The Future of Mobility: Are the Young Professionals ready to rise to the challenge?

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Being CSA: My Objectives

- Provide leadership on developing technology and innovation
- Improve the strategy for science and innovation research and future proof decision making in the DfT
- Position DfT as a leader in science across Whitehall and maximise value of the SAC
- Develop stronger links between science and internal stakeholders and provide strategic science input and evidence into analysis work programmes
- Join up science across Government through CSA network
- Identify and deliver on a number of high priority scientific issues
- Engage and influence research and innovation funders
- Support Industrial Strategy and Sector Deals
- Future-proof DfT investment decisions through science
The CSA: Key things I do

- Provide leadership on developing technology and innovation
- Improve the strategy for science and innovation research and future proof decision making in the DfT
- Position DfT as a leader in science across Whitehall and maximise value of the SAC
- Develop stronger links between science and internal stakeholders and provide strategic science input and evidence into analysis work programmes
- Identify and deliver on a number of high priority scientific issues including:
  - air quality, vehicle emissions and decarbonisation;
  - intelligent infrastructure and smart condition monitoring;
  - older people mobility and accessibility;
  - big data/smart Cities and MaaS;
  - railway signalling/digital railways;
  - drones and future flight;
  - National Security
  - Spaceflight/spaceports;
  - engineering skills; and
  - cooperative and autonomous vehicle
- Support Industrial Strategy and Sector Deals
- Future-proof DfT investment decisions through science
Challenge to understand and join up the silos and take an integrated look at smart transport and smart cities.

For the first time digital connectivity give us the opportunity to consider how transport modes could be better joined together to provide a more seamless transport system
- new business models
- access to data
- unified payment mechanism
- what do users want?
- Quantifying benefits
- Mobility as a Service
- Agnostic Logistics

Provide leadership and make sure the ‘rest of the world’ knows what we are thinking
The UK transport system faces Challenges & Opportunities

Why Opportunities?
- Flying cars
- Drones
- Multimodal transport
- Electrification
- High speed rail
- Autonomous vehicles

Why Challenges?
- Connected vehicles

and more…
Why is S&T capability important for DfT

- The **technological development** in the transport science and industry is unprecedented.

- **Capability building** is required across DfT, its agencies and its supply chain to enable us to anticipate, exploit, mitigate and lead S&T-led change.

- The consequences of **doing nothing** are that we may not have the capability to effectively provide governance and regulation of the future transport system.

- DfT’s **CSA** and research leads have identified skills DfT is likely to need for the future.

Examples of likely DfT Capability Needs

- **Cyber Security**
- **Systems Engineering**
- **Behavioural Science**

and more…
Rapid advances in technology and new business models are driving fundamental changes to the way in which we get around.

**Automation**
Improved sensors, increased levels of computing power and data, Artificial Intelligence.

**Cleaner transport**
Rapidly falling battery prices, improvements in energy density and electric motors, developments in alternative fuels.

**New modes**
New ways of transporting people and goods, such as drones and e-bikes.

**Changing consumer attitudes**
Users are expecting to be able to plan, book and pay for transport through mobile applications.

**Shared mobility**
Models based on shared ownership or use of vehicles are becoming more prevalent.

**New business models**
New digitally enabled models of transport provision including dynamic demand responsive transport and Mobility as a Service.

**Data and connectivity**
Allows information to go to network operators and users in real-time and optimise fleet and network management.

These changes have the potential to lead to a transport system that is safer, more responsive to user needs, more accessible, and more efficient. But there are potential downsides to manage too.
These changes will emerge in unpredictable ways and will pose major questions for transport policy

Timing
- Predictions for when new transport services will come to market vary wildly
- This complicates policy that is reliant on forecasting

Infrastructure
- New infrastructure will be needed, but we do not yet know what
- Wrong decisions could mean investing in infrastructure that is obsolete before it is useful
- Need to engage closely with the market

Trust
- Different groups in society respond to technology differently
- Involving people in the design of new transport services is likely to help public acceptance

Data/security
- All networked devices are vulnerable to cyber attack
- A framework will be needed to enable data sharing while protecting privacy and preventing anti-competitive behaviour

Regulation
- Transport regulation has grown up piecemeal over many years and could hamper innovation
- Setting a framework for technology that is not yet established is challenging

Employment
- Approx. 1.6m people work in the transport sector in the UK
- Greater automation will influence the labour market, create new jobs and remove current ones
Emerging Transport Technology brings both opportunities and risks

- Technology and wider changes have the potential to radically alter how the transport system operates.
- The FoM Grand Challenge was designed to ensure we optimise the benefits and manage the risks of electrification, automation, new business models and new modes of transport.
- Transport Technology innovations go beyond FoM, and impact on all aspects of DfT’s business, bringing both opportunities and risks.

**Risks**

The level of risk associated with technological innovation increases over time as *uncertainty* becomes greater.

Risks cover all aspects of our business:
- The *value for money* of our investments
- The *deliverability* of schemes and outcomes
- *Unintended consequences*, e.g. increased inactivity; lack of accessible transport; inefficient/monopoly markets
- *Being left behind* and no longer in charge of meaningful regulatory levers

**Opportunities**

Technology also brings the opportunity to improve the way we travel, lower costs, and facilitate economic growth.

For example there are opportunities for:
- **Industry**: potential to improve efficiency and productivity in the UK and to gain a UK competitive advantage.
- **Individuals**: a safer, cleaner, more accessible, more usable transport system.
- **Freight**: a cleaner, more efficient system.
- **Cross-government challenges**: solving cross cutting issues such as health and land use.
Our approach for evidence generation

- Commissioned research
- Influence others to conduct or fund relevant research
- Exploit existing evidence and research
Emerging Transport Technology affects DfT’s work

Technological innovation can influence our work in two ways:
1. Can change the way we deliver current policy aims
2. Can create new opportunities and new policy direction

Horizon scanning
To anticipate potential technology-driven changes, allowing us to stress-test existing thinking and consider new opportunities.

Supporting innovation
Technological innovation should be built into the way we work.

Planning
Consideration of technological innovation needs to be built into all stages of policy development.

Delivery
Considering technology in our delivery models could increase efficiency.

Procurement
Building technological innovation into procurement models builds resilience in the face of technological change.

Leadership
Help industry and the research community focus on our priorities and in areas we would like to see technological solutions.
The Future Mobility Grand Challenge is an opportunity to focus effort and cement the UK’s place at the forefront of transport innovation.

The Industrial Strategy established Grand Challenges to “put the UK at the forefront of the industries of the future, ensuring that the UK takes advantage of major global changes, improving people’s lives and the country’s productivity.”

**Future of Mobility**
We will become a world leader in the way people, goods and services move.

**Clean growth**
We will maximise the advantages for UK industry from the global shift to clean growth.

**Ageing**
We will harness the power of innovation to help meet the needs of an ageing society.

**Artificial Intelligence**
We will put the UK at the forefront of the AI and data revolution.

### What is changing?

- For many years advances in transport services have been incremental and predictable. Fixed infrastructure, a legacy regulatory framework, and lack of access to data created high barriers to entry for innovators.
- This is no longer true. Advances in data science, artificial intelligence and sensing technology have increased the clock speed of transport innovation.
- On roads and rail, in the air and in the sea, automation, electrification and demand-led transport services promise to improve safety, reduce emissions and improve user experiences.
- The UK was at the cutting edge of previous transport revolutions and is well placed to lead this one too.
As well as a chance to secure better transport outcomes, this represents a massive industrial opportunity.
Five Pillars of future ITS/Intelligent Mobility

Connected
Moves as part of system...in time, multi-modal
DATA: The key to new network management – people and freight

Automated
FULLY automated – can move when empty
HIGHLY automated – needs a "driver"

Electric
Ideally electric or other future energy source

Pricing

Shared
Increased interest in shared fleets and use of "mobility as a service"
The key to place-making benefits

Source: WSP, ITS Montreal
Making Sense of the Road Environment
Trends in automation

- Not limited to cars: new technologies such as last mile delivery pods, drones, moving in to areas of traditional transport such as trains, ships and agriculture.

- Changing consumer perceptions. Consumers are increasingly expecting information to be available readily and easily. The smart phone is the only thing some people need to consume transport.

- A move toward a sharing economy. Asset ownership (cars) could be diminishing. Ride sharing and car sharing could lead to a shift away from private car ownership.

- UK ambition to be a world leader with over £500m invested or committed.

- Not clear whether this will lead to more or less vehicles on the road and thus the demand for energy.
Ah, Britain. The only parliament in the world where someone turns up by horse drawn carriage to promise everyone else driverless cars.
Decarbonisation
There are a number of factors driving action on energy in DfT

Road to Zero Strategy
- Published July 2018. Sets out how Government will support the transition to zero emission vehicles
- Ensure the UK is well placed to capitalise on new economic opportunities and drive down emissions from conventional vehicles.
- Considers GHG and air quality in parallel for the first time
- Brings together a range of policy initiatives into a single strategy that provided certainty to consumers and industry about Government’s position and priorities.

Clean Growth Plan
- Published October 2017.
- Primarily road-focused.
- Also provided funding to reduce the CO₂ from domestic shipping and aviation.

Clean Air Strategy
- Published 2019.
- Sets out the actions required across government and society to improve air quality.
- Includes how we will:
  - protect health
  - protect the environment
  - secure clean growth & innovation
  - reduce emissions from transport, homes, farming and industry

Strategic priorities are to:
- By 2050 almost every car and van to be zero emission
- By 2040 to end the sale of new conventional cars and vans
- By 2030 at least 50%, and as many as 70%, of new car sales and up to 40% of new van sales to be ULEV
- By 2025 to review progress, seeking to maintain the UK’s leadership position and meet our ambitions.
The scientific evidence base has deepened, changing the global political context for tackling climate change. Transport is the UK’s largest climate change problem.

- Cars, vans and trucks are the most significant sources, accounting for 86% of domestic transport emissions in 2017. Road transport emissions have increased by 3% since 1990. Improvements in the fuel efficiency of these vehicles have only partially offset the emissions generated by increased traffic volumes. Van traffic has doubled, car traffic has increased by 22% and HGV traffic by 10%.

- Transport is the largest emitting sector, accounting for 33% of the UK’s 2018 greenhouse gas emissions. Whilst other sectors have reduced emissions dramatically since 1990, transport has only fallen 3%. Transport emissions had risen three years in a row before levelling in 2017 at their highest level since 2009 – before falling 3% in 2018.
Decarbonisation

PROGRESS BY SECTOR

- Power
- Waste
- Transport
- Industry
- Buildings
- Agriculture & LULUCF
- F-gases
Recently we’ve written (or are writing) individual modal strategies and supported many others

Since the 2017 Clean Growth Strategy we’ve published:
- Road to Zero;
- Maritime 2050;
- Light Rail and other rapid transit call for evidence
- E10 petrol, consumer protection and labelling
- The Last Mile – delivering goods more sustainably
- Future of Mobility: urban strategy; and
- Aviation 2050 Green Paper

And led international negotiations at ICAO and IMO.

In 2019 we are due to publish:
- Carbon Offsets for Transport call for evidence
- The Clean Maritime Plan; and
- The Aviation White Paper

This week – a Transport Decarbonisation Plan was announced which will see the Department meet it’s part in net-zero 2020.
Decarbonisation Plan announced 15th October 2019

News

DfT announces UK’s first transport decarbonisation plan

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The Government has announced plans for the full decarbonisation of the transport sector by 2050. The announcement follows four months after the UK legislated for net zero emissions by 2050 and is published as a formal response to the latest progress report from the Committee on Climate Change.

The Government says that the groundwork for the Transport Decarbonisation Plan will start immediately, with the Department for Transport (DfT) publishing a document setting out the challenge later this year. Due to be completed next year, the plan will set out in detail what government, business and society must do to deliver the emissions reductions needed from all modes of transport. In particular, the Government says, it will consider how UK technology and innovation can be implemented to encourage major changes to the way people and goods move across the UK.

DfT has recently published sector strategies to cut carbon emissions across transport, including the Road to Zero, Maritime 2050 and the Clean Maritime Plan as well as the Aviation 2050 green paper, and upcoming aviation strategy, scheduled for publication early next year.

The Government says: “With the move to net zero, there is a need to go further and faster to reduce emissions. The Transport Decarbonisation Plan will take a coordinated, cross-modal approach to deliver the transport sector’s contribution to our decarbonisation targets.”

The Transport - Energy Nexus
The Scale of the Challenge:

Great Britain’s Energy Vectors – in GWh per day

Transport fuels = Aviation Fuels + DERV (Diesel) + Motor Spirit (Petrol)

Data are from National Grid, Elexon and BEIS. Charts are licensed under an Attribution-NoDerivatives 4.0 International license based on the paper [http://bit.ly/seaediagram](http://bit.ly/seaediagram) by Dr Grant Wilson.
Modal Hydrogen Opportunities

- Commuter rail services and gaps in electrification are good opportunities.
- Hydrogen is less suited for freight or high speed rail due to storage volume requirements.
- Road freight is a relatively small proportion of transport emissions, but is difficult to decarbonise by other means.
- The back-to-depot duty cycle of buses make them amenable to hydrogen powertrains.
- Maritime presents big opportunity, but can be a difficult place to innovate due to its fragmented nature and long life cycles. Hydrogen and ammonia could be very beneficial here.
Future Proofing
Our approach for the future of transport

It is essential DfT builds its capability to use technological, demographic and social evidence.

Transport Futures

**Futures community:** Bringing together DfT staff to develop skills, share good practice and a consistent approach

**Future of Mobility Foresight:** Cross-government report focusing on governance, user decisions and freight in relation to future technology

**Future-proofing decision-making:** Ensure that science, technology, innovation and futures thinking are embedded into business planning and delivery to build resilience in DfT’s decision-making

External funding

**Strategic Priorities Fund:**
- Trustworthy Autonomous Systems
- Clean Air
- National Timing Centre
- Space Weather Innovation

**Industrial Strategy Challenge Fund**
- Driving the Electric Revolution
- Future Flight
- The Faraday Battery Challenge

External Engagement

**Science Advisory Council (SAC):**
DfT’s SAC brings together academic and industry experts to provide independent advice and challenge to DfT through scrutinising emerging technologies in detail, bringing together experts in the field, and publishing position papers

**Transport Research & Innovation Board (TRIB):**
TRIB brings together transport research and innovation funders and leaders to build the sector and focus on DfT’s and ALB’s priorities. Their initial priorities are:
- Transport integration
- Health, wellbeing and inclusivity
- Data (sharing, interoperability and cyber security)
- Infrastructure (including smart and digital infrastructure)
Futureproofing our decision making

We are working to future-proof decisions in key areas such as the Williams Rail Review and Transforming Cities Fund

• Using scenarios to ‘stress test’ policy options for the Williams Rail Review to make them resilient to future change.
• Working with cities to future-proof investment plans as part of the co-development phase of the Transforming Cities Fund.

To anticipate the future and achieve the best outcomes from emerging technology, we have created Visions of the Future for 2030 for key future technologies

• Hypothetical but plausible, aspirational futures for passenger and goods transport in the UK in 203
• Based on:
  • Mobility as a Service,
  • smart infrastructure & construction
  • hybrid aviation
  • Hyperloop.
• They provoke discussion on what sort of transport system we would like to deliver and how DfT might achieve these positive outcomes.
Other technologies that might surprise us

- **Smart infrastructure and construction**
  - The tides of technology are flowing in many other areas too, driven by
    - AI, robotics, sensing and battery technology, and
    - the need of big companies create new markets and take dominant positions in those.

- **Hybrid and electric aviation**
  - I’m going to talk about smart infrastructure & construction, hybrid aviation and hyperloop.
  - All three have recently been reviewed by DfT’s Science Advisory Council. At least one of these is already here, one is pretty certain and one is at least technologically plausible.

- **Hyperloop**
  - I’ll review the core concepts and will suggest some potential policy implications.
At least 19 companies are developing short range flying cars

- **Volocopter**
- **Airbus modular car/UAV concept**
- **Terrafugia (a Geely group company)**
- **Uber Elevate**
Skills
To do all of this we need to rethink the skills needed by transport professionals

- Work in inter-disciplinary project teams
- Help deliver credible evidence for decision making and investment
- Have a wide overview of a project's wider objectives and context
- Systems thinking and systems engineering skills (should be embedded in all S&T undergrad degrees)
- Have time for life long learning as the way we do transport and the technologies available will rapidly change
- Understand risk
Understanding users

**Public Attitudes tracker**
Bi-annual monitoring of the public’s awareness, understanding and acceptance/appetite for new technologies

**Think People programme**
Working across DfT to ensure people are at the heart of the design and operation of transport system

**Using evidence**
Identifying, synthesising and generating evidence to feed into the decision-making process. The Think People interactive Dashboard is a key tool

Fostering innovation

**Central Innovation Programme**
T-TRIG is a cross-DfT, cross-modal innovation programme designed to encourage and support early-stage innovation and prototyping. Over half of funded grants have gone on to further collaborations with some major success stories

**Group-led innovation**
Technology innovation is being built in across modes including: innovation in franchising; digital rail; low carbon maritime, high speed rail technology; future roads technology; CCAV; OLEV; aviation; infrastructure

Future of Mobility Grand Challenge

**Regulatory Review**
To identify and address regulatory barriers to deploy emerging technologies and facilitate innovation

**Capability Building**
Build capability across DfT, its agencies and its supply chain to enable us to anticipate, exploit, mitigate and lead S&T led change

**Experimentation & trialling**
New mobility services trialled at scale in UK, drawing on public/private funding. Showcasing innovation for ISCF

**Evidence & Analysis**
To ensure interventions are made with the best possible information by filling key evidence gaps
The future and beyond….

- We are on a cusp with the unprecedented rapid advancement of technology.
- Vehicles, infrastructure, travellers and cities will be fully connected.
- How do we do this?
- What is the vision?
- What does society want, what does it expect?
- What skills and capabilities do we need to deliver this. We certainly don’t have enough data science or new civil engineering and planning skills within government and the ability to have a systems view of the problems.
- How can the CIHT help DfT deliver its strategies and also address my 3 CSA priorities?
THANK YOU

Any questions please contact me on:

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