around €30 million per km, or €23 million per km without the costs of diverting utilities.



Nottingham Tramlink. Source: www.mumblingsnerd.com/mumblog/nottingham/



Nottingham's Tramlink

Key points:

- ▶ Nottingham Tramlink, which is a PFI project promoted by six private companies in association with the City Council, had kept its costs to £28m per km (now about €38m/km at the current exchange rate).
- ▶ The higher costs in the UK are due to much higher tendering and project appraisal costs.
- ▶ Diverting utilities includes betterment and adds 10-15%.
- ▶ UK standards impose extra costs e.g. ticketing machines from Germany had to be adapted adding 25% to each of them.
- ▶ Nottingham sought to generate local benefits, such as 8,000 jobs and £125 million of local purchases.
- ▶ It was uniquely helped by the workspace parking levy which raises £12-14 million a year, or about a third of the project costs, and businesses did not relocate but have even been attracted.

Cost of French tramways built since 2006

- Le Mans - €25.4m/km with Utilities Diversions (€18.8 excl UD) built in 2007
- Dijon and Brest built in parallel, benefitting from economies of scale by sourcing the trams together - €25.8/km (excl UD) built in 2012
- Tours - €24.1/km (excl UD) built in 2013
- Typical cost today for traditional tramway would be €30/31m/km or €23m/km excluding utilities diversions
- Besançon – cheapest tramway in France €15.8m/km (excl UD) built in 2014. This is about 30% cheaper than a traditional tramway

Comparison with UK costs

- Nottingham tramway is a PFI Contract costing about £28m/km (€38m/km at today's exchange rate) for two new tramlines albeit with complex bridge structures and uprating of existing trams
- Construction costs in France and UK are broadly similar
- UK has higher tendering and project appraisal costs and some specific UK standards are incorporated – adding about 10%
- UK projects usually include improvements to the urban environment and have roofs over maintenance depots – all adding about 10%
- Utilities diversions are always included with betterment - adding about 10% to the construction cost

Conclusions

The event proved popular with a wide range of participants. Discussion of the papers presented drew out many important points.

There was strong agreement that the workshop and the work leading up to it should be seen as the start of a process, not the end. However, serious concern was expressed that comments on the draft Oxford Transport Strategy were required by 2 April, within three weeks, and decisions on pedestrianising the centre would be taken shortly. It was therefore important that people interested in the proposals for tramways and associated development submit their views to the consultation. Participants also stressed the need to further develop the proposals in practice. Five conclusions can be drawn, which point to further work:



St Giles, Oxford, with mass transit and pedestrianised space. Source: www.oxfordshire.gov.uk

1. Benefits of trams

Trams seem to offer benefits over segregated bus lanes in historic cities. Options need to be clearly articulated and assessed in terms of modal shift, image and investment, and amenity including carbon emissions. Oxford should be benchmarked against other competing cities, even if they are in other countries. An appendix assesses the advantages of trams versus buses.

2. Taking a lead from Europe

Continental European cities appear to be benefitting from taking different approaches to planning, project appraisal and procurement. Oxford should be leading the way in terms of integrating transport and development planning, and in packaging finance for transport options that will minimize car use while maintaining high levels of accessibility across the city and its catchment areas.

3. Refinement is needed

The options in the draft Oxford Transport Strategy need much more refinement. For example, the feasibility of tunnelling roads under the city centre needs close examination. Oxford should be looking at different routes with and without different possible extensions, as well as the impact of a dispersed growth strategy on movement and accessibility.

4. Study tours to learn

Nottingham and continental cities such as Grenoble provide interesting models. Study tours would be beneficial before any final conclusions are drawn. There may be scope for further collaboration, if only to avoid learning from mistakes the expensive way.

5. Test conclusions from Sintropher project

There would be benefits from testing out the conclusions from the Sintropher project in Oxford, particularly with regard to strategic integration, financial mechanisms and Multi Criteria Analysis.

Finally, it is worth recalling that many French cities which now have very effective tram systems and vibrant centres experienced similar debates and uncertainties in the years leading up to their decision to build their first tram line.

Appendix:

Trams and Buses - balancing the benefits and costs

There has long been an often sterile debate over the virtues of buses, with their greater flexibility and low costs, compared with trams, with their predictable routes but higher capital costs. The UCL event highlighted the need to assess options against multiple criteria, not simply costs. These could include image, modal shift, and amenity as well as time savings and safety. Multiple Criteria Analysis (MCA) is particularly important in historic cities that draw foreign tourists in large numbers who may have higher expectations than residents. The Treasury's 2011 *Green Book* requires the 'non-market impacts' of projects to be properly assessed, and as Bus Rapid Transit also involves huge costs, further work is needed.

A response after the seminar made the valid argument that allocation of road space forms a key issue. To work well buses also need segregated routes. Clearly modern buses still have a vital role to play in the life of a city, especially as current technologies have substantially reduced the noise and pollution of their predecessors. Oxford benefits from a high level local bus system, with frequent services during the day, and there is a substantial modern bus station close to the main current shopping area. The city is connected to London by rapid and relatively inexpensive express coaches, while, as a tourist destination, it also attracts many coaches into its centre;

these help to cut car use. Oxford's hybrid buses have low emissions, and provide very extensive services, but suffer from limited segregation, which causes delays at the many intersections they pass through (e.g. crossing the A40).



Oxford buses



Nottingham's Tramlink



Strasbourg



St Etienne

Trams in Oxford would face very strong competition from bus services unless an integrated system could be introduced along the lines of parts of London or European cities. However, the impacts depend on the specific location. We now have the experience of various busways, including Cambridge and Luton's guided busways, to draw on as well as the impact of new tramways in Nottingham. Hence a more thorough assessment is possible than has been undertaken in the draft *Oxford Transport Strategy*. Some clear messages come from Fiona Ferbrache's research into Grenoble, Oxford's twin city in France, which are also developed in an article in *Tramways and Urban Transit*.¹ Here we can only list some benefits that need to enter into any assessment:

- ▶ First, trams can penetrate the centre of a historic city, while keeping to strictly guided routes, so allowing people to wander, cycle or eat out in pedestrianised or 'shared' areas without conflicts. They use less road-space, which is important in historic areas where streets are narrow. This means that trams are usually less intrusive than buses, (and can do away with overhead wires in sensitive areas, as in Nice or Bordeaux, for example).
- ▶ Second, trams can speed up access between peripheral housing estates or employment areas and central areas or inner city nodes, their speed being aided by faster and easier boarding.
- ▶ Third, where space is limited, tramways can also be used by cyclists (who are banned from Cambridge's busways). Where appropriate they may also be used by buses, with cars diverted down other roads; overtaking is impossible, but this should not be a problem with reasonable coordination of bus and tram services. It is financially prohibitive for tram lines to reach into low density residential areas, but that is the role of complementary local buses. As well as having a Continental image, trams can offer lower running costs per passenger with one driver for each high capacity multi-section vehicle. Tram lines are easier to understand and more predictable to the visitor. In the centre a reduced number of movements makes them less intrusive than double decker buses. Lower vibrations do less harm to historic buildings, and avoid the damage done by power steering to road surfaces. The costs of introducing trams, which include utility diversions, are considerable, and there can be disruptions to local services: but these can all be assessed within a disciplined MCA appraisal.

¹ Reg Harman and Nicholas Falk *Developing Historic Cities: the case for an Oxford Metro, Tramways & Urban Transit*, April 2015

Appendix:

Trams and Buses - balancing the benefits and costs

So the answer, of course, is an integrated system that uses every mode for what it does best. Good interchanges, as in Strasbourg, for example, can enable easy transfers, but are still all too rare in the UK. By combining trams on high frequency spines with buses in lower density areas, and optimising the use of bicycles in association with public transport routes, the real objective, which is to reduce congestion and the impact of the car, can be achieved. Route planning, in association with development and regeneration, should make the most of available under used corridors (including surplus rail rights of way). A steel wheel on a steel line uses less energy, and so should help Oxford to achieve its carbon reduction objectives. Oxford should therefore provide an excellent test case for making the best use of all the different modes, and for using evidence to reach informed conclusions that are forward looking.



In Freiburg the tram is built as the central artery in to the new neighbourhood - supporting sustainable transport behaviours.

Lessons from Europe:

The table below show the Model Shift in Freiburg, Germany

Year	Journeys made by Car	Journeys made by Public Transport	Journeys made by Bicycle
1976	60%	22%	18%
1989	48%	25%	27%
2010	34%	33%	33%



Nottingham's Tramlink



Nice

