Innovations which help to create new markets or value chains, and eventually disrupt existing markets and value chains (over a period of years or decades), to the extent that they displace earlier technologies. E.g: the DVD player was a disruptive innovation for VHS players.

Autonomous vehicles (driverless vehicles)
Vehicles able to sense the road environment around them and navigate themselves to destinations by negotiating other traffic and road hazards. Vehicles are being manufactured with increasing degrees of autonomy and are anticipated to become fully driverless within the next 10-15 years.

Disruptive innovation
Technologies considered so new that they could have a high risk of being unreliable and require considerable investment in order to make use of them. A proportion of bleeding-edge technology will find its way into the mainstream (e.g. email).

Vehicles manufactured with increasing degrees of autonomy and are anticipated to become fully driverless within the next 10-15 years.

Crowd sourcing
A distributed problem solving and production process that involves outsourcing tasks to an undefined public ('crowd') rather than a specific entity.

Digital exhausted
Virtual 'trials' of data that are generated by individuals and things through the electronic interactions and transactions with both private and public sector organisations.

Disruptive innovation
Innovations which help to create new markets or value chains, and eventually displace existing markets and value chains (over a period of years or decades), to the extent they displace earlier technologies. E.g. the ODO phone was a disruptive innovation for IVR players.

GNS
Global Navigation Satellite System (GNSS) receivers commonly used for surveying and navigation.

GPS
A space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more global positioning satellites.

Hacking
A methodological tool used for system hacking or code breaking. Typically consisting of a rule and a way, in which computer programmers and others involved in software development come together to create usable software. Transport hackathons can focus on building existing transport related apps, visualisations, or conduct insightful data analysis.

Innovate UK
The organisation formerly known as the Technology Strategy Board, which is responsible for disbursing innovation funding, mentoring and networking in order to accelerate the uptake of innovative technologies and practices across UK industrial sectors.

Internet of Things (IoT)
The proliferation of device and ICT applications connected to the internet (such as smart meters, smart grids, and smart transport services) based on sensor networks and machine-to-machine communication. The number of networked sensors and information generation is growing at over 30% per annum, creating a rapidly expanding "Internet of Things" (IoT) that is projected to contain as many as 150 billion devices by 2020.

Interoperability
The ability of different networks or discrete, closed systems (e.g. bus, rail, coach) to integrate and work together in order to allow for the seamless transfer of information, people and things. Interoperable transport systems are expected to form the basis for future intelligent mobility systems.

Knowledge Spine
An experiential real-world environment being set up in Oxfordshire that is intended to support the accelerated design, prototyping, and testing of new technologies and mobility systems.

Living Lab
The development of a local "hub" or "hatch" to provide a central point through which local authorities can develop partnerships with universities and businesses to develop innovative transport tools and approaches and technology that enhance services, manage infrastructure more efficiently and provide a basis for local businesses to address problems thus reducing burden on public sector finances.

Mobility as a Service
The concept through which the movement of people and things (e.g. goods and services) can be bought and sold on a pay-on-give basis, or through subscription models. These approaches have become increasingly common in the world of software and technology, and are anticipated to underpin the development of intelligent mobility services.

Open data
Open data is information that is available for anyone to use, for any purpose, at no cost.

Oxynbeles
The organisation set up by InnovateUK to accelerate the UK's development of intelligent mobility systems and their export to other locations in the world.

Privacy
The development of a local "catapult" to provide a central point through which local authorities can develop partnerships with universities and businesses to develop innovative transport tools and approaches and technology that enhance services, manage infrastructure more efficiently and provide a basis for local businesses to address problems thus reducing burden on public sector finances.

Sentiment data
Subjective information collected through social media and other sources that can be mined using natural language processing, text analysis and computational linguistics techniques.

Transport Systems Catalyst
The organisation set up by InnovateUK to accelerate the UK's development of intelligent mobility systems and their export to other locations in the world.

UTMC
Urban Traffic Management Control systems are used to manage traffic lights, bus and light rail priority, and car parks in UK cities.
1.1 A fresh approach to planning and delivering local transport is needed if we are to successfully, and sustainably, connect the places in Oxfordshire where the majority of people will live and work over the coming 20 years. This is particularly true for the Oxfordshire Knowledge Spine (Bicester - Oxford - Science Vale UK), which the Oxfordshire Local Enterprise Partnership’s (LEP) Strategic Economic Plan (SEP) identifies as the key driver for local economic growth. Other parts of Oxfordshire will also be key contributors to the success of the county’s growth strategy. Banbury in particular is a hub for employment in its own right. Banbury, Witney and Carterton each have individual area strategies which provide housing for significant numbers of people who work in the Knowledge Spine. Science Transit relates to connectivity within, to and from the Knowledge Spine.

1.2 A number of strategic challenges, which also present significant opportunity for purposively directed growth and local improvement, emerge in relation to this area and its connectivity:

- The anticipated scale of housing and employment growth will place significant additional demands on the county’s transport infrastructure:
  - With an integrated approach to transport and land use planning, major new developments can be located and designed to support new transport services, providing the catalyst for change and bringing benefits to existing communities.

- Reducing carbon emissions to address climate change, requires a radical change in the way transport is provided and used:
  - Over the next 20 years, new, innovative products and systems will create a very different environment for mobility, with new ways of travelling and more efficient use of time, vehicles and space.

- Travel from highly desirable and affluent areas, predominantly rural market towns and residential hinterlands, is contributing to rising traffic levels and road congestion. Predicted local economic and population growth is likely to increase demand for car travel as the residence of viable and equally attractive alternatives, placing greater strain on existing networks.

- There are planned improvements to nationally important road, rail, and air connections that run through the County and serve local, regional and strategic national mobility needs. These will make it even easier for people to travel through the county of Oxfordshire, as well as get to Heathrow and London. These improvements are likely to make the county an even more attractive location for businesses and people but may increase traffic volumes on local feeder roads.

- Continued rapid development of technology and communications will further accelerate the collection and transfer of data in both business and personal contexts. Much of the detail Oxfordshire is currently closed and not integrated.

- More intelligent, data-driven transport systems that better integrate with personal and business mobility needs are widely expected to emerge. Oxfordshire has an opportunity to be at the forefront of these developments by being in a live test bed for intelligent mobility system development and implementation.
1.3 Science Transit is a direct response to these challenges. It defines a high-level vision, and outline roadmap, for the development of better-integrated, high quality mobility systems that both serve the Oxfordshire Knowledge Spine and connect it with the rest of the County. We envisage a future system made up of four main elements:

- Projects which promote innovation in mobility and integrated transport delivery.
- Projects which encourage intelligent mobility and open Oxfordshire data to promote research and enterprise.
- Key infrastructure improvements which will improve connections between key areas along the Knowledge Spine. For example, upgrading pinch-point junctions and utilising new road-based lines. These infrastructure projects will sometimes be led by opportunities in funding streams.
- Route enhancements which will improve connections between key locations along the Knowledge Spine including new public transport routes and improved frequency of services on existing routes.

1.4 Science Transit is aligned with the County Council’s practically-focused strategies for improving the county’s transport networks: LTP4, accompanying area strategies, bus, rail and cycle strategies.

1.5 By implementing Science Transit alongside the strategies described above, we aim to:

- Embrace new technologies and data innovation to unlock intelligent mobility, presenting information to all users to make truly informed choices about the way they travel.
- Accelerate local growth through innovative R&D, providing opportunities for forward-looking business and research organisations and their highly skilled workforces to test and bring new products and technology to market.
- Improve connectivity between places where people live, work and spend their leisure time, ensuring all aspects of the door-to-door journey are fast, reliable, seamless and affordable.
- Integrate transport and land-use planning to improve non-car-based mobility, creating an environment where sustainable travel is the simplest and obvious choice.

2 STRATEGIC CONTEXT

2.1 Oxfordshire is renowned across the globe for its academic excellence, innovative business culture and the quality of its built and natural environment. The city is home to Europe’s largest concentration of multi-million pound science research facilities, underpinning our leading position in advanced engineering, manufacturing and life sciences, as well as sitting at the heart of the UK’s growing international space cluster. We are therefore prime for investment with solid economic foundations and ambitious plans to support growth and the creation of sustainable jobs for local communities.

2.2 Oxfordshire makes a disproportionately large contribution to UK economic performance in relation to its geographic size and population.

- Importance to the national economy

  - Over 50 Nobel Prizes within the Oxford academic cluster
  - 9.5m visitors per year (sixth most visited city in UK) spending £770m
  - One of the lowest unemployment rates in the country
  - The county is a centre for automotive innovation; and home to numerous F1 teams, including world champions
  - Science Vale UK has one of the largest concentrations of multi-million dollar science research facilities in Europe. Harwell Science and Innovation Campus employs 4500 people on a range of science projects
  - Oxford ranked second amongst 64 UK cities in terms of percentage of working population with NVQ4 or above

- Use of the lowest unemployment rate in the country

  - Oxford is amongst the top five universities in the world. Name: Top 15
  - In Madagascar, the UK is a leading high tech firm. Harvesting around 800,000 people

- The country is a leader in academic research, and home to numerous FT teams, including world champions

- Oxford ranked second amongst 64 UK cities in terms of percentage of working population with NVQ4 or above
A prosperous and growing county

2.3 Oxfordshire is currently one of the fastest growing, and most dynamic, areas in the UK. The City Deal and Oxfordshire Local Enterprise Partnerships’ (LEP’s) Strategic Economic Plan (SEP), both set out a vision for accelerating economic growth to meet the needs of the area’s science and knowledge-rich economy. Per Oxfordshire County Council’s overarching growth plan, the aim is to place the county at the forefront of the UK’s global growth ambitions to 2031 and beyond, through the delivery of:

- 85,000 new jobs
- 100,000 new houses
- An additional 1,000 apprenticeships for young people in priority growth sectors
- £6.6 billion additional GVA
- £815m of highways improvements and £500m of rail investment delivered
- £2.5 billion private sector investment

2.4 To date the various local planning authorities have progressed their Local Plans to different stages. The following diagrams summarise the main locations currently being envisaged as the focal points for future growth across Oxfordshire according to the Local Plans and the Strategic Housing Market Assessment (SHMA1):

Scale of development and commuter trips to, from and within Oxfordshire 2031

- Outer Oxfordshire: 69,000 households, 58,000 jobs
- Oxford and Inner Oxfordshire: 31,000 households, 30,000 jobs

Additional demand

When existing patterns of commuting trip generation, distribution and mode share applied to the anticipated Local Plan housing growth throughout the county, the city will see the following additional level of commuting:

- 13,600 car trips
- 4,300 bus trips
- 2,900 cycle trips
- 900 rail trips
- 2,400 walking trips
- 2,000 other modes

2.5 Government funding secured through the City Deal and SEP will be controlled locally to boost innovation and business growth, and create jobs in the technology and knowledge sectors in which Oxfordshire is already strong. This funding will also be used to stimulate private sector investment, focusing on the following thematic objectives:

- Innovative Enterprise: Growth led by innovation, R&D and business collaboration
- Innovative People: Specialised and flexibly skilled people across all sectors
- Innovative Place: Quality of urban and rural environments and choice of homes
- Innovative Connectivity: Freedom of movement and interconnectedness for people and things
The Knowledge Spine and Innovation

Hubs

2.11 Unless public transport, walking and cycling can provide a viable alternative to the private car, people will continue to rely on it for short journeys within and around Oxford. This poses a significant challenge for our future growth plans which, if not addressed, will result in greater levels of congestion and pollution.

2.12 Car ownership in areas outside of Oxford is high, with, for example, 76% of all households in South Oxfordshire owning a car. Rising car ownership is a key challenge for future growth, with forecasts predict the total number of cars owned across the county will increase by approximately 70,000 vehicles (+19%) between 2013 and 2031 in Oxfordshire. This is higher than the growth of the number of households in Oxfordshire (16% between 2013 and 2031).

2.13 This high car ownership translates into high levels of car usage, including for commuting trips. Census data from 2011 reveals that around 80% of commuter trips to work were made by car. Travel into Oxford is also predominantly by car, but 15% of trips into the city are by bus and 10% by bike and walking. Travel into Oxford is also predominantly by car, compared to the national average of 74%. Forecasts based on projected growth and residential development across the county predict the total numbers of cars owned in Oxford and its commuter areas will increase by around 45,000 vehicles (+17%) between 2011 and 2031. This is higher than the growth of the number of households in Oxford (16% between 2011 and 2031).

2.14 All of the major settlements in Oxfordshire, and in particular Didcot, Witney and Oxford, see a greater proportion of people travelling into the city by car rather than by public transport. The table below provides an overview of commuting patterns and gives an indication of the need for effective mobility links that connect locations situated within the Knowledge Spine to each other, as well as key residential and work locations outside the Knowledge Spine into the area.

<table>
<thead>
<tr>
<th>Commuting Mode</th>
<th>Oxford</th>
<th>Didcot</th>
<th>Witney</th>
<th>Carterton</th>
<th>Banbury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car driver</td>
<td>80%</td>
<td>75%</td>
<td>74%</td>
<td>70%</td>
<td>73%</td>
</tr>
<tr>
<td>Walking</td>
<td>2%</td>
<td>3%</td>
<td>7%</td>
<td>6%</td>
<td>4%</td>
</tr>
<tr>
<td>Cycling</td>
<td>1%</td>
<td>8%</td>
<td>5%</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>Bus</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Other</td>
<td>7%</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
</tr>
</tbody>
</table>

2.15 All of the major settlements in Oxfordshire, and in particular Didcot, Witney and Oxford, have a greater proportion of people travelling into the city by car. Using the above key links, the following table provides an indication of the number of households in Oxfordshire. This is higher than the growth of the number of households in Oxfordshire (16% between 2013 and 2031).

Commuting mode share, 2011 Census

2.16 The Knowledge Spine and Innovation represents a cornerstone of the economic growth strategy in Oxford and the county. The Knowledge Spine crosses the county, running from Harwell and Culham in the south, to the world-class Bio Innovation in Oxford, on to the advanced engineering hub at Abingdon, and through to the life sciences Bio Innovation in Didcot, so as to advance the growth plans for the future.

2.17 Key innovation areas within the Knowledge Spine include the creation of high value science-related jobs within the vicinity of the Harwell Science, and Oxford University Science Parks. The Oxford Science Vale and Innovation Hubs represent a key component of this vision, and Connecting Oxfordshire (LTP4). Importantly, the growth plans themselves provide an opportunity for a major land use re-purposing and transformation of existing brownfield and greenfield sites, providing housing for significant numbers of people who work in the Knowledge Spine. The employment sectors identified also provide significant opportunity for effective mobility links that connect locations situated within the Knowledge Spine to each other, as well as key residential and work locations outside the Knowledge Spine into the area.

Challenges of accommodating future growth

2.18 A key challenge moving forwards is that our future growth plans are threatened by our current success. Existing patterns of development and high income levels have created an environment defined by high car ownership and high levels of car use – particularly outside of Oxford. Increasing current levels of congestion and pollution.

2.19 In the future, we will need to provide an effective mobility system that provides real alternatives to the private car and helps to reduce traffic congestion. This is a key aim of both the Science Transit vision, and Connecting Oxfordshire (LTP4). Importantly, the growth plans themselves provide an opportunity for changing travel patterns and making public transport more attractive and viable.

Increasing demand for mobility

2.20 Unlike public transport, walking and cycling can provide an equally as attractive alternative, the predicted economic and housing growth will result in greater demand for private motor vehicle travel in the future – thereby increasing current levels of congestion and pollution.

2.21 The creation of high value science-related jobs within the area defined as Oxfordshire’s Knowledge Spine represents a cornerstone of the economic growth strategy envisioned in our City Deal and NSF. The Knowledge Spine crosses the county, running from Harwell and Culham in the south, to the world-class Bio Innovation in Oxford, on to the advanced engineering hub at Abingdon, and through to the world-class Bio Innovation in Didcot, so as to advance the growth plans for the future.
2.15 It is considered that high incomes and poor public transport accessibility are key reasons behind this trend, and improvements to public transport are essential if the growth in car use is to be reduced.

2.16 Although Oxford city centre is the largest urban area in the county, Oxfordshire presents a challenge to serve dispersed “polycentric” employment sites and housing development that have traditionally resulted in high levels of private car use because of difficulties in providing commercially viable public transport.

2.17 Reflecting its size, geographically central position in the county, and the range of employment opportunities available in the city, Oxford itself attracts workers from a wide geographic area. It is the main commuter trip attractor in the county, accounting for around 13,000 passenger car movements each weekday peak hour morning. As well as commuters, Oxford attracts tourists from all over the world. It was the seventh most visited town or city in Britain in 2013; attracting around nine million visitors per annum in total.

2.18 The Oxfordshire Strategic Transport Model reveals that a large number of trips are currently made in the morning peak period on weekdays between key towns and Oxford. Although movements between these locations are greatest in the direction of Oxford, Bicester, Abingdon, Wantage, and Didcot are also significant trip attractors in their own right.

2.19 The projected future growth of local settlements is forecast to result in a strengthening of these movements during peak hours - particularly those emanating from Didcot, Abingdon, and Bicester.
Traffic congestion and its impacts

2.20 Perhaps unsurprisingly, the key characteristics of Oxfordshire’s dispersed population and employment centres, complex movement patterns, and high levels of car ownership and usage have resulted in a highly congested road network.

2.21 The A34 and A40 already experience high levels of traffic and only tend to benefit from bus lane segregation and local bus services. Buses rely on the same roads to operate, and nearly every major road in Oxford, and near to capacity for much of the day. As a result the A34 and A40 are not resilient to minor incidents and disruptions, which often result in major congestion events. Conversely the frequency of major urban road systems that link local residential areas and employment locations all experience high volumes of vehicles in relation to available highway capacity.

2.22 Future growth in jobs, population and car ownership levels will have a significant impact on the highway network’s ability to cope with rising traffic volumes. During the morning peak hours there are projected to be more areas of stress on the network, particularly on the A34 between Oxford and Bicester, on sections of the Bicester ring road; and between Abingdon, Kidlington, and Didcot.

2.23 Oxford and Bicester, on sections of the Bicester ring road; and A415 that link key residential areas and employment centres, complex movement patterns, and high levels of car ownership and usage have resulted in a highly congested road network.

Transport opportunities arising from projected growth

2.24 Although the challenges presented by Oxfordshire’s projected growth over the next 20 years may seem overwhelming, many of the new residential and employment developments being envisaged will address funding and congestion concerns.

Intelligent Mobility for Oxfordshire

2.25 The emerging concept of Intelligent Mobility refers to applications and solutions that make transport systems more responsive and predictive ‘data-driven’ travel planning tools. The benefits are numerous and include:

- More efficiently and sustainably connect goods, services, events, and people
- Optimize available infrastructure capacity to minimize the time, energy and resource efficiency of travel and transportation
- Are more readily connectable and flexible - promoting seamless journeys across all transport modes that can flex according to disruptions, changes in schedule or demand for other ADAS or other user-dependent services
- Generate lesser environmental and social impacts than current transport systems

2.26 Intelligent Mobility services are not currently very well defined and are at different stages of development, or are technologically feasible, are defined, since many are yet to come to market. Those envisaged will unlock funding and create opportunities to improve the movement of people and goods around the world. The TSC forms part of an emerging network of seven technology and innovation centres established and overseen by the UK’s innovation agency, Innovate UK. Together, they represent a £1bn public and private sector investment up to 2018.

2.27 The international market for Intelligent Mobility services is estimated to be worth £900bn2 by the Transport Systems Catapult3. As a global centre for research and development, the Innovation Hubs that make up the Oxfordshire Innovation Spine are perfectly positioned to capture a share of this market.

2.28 Science Transit seeks to develop the concept of Intelligent Mobility and apply it to real world transport systems within Oxfordshire – with particular emphasis on influencing and changing the way people think about mobility. We envisage the planned transport improvements to the Knowledge Spine area will act as a live test-bed and proving ground for Intelligent Mobility systems, techniques, and services. In doing so we will work in partnership with local transport authorities and commercial providers to develop and improve the expertise.
2.29 The consolidation of people in the main existing settle-
ments like Oxford, Banbury, Carterton, Bicester, Witney, Didcot and Aylesbury will help to strengthen the viability of enhanced public transport investment linking these
towns to employment hubs. Anticipated investment to
create new jobs across the country’s Knowledge Spine,
focused on the country’s Innovation Hubs, will also help to
define principal employment locations that can feasibly
be connected to each other, and to local towns, by public
transport.

2.30 Projects highlighted in the Science Transit Strategy aim
to achieve improved connectivity to new and existing devel-
oped locations by public transport alongside service
quality, passenger experience, and journey times/reliability improvements. For example, achieving a 10% reduction in
door-to-door public transport journey times alone would
increase by around 20% the proportion of Oxfordshire’s
current population that could access key employment
destinations within 20 minutes by public transport:

<table>
<thead>
<tr>
<th>Town</th>
<th>Travel Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxford</td>
<td>0 - 10</td>
</tr>
<tr>
<td>Didcot</td>
<td>10 - 20</td>
</tr>
<tr>
<td>Witney</td>
<td>20 - 30</td>
</tr>
<tr>
<td>Wantage &amp; Grove</td>
<td>30 - 40</td>
</tr>
<tr>
<td>Abingdon</td>
<td>40 - 50</td>
</tr>
<tr>
<td>Bicester</td>
<td>50 - 60</td>
</tr>
</tbody>
</table>

2.31 Employment and residential growth will generate contribu-
tions from property developers and additional public
revenues that can be invested in highway network improve-
ments. Planned improvements to junctions on the A4 (at
Hanley, Kennington, Milton, Chilton, and around Harwell),
on the A34 (Chains Green and Downs Road), within Oxford
city centre, and new link roads at Grove, Wantage, and
South West Bicester will help to improve traffic flows and
public transport journey times alike.

2.32 Science Transit is part of a suite of local transport plans and
strategies that will combine to address existing and future
traffic congestion challenges in Oxfordshire:

- **Supporting strategy setting out conditions in which commercial
  services can thrive, and where subsidised services are needed.**
- **Supporting strategy setting out the role Active & Healthy Travel has to
  play in Oxfordshire.**
- **Unlocking pinch points on the highway network**

Unlocking pinch points on the highway network

2.33 Employment and residential growth will generate contribu-
tions from property developers and additional public
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public transport journey times alike.

**Strategic fit with existing transport policies and strategies**

2.32 Science Transit is part of a suite of local transport plans and
strategies that will combine to address existing and future
traffic congestion challenges in Oxfordshire:
3 SCIENCE TRANSIT VISION & OBJECTIVES

Our vision

3.1 Science Transit will realise a next-generation mobility and information system for the Oxfordshire Knowledge Spine across all modes of travel. It will link together two Innovation Hubs, and connect them to locations of identified housing and economic growth across the county. New developments will support Science Transit delivery through strategic land use planning to prioritise non-car-based mobility and route bi-directional demand for public transport services where possible. Science Transit will represent a credible and viable alternative to private car use by meeting people’s basic mobility needs, as well as their expectations of speed, comfort, reliability, environmental sustainability, affordability, and journey experience.

3.2 This is about more than just improving bus services. The Science Transit vision is to ensure local transport links are deeply integrated with mainline rail and strategic highway connections to neighbouring towns, London, and Heathrow. New interchange locations will connect new and existing public transport services with walk, cycle, car-based, and air travel modes. Smart uses of real-time data generated through our effective coordination of mobility networks, and system users’ movements, will increasingly enable people to seamlessly combine multiple travel modes to complete their door-to-door journeys.

3.3 To achieve this, Science Transit will actively seek to exploit:

- New and emerging technologies that improve the environmental efficiency and sustainability of conventional transport systems.
- Ticketless and cashless payment systems that are expected to enable seamless interchange across travel modes in the future.
- New and innovative uses of data that are being collected from local transport networks and vehicles in real-time.
- Certain new modes of travel (e.g. autonomous vehicles) that are emerging from the intersection of technology, data, and transport system research & development.
- Partnerships with local transport operators, developers, and businesses to improve timetable coordination, service frequencies, and existing interchange and cycling infrastructure.

3.4 This ambition was outlined in Oxfordshire’s feasibility bid to Innovate UK in 2014 to develop integrated transport solutions with Science Transit enabling the Knowledge Spine Area to be treated as a ‘living laboratory’ for the development and demonstration of ‘Mobility as a Service’.

Its legacy will be a set of integrated mobility products that are end-user focused, seamlessly integrated with each other, and highly valued by time and money-conscious consumers.

Strategic objectives

3.5 Five interrelated and interdependent objectives will underpin the development of the Science Transit system. They are to:

- Drive new technologies and data innovation to unlock intelligent mobility.
- Accelerate local growth through innovative R&D.
- Improve connectivity between places people live, work, and spend their leisure time.
- Integrate transport and land-use planning to improve non-car-based mobility.
- Deepen public & private sector partnerships.

3.6 The remainder of this section is structured around these objectives to explain each in more detail.

5 ITS Europe defines Mobility as a Service (MaaS) as a mobility distribution model in which a customer’s major transportation needs are met over one interface and are offered by a service provider.
3.7 Intelligent mobility services will be primarily, but not exclusively, driven by technological innovations and new analytical possibilities being created by accelerating flows of so-called digital exhaust data. Such digital exhausts are a by-product of the online activities of Internet users and are created when people move around, purchase goods and services, or post updates to social networks. Such data is increasingly becoming available in real-time:

- Car parking data platforms (e.g. Park at my House)
- Car sharing databases (e.g. Oxfordshire Liftshare)
- Digital / social media surveys
- Overt crowd-sourcing
- Ticket sales and patronage data (ATOC RJIS)
- Public transport fares (ATOC rail fares database)
- Public transport schedule data (Traveline National Dataset)

3.8 Although it is impossible to be certain, given the emerging nature of many data processing and autonomous control systems at the time of preparing this strategy, we envisage the following possibilities will be unlocked by adopting a data-driven and proactive technology approach through Science Transit:

- More timely, accurate, and insightful intelligence for transport system managers in respect of what is happening across the county’s transport and movement at any given time. This more proactive network management will draw on data from both public and private sector data owners, and Oxfordshire County Council’s role will likely involve acting as an independent broker for this data.
- Scope for autonomous mobility network control and management systems that require less human intervention. These are likely to operate based on intelligent responses to data that are being collected and analysed in real-time, and independently compared against historically collected and pattern-analysed datasets.
- Deeper insight and intelligence for strategic transport planners, enabling more efficient design and implementation of new mobility systems.
- Personalised and context-specific multi-modal travel information that can be delivered to individuals across multiple platforms. This will power digital tools that can be delivered to individuals across multiple platforms. This will power digital tools that are able to make more intelligent, data-driven decisions about their personal mobility options in a range of scenarios - optimizing their use of time, money, CO2 and calories when moving around.

3.9 In line with Oxford’s emerging Smart City Strategy, Science Transit will be both a key contributor to, and consumer of, successful delivery against this objective will involve embedding the latest mobility technologies and data analytics into our digital exhaust data collected from operation systems at the time of preparing this strategy, we envisage the following possibilities will be unlocked by adopting a data-driven and proactive technology approach through Science Transit:

- Infrastructure management
- Real-time data exploitation
- Predictive modelling
- Vehicle manufacturing
- Infrastructure management
- Personalised and context-specific multi-modal travel information that can be delivered to individuals across multiple platforms. This will power digital tools that can be delivered to individuals across multiple platforms. This will power digital tools that are able to make more intelligent, data-driven decisions about their personal mobility options in a range of scenarios - optimizing their use of time, money, CO2 and calories when moving around.

3.10 Driving economic growth through innovation is a key future theme for the county, and our delivery of the Science Transit Strategy will create opportunities for precisely this. Its commitment to embracing emerging environmental sustainability and intelligent mobility technologies in transport and other areas deliberately seeks to create significant research, development and innovation opportunities for the following businesses and sectors to benefit from future investment in the local transport system through innovative Research & Development (R&D) in:

- Vehicle manufacturing
- Communications technologies
- Electronic sensors and controls
- Logistics and distribution
- Traveler information systems
- Predictive modelling
- Infrastructure management
- Real-time data exploitation

3.11 Each of these are fast-moving, independent business sectors that have historically operated with little formal connection to each other. As such, existing intelligent mobility initiatives often appear fragmented, with the concept’s full potential yet to be realized.

3.12 Science Transit will help overcome this lack of integration by establishing R&D projects that enable different transport to participate in continuous, intelligent vehicle-to-infrastructure and vehicle-to-vehicle interactions. These offer unexplored potential to tackle global problems of congestion, poor traveller experience, fuel consumption, environmental pollution, and road safety.

3.13 If successful, working in coalition with businesses and University partners, Oxfordshire’s transport system will become a ‘living-lab’ for internationally significant, bleeding-edge mobility technologies that benefit our county whilst also being scalable for export to other regions around the world.

4 Bleeding edge technologies are considered so new that they could have a high risk of being unreliable and require considerable investment in order to make use of them. A proportion of bleeding-edge technology will find its way into the mainstream (e.g. email).
3.14 We foresee a combination of tangible improvements to a consumer service that people in Oxfordshire can purchase easily, as and when they need it, for their trips to/from, and within the county. This includes the work we are planning to be:  

- **User-focused** - We will integrate with modern lifestyles, and align with evolving demands and expectations for personalized mobility options (both for people and goods). It will allow for informed decisions, be simple to use, and enable people to combine whatever modes of travel they want to use in order to get where they are going. Information and communication will form the key interface between the user and transport service.

- **Seamless** - The physical and virtual integration will ensure coordinated transfers between modes and create a ‘zero change’ wait, whereby all modes of transport are available. This will make travel between places as seamless as the example above, the more successful we are in 2031 to providing mobility services that people live and work easily, as and when they need it, for their trips to/from, and within the county. This is the strategy to become fully embedded within the future growth aspirations, development proposals, and urban design features of the areas it serves.

- **Trusted services** - In which users perceive value beyond cost, and allow people to combine whatever modes of travel they want to use in order to get where they are going. Information and communication will form the key interface between the user and transport service.

3.15 Another key objective for our successful delivery of Science Transit is for the strategy to become fully embedded within the future growth aspirations, development proposals, and urban design features of the areas it serves.

3.16 The National Planning Policy Framework (NPPF) provides the policy requirement to locate major developments, where the relevant travel corridor will be maximised and the use of sustainable travel modes can be maximised. However, there is also scope through future Local Plans and Policies to deepen the integration between development proposals and the Science Transit system. For example, encouraging development and local planning authorities to focus growth in locations adjacent to high frequency transport corridors can help to further promote demand for services, and reduce reliance on cars. Development proposals can be designed with ‘value’ factors to make people more likely to use sustainable transport. For example by providing parking in secure garaging areas a short distance away, eliminating private cars from certain areas and ensuring that public transport is the only option within walking distance. This reduces the likelihood that a traveller will change transport modes and ensures a more sustainable transport solution to their journey as the default option when they begin their trip.

3.17 Through Science Transit our aim is for transport and land-use planning considerations to be integrated from the outset of development proposals, in residential, commercial, and employment developments. If successful we will create a virtuous cycle that enables greater mobility and development to both support, and be supported by, commercially viable sustainable connectivity.

3.18 We foresee a combination of tangible improvements to existing public transport routes (as set out in the Bus and Area Strategies), the construction of new mass rapid transit capacity, and the creation of Science Transit interchanges (described in more detail in section 4) for seamless inter- 

3.19 The local business community and our Local Enterprise Partnerships will be involved, in-kind support, and investment from private sector and research delivery partners.

3.20 An example already in development, is the OXybeles concept, funded in partnership with Oxfordshire County Council and local Universities. It will act as a virtual transport industry innovation and business support service. This provides Property for both local businesses and the OXybeles partnership, and water recuperations through congestion savings are anticipated outcomes. The partnership will build on existing work being led by Oxfordshire County Council around digital traffic monitoring, responsive journey planning tools, transport management and smart transaction technology.


8 A hackathon (also known as a hack day, hackfest or codefest) is an event, typically lasting between a day and a week, in which computer programmers and other entertainment enthusiasts gather to create software. Transport hackathons can be focused on building transport-related apps, visualisations, or conduct insightful data analysis.
4 OUR APPROACH TO DELIVERING SCIENCE TRANSIT

General approach

4.1 The ultimate vision for Science Transit is of establishing an integrated mobility system that is very different to existing ways of providing public transport. The approach we adopt to achieve this will involve recruiting the strengths of the networks we have today and evolve different components of the system appropriately.

4.2 The Science Transit Strategy will evolve over the next 30 years as funding, growth, development, investment, partnering, and intelligent mobility opportunities arise. Our long-term vision means the foundations on which Science Transit will be built will evolve over time to adapt to changing patterns of travel demand, instead individual components of the Strategy are expected to mature at different times, and in different locations, across the country.

4.3 For example, widely anticipated advances in technology and data analytics are expected to dramatically change the landscape within which mobility services are delivered. Generational pervasiveness of services, and fluidity in response to changing patterns of travel demand, are expected to become common features of both urban and rural mobility systems. We do not know what some of these technologies will be but the Science Transit Strategy needs to be flexible enough to take them on board and adapt their benefits. As such our approach to delivering Science Transit will draw on four overriding principles:

User-centred

To respond to rapidly changing technology and analytical possibilities that will shape the evolution of the current digital revolution.

Quality

Throughout our approach to planning, designing and delivering Science Transit we will aspire to the highest global standards and our operational policies.

Flexibility

The components of the Strategy we select and where we place them must meet the mobility needs and aspirations of local communities, businesses, and leisure travellers alike.

Intelligent

To purposely and deliberately create a mobility system that is data-driven, truly multi-modal, and adaptive to changing mobility patterns.

4 Key features and principles of the future system

4.4 It will be vital for Science Transit to get the basics of mobility right to satisfy the demands of both users and non-users. Science Transit must be accessible, affordable, reliable, and frequent. It must offer a rapid journey time, with seamless interchange, and serve desired origins and destinations. To additionally attract non-users to the system, and therefore to achieve modal shift, Science Transit needs to be of high quality and appeal to people that would not usually consider using conventional travel forms of mobility.

4.5 In designing and developing the system we will use the following hierarchical series of questions to help us, or potential-users, might ask themselves when considering whether Science Transit’s mobility options are relevant to them:

- Does it do the job I need?
- Is it relevant to my needs, is it usable?
- Does it reinforce me as a person or user to use it?
- Am I willing to pay for this service quality?
- Do I consider the price a quality product, and is it ethical?
- Does it diminish me as a person to use it?

Critically therefore, Science Transit must do a core job of being accessible, affordable, reliable, frequent, and running on time.

4.6 Critically therefore, Science Transit must do a core job of holding the following hierarchical series of questions to help us, or potential-users, might ask themselves when considering whether Science Transit’s mobility options are relevant to them:

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- Do I consider the price a quality product, and is it ethical?
- Does it diminish me as a person to use it?

4.7 On this basis, the key design features of our fully-realised Science Transit will involve:

- Responsive to demand based on data-driven operational management and adaptive learning from user’s feedback.
- Transformed smart mobility information
- Cashless payment systems using smartcards, bank cards and smartphones.
- Identifiable branding across multiple modes of travel.
- Rewards and incentives for repeated use of the Science Transit network and off-peak travel.
- Relevant to different user contexts and journey purposes at all journey stages.
- Available via multiple digital sources (web, smartphone app, digital TV).
- Updated in real-time, to provide the latest insights and intelligence.
- Comparative travel time and cost information for an individual’s options.

4.8 Deeply embedded, intelligent, and data-driven, mobility technologies will cut across all four of these key design features; and is considered a critical enabler to achieving our long-term vision for Science Transit.

Report change

- Transport interchanges and vehicles that are truly accessible for all
- High quality audio-visual information
- Free WiFi in Transport interchanges
- Linked to local walk and cycle networks
- Seamless transition between different modes of travel
- Retail and service activities to enable productive use of other transportation modes

High quality features

- Free and efficient, get off, and autonomous small vehicle connections.
- Reliability journey times achieved via priority use of road networks.
- Safety and security paramount
- Free WiFi connectivity on-board
- Easy to access vehicles for all users
- Responsive to demand based on data-driven operational management and adaptive learning from user’s feedback.

Accessibility to mobility systems

9 Incentives such as those provided in Singapore might be considered:


2120
4.10 These assets are currently focused around Oxford, as the attractor of trips. The county's existing transport networks: the following assets provide the basis on which our strategy will be implemented:

- **Networks**
  - Evolving Oxfordshire's existing transport networks.
  - The following assets provide the basis on which our strategy will be implemented:

<table>
<thead>
<tr>
<th>Possible evolution of Science Transit</th>
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<tbody>
<tr>
<td>Stage 1</td>
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<td>Stage 2</td>
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<td>Stage 4</td>
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<tr>
<th>Intelligent data-driven mobility</th>
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<tr>
<td>Limited automatic data collection</td>
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<tr>
<td>Increased data collection and use of individual organisations</td>
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<tr>
<td>Open data sharing, collaboration and data sharing between different transport modes and local public transport data</td>
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<th>High Quality mobility</th>
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4.11 In practical delivery terms, Science Transit, alongside other related transport strategies and policies, will deliberately broaden the range of mobility options beyond the existing transport networks. In doing so we will seek to address the following weaknesses currently present in local transport networks:

<table>
<thead>
<tr>
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4.12 At the heart of Science Transit is the recognition it needs to be:

- Easy to use
- Seamless
- High Quality

4.13 By taking the strengths and weaknesses listed above into account, and mapping them against the key components that will make up Science Transit, we can indicate where Oxfordshire's transport networks currently sit within that framework.
4.15 Alongside traveller information, fare collection is a business-critical support system that will respond to, and facilitate, the broader Science Transit system’s operational design and critical support system that will respond to, and facilitate, the implementation of the components which make-up the travel services. On: the mechanism for making payment, is a key point of business model. Creating an easy to use mobility system

4.24 Developing a strong, coherent and branded identity for the Science Transit system is an important consideration of overall system design. Whether a sign, slogan, logo or word branding, the system will ensure a constant message to the audience, aiding recognition and building awareness amongst the population. An engaging brand will help us to achieve one of our key goals, to encourage and support system users to fully integrate into the Science Transit system.

4.25 The growing availability of real-time transport data feeds (particularly in major urban areas) is rapidly changing our habits. The importance of revenue and patronage information is central to empowering public transport users and non-users into making more intelligent decisions about their choice of travel modes. The most world’s successful travel operators are able to make decisions about the form of transportation itineraries without the need to interact with it. There are often utilising this data to develop new services that can be used to reduce the waste of the journey’s and their overall system. The potential for real-time data feeds will come to act as the glue that binds together the Science Transit system alongside the rest of the county’s transit systems. We envisage scope for scope for services on offer through Science Transit.

4.28 The process of accommodating small demands (both short trips, and longer trips from locations where there is limited provision elsewhere. Data-driven, performance of connecting services and mobility options.

Joining-up smart mobility information

4.30 More intelligent information for system users

4.31 Travel Information, like all human activity, has traditionally been a system that has been managed by the customer service and operations personnel and focused on how to best service the customer. Related to mobility information is central to empowering public transport users and non-users into making more intelligent decisions about their choice of travel modes. The most world’s successful travel operators are able to make decisions about the form of transportation itineraries without the need to interact with it. There are often utilising this data to develop new services that can be used to reduce the waste of the journey’s and their overall system. The potential for real-time data feeds will come to act as the glue that binds together the Science Transit system alongside the rest of the county’s transit systems. We envisage scope for scope for services on offer through Science Transit.

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Embracing intelligent data driven mobility

4.31 Our desire to embrace intelligent, data-driven, mobility is
underpinned by our observation they are already disrupting11 existing transport networks, and look to set new
patterns of mobility for the foreseeable future. Our
expectations that intelligent mobility techniques and practices will
come at a cost of all of the Science Transit system components. The
primary motivations are that intelligent mobility will enable:
- Decrease in greenhouse gas emissions over 20 years
- Significant improvements in user experience, reducing journey
  times, and improving flow of journeys on transport systems
- Significant improvements in the efficiency of transport services
- Sustainability and resilience

4.32 While this is a long-term aspiration and is not something
that can be achieved overnight, the benefits that intelligent
mobility has the potential to bring can help underpin the development
and design of the better optimised Science Transit system.

4.33 As a practical first step towards achieving more intelligent
mobility, the collection and usage of transport-related
information is key. The collection of transport-related
information from a range of local and national data sources will
derive the development and design of the better optimised Science Transit
system. The data will need to be considered. Long-term, these costs may
be unexpected as they have not been considered in the Oxfordshire Knowledge Spine, or borne by new com-
mercial models (e.g. through sales of seemingly unrelated
products).

4.34 Not all of the datasets required for intelligent mobility are
currently freely and openly available, and some are unlikely
to ever be made available in this way. But when collected
and combined in real-time they offer scope for deeper
understanding of transport systems with

4.35 Resolving the technical problems associated with collecting
and combining the data from the multiple sources de-
scribed above will not in itself bring about a change in the established
patterns of mobility but will make it possible to use the data to
provide a high level of actionable real-time intelligence for system coordinators
and autonomous control systems for individual mobility

4.36 The table to the right summarises the key drivers and
opportunities for exploitation through Science Transit

<table>
<thead>
<tr>
<th>Driver/Opportunity/Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced operating costs and staffing requirements</td>
<td>Reduced costs and staffing requirements, allowing for improved service quality and customer satisfaction</td>
</tr>
<tr>
<td>Better use of existing transport network capacity</td>
<td>Increased capacity and efficiency of existing transport network infrastructure</td>
</tr>
<tr>
<td>Reductions in fuel and transport emissions</td>
<td>Lower emissions and reduced environmental impact</td>
</tr>
<tr>
<td>Driverless technologies and control systems</td>
<td>Development of advanced technologies for autonomous mobility solutions</td>
</tr>
</tbody>
</table>

4.37 Projects that could be delivered in partnership with local
government include the following opportunities:

- Dynamic traffic and transport modelling
- Fully integratable payment systems across all locally provided services
- Next generation electric vehicle charging infrastructure
- Ultra low emissions vehicle propulsion technologies
- Exploration of the public WiFi connectivity for pedestrian travel and passenger tracking
- Intelligent two way feedback between driver and vehicle, including crowd sourcing feedback on journey
  time and cost
- Autonomous passenger and freight vehicle design, implementation and service delivery
- Optimised performance and control of existing transport services
- Improved control of existing transport services
- Reduced operating costs and staffing requirements
- Better use of existing transport network capacity
- Reductions in fuel and transport emissions
- Driverless technologies and control systems

4.38 Intelligent mobility strand

- Efficient, cost-effective and high quality public transport network
- Better-informed strategic plans for winter readiness
- Faster response to emergencies and incidents
- Tailored, contextual assistance for tourists with particular needs
- Reduced time and costs associated with moving people and goods
- Reduced carbon and transport emissions
- Improved access to public transport services
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- Driverless technologies and control systems

4.39 Autonomous vehicles:

- Mobility as a service procured on-demand
- Tailored, contextual assistance for tourists with particular needs
- Reduced time and costs associated with moving people and goods
- Improved access to public transport services
- Reduced operating costs and staffing requirements
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- Better use of existing transport network capacity
- Reductions in fuel and transport emissions
- Driverless technologies and control systems

11 11 GNSS - Global Navigation Satellite System (GNSS) provides constant connectivity for users in the network.
Delivering smooth interchange

4.38 All journeys involve some form of interchange, whether it is walking to the bus stop to get on a bus, transferring from one mode to another, or parking the car and walking to the station.

4.39 To this end through the Science Transit plan public transport and Area Strategies we will establish a network of stops and interchanges that serve key destinations across the Knowledge Spine, and act as interchange points between major modes of transport. These will differ in scale from one location to another but, as a general rule will:

- Accommodate high frequency services, and large flows of people, at peak times.
- Facilitate seamless, stress-free transfer across multiple modes of travel.
- Be situated in locations that are close to the strategic highway network, providing maximum opportunity for park and ride and mode-shift from private car use.
- Maintain safe walk and cycle access by keeping people segregated from public transport and vehicle movements.
- Become an integral part of the land-use mix to create vibrant centres of activity that reduce ‘dead-time’ commonly associated with interchange between travel modes.

4.40 The following hierarchy is envisaged for the future interchanges:

- Local - a simple stop serving a limited number of routes, with safe and convenient access by walking and cycling, and perhaps some cycle parking.
- Transit - an interchange served by a range of different services, perhaps with a number of stops/stations, at the convergence of walking and cycling routes, with pick-up/drop-off facilities, and possibly some guiding to facilitate park and ride.
- Strategic - a major interchange potentially served by national and regional rail or bus services, many local bus services, and including nesting and proposed Park and Ride sites.

4.41 We envisage that many Strategic Interchanges will, over time, become connected to each other by rapid transit services designed to move large volumes of people at regular frequencies. Where passenger volumes do not support mass rapid transit services, then high frequency services will operate at peak load frequencies that are sufficient to attract many commuters (e.g. many suburbs). Key aspects of the Science Transit planning campains at each of the county’s various science parks, will be connected by feeder bus or small vehicle services as well as secondary walk/cycle and demand responsive mobility services.

<table>
<thead>
<tr>
<th>Interchange Type</th>
<th>Potential Locations</th>
<th>Facilities</th>
<th>Transit Modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Less accessible parts of residential and employment areas</td>
<td>RTPI, information, shelter</td>
<td>Local bus, small vehicles, DRT, driverless ‘Pods’</td>
</tr>
<tr>
<td>Transit</td>
<td>Major residential developments, innovation areas, town centres</td>
<td>RTPI, information, improved shelters, plus some retail and service activities</td>
<td>As above plus higher capacity/frequency services</td>
</tr>
<tr>
<td>Strategic</td>
<td>Railway stations, park and ride interchanges</td>
<td>RTPI, information, interchange building offering wide range of retail and service opportunities</td>
<td>As above plus rail, regional and national coach, park and ride</td>
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</table>

4.42 The following hierarchy is envisaged for the future interchanges:

- Local - a simple stop serving a limited number of routes, with safe and convenient access by walking and cycling, and perhaps some cycle parking.
- Transit - an interchange served by a range of different services, perhaps with a number of stops/stations, at the convergence of walking and cycling routes, with pick-up/drop-off facilities, and possibly some guiding to facilitate park and ride.
- Strategic - a major interchange potentially served by national and regional rail or bus services, many local bus services, and including nesting and proposed Park and Ride sites.

4.42.1 We envisage that many Strategic Interchanges will, over time, become connected to each other by rapid transit services designed to move large volumes of people at regular frequencies. Where passenger volumes do not support mass rapid transit services, high frequency services will operate at peak load frequencies that are sufficient to attract many commuters (e.g. many suburbs). Key aspects of the Science Transit planning campaigns at each of the county’s various science parks, will be connected by feeder bus or small vehicle services as well as secondary walk/cycle and demand responsive mobility services.

<table>
<thead>
<tr>
<th>Interchange Type</th>
<th>Potential Locations</th>
<th>Facilities</th>
<th>Transit Modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Less accessible parts of residential and employment areas</td>
<td>RTPI, information, shelter</td>
<td>Local bus, small vehicles, DRT, driverless ‘Pods’</td>
</tr>
<tr>
<td>Transit</td>
<td>Major residential developments, innovation areas, town centres</td>
<td>RTPI, information, improved shelters, plus some retail and service activities</td>
<td>As above plus higher capacity/frequency services</td>
</tr>
<tr>
<td>Strategic</td>
<td>Railway stations, park and ride interchanges</td>
<td>RTPI, information, interchange building offering wide range of retail and service opportunities</td>
<td>As above plus rail, regional and national coach, park and ride</td>
</tr>
</tbody>
</table>

Illustrative Transit Network
4.4 The aim of the Science Transit system will be to provide the majority of people who work in Oxfordshire with journey options that involve no more than one, single, unbroken, interchange through a Science Transit Interchange and maintain the need for private car. In developing and improving the network, consideration of the features that will need to be implemented include:

- Further roll out of Real Time Passenger Information.
- Relocation and increase in the number of Park and Ride sites, as proposed in the Oxford Transport Strategy, to serve all parts of the knowledge spine, and current and future employment and education hubs on site- (real and virtual).
- Improvements to existing or creation of new rail stations to serve as Strategic Interchanges, with a wide range of services, in order to provide for a range of movement patterns along different routes.
- Creation of Transit Interchanges in new developments and existing rural communities, with improvements to existing transit interchange facilities.
- Design for a wider range of vehicle types to serve gradu-ated demand across routes.

Achieving high quality services

Deploying appropriate transit vehicles

4.46 The service types described above represent a continuum that can be deployed on a range of vehicle-types to serve graduated demand across routes. The key service types, and the roles they are envisaged to play, are outlined to the right.

Service types

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector – Smaller vehicle services operating on scheduled and flexible routes</td>
<td>Provide feeder services to connect Local Interchanges in residential / destination areas with nearby Strategic Interchanges. Deployed on high-demand corridors.</td>
</tr>
<tr>
<td>Premium services</td>
<td>High frequency links between Strategic Interchanges.</td>
</tr>
<tr>
<td>Rapid Transit (RT)</td>
<td>High degree of segregation and priority from road traffic delivering reliable journey times.</td>
</tr>
<tr>
<td>Premium/Super/cycle routes &amp; walking</td>
<td>Differentiating the appearance of bus running ways can be used to promote a stronger image, and generate greater modal shift. However, this needs to be balanced against the lower costs and greater flexibility offered by high quality segregated bus-based systems. The lead times, cost, and permanence of any form of segregated running way are likely to be appropriate for high-demand links between Strategic Interchanges that connect major employment sites, in the knowledge spine and high demand major road network.</td>
</tr>
<tr>
<td>Premium/super cycling routes</td>
<td>Frequent interchange opportunities with high quality public transport and demand responsive services.</td>
</tr>
<tr>
<td>Essential connection into Science Transit network for people living and working in rural areas.</td>
<td></td>
</tr>
</tbody>
</table>

Service types and roles in Science Transit

4.47 The service types described above represent a continuum. Lower-cost service that are more flexible can be deployed with little lead-time in areas that are less accessible, where no service exists for people living in rural areas, and where the network is already in place. Higher-cost services that are more responsive can be deployed with little lead-time in areas where a higher level of service is appropriate, across the Knowledge Spine and on interconnecting routes from major rural and employment areas.

Improved priority and segregation

4.49 Science Transit aims for more rapid services to deliver travel time savings and more reliable journeys. Key to this is the ability to "lock in" travel demand through strategic interchanges located at the entry and exit points of major routes. This is the case for the Oxford Transport Strategy for Oxfordshire. It is notable that many of the proposed Service Type descriptions allow for the integration of a wider range of vehicle types, including those currently in development in the UK (Simply Connect) and those that are expected to be available in the near future.

4.50 Just as railway tracks indicate where a train travels, treat-ment of bus-based systems will provide a similar infrastructure. Only high levels of segregation and priority will deliver this. These are likely to be features of routes that connect major employment sites, across the Knowledge Spine and on interconnecting routes from major rural areas.

4.51 We anticipate investment in a guided system will also help to promote a stronger image, and generate greater modal shift. However, this needs to be balanced against the lower costs and greater flexibility offered by high quality segregated bus-based systems. The lead times, cost, and permanence of any form of segregated running way are likely to be appropriate for high-demand links between Strategic Interchanges that connect major employment sites, in the knowledge spine and high demand major road network.

4.52 Over the timescale being considered by Science Transit, greater integration of services will come directly to people through the introduction of new travel technologies. Early signs of these kinds of system are evident in the form of services like Click & Collect, which are changing people’s movement patterns and mobility demands. The Science Transit Strategy will need to adapt to these technology- driven changes in order to ensure it remains relevant over the life of its 20 year delivery horizon.
5 DELIVERY ROADMAP

Context

5.1 As a long-term vision for improving mobility options and connectivity into, and within, the Oxfordshire Knowledge Spine, we envisage Science Transit will be delivered gradually over a 20-year timeframe.

5.2 The Future-Focused time-horizon, and desire to proactively integrate intelligent mobility into the Science Transit system, means anticipated technological innovations and research-led development will introduce considerable variability over when specific components can feasibly be delivered. As identified in the previous section, future levels of public funding available, the actual scale and location of demand for movement created through settlement growth in Oxfordshire, and relative transport priorities all impact upon the accuracy with which we can plan and deliver our vision.

5.3 Our roadmap for delivering Science Transit needs to account for this inherent uncertainty, and to allow different components of the Science Transit system described in the previous section to move forward at different speeds – whenever demand, funding and private sector opportunities emerge. The timeline on the following page therefore constitutes an outline plan, with the near-term activities grounded in current and planned projects. The kinds of projects considered necessary to fully achieving all of the Science Transit objectives, but which may currently appear aspirational, are shown as medium and longer-term activities. We note these projects may not be delivered in the precise order they are described, but envisage they are likely to come to fruition over time in a manner that ensures the components of Science Transit are gradually assembled as part of an integrated system.

The Roadmap

5.4 On this basis our indicative Science Transit delivery roadmap is set out overleaf. For each potential Science Transit project we have estimated the amount of time related to the three key stages of:

- **Aspiration**: Pre-feasibility work to appraise and prioritise new project ideas.
- **Feasibility**: Detailed appraisal to determine each idea’s viability and deliverability.
- **Implementation**: Technical delivery of the project, resulting in improved mobility.
Science Transit Roadmap - projects implemented by 2017

<table>
<thead>
<tr>
<th>Year</th>
<th>Project</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>Hinskey Hill Junction Improvements stage 1</td>
<td>Proposed</td>
</tr>
<tr>
<td>2015</td>
<td>Oxfordshire Journey Planner stage 1</td>
<td>Proposed</td>
</tr>
<tr>
<td>2016</td>
<td>Trial of electric bus vehicles and charging</td>
<td>Proposed</td>
</tr>
<tr>
<td>2017</td>
<td>Free public WiFi installed on all Science Transit branded buses and at Interchanges</td>
<td>Proposed</td>
</tr>
</tbody>
</table>

Science Transit Roadmap - projects implemented beyond 2017

<table>
<thead>
<tr>
<th>Year</th>
<th>Project</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>A40 bus priority enhancements</td>
<td>Proposed</td>
</tr>
<tr>
<td>2017</td>
<td>Science Transit/Voucher tourist scheme: Science Transit digital traveller rewards programme introduced in partnership with local mobility service operators</td>
<td>Proposed</td>
</tr>
<tr>
<td>2018</td>
<td>Science Transit branding applied to key routes linking the employment areas on the knowledge spine</td>
<td>Proposed</td>
</tr>
<tr>
<td>2019</td>
<td>Driverless small vehicle services introduced</td>
<td>Proposed</td>
</tr>
<tr>
<td>2020</td>
<td>Demand responsive small vehicle service linking residential and innovation areas with nearest Science Transit Interchanges</td>
<td>Proposed</td>
</tr>
<tr>
<td>2021</td>
<td>Workforce Parking</td>
<td>Proposed</td>
</tr>
<tr>
<td>2022</td>
<td>High quality Science Transit Interchanges completed, allowing seamless interchange between RT/Rail, pedestrian, private car and public transport modes</td>
<td>Proposed</td>
</tr>
<tr>
<td>2023</td>
<td>Integrated, multi-platform cashless mobility purchase across all modalities available in Oxfordshire</td>
<td>Proposed</td>
</tr>
<tr>
<td>2024</td>
<td>Science Transit/Voucher tourist scheme enhanced: Science Transit digital traveller rewards programme expanded</td>
<td>Proposed</td>
</tr>
<tr>
<td>2025</td>
<td>Science Transit branding applied to key routes linking the employment areas on the knowledge spine</td>
<td>Proposed</td>
</tr>
<tr>
<td>2026</td>
<td>Multi quality Science Transit Interchanges completed, allowing seamless interchange between RT/Rail, pedestrian, private car and public transport modes</td>
<td>Proposed</td>
</tr>
</tbody>
</table>
6.6 With the intelligent real time data available on congestion, parking availability, and public transport capacity, it is possible to encourage a dynamic approach for pricing road usage, car parking and transit services that optimises the use of available parking and highway capacity. To envisage a dynamic approach to pricing for road usage, car parking and transit services that optimises the use of available parking and highway capacity, it is essential from an acceptability perspective.

Stage 1 Stage 2 Stage 3 Stage 4 Stage 5
Land use integration
No integration
Afford policies to encourage integration
Integrate into existing development plans and within Planning Policy
Public transport included in development plans and within Planning Policy
Innovative mechanisms required for transport accessibility
Policies on uses, densities and parking standards related directly to public transport accessibility

Demand management
No parking or other fiscal measures
Parking charging and some supply limitations
Differential charging according to location and purpose
Congestion charging/ workplace parking levy
Dynamic pricing of parking, road use and public transport

Funding
Government grants
Increasing private sector funding, eg from developers
Provide sectoral incentives for developers or funds to support the delivery of science and urban development
Incentivise investment in land value increases to allow better land use, better integration and improvement in quality

Spatial Planning
6.7 There is a need for 100,000 homes or 5000 per annum to be built in Oxfordshire between 2011-2031. There is currently a large shortfall in provision with only 3,463 homes being built in the three years 2011-2014. Whilst there are many reasons for this shortfall, a clear commitment to delivering Science Transit, together with its integration within the spatial plans for the county, will help address concerns over the impact of growth on transport networks and infrastructure. To achieve this, Science Transit must become embedded within the future growth, development and urban design of the areas it serves.
6.10 Over the time horizon for delivering Science Transit, there is the opportunity through flexible local plans and to support funding of Science Transit, the potential level of land for parking services, and land values, creating additional revenue for more productive and valuable use, thereby increasing opportunity for using land currently taken up by parking and at innovation and business parks. This would create an environment that needs to be captured and accessible for all possible modes of travel, and it is the very nature of political and economic cycles that the availability of grant funding from Government is unpredictable, targeting ahead of the game, being able to demonstrate economic, environmental and social benefits from development will, however, remain the best approach to securing investment. The following sections set out some of the key principles of the funding strategy and discuss the potential sources of funding that will facilitate the delivery of Science Transit.

Principles
6.11 Science Transit will be developed and delivered over the next 20 years and while immediate funding has been secured, Local Growth and City Deals are initial for public proposals, unfunded and scalable strategy is required to deliver the term. Both capital and revenue funding will be required and it is the very nature of political cycles that the availability of grant funding from Government is unpredictable, targeting ahead of the game, being able to demonstrate economic, environmental and social benefits from development will, however, remain the best approach to securing investment. The following sections set out some of the key principles of the funding strategy and discuss the potential sources of funding that will facilitate the delivery of Science Transit.

Funding
6.12 The short walk/cycle distances create a high demand for public transport interchanges and stops, with the highest density development closest to the public transport node. This would create an environment that needs to be captured and accessible for all possible modes of travel, and it is the very nature of political and economic cycles that the availability of grant funding from Government is unpredictable, targeting ahead of the game, being able to demonstrate economic, environmental and social benefits from development will, however, remain the best approach to securing investment. The following sections set out some of the key principles of the funding strategy and discuss the potential sources of funding that will facilitate the delivery of Science Transit.

6.13 Principals
6.14...