



Future Transportation (people & freight) –

How will we be moving in the future?

Blue Paper

Post Covid statement

This document builds on the TDUK workshop for Future Transport which explored the trends and likely impacts affecting transport, particularly with reference to the underground assets.

This document was written prior to the outbreak of COVID-19 and many of the questions and areas that this paper deals with have been significantly affected by the global pandemic. The social, professional and infrastructural landscapes across huge swathes of both urban and rural environments around the world have been radically altered by the global pandemic and many of the subjects and spaces explored in this paper are now uncertain.

Some major changes catalysed by COVID include: increased rate of people working from home; a reduction in long distance travelling; high increase of delivered goods; vast reduction of public transport use; and changes in the levels of crowding in both building and transport spaces. Whilst the effect of these emerging trends may reduce as time goes on and a successful vaccination is introduced, and we may even reverse back to the pre-COVID trajectory of transport use, we will still need to design our cities and systems to be more cognisant of, and resilient in, the wake of a global catastrophe like the one we are still witnessing.

The use of underground assets, both existing and new, will still have an impact on our methods of transportation of people and goods and in turn the design of our cities and settlements. However, it is likely that post-COVID society's transport needs will change and, together with essential environmental objectives, a different use of the underground will emerge. We will need to re-consider the design of cities and purpose of space in the wake of post-COVID behaviour, both individually and collectively. Interestingly, technology has played a huge role throughout this pandemic in creating platforms that redefine movement and it seems that technology will be a significant impact-driver post-COVID.

TDUK will re-visit the context of each of the blue papers in the post-COVID world and analyse the trends and ideas proposed for ongoing relevance.

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Think Deep UK is a group of built environment experts committed to creating resilient, sustainable and liveable cities through smart use of underground space. Led by a voluntary, multidisciplinary group of professionals, our mission is:

- To promote an awareness of the value of underground assets and to create a policy framework that can enable their fair use;
- To inform and guide the general public, decision makers, politicians and professionals how the use of urban underground space can create better cities with socio-economic benefits for society;
- To encourage thinking deeply when making decisions and planning for the future of our cities;

This paper has been prepared by Think Deep UK following a workshop on the Future of Transportation (people and freight).

The workshop was attended by a cross-section of industry experts including urban planners, freight specialists, academics, transport planners, architects, geotechnical engineers, tunnellers and researchers. The workshop participants are thanked for their input into the subsequent production of this paper.

The aim of this paper is to consider how underground spaces can be better designed and integrated into the urban fabric—specifically, transport underground spaces. As cities densify through layers of development, Think Deep UK is exploring the future trend of transport; this paper explores future pressures transport, and the underground, will need to accommodate.

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Introduction

The second TDUK workshop considered what future trends in transport would bring to city planning and what role underground space will play. Kindly hosted by PLP Architecture, this event was attended by around 30 people from clients to planners and engineers from Europe and the UK. The workshop explored how these future developments in transportation might affect our cities and in turn what this effects would mean for our planning systems and our ability to facilitate and control positive outcomes.

This blue paper builds on the output from the workshops and proposes key ideas in planning for future transport, whilst linking these ideas to the use of underground space, when appropriate.

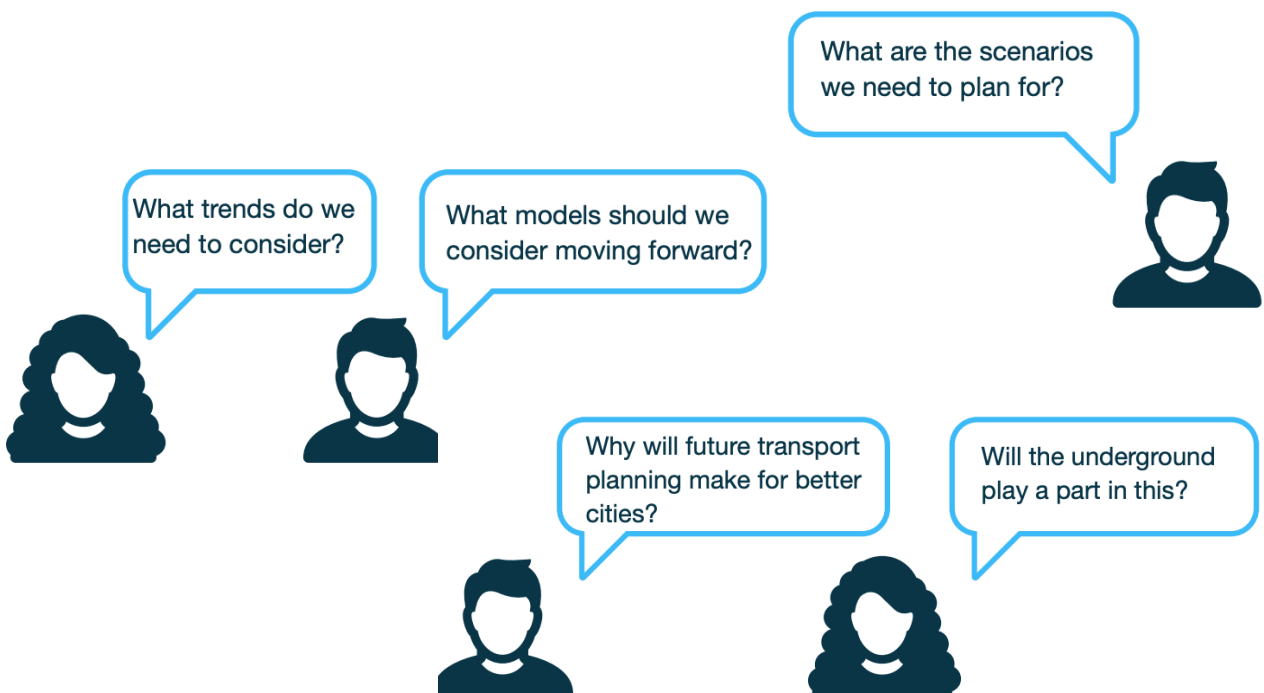


Executive summary

The second TDUK workshop considered what future trends in transport would bring to city planning and what role underground space will play. Kindly hosted by PLP Architecture, this event was attended by around 30 people from clients to planners and engineers from Europe and the UK. The workshop explored how these future developments in transportation might affect our cities and in turn what this effects would mean for our planning systems and our ability to facilitate and control positive outcomes.

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London is not representative of the state of urban transport in the UK, with its well-established and widespread underground tube network. Most other UK cities, like Birmingham for example, have public transport at surface-level and consequently increased pressures on their road networks. Are changes in expectations and behaviour the key, or are emerging technologies like electric vehicles, able to singularly cut out the issues caused by surface level transport systems? An increased use of public transport systems, both for people and goods, is an area of further exploration that needs consideration.



Key findings

- Cars still dominate as the primary mode of transport in urban centres and also have the greatest negative impact on the environment. Technology alone cannot solve this issue – changing all cars to electric increases overall power consumption and is still an inefficient modal use.
- A combination in a change of behavioural expectations about ‘what a transport system is able to provide’, together with a ‘step change’ use model, may be able to better meet our needs. This will mean travelling less, use private vehicles less, and maybe reduce our expectations of being ‘on time’ or at a desk at 9.
- A re-working of the transport model for cities is may give a greater weighting to travelling below ground. This also may enable a better use of the high value systems we have created and are creating i.e. we use it to service goods in the hours it is used less for people.

Overview for the UK

Below is a list of issues and trends that are impacting the UK – we are becoming better at knowing what works and what is ‘good for us’ but are we able to create step changes in both the short- and long-term and how might we do this?

- The transport sector is affected by broad trends such as changes in demographics, technology and social attitudes.
- In the UK, travel by air and rail has risen since 1995, while bus use has fallen.
- Movement of freight by light goods vehicles (cars / vans) has increased significantly.
- There is an increasing awareness and data evidence of the effect of greenhouse gas emissions, air pollution and noise pollution on health and the general environment.
- Revenue from both road vehicle and fuel duty is set to fall over coming decades.

- Emerging technologies give access to vast amounts of data, improving the way transport networks are analysed and planned, and reducing maintenance costs.
- “Last mile” travel has an impact on underground transport planning. Many cities outside London are considering underground metro systems
- Stress and well-being in travel are increasingly needing wider consideration.

How can we predict a future transport scenario and plan for that in both the short- and long-term?

The workshop challenged participants to consider three different scenario time horizons and problematic issues, innovations and changes that could have an impact in the short, medium and long-term.

Future scenario planning

Under the headings ‘**current state**’, ‘**innovations**’ and ‘**new paradigms**’, we defined current city transport problems and ideas required to overcome the issues identified under each theme.

The theme of ‘new paradigms’ considered whether a change in expectation, behaviour or transport model might alleviate certain contemporary issues by reducing the reliance on innovations in order to meet the increasing travel need. Current pressures faced by city-based transport sectors include poor air quality, over-use, personal stress using the system, reliability, capacity and safety issues.

Many public transport routes are currently overcrowded and with fragile performance systems, resulting in poor passenger experience. One way of dealing with this is through improved signalling and train communication to provide increased system capacity and hence reduce overcrowding. However, a new, alternative paradigm might be to spread usage pressure across a longer peak timeframe by changing work patterns. This trend is already happening but a number of linked concepts could also be explored further to feed into the scenario planning of this new paradigm (such as journey predictability, pricing and train booking).

New paradigm

The timeframe of innovations may be such that new paradigm thinking may be more effective in improving future transport expectations and satisfaction. As change occurs quickly, it is necessary to be constantly understanding and predicting such developments in order to better forecast and futureproof, to ensure that a more realistic, integrated and inclusive approach is established.

The table below shows some of the most common key words proposed in each of the time horizons at the workshop and the linkage between them shows how to better prioritise the potential approaches in re-defining 'need'.

We believe that achieving a real 'step change' will require intervention planning to make best use of the opportunities arising from innovation in order to reach a higher paradigm.

An example of this may be:

Current model - Steps

1. I need to get to a meeting in 30 minutes across town for a certain time to meet two people.
2. I leave to walk and intend to take a pay-as-you-go hire cycle.
3. No cycles for hire at the pick up area means I take a bus to a location near to the meeting and then plan to walk the last stretch.
4. Road works slow the journey and I am 10 minutes late for the meeting. Luckily one other person is also late for the meeting

If the meeting was later and I knew my journey wasn't 'resilient' and work out I may have taken a longer tube journey interchanging between three lines

In this model the outcome is stress, lateness, disappointed expectations and inefficiency.

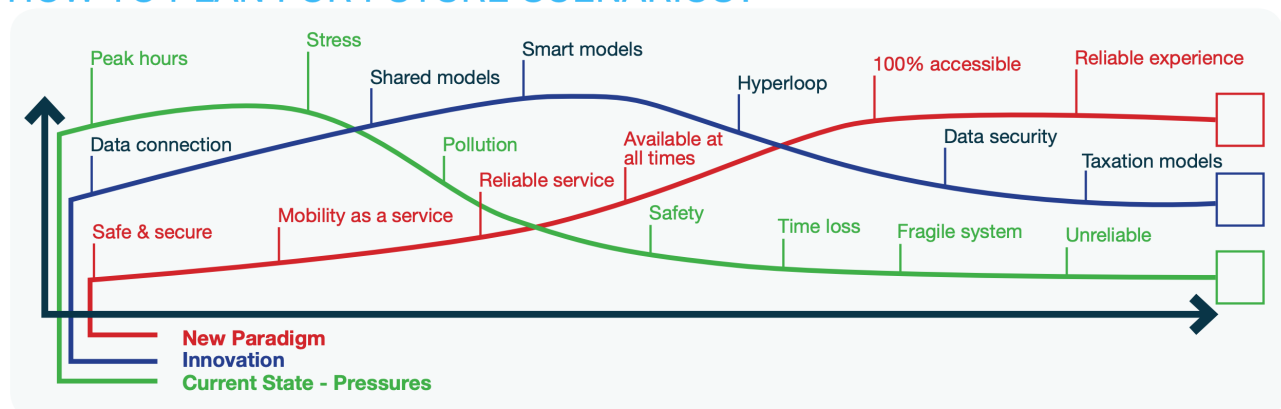
An alternative model might be:

Intervention model - Steps

1. The time window of the meeting is planned to be longer – somewhere within a two hour slot.
2. The locations of the three attendees is known by a central program that works out the relative journeys across town with multiple modes (inputted in advance for each user preference)
3. With real time data, a plan and a leave point is given to each person, a central location point between the three is also an option with a 'while travelling' work option also given to each.
4. A longer but more reliable route option is given to each (with step and health input calculated) so person:
 - a. travels with music headphones and a high walking model through quiet streets,
 - b. travels with a catchup virtual call carried out on a bus, and
 - c. travels with a short cycle journey on a pre-reserved bike slot.

They all agree to meet between the three locations at a high quality outside environment where their meeting place and slot is pre-reserved.

HOW TO PLAN FOR FUTURE SCENARIOS?

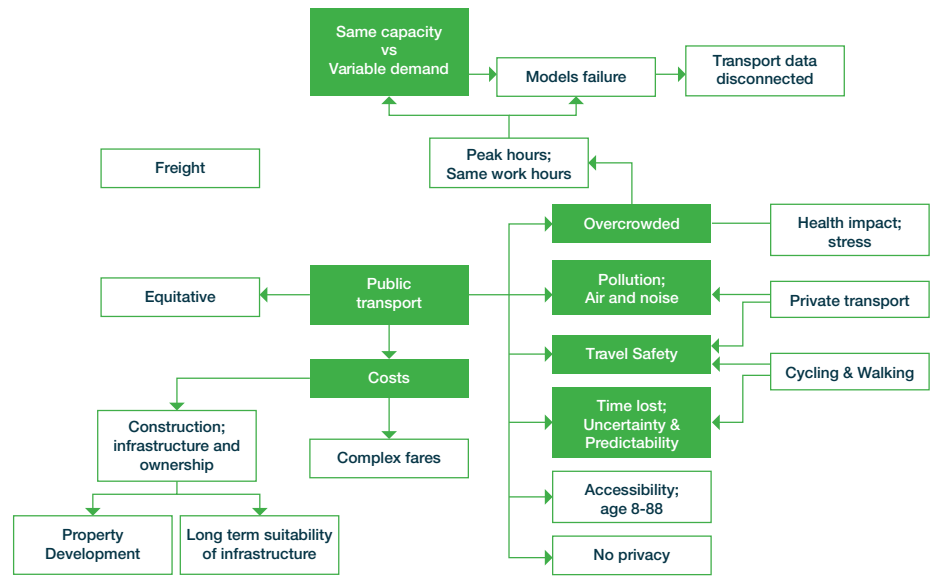


The second part of the workshop considered trends. Some of these are listed

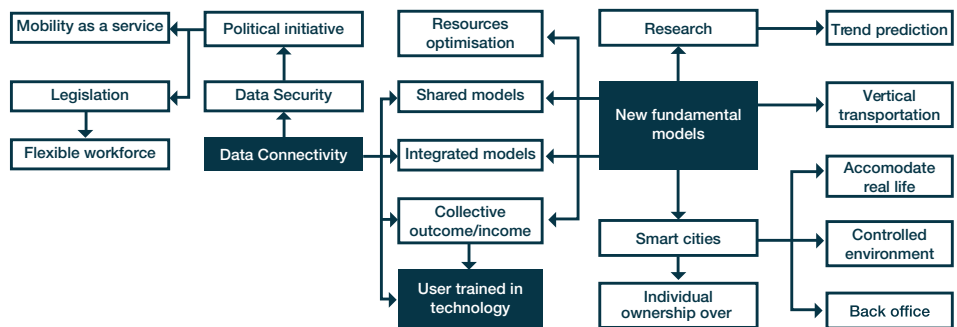
Here the outcome is: enjoyable and productive healthy journeys, pre-planned, maybe to a longer overall window but with less pressure on the transport system and an improved outcome. However, with this 'smart model' as a trade-off we have released our data and privacy and there could also be commercial pressures that impact on our behaviours.

Our workshop showed a range of impacting issues that affect the Current state, innovations that can help as well as factors that affect the longer term – new paradigm model. The 'new paradigm' horizon considers ways to combat the pressures, including new data structures, shared models and more passenger-focussed offers such as mobility as a service model (like Uber), point-to-point travel systems and technological advances that change travel expectations.

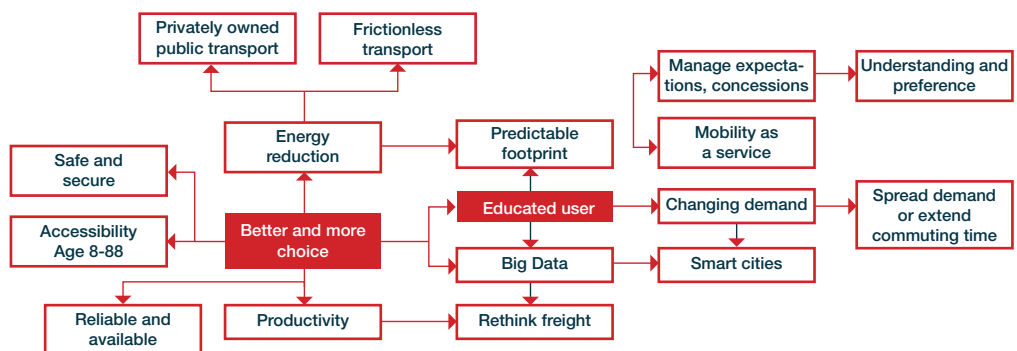
Current state



Innovations



New Paradigms





Workshop brain storming considering trends

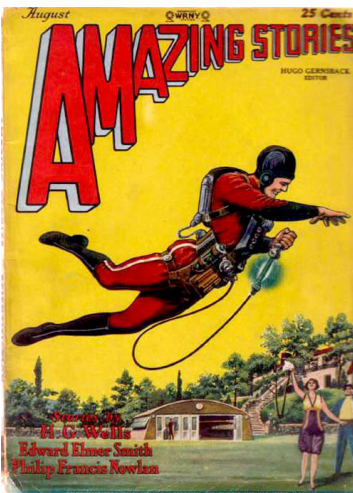
Trends

The jet pack paradigm

One challenge is that trends are perceived to come into mainstream use faster than they actually do and that by reporting on them more we ‘increase their chance of success’ and in turn impact on day to day life. Jetpacks serve as one example of this: the concept of a jetpack was first floated over 100 years ago. Technological break throughs in the 1960s enabled proto-voyages and various trials, but the media coverage and cultural representation gave the impression that we would be moving around in this way within a decade. Even today, jetpacks are not a viable or serious consideration for mass transportation, even though there are a few instances of effective technology and niche usage. The question is: what impacts does this actually have on our lives and how socially/culturally significant are they?

Trends and innovative new concepts often consider polarities of use - wheel vs airborne travel, personal vs shared modes, on-demand vs turn up and use. Trends may also not completely obviate the previous methods we have used: i.e. the car allows for full personal travel, yet we still use mass transit such as the underground metro for major travel movement between cities. So although we can, it does not dictate that we will. Often new and old, high vs low technology solutions sit side by side, each still fulfilling a purpose in their own right – for example the popularity of cycling has not dwindled.

The following key trends were identified by the workshop as important to consider regarding the level of their impact and their importance when planning for future transport models.



TRENDS TO CONSIDER IN THE FUTURE



Individual transport



Wheel based



People movement



High energy



Co-ordinated



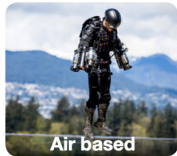
Safe



Hyperloop



Shared transport



Air based



Data movement



Low tech



Un-coordinated



Un-Safe



Bike

The question is *how do we consider trends and accommodate and plan for them* - For example, is hyperloop coming soon? Is the Tysson Multi lift (moving horizontally and vertically) going to impact building and city design? Did the Sinclair C5 change travel patterns? And what is the priority of influence we need to give to these emerging concepts and technologies?

With energy pressures, the cost per mile and energy use type will increasingly play a part in informing trend decisions. Electricity is likely to become the most significant power for travelling in the more developed cities and countries. Human-powered travel may also globally increase as a net transport type. The low pollution and energy efficiency agenda has already had major ramifications in e-mobility but infrastructure needs to be carefully brought forward to enable the level of electricity demand to be met. Taxing and cost structures for journeys also need to be considered in maintaining the infrastructure (such as roads and railways). Both existing and planned underground routes are able to maintain the high-speed direct journey through, and into cities and will most likely be viewed as 'high-value systems'.

Broader questions that we face regarding transport use and modal choice include:

- Will the inefficiency of air travel (compared to wheels) ever be overcome or will we be able to proportionally tax and balance the energy use of all modes of travel?
- The level of energy use per mile is not a level playing field based on cost tax or convenience and this is also not represented in business case models in a fair or proportional way.
- What trends do we really need to plan for and which will have the biggest impacts? The major Scandinavian trend is cycle use – now at 40% of modal share in

trip choice – will this trend ever reach the UK or are there contextual reasons (societal, cultural or even geographical) which would limit its popularity here.

- Are our expectations of how much we travel in the future going to continue increasing?
- Is comparing transport plans to 'do-nothing' scenarios correct? Time is only one of the business case drivers for transport

There is a growing trend for greater environmental impact assessment of transport, to make it less visually harmful and reduce the impact on natural environments. We can see this emerging in the planning of HS2 where a large proportion of the route is being pushed underground as a consequence of environmental mitigation. This trend is also being seen in road planning and is a key area where underground design is coming to the fore.

Our workshop concluded that new technological solutions would not unlock transport problems for us in the near future. Discussion around the emerging new topics such as Hyperloop, Drone use, AV (automated driving vehicles) and flying vehicles concluded that:

- these trends and technologies would only affect a small minority of journeys,
- new technologies did not appear to address the significant issues facing existing modes of transport
- due to the layouts of our existing cities, surface transport networks can only have influence when using the existing 'hardware' – primarily roads
- the underground space was an area that is increasingly considered for cities that need to create fast routes into city centre regions and cross-city routes.

Movement of people

Considering both country-wide and London-based statistics, the workshop discussed the emerging changes and modal shifts that are happening.

London is trending away from private vehicle use as increased taxes are acting as a deterrent, but the split of use into alternatives modes is not so predictable.

- Since TfL was formed in 2000, the car mode share has fallen by 11 percentage points from 48% to 37%
- Car kilometres travelled in London have been falling since 1999. From 2007, car travel also started to fall outside London, albeit by much less.

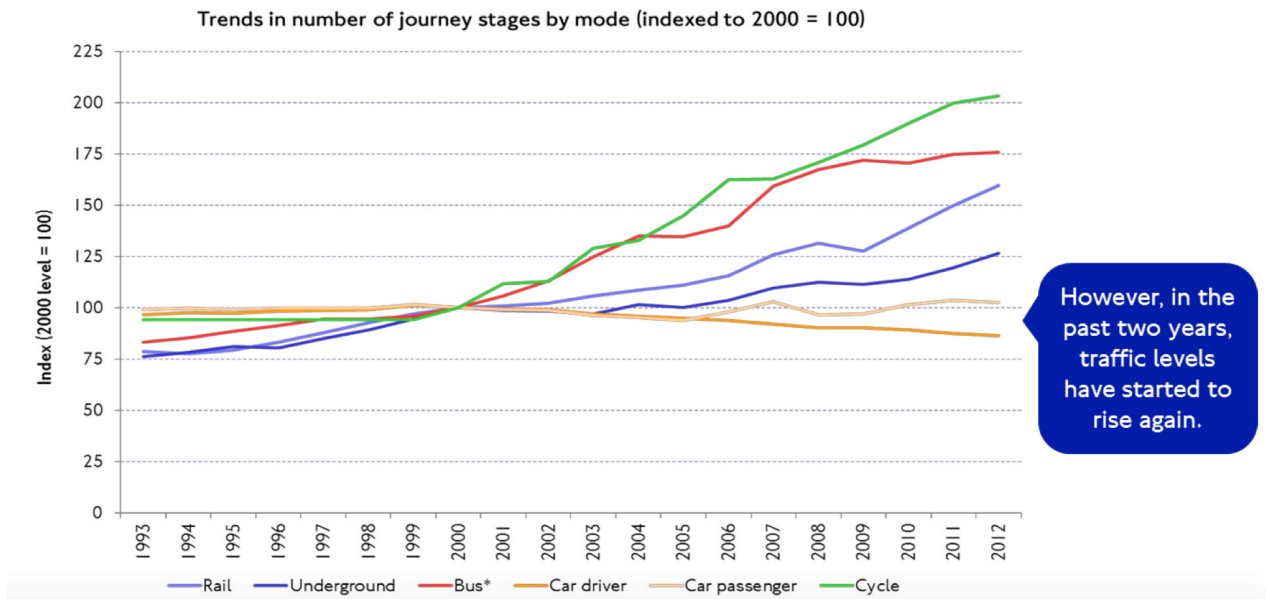


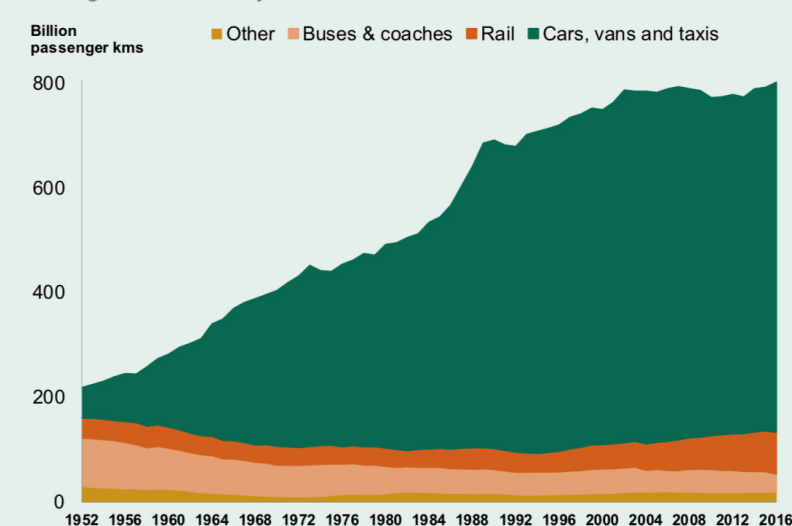
Image taken from Transport for London briefing paper 2017 - The changing nature of travel demand in London

Impacts of new public transport modes have not been significant across London and the latest rise in Uber has started to reverse the reduction of use of cars in our cities again. One reason may be that bus journeys, for example, become less efficient and less appealing as they become slowed down by increased traffic congestion, thus making tube travel more attractive.

However, if we look at the rest of UK, the total distance travelled has been increasing faster than population growth. The proportional use of road-based vehicles has been increasing at an alarming rate and has only slowed a little over the last 10 years.

Passenger transport [TSGB0101-0102](#)

Passenger kilometres by mode, Great Britain: 1952 to 2016



801 billion passenger kilometres - the highest volume ever recorded

Over 80% of passenger kilometres in 2016 were by car, van or taxi

Over 8.3 billion passenger journeys in 2016/17

4.9 billion passenger journeys on local bus services - 61% lower than 1950.

Image taken from Transport Statistics Great Britain 2017 - DfT Publication

The reasons why we are travelling and the modal proportion of journey number is also of interest. We are making different journey types and the influence on the transport mode of choice is more complex than may be thought. To influence change, single areas of innovation, (for example pay as you go charging models), may have less of an effect in the overall market than we expect or plan for.

Commuting is often perceived as the principal factor in creating stress on transport systems and their

users. However, the highest proportion of journeys is in the support/leisure areas. **Shopping plus leisure purposes create the highest number of journeys.**

Often these will involve the transportation of materials as well as people, so the reasons of private vehicle use expansion can be more easily understood. We may also make leisure journeys as a group (eg families) which leads to a preference for the use of private vehicles, for additional convenience.

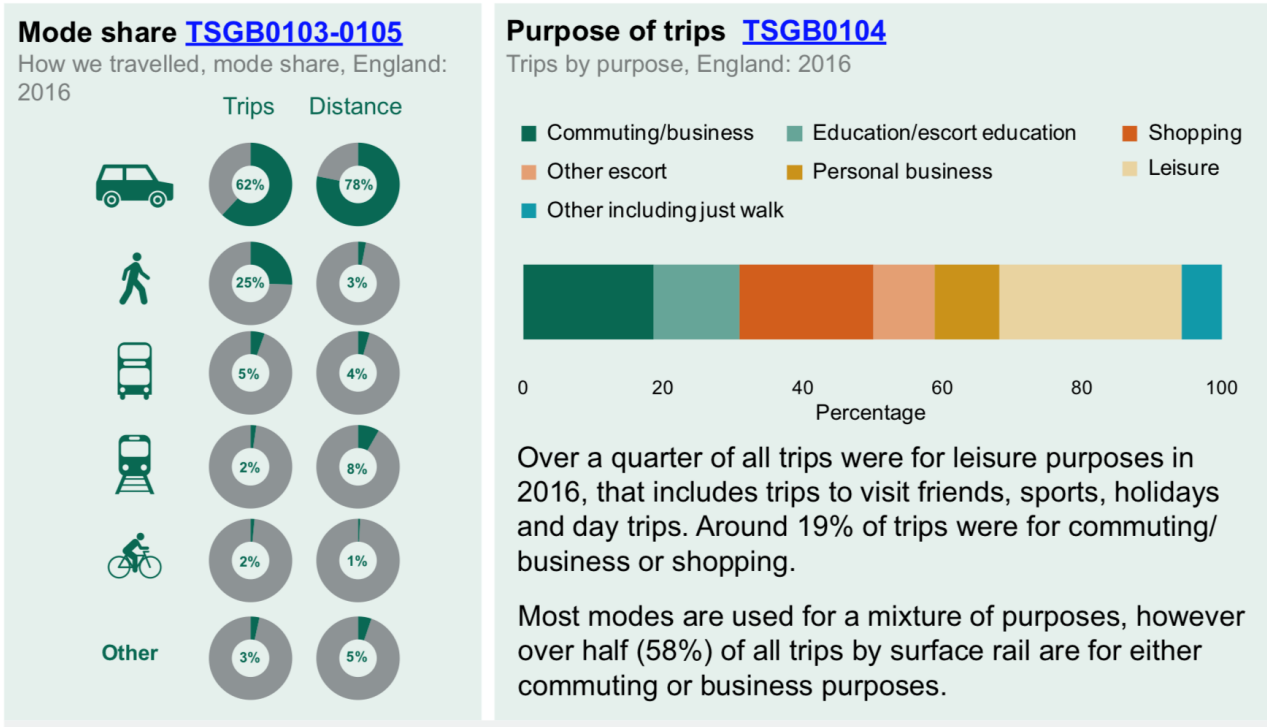
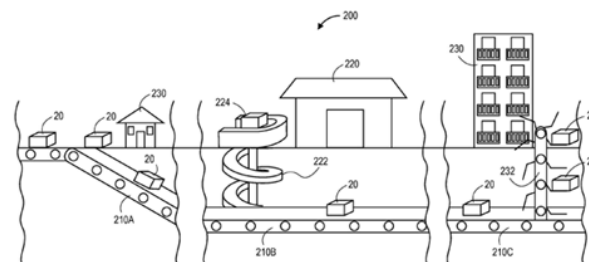


Image taken from Transport Statistics Great Britain 2017 - DfT Publication

Movement of Goods

We discussed at the workshop how freight models are changing and their relationship to storage and servicing in city centres, outer areas and the ‘last mile’ journey of distribution. The ‘last mile’ is changing from a home-to-shop journey to the delivery of goods bought online, and this is having a profound effect on transport trends and journey patterns. Efficiencies in transport and home convenience are offsetting how our urban areas perform – ‘the death of the high street’ vs the rise of out-of-town ‘big box’ retail (almost distribution centres in their own right). Some of these trends are here to stay and so the workshop brought key areas of influence into the planning models – particularly where an underground route may offer a better dedicated route for freight or an underground transport corridor could also be shared with a freight function. For example, the re-use of the old postal tunnels in London may be interesting for new freight use in the delivery and transport of goods bought online.

We considered where **underground space** plays a significant part in planning for the future. **We concluded that underground space might be most effectively used in ‘last mile’ journeys in city centres and high-density areas.** Additionally, in sensitive areas where the impact assessment justifies a higher civil

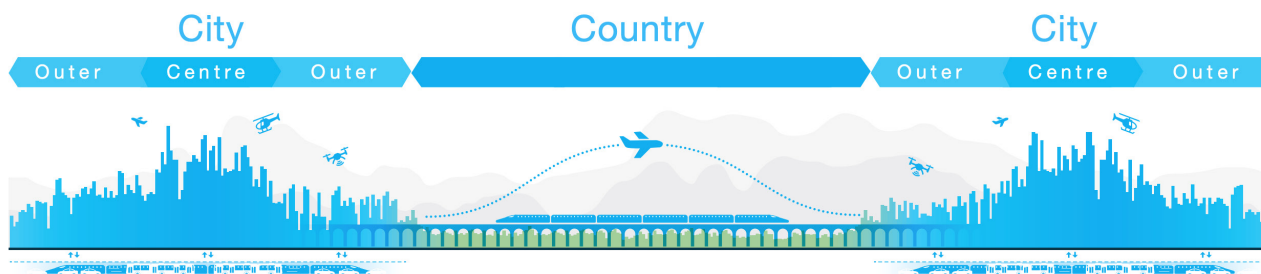


intervention. Interestingly Amazon have applied for patents covering the idea of distribution networks that work from a network of under-ground routes

Journeys are being increasingly broken up into multiple stages rather than single point-to-point modes and this trend is likely to continue.

Commuter journeys may involve a drive and park, a small walk, train, and cycle hire to the final destination. Therefore, as any areas of system design (for which transport is one), a successful approach considers many areas in parallel in order to influence a joined-up change. **The underground space will play a part in this and the impact of where and how is key to area to plan for and address, in terms of city planning.**

POINT TO POINT TRAVEL - ABOVE GROUND vs BELOW



Scenario planning and spatial zoning

The second workshop task showed the current location of many assets in the mix of overground and underground space and, from an urban planning perspective, posited the question of **where these functions** would be **sited in the future?** Workshop groups considered what these spatial zoning maps meant for future planning and how we may safeguard transport corridors amongst these assets.

future combine a variety of uses – perhaps all low carbon modes sharing the corridor.

The output of this exercise showed that three scenarios of organisation are possible: an organic piecemeal model, a better planned model, and a new paradigm model. Predominantly underground transport has a more significant impact in the latter two models since it involves long term planning and is of a high cost.

See below the sketch used in the workshop describing the use of transport corridors and how these could in the

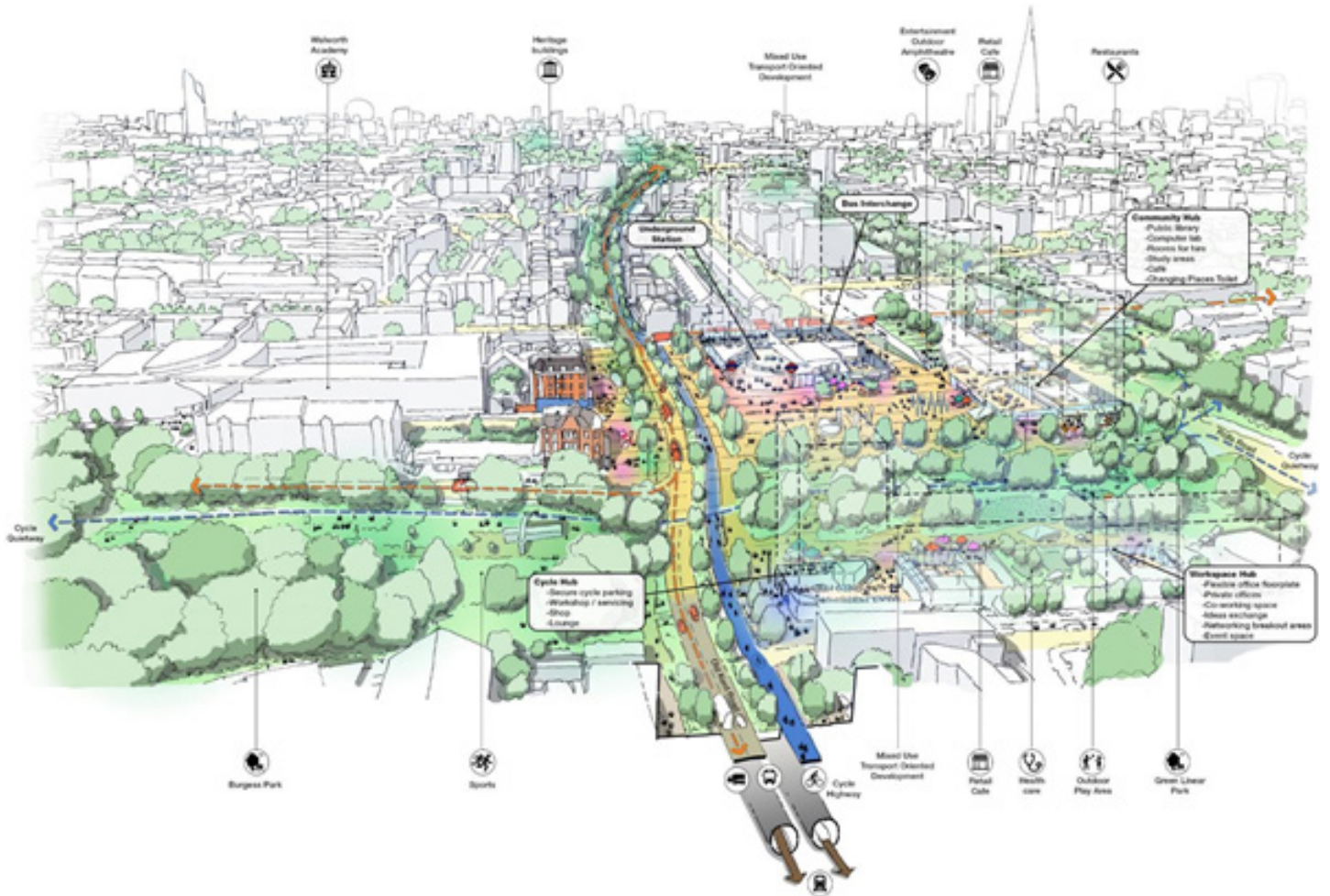


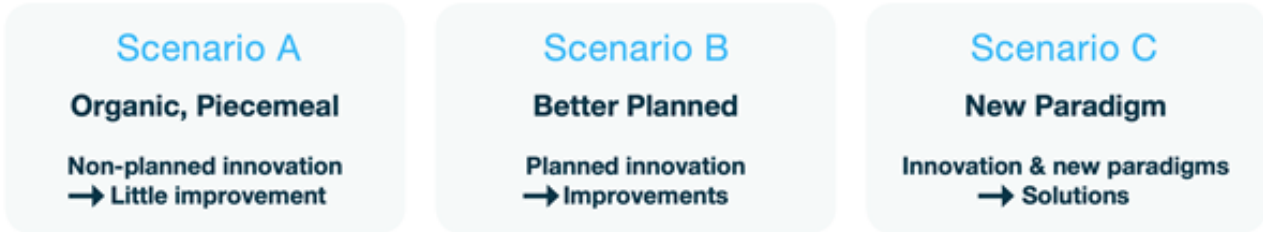
Image by Weston Williamson and partners

Models

The workshop examined three areas of concern when analysing time horizons: issues, ideas and trends. We explored whether a new type of model for transport planning might change expectations in order to create a future that works for all.

Each scenario model has different impacts in planning for cities and valid pros and cons were discussed.

New paradigm - In addition to a better planned model, expectations, behaviour and models of transport are considered and planned for. By changing the need for movement, as well as the expectations for it, the system has more resilience and better, more unified effects. This means that the system can meet the users' experience expectations as well as changing their view of the need. Habit changing, new working models, travel service and range of offers all can play a part in creating a better, low-conflict system that works better for all.



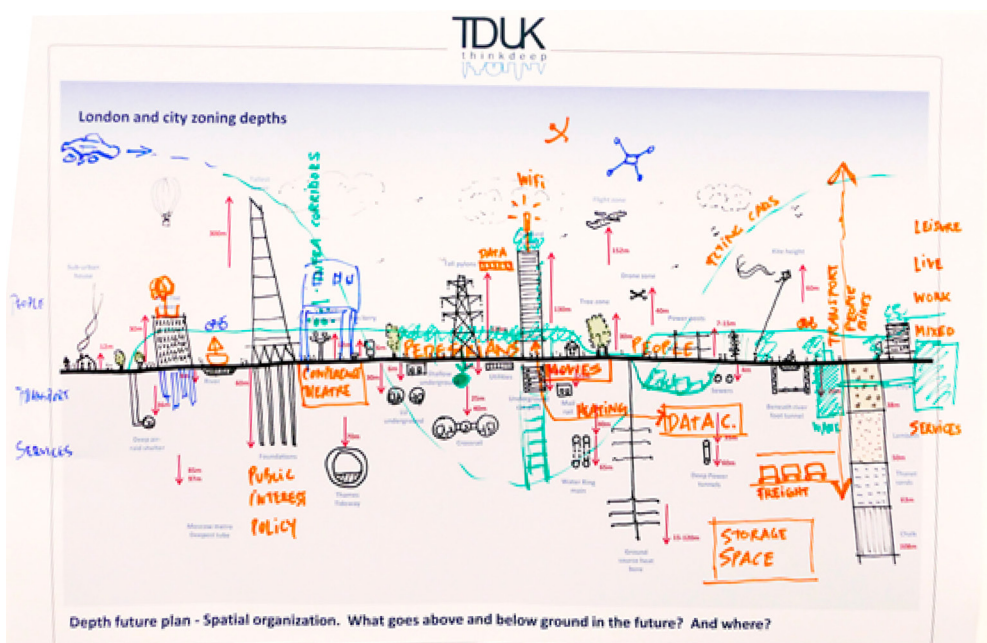
Organic model – the piecemeal addressing of change is reactionary, future proofing is not envisaged to be able to be either predicted or planned for and that doing so is considered a waste of time. Innovations will mainly mitigate poor outcomes, and improvements may be slow and non-joined up.

Better Planned –Innovations and trends are predicted and planned for. Near-future technologies are facilitated and encouraged with space provision and new policy considered in advance of implementation, such that benefits are realised faster and do not compromise the existing status quo of transport systems. The improvements come from the advanced thinking and planning that encourages and facilitates change.

The wider group discussion found that a combination of Scenario B – better planned – and Scenario C – new paradigm – would be the best model to approach planning for the future.

Under Scenario B, a number of different models were proposed by the workshop groups:

- a spatial pro-active planned approach
- a use class and underground use approach
- a safeguarding model that plans for zones and corridors within our cities.



Team output from the workshop

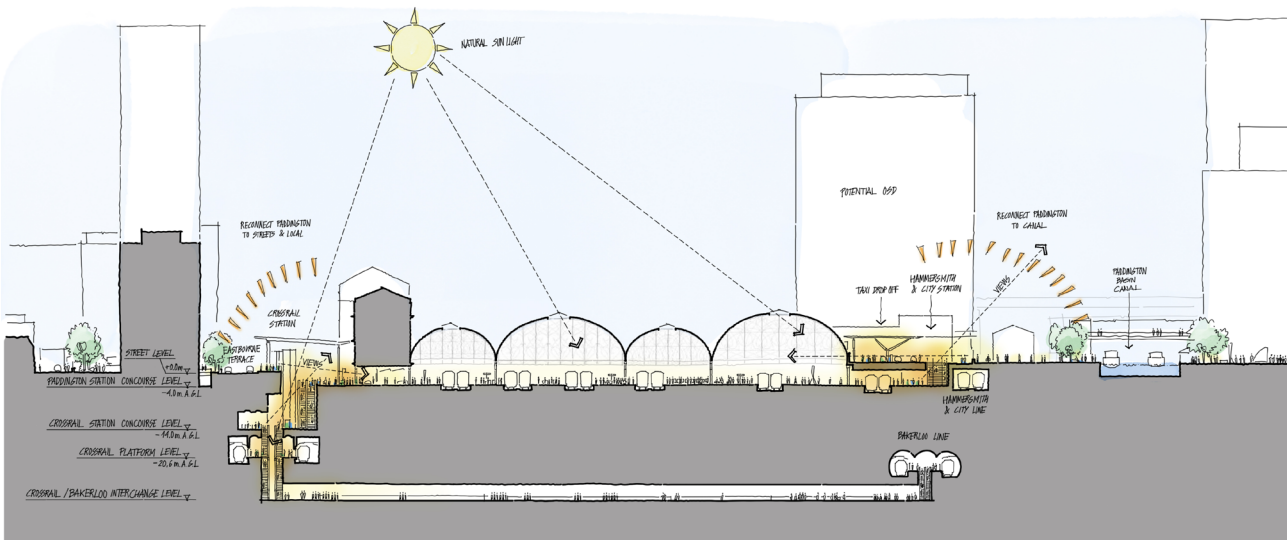
Further discussion centred around 'last mile' travel and the zoning of journey speeds between cities. How can the transport modes compliment, integrate better and link between current and future systems?

The proportion of use of future transport types and how they link between the use of above ground and underground space is an area that the workshop group believe needs more careful consideration. For example, drones may be able to use underground tunnels and come to surface at shafts so that they don't affect air travel or create a different type of safety and pollution issues (noise).

City safeguarded transport corridors may be planned to be oversized in anticipation for future uses.

The workshop was unanimous that better planning and more efficient use of underground space would be needed in the future to provide great transport capacity and to improve the quality of life in the above-ground urban environment

The quality of underground spaces can be as effective and as high quality as above ground spaces – see Crossrail Paddington as an example of a naturally lit metro station.



Conclusion

The workshop took a pragmatic approach to a subject that can often be skewed by technologically romantic visions of the future. Society's belief in technology can often result in pragmatic planning and policy change being less influential or popular as force for change (see the congestion zone) There is also a parallel danger that big policy moves will be made without real insight, knowledge or considered need. For example, is the replacement of all non-electric vehicles with electric and hybrid cars really the answer? We can also miss the overall bigger trends and this can skew the level of success or impact of some of the lower-level innovations.

We need to develop both an holistic and robust model in considering future planning as well as change our expectations for the travel needs we have and what constitutes a good journey . A 'quality of life' and low carbon model vs the current speed and demand model. Is this 'social value' vs the 'DfT business case' model?

Defining the value drivers behind the future model will be key in influencing our city designs and ensuring that we move into the future with our 'eyes wide open', creating a high-quality of life and environmental future.

The output of this TDUK piece on Future transport posited:

That being pro-active in planning long term for the future of transport movement is critical.

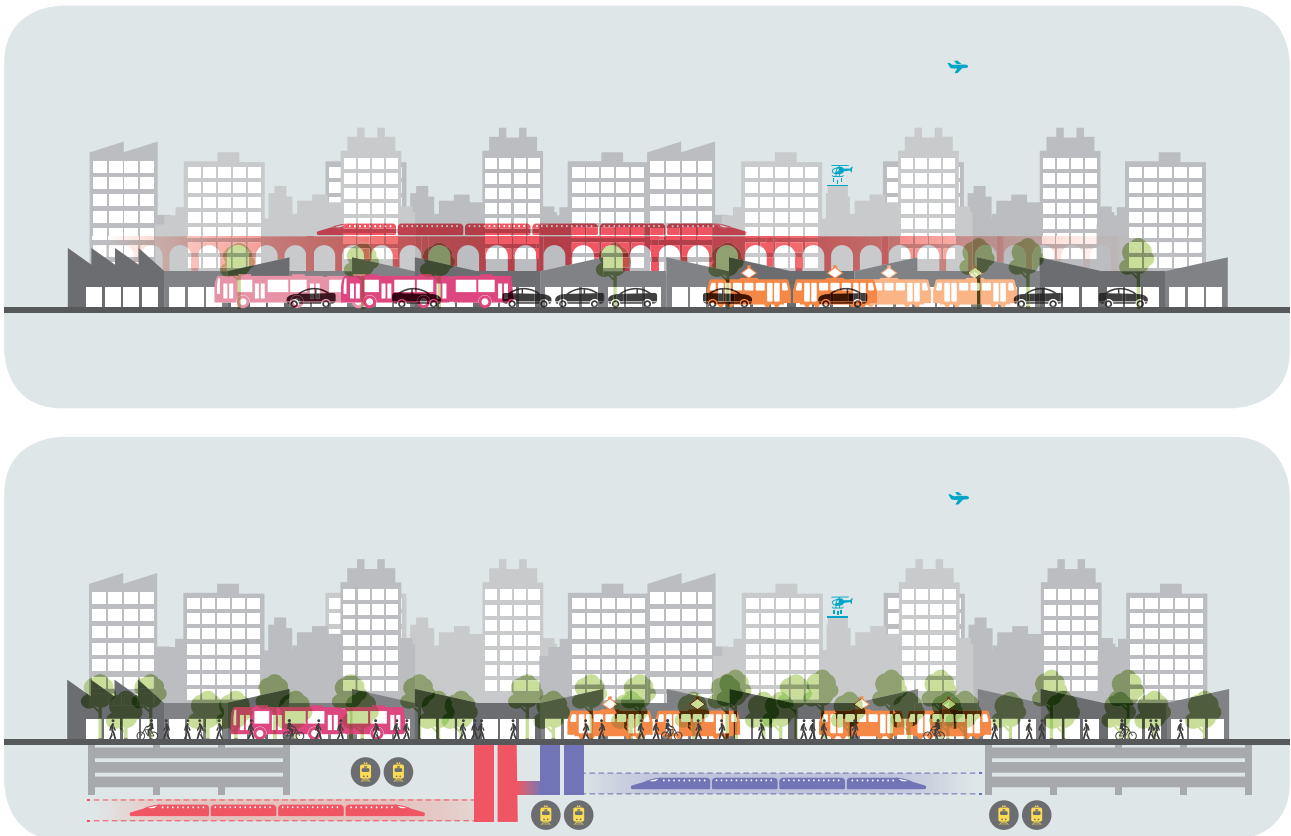
That a 'new paradigm' series of 'trend and influence' studies should be progressed to inform future transport planning and quantify potential impact levels

An improved planning 'spatial' model is developed for our cities to:

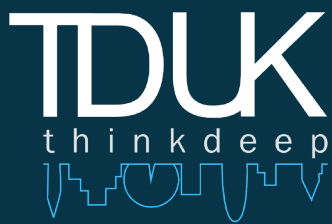
- *include the future expansion plans linked to transport and the*
 - *provision for proper transport corridors*
- Create a new version of the DfT-green book 'model' for transport business case, better quantified to quality drivers.

Whole impact modelling to be developed – bringing better indicators for carbon and social/health metrics

Ways to organise/safeguard cities



* Post workshop note - As an example CAMS (Cambridge Autonomous Metro) is nearest latest innovative thinking that the UK is developing - this includes underground aspects as well as a new high quality model for transport



Get involved by contacting us:

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Web | www.tduk.org

Email | thinkdeepUK@tduk.org

Twitter | [@ThinkDeepUK](https://twitter.com/ThinkDeepUK)