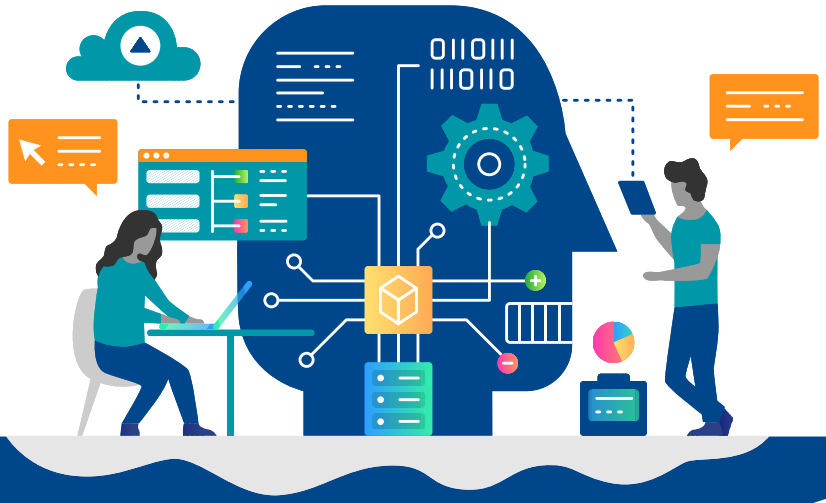
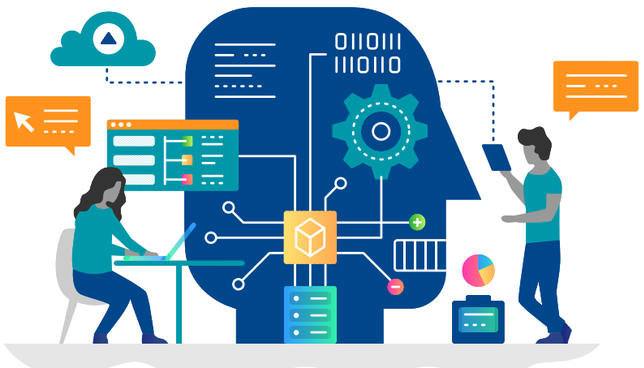
CIHT

The role of data and artificial intelligence in achieving transport decarbonisation



October 2023

The role of data and artificial intelligence in achieving transport decarbonisation



Published by the:

Chartered Institution of Highways & Transportation

119 Britannia Walk
London N1 7JE

t: +44 (0)20 7336 1555
e: info@ciht.org.uk
www.ciht.org.uk

Registered Charity in England No. 1136896
Registered Charity in Scotland No. SC040873
Registered Charity in Republic of Ireland No. 20103989

Published October 2023

Contents

Acknowledgements

The Chartered Institution of Highways & Transportation (CIHT) would like to thank the following people without whom the document would not have been possible.

Project group

The project group was chaired by Jon Parker, member of CIHT's Learned Society and Technical Strategy Board, and was made up of representatives from organisations in CIHT's Partnership Network and CIHT Technical Champions.

Jon Parker, ITP (a company of Royal HaskoningDHV)
Simon Fraser, Balfour Beatty
Alex Walton, Arcadis
Steve Frost, Milestone Infrastructure
Amina Hamoud, University of the West of England
Wim Melis, University of Greenwich
Dan Rennison, Costain
Yousef Majeed, Arup
Kevin Carrol, Ringway
Andy Graham, CIHT Technical Champion
Nadia Lyubimova, Stantec
Syed Yaseen, CIHT Technical Champion
Petar Valchev, Ramboll
Andy Pickett, CIHT Technical Champion
Samer Karrar, London Borough of Newham

Recognition is also due to CIHT staff members, including Isobel Wilson and Joan Roemmele.

Disclaimer

Executive summary

Artificial intelligence (AI) is a technology aimed at performing human-like tasks, such as perception, logic, and reasoning. AI is not a new phenomenon, but it is a topic that has recently been gaining greater attention and is becoming more common in our work and social lives than ever before.

There are many benefits AI can bring to the highways and transportation industry, especially when it comes to improving safety, providing more insightful transport planning, and efficient asset management, as well as improving the way the public experiences transport systems.

When it comes to decarbonisation, there are already examples of data and AI being used to:

- **Accelerate modal shift to public transport and active travel** by creating reliable databases on sustainable transport use; optimising traffic flow in favour of active travel and public transport; and monitoring the condition of active travel infrastructure.
- **Decarbonise road transport and how we get our goods** by aiding site selection of public electric vehicle (EV) chargepoints; managing grid capacity for EV charging; and reducing congestion, improving traffic flow, and improving road safety to avoid traffic incidents.
- **Delivering and maintaining low-carbon infrastructure** by predicting asset life cycles; analysing the integrity of existing assets; and recommending low-carbon infrastructure.

However, there are also barriers we must overcome if AI is to be widely adopted in our industry, including:

- **Lack of skills and understanding**, especially when it comes to people who specialise in data/AI and possess transportation sector knowledge.
- **Funding and investment** – although some schemes have been set up to encourage AI innovations, more support needs to be offered to the public sector, for whom investing in new technologies can be expensive and risky.
- **Open data standards** are needed to ensure that the way the transport industry (and all industries in the UK) collects and stores data is standardised, which will make data sharing easier and more valuable.
- **AI strategies and policies** must be developed that provide leadership and guidance to the highways and transportation sector, so that AI can be confidently and ethically adopted.

This report intends to serve as an introduction to AI for the highways and transportation sector. We hope you gain a better understanding of what AI is, the importance of data for creating successful AI outputs, where AI is already being used in the transport sector, where it is likely heading, and what needs to be done to accelerate successful AI adoption.

1. Introduction

1.1 About this report – role and scope

Two of the most significant topics of conversation within the transport sector at the moment are decarbonisation and AI. Decarbonisation is a cornerstone of government policy, and it is critical in our ability to tackle climate change and achieve net zero. AI is heralded as a revolutionary approach that has the potential to accelerate our transport decarbonisation ambition in many ways. However, when it comes to awareness and understanding about AI, most transportation professionals have very limited knowledge about its development and application.

Hence, at the start of 2023, CIHT established a project group, made up of representatives from the CIHT Partnership Network and Technical Champions, to gather industry knowledge on the current state and use of AI and its future potential.

Through early meetings of the group, it became clear that the scope of the work should be extended to incorporate "transport data" (given AI is so dependent on proven data), and that the focus of our work should be on the role that AI plays in helping to decarbonise our transport system. This ensures a clear purpose to the work and avoids the risk of studying "technology for technology's sake".

This report sets out the findings and aims of the group to raise awareness of the current and future potential of AI and its application in relation to the decarbonisation of the transport system. We hope it acts as a starting point for further research and discussion among transportation professionals, helps to raise awareness and knowledge in this emerging area, and signposts some examples of best practice to help inspire and articulate how AI might best be used to help decarbonise transport in the years to come.

1.2 What is AI?

The definition of AI is often derived from combining the definitions of "artificial" (created by people) and "intelligence" (able to learn and understand things easily).

However, dictionary definitions of AI are often limited because they tend to refer to specific applications. For example:

The study of how to produce machines that have some of the qualities that the human mind has, such as the ability to understand language, recognise pictures, solve problems, and learn.
(Cambridge Dictionary Online, 2023)

The branch of computer science that deals with writing computer programs that can solve problems creatively.
(Wordnet, 2023)

Just like the human brain, there are a wide range of outcomes that AI can achieve, hence why it is often hard to define exactly what AI "does". To try to understand it in a simplistic way, AI can be thought of as a system of technologies used to perform human-like tasks, such as perception, logic, and reasoning.

Broadly speaking, the primary functions of AI can be grouped into three main areas:

Primary functions of AI	Illustrative example – an AI system that receives a video feed of a road
1. Perceptive AI – AI systems that receive and process data to understand a situation.	The AI system uses the live data from the video feed to detect the number and type of vehicles that pass through it each day.
2. Predictive AI – AI systems that receive and process data to anticipate or forecast future scenarios.	The AI system uses historical data from the video feed, cross-referenced with other data sets (such as when local events have happened and weather conditions) to predict what traffic on that road will be like in the future, (e.g. on a sunny football match day in April).
3. Generative AI – AI systems that receive and process data to make decisions and generate new content.	The AI system uses historical data from the video feed, along with other relevant data, to write a report on when the road is used most and by which types of vehicles and includes an analysis of what factors may influence this.

A lot of AI systems will use machine learning to perform the tasks described above. However, not all AI systems will do so and it is important to know the difference between machine learning and AI.

- AI is the ability of technology to perform human-like tasks.
- Machine learning allows an AI system to autonomously learn about and develop the task it has been given, based on the self-learning algorithms, statistical models, and data it has been fed.

Throughout this report we will feature various case studies that use perceptive, predictive, and generative AI to highlight the multiple ways that AI is already being used in the highways and transportation industry.

However, it should be noted that the use of case studies here is not to recommend or advocate for the featured product or service over its competitors – they are merely used to build a picture of where we currently are as an industry and to help bring some AI concepts to life.

1.3 Vocabulary

To help the reader better navigate this report, we have put together a list of common technical terms used when discussing data and AI.

Technical term	Definition
AI systems	A set of technologies that implement techniques such as machine learning, deep learning, and neural networks, which allow them to perform human-like tasks.
Algorithm	Computer software written to achieve a specific task.
Artificial intelligence	Technology that can perform human-like tasks, such as perception, logic, and reasoning.
Big data	A broad term for data sets so large or complex that traditional data processing applications are inadequate.[1]
Data cleaning	The process of fixing or removing incorrect, corrupted, incorrectly formatted, duplicate, or incomplete data within a data set.[2]
Data mining	The processing of large amounts of data to extract new kinds of useful information from it, based on patterns and relationships. [3]
Deep learning	A type of machine learning where a computer processes data in the same way a human brain would think about it.
Machine learning	An application of AI that autonomously learns and improves the accuracy of what it delivers, based on the self-learning algorithms, statistical models, and data it is given.
Natural language processing	A type of generative AI that processes natural language data sets to learn text patterns and relationships to mimic the way humans write.
Open data	Data that can be freely used, reused, and redistributed by anyone. [4]
Predictive modelling	The processing of large amounts of historical data to identify trends or patterns (data mining) and using those insights to predict future scenarios or outcomes.
Semi-structured data	Data that has not been clearly categorised but does have some level of organisation (e.g. emails that can be sorted by date or sender etc.).
Structured data	Quantitative data that can be stored in a structured way and filtered based on specific categories (e.g. numerical values such as temperature or time stored in a table).
Unstructured data	Data that does not have structure and has not been categorised.

[1] What is big data? Oracle [2] Definition of data cleaning, Tableau [3] Definition of data mining, Oxford Reference [4] What is open data? Open Data Handbook

2. Importance of data

2.1 Transport data

AI systems heavily rely on the data fed into them to build a picture of the world, and they use this to provide users with the output asked for. Simply put, data is at the heart of any AI system.

A recent CIHT survey found that most respondents utilised data on traffic flow and congestion, and that the most common ways of collecting data were through surveys or sensors.*

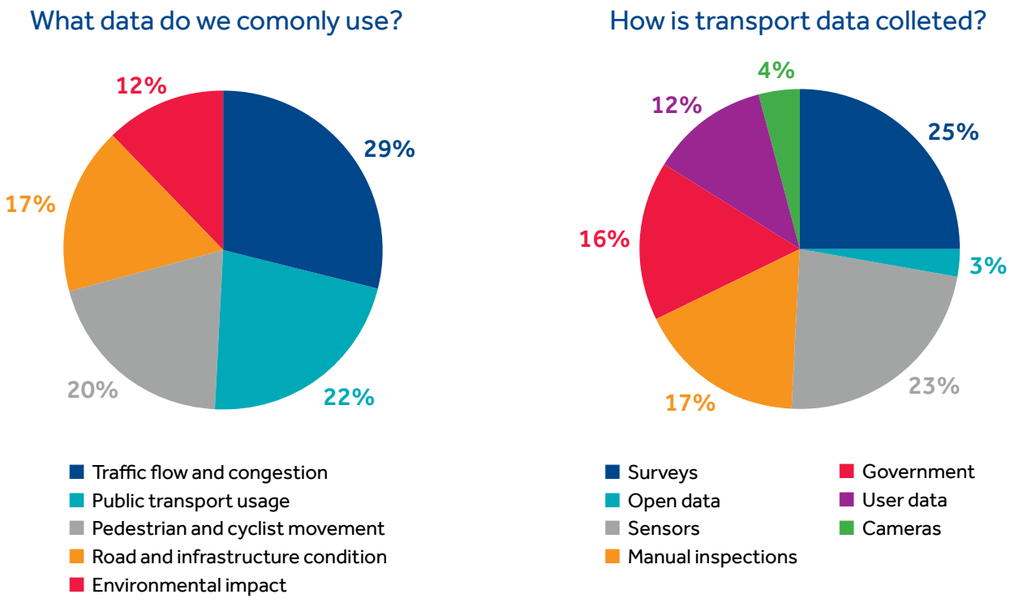


Figure 1: Responses given through a CIHT survey to the questions "How do you collect the transport data you use" (open text answers) and "What types of transport data do you currently have access to in your work?" (multiple-choice answers)

The quality and quantity of data fed into an AI system play a significant role in how accurate the outputs will be. The saying "garbage in, garbage out" when using computers to solve real-world problems still applies with AI, as incomplete and inconsistent data will introduce uninformed, biased answers.

The importance of data quality is heightened in a dynamic area such as transport, where impacts such as public holidays, weather, events, and strikes, among other instances, mean the networks we want to study and manage are never as easy to understand as it might first appear. Transport networks are subject to great variability, even without recent influences such as COVID-related travel pattern changes, e-mobility, and economic changes.

Traditionally, transport has relied on disparate and limited data sources, often leading to assumptions-based decision-making (data poor, assumption rich). However, the modern landscape offers a wealth of new data services and sources, which can supplement existing data and aid in creating a more comprehensive understanding of transport-related challenges.

An example of some data services already available are:

- The Bus Open Data Service, providing real-time bus locations across England every 20–30 seconds.
- The Find Transport Data metadata catalogue, providing access to national and local data sets.
- National Public Transport Access Nodes (NaPTAN), Great Britain's data set of all public transport access points – anywhere you can get on or off public transport (including bus, rail, tram, metro, underground, air, and ferry services).
- National Parking Platform (NPP), a local authority owned and Department for Transport (DfT) funded pilot project that facilitates data exchange between parking operators and service providers.
- Street Manager, a single source of open data on road and street works.

These data sets and sources can be used to enhance data coverage, fulfilling a "big data" approach that integrates diverse and complementary data sets, such as roadworks, incident data, and weather information, providing a more holistic understanding of a transport network. Once these data sets are established as big data, AI can then be used to help solve prevalent transport challenges.

2.2 DfT's Transport Data Strategy

In early 2023, DfT published its new Transport Data Strategy, which sets out how DfT will work with and support the transport sector to harness the benefits of data to help grow and level up the economy, reduce environmental impacts, and improve transport for users.

In the document, DfT outlines seven data principles that form the basis of its strategy:

Data and algorithms should be used ethically. ***In a recent CIHT survey, respondents strongly agreed with this data principle the most (80% of respondents strongly agreed).****
Data from new mobility services should be shared where appropriate
Data generated through public investment should be used for public benefit
Data should be protected and appropriately governed, maintaining public trust, while not using security and privacy as blockers to innovation where privacy protecting solutions can be found ***In a recent CIHT survey, respondents disagreed with this data principle the most (15% respondents disagreed).****
Data should be open by default and using open standards
We should test the market before commissioning new services and solutions
Where these principles are not met and the case for intervention can be made, we will consider the use of regulation or legislation

If embedded into practice, these data principles will be key to shaping the attitude of the transportation industry towards the way we collect, process, store, and share data.

* For further insights into the results of this survey, please see the Appendix

The Transport Data Strategy also outlined a series of barriers identified by DfT as preventing widespread innovation in the sector. In a recent CIHT survey* on the Future of Transport Data we asked respondents to state how much these barriers were preventing innovation in their job roles. We have ordered the barriers below from most preventing to least preventing, based on the results of this survey:

- **Data standards and quality.** Data is not held in recognised, consistent, standard formats, making it hard to use for live services.
- **A lack of widespread data-literate culture and technical skills** across the transport sectors is affecting areas such as data governance, data management and data privacy as well as technical skills gaps in APIs, data engineering, and data science.
- **There is a lack of leadership in transport data** including on data privacy and security, procurement, appropriate technologies, standards/formatting, and a vision of what the government wants, to help inform investment decisions.
- **Legal and contractual barriers**. Organisations are in long-term contracts where, historically, data was not valued or considered as an asset. Consequently, open data and data sharing are hard to address until the next time a contract is let.
- **Discoverability**. It is difficult for innovators to find out what data is available and under what conditions it can be accessed and used.
- **There is a lack of incentives** to invest in and make data available for most of the organisations who hold, or could easily collect, vital transport data, as the benefits typically accrue to the data aggregators and developers who build and offer services using this data.
- **Privacy, security, and ethical concerns**, as well as wider cultural factors within organisations can lead to a risk-averse approach to opening data and data sharing.

To overcome these barriers, DfT put forward five themes and corresponding mission statements that it believes will enable innovation. Based on the results of the CIHT Future of Transport Data survey,* we have listed these themes and mission statements in order of what our survey respondents felt would be the most effective.

- **Data standards and quality**
  Create a transport data standards panel and develop a data standards catalogue, which will promote transport data standards and improve data/sensor quality.
- **Governance, protection, and ethics**
  Review terms and conditions in grant funding and contracts about data ownership and release, contribute to and align with other national data strategies, explore the development of a data ethics panel, issue an annual data survey.
- **Sharing, discoverability, and access**
  Create and maintain a transport data catalogue, make data open by default, and explore solutions on secure data sharing.
- **User needs and communication**
  Develop the wider transport data community through events and blogs, develop an evidence base for investments in data, and run roundtables on data to provide an advisory/challenge function.
- **Skills, culture, and leadership**
  Establish a regular transport data expert group and develop and coordinate a programme of transport data innovation events in collaboration with a range of partners.

2.3 The journey to AI

The highways and transportation sector is currently on a journey towards AI (Figure 2). To be able to have the skills and resources necessary to implement AI, we must first focus on what data we have available to us, specifically the provenance, quantity, and quality of that data. Once this is established, we can then look at how we use this data. Depending on what point an organisation is at on its "data maturity journey" this could be using the data for simple reporting (descriptive analysis – what happened?), or to give more in-depth strategic insights (diagnostic insights – why did this happen?). Advancing on this, data can be used for scenario planning (predictive analysis – what might happen in the future?). In the most advanced cases, AI can be used to perform these tasks autonomously, or at a speed that allows decisions to be taken in real time.

* For further insights into the results of this survey, please see the Appendix

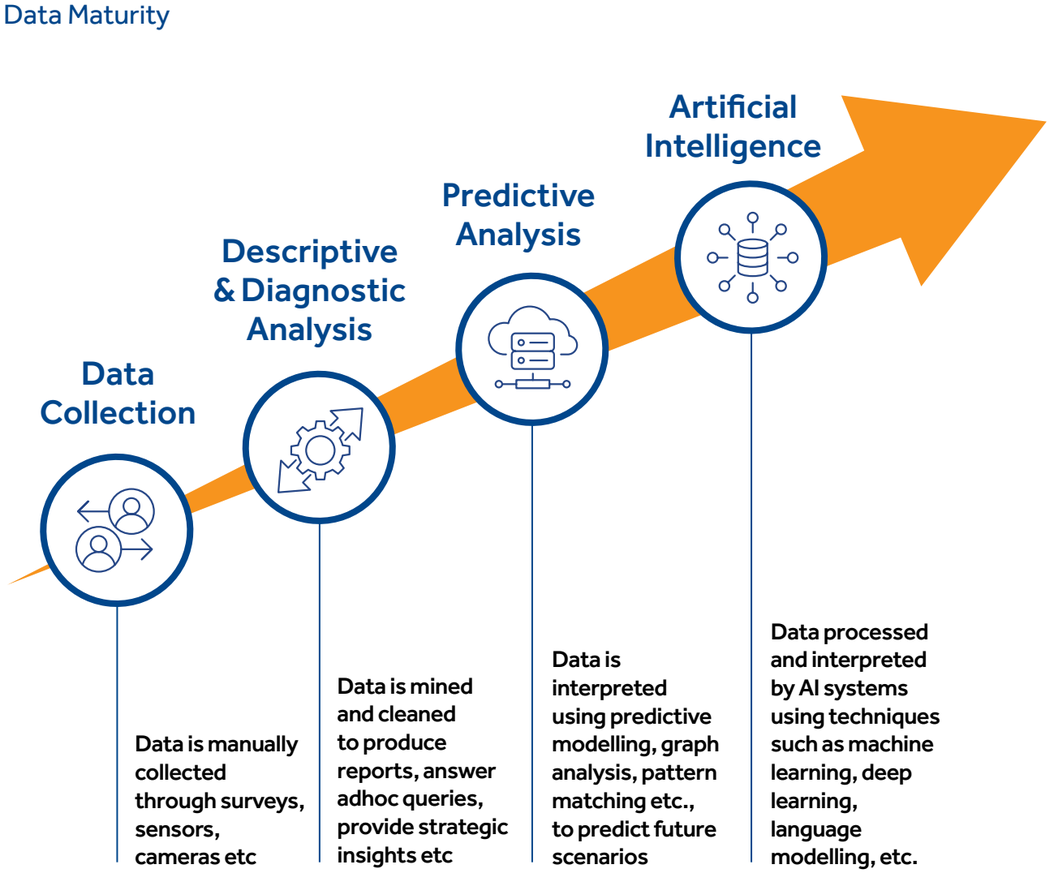


Figure 2: Illustration of the current journey of the highways and transportation sector towards use of AI

3. How is AI currently being applied?

3.1 Government policy in relation to AI

The UK government has ambitious plans to become a world leader in AI technology and is currently one of the top three countries in the Global AI Index – a benchmark of nations' levels of AI investment, innovation, and implementation. To achieve its vision to "remain an AI and science superpower fit for the next decade" the UK government produced a National AI Strategy in 2021, which sets out three outcomes to be achieved:

- **Investing in the long-term needs of the AI ecosystem through:**
  - Supporting researchers and entrepreneurs
  - Ensuring the UK has a diverse range of people with AI skills
  - Ensuring innovators have access to the data and computing resources
  - Supporting growth for AI through a pro-innovation business environment
  - Ensuring UK AI developers can access markets around the world.
- **Ensuring AI benefits all sectors and regions by:**
  - Supporting AI businesses to get to market
  - Understanding the factors that influence whether to adopt AI into organisations
  - Leveraging AI capabilities to tackle real-world problems
  - Leveraging the whole public sector's capacity to create demand for AI and markets for new services.
- **Governing AI effectively by:**
  - Establishing an AI governance framework
  - Setting an example in the safe and ethical deployment of AI, ensuring trustworthiness
  - Contributing to the development of global AI technical standards and promoting international agreements.

Since the publication of the National AI Strategy, the UK government has released an AI Action Plan, to be updated annually, which will set out how it plans to achieve the above outcomes, as well as the progress that has been made so far.

Some notable highlights from the 2022 progress update were:

- DfT committed to developing safety and cyber security in connected and automated mobility (CAM) via the Centre for Controlled and Autonomous Vehicles.
- The Department of Health and Social Care (DHSC) committed £1.4 million towards research on AI and racial and ethnic inequalities.

Since then, the Department for Energy Security and Net Zero published an AI for Decarbonisation Innovation Programme, which supports the development of innovative AI technologies for decarbonisation applications, with a specific focus on power, industry, and agriculture.

The programme has so far been delivered in two streams:

- **Stream 1** sought to establish an AI for Decarbonisation's Virtual Centre of Excellence (ADViCE) to coordinate and engage with AI and decarbonisation stakeholders across relevant sectors in a fair and open way.
- **Stream 2** encouraged businesses to apply for grants to pilot the development of AI approaches that address decarbonisation.

Successful projects of Stream 2 featured a range of AI applications, including:

- The University of Nottingham's proposal to create an AI system that forecasts weather patterns to improve solar-powered grid management.
- Open Climate Fix Ltd's proposal to use AI and real-time electricity grid data, satellite imagery, and weather data to forecast when solar power will be generated and transferred to the electricity grid to reduce network congestion and maximise the amount of renewable energy transmitted.
- Carbon Re Ltd's proposal to use AI to reduce fuel consumption in the manufacturing of cement.

3.2 Pros and cons of AI application

Scepticism towards new technologies is not new within the transport sector, as we have seen recently, for example, with the development and deployment of autonomous vehicles. Public concerns are often focused on the reliability and safety of new technologies, rather than any wider societal benefits that might be derived. It is likely that any future AI technology that involves controlling or operating moving vehicles will likely face the same concerns.

Therefore, a clear evidence-based, unbiased approach that equally analyses the pros and cons of AI will be critical in ensuring that AI is developed and regulated in a way that gains the public's trust.

In Figures 3 and 4 we illustrate some of the potential positive gains that AI can bring to the transport sector, including some case studies where this is already being implemented, as well as covering the potential pitfalls of AI that might not be obvious at first glance.

Pros of AI

TRANSPORT MANAGEMENT

Asset Management

AI systems are used to analyse images of roads and road assets to identify defects

BENEFITS:

- Real-time assessments can be made as data is compared with live databases to provide dilapidation reports, maintenance actions, etc
- Vehicle mounted equipment can be used to gather data, removing the risk of having employees on the roadside

CASE STUDY:

MAVIS (Mapping and Visual Imaging Scooter) by XAIS incorporates imaging and mapping technology into a mobility scooter to extend comprehensive carriageway and asset condition surveys to footways and other non-vehicular access routes.

A 360° panoramic camera is used to continuously record high-definition panoramic imagery. This data is then processed using AI analysis specifically tailored to footway requirements - picking up UKPMS comparable defects, highlighting fretting and identifying cutback where the footway is overgrown.

Commended in the CIHT Technology and Innovation Award 2023

Intelligent Traffic Management

AI systems can detect traffic congestion, accidents, or road closures promptly and reroute traffic, adjust signal timings, or providing alternative travel options

BENEFITS:

- Traffic flows more efficiently
- Congestion is reduced

PLANNING

Large Language Models

AI can be used to pull together information needed to complete transport planning reports

CASE STUDY:

SchemeFlow automates data collection, analysis and report drafting for transport planning reports.

Using automated location data, SchemeFlow automatically pulls in the relevant data and mapping using APIs from sources such as Ordnance Survey, GOV.UK, Google Maps.

It also refers to a database of transport-related local planning policy and guidance from council websites.

It then uses Large Language Models to draft summaries and written analysis for transport planners to use in their reports.

BENEFITS:

- Information needed is quickly gathered in one place
- Employees have more time to focus on complex issues

Predictive Modelling

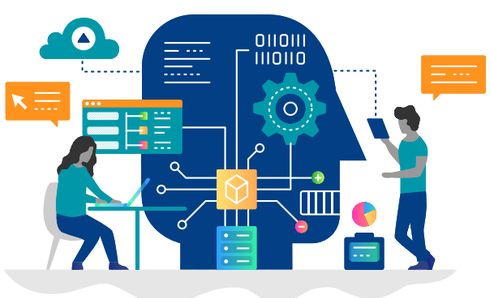
AI can be used to perform high-level analysis that consults historical weather conditions, traffic conditions, and common data trends to predict future conditions and foresee various scenarios

BENEFITS:

- Precise insights can lead to more effective planning and maintenance strategies

CASE STUDY:

EventFlow by Siemens uses AI in America to predict where changes in traffic patterns will occur as a result of events. This helps traffic managers know in advance where bottlenecks could occur and do something about them, such as change the timing of traffic lights



PUBLIC ENGAGEMENT AND USER EXPERIENCE

Natural Language Models

Chatbots and Voicebots (automated phone calls) can be used to analyse, and respond to, stakeholder queries

CASE STUDY:

Amelia.AI by IPSoft was used by Enfield Council to work on frontline council services, taking resident queries, handling requests for permits and authenticating licences.

Amelia handled over 2,300 queries in a 3 month period and was able to recognise the intent of user requests 98% of the time.

Thus, Amelia was able to absorb time-intensive routine requests while freeing up council employees to focus on more complex issues.

BENEFITS:

- The volume of, and speed that, users' queries are analysed/ responded to increases
- Employees have more time to focus on complex issues

Network of Autonomous Vehicles

Autonomous taxis, buses, delivery services, etc., can be used to create more personalised travel experiences for the general public

BENEFITS:

- Public transport becomes a more appealing option

IMPROVED SAFETY

Identification of road safety risks

AI systems can be used to analyse visual satellite imagery to identify land use, carriageway separation, pedestrian crossing facilities, road curvature, junction classifications, speed limits and presence of vulnerable road users

CASE STUDY:

Global Roads by Agilysis uses AI technology to remotely measure traffic speed and flow. The initial project for the African Road Safety Observatory resulted in maps of 25,000km of geospatially matched data showing where 75% of travel occurs in Kenya and Ethiopia, to support monitoring and reporting road safety indicators

Winner of the CIHT Road Safety Award 2023

BENEFITS:

- Roads can be assessed remotely
- Large areas of roads can be analysed in short periods of time
- Detailed and holistic insights into the safety conditions of a road can be gathered

Figure 3: The positive gains that AI can bring to the highways and transportation sector

Cons of AI

SAFETY AND SECURITY

Data Security

The reliability of AI algorithms and the potential for malfunctions or hacking raise concerns about the safety of autonomous vehicles and other AI-powered systems

AI Controlled Vehicles

How should autonomous vehicles be programmed to make decisions in potentially dangerous situations?

DATA ACCESSIBILITY

Data Storage

Issues arise over whom data belongs to and/or whether permissions are needed to store or access it

Data Collection

Data collection isn't standardised, so the methods and frequency at which data is collected differs between organisations, making interpretation of multiple data sets difficult

IMPLEMENTATION

Skills

The availability of qualified professionals in AI that understand both the technology issues and the highways transportation field will hold back the pace at which improvements can be developed

Behaviour Change

Industry acceptance to change to new solutions can be slow due to ensuring the right policies and training are in place to make the most out of it

Carbon Intensity

AI technologies can increase carbon emissions, such as the carbon footprint associated with cooling servers that house data; or have unintended consequences such as increasing car use

ETHICAL DILEMAS

Biased AI

Incomplete and biased data sets could lead models to make incorrect decisions, which will need to be validated before putting into general use

Reliability

An AI system isn't aware of what it does not know, and will always provide an answer, even if that does not necessarily make sense to us

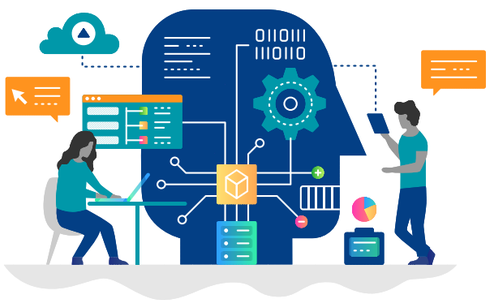


Figure 4: The risks associated with introducing AI solutions to the highways and transport sector

4. Using AI for transport decarbonisation

4.1 UK government transport decarbonisation strategy

Transport in the UK must undergo significant changes in the coming years if net zero is to be achieved by 2050. In 2021 DfT published its long-awaited Transport Decarbonisation Plan, which set out the government's commitments and the actions needed to decarbonise the entire transport system in the UK.

Some of the key commitments in this plan were:

- **Increasing walking and cycling:**
  - Double cycling from 0.8 billion stages** in 2013 to 1.6 billion stages by 2025
  - Increase walking to 300 stages per person per year by 2025
  - Increase the percentage of children that usually walk to school, from 49% (2014) to 55% (2025) of children aged 5 to 10.
- **Creating zero-emission buses and coaches:**
  - Support the delivery of 4,000 new zero-emission buses and the infrastructure needed to support them
  - Deliver the first all-electric bus town or city
  - Deliver the National Bus Strategy vision of a transformed bus industry.

CIHT has supported the National Bus Strategy by launching the Bus Centre of Excellence in 2023. CIHT hopes that DfT funding for this initiative will continue beyond March 2025 to ensure the bus sector can further enhance its capabilities and deliver sustainable local transport provision.

- **Creating a zero-emission fleet of cars, vans, motorcycles, and scooters:**
  - Invest £15 million in 2021/22 to help address the backlog in traffic signal maintenance to improve traffic flow and reduce emissions
  - Consult on regulatory options, including zero-emission vehicle (ZEV) mandates, to deliver petrol and diesel phase-out dates for new vehicles.

CIHT responded to this consultation in 2023, highlighting that the proposed ZEV mandate would cause an increase in EVs on our roads, without ensuring there are sufficient public chargepoints to support them. CIHT recommended that the mandate be revised to incentivise providing a minimum number of public chargepoints, in line with the projected minimum numbers of ZEVs for each year.

In this section we will explore how AI is already being used to decarbonise transport, as well as how it can be implemented soon, to achieve the strategic priorities in the Transport Decarbonisation Plan.

4.2 Accelerating modal shift to public transport and active travel

Decarbonising transport will require a shift to cleaner, more sustainable, and active modes of transport. In the DfT 2020 Gear Change strategy for active travel, the UK government set a target for 50% of all journeys in towns and cities to be made by active travel modes by 2030. This target was reiterated in the Transport Decarbonisation Plan, which included a strategic priority of accelerating modal shift to public and active transport and an intention that *"public transport and active travel will be the natural first choice for our daily activities"*.

However, with the 2023 reductions in government investment for active travel infrastructure, the onus will be on local authorities and the private sector to be more creative and innovative in facilitating modal shift to public transport and active travel, and AI can potentially help to accelerate that transition.

** A stage is defined as a change in the form of transport during a journey; for example, cycling to a railway station to catch the train and then walking to the office is three stages.

Below is a selection of case studies gathered by the project team where AI is currently being used to process and analyse data such as traffic counts and road asset conditions, as well as images and videos, to provide more detailed insights into:

- Which modes of public and active travel are used and why
- What safety risks there are for active travel users
- The condition of active travel infrastructure.

These case studies can be used to identify barriers to behaviour change and make decisions such as:

- Where to improve infrastructure provision and condition
- How to improve the journey experience for users
- How to improve the cost-effectiveness of sustainable transport modes.

Table 1: Examples of current uses of AI to accelerate modal shift to public transport and active travel

Challenge	AI solution	Examples
Measure and monitor levels of sustainable transport use to create a reliable database that can be used to evaluate modal shift targets and identify areas of improvement.	AI-based image and video analysis of vehicles and pedestrians using roads and pavements, gathered from cameras, automatic traffic counters, and sensors.	VivaCity Smart Traffic Monitoring VivaCity's sensors provide real-time data, streamed to the cloud, on how a road space is being used, including classified counts of up to 32 classes (pedestrian, cyclist, cargo bike, car, van, etc.,) as well as vehicle paths, median journey time, and speed. Sentinel Optical Sensor In a transport setting, key data points captured by Sentinel include: vehicle classification, volumetrics, average velocity, and traffic flow paths. Pedestrian activity is also a key feature including flow path, dwell, and volumetrics.
Make public transport and active travel a more attractive and a quicker option by improving journey times and ease of use.	Smart traffic management systems that use AI to analyse data and control traffic lights optimise traffic flow in favour of active and public transport in real time.	Simplifai Simplifai's software can be connected to existing data sources and traffic control devices to change traffic lights across a city to manipulate traffic flow and road occupancy in a way that will achieve a set goal. Flowtack Royal HaskoningDHV innovation utilising cloud technology, AI, and machine learning to optimise efficiency of traffic signal control and prioritise sustainable transport.
Regularly monitor the condition and level of service of active travel infrastructure to deliver effective targeting of infrastructure improvements and maintenance.	AI-based image and video analysis of walking and cycling routes to monitor condition and serviceability of active travel infrastructure.	Gaist Gaist uses AI image analysis to review geospatial data to map and understand the state of an active travel network. MAVIS Mapping and Visual Imaging Scooter (MAVIS) travels where cars cannot to capture asset and condition data on footways and cycleways. This data is then processed using AI to detect, measure, and highlight defects.
Gather reliable information that reflects the user experience of cyclists to improve safety, reliability of journeys, and level of service for users.	AI analysis of crowdsourced sensor data gathered from cyclists using their own personal bikes.	See.Sense See.Sense smart bike lights that contain AI sensor technology that monitors the rider's environment 800 times per second to generate highly granular data on road surface, swerving, braking and dwell times, enabling a comprehensive view of cycling conditions in a city to be pieced together.

4.3 Decarbonising road transport and how we get our goods

There are 40.7 million licensed vehicles[5] on the UK's roads and this number is increasing. Decarbonising road transport and the movement of goods is crucial for addressing climate change and reducing greenhouse gas emissions.

Strategies to decarbonise road transport and the movement of goods include electrification, infrastructure development, last mile delivery, smart logistics, alternative fuels, and regulatory incentives to support the adoption of ZEVs and encourage sustainable transport practices.

However, despite several UK government policies to help push towards ZEVs, such as the ban on the sale of petrol and diesel cars in 2035, uptake is still slow for many reasons, including a lack of charging infrastructure and the high price tag that comes with purchasing a ZEV. It is therefore likely that the use of petrol and diesel vehicles will still be the prevalent form of car use well into the late 2030s.

The examples in Table 2 highlight how AI systems can be used to minimise the impact of petrol and diesel vehicle emissions, while also providing insights to improve infrastructure roll-out to support EV uptake.

Table 2: Examples of current uses of AI to decarbonise road transport and how we get our goods

Challenge	AI solution	Examples
Find optimal locations to place public EV chargepoints.	AI systems that collect and process geospatial data, along with data provided by energy networks to recommend the optimal type and location for a public EV chargepoint.	Mind Foundry's AI platform Combines geospatial modelling with a variety of different data sources and advanced uncertainty awareness forecasting to intelligently model and predict the changing requirements for EV charging infrastructure.
Manage grid capacity for EV charging.	AI systems that collect data on grid capacity, energy prices, and weather to automatically charge EVs at optimal times (e.g. when prices and carbon levels are low).	Vehicle-to-grid (V2G) system Supported by multiple organisations* this system uses AI and market signals to automatically charge vehicles at the cheapest and greenest times.
Reduce congestion and improve the flow of traffic so there are fewer emissions from stationary vehicles.	AI algorithms to analyse real-time traffic data from various sensors and cameras to adjust signal timings dynamically.	VivaCity Smart Signal Control Sensors capture occupancy data across several lanes, junction arms, and detection zones, which is then sent to controller cabinets to optimise signalling and enable junctions to operate efficiently in response to real-time demand and behaviours. Now Wireless AI-powered air quality monitoring Air quality sensors take real-time measurements of pollution levels in the air while using connected CCTV cameras to analyse vehicle type, travel time of day, and length of trip. The AI system can then divert traffic from a congested area, encouraging it to flow better through track light sequencing or sending text messages to drivers recommending alternative routes or travel times. EloySignals Uses AI to optimise traffic flow while offering priority to emergency services and vulnerable road users.
Improve road safety to avoid traffic incidents that can lead to congestion.	AI systems that automatically detect traffic incidents and send out alerts.	AID.VISION A solution powered by AI systems that automatically detects various types of incidents such as stopped vehicles, objects/animals/people in the road, fire, and vehicles moving in the wrong direction, which then triggers real-time alerts to an operations centre.

[5] General facts and figures about road use, RAC Foundation.

* OVO Energy, Kaluza, Nissan Motor Company, research consultancy Cenex, and Indra Renewable Technology, and supported by funding from the Office for Zero Emission Vehicles (OZEV) and the Department for Business, Energy and Industrial Strategy (BEIS).

4.4 Delivering and maintaining low-carbon infrastructure

When discussing the emissions attributed to infrastructure, people often refer to "whole-life" carbon emissions, meaning the entire amount of carbon produced by any particular built asset over the course of its life cycle.[6] These are commonly broken down into operational carbon emissions (associated with running the asset, such as road lighting and traffic lights)[7] and embodied carbon emissions (associated with building, maintaining, and deconstructing the asset).

To address net zero targets, there needs to be an increased focus on the whole-life carbon emissions of buildings and infrastructure, including embodied carbon emissions.[8]

As an industry, we therefore need to look at how we can deliver and maintain low-carbon infrastructure (infrastructure assets that produce fewer emissions throughout their life cycle). It is also important to remember that the PAS2080 hierarchy (the leading standard for carbon management solutions in buildings and infrastructure development) tells us that our most impactful action is to "avoid" works; build nothing, build less, build clever, build efficiently.

Therefore, as the maintenance sector becomes increasingly data-rich,[9] engineers can use AI to better assess asset renewal needs today, and to predict them into the future. Thus, as can be seen in the case studies in Table 3, AI can help the highways and transportation industry redefine how we make whole-life carbon assessments, which are essential for delivering and maintaining low-carbon infrastructure.

Where National Highways construction and maintenance emissions come from today: [10]

- **Concrete and cement = 28%**
- **Materials transport = 25%**
- **Steel = 10%**
- **Asphalt = 9%**
- **Aggregates = 3%**
- **Other materials = 2%**
- **Operational energy = 1%**

Table 3: Examples of current uses of AI to deliver and maintain low-carbon infrastructure

Challenge	AI solution	Examples
Analysing the integrity and renewal needs of concrete structures.	AI systems that collect and process data on the condition of concrete structures to map out where existing or future faults and defects may arise.	AUTOSPEX (Niricson) Processes optical, thermal, and acoustic data of bridges, which is used to build an interactive baseline condition map for the entire bridge structure to detect defects and quantify cracks, spalls, leakage, and delamination in the concrete of the bridge.
Predicting remaining asset life to make the best use of existing assets.	AI systems that use predictive modelling to forecast the deterioration of existing assets and predict when they will need maintenance.	Enterprise Decision Analytics (Arcadis) Uses historical data on asset condition to understand the impact an asset has on avoiding the depletion of natural resources such as carbon emissions and water consumption, or overall sustainable processes that the organisation has in place by understanding the profile and life cycle of an asset.
Deciding what new infrastructure to invest in to be able to write local transport plans optimised for carbon.	AI systems that use optimisation – weighing up multiple ways of achieving specific goals and calculating which solution will be the most successful.	Transport Strategy Optimizer (Arcadis) Uses AI to optimise local transport plans, balancing between different strategic outcomes such as carbon, cost, or customer needs.

[6] Whole life carbon: what is it and how do we reduce it? [7] Measuring road infrastructure carbon: a "critical" in transport's journey to net-zero

[8] Reducing the whole life carbon impact of buildings [9] Data-driven transport infrastructure maintenance [10] Net zero highways: our 2030 / 2040 / 2050 plan

4.5 Horizon scanning

AI is a continuously developing field, which makes it hard to predict the pace and direction at which new technologies will emerge, even within the next three years. Then, even when predictions are made, it is hard to know whether they will be fulfilled or if external factors will influence AI's success.

Uncertainty over the direction of new technologies can often halt uptake and innovation, with organisations (especially those in the public sector) hesitant to adopt these new technologies without confirmation of how and when they could be implemented.

The project team have proposed several current challenges they think could be solved using AI systems (outlined in Table 4), to provide the highways and transportation sector with food for thought on how AI technologies may develop in the future.

AI will not be the answer to everything, and other technologies can also be used to solve some of these challenges. Most of all, we need human ingenuity to mould these technologies to our needs, to apply them so they enhance our decisions, while we remain cognisant of their limitations.

Table 4: Examples gathered by the project group on the future uses of AI to address current challenges that will accelerate modal shift to public transport and active travel

Potential future applications of AI **Accelerating modal shift to public transport and active travel**		
Challenge	**AI solution**	**Outcome**
Provide personalised demand-responsive travel (DRT) solutions.	A fleet of connected, autonomous buses that predict when and where travel demand will be greatest and respond to this accordingly.	Public transport tailored to the communities it serves, making it an easy and reliable mode of transport.
Gain better understanding of user behaviour and motivation to choose sustainable modes.	AI systems that perform high-level behavioural analysis modelling and understanding of user choices on modes of transport.	Development of improved initiatives and policies for promoting active and public transport.
Identify and prevent faults in public transport fleet and infrastructure.	AI systems that capture and report faults, in real time, as well as predicting future faults.	More reliable journey experience and fewer delays.

Potential future applications of AI **Decarbonising road transport and how we get our goods**		
Challenge	**AI solution**	**Outcome**
Reduce greenhouse gas emissions from petrol and diesel engines.	AI systems built into vehicles that analyse drivers' behaviour and are also connected to green light optimised speed advisory (GLOSA) systems to provide drivers with real-time feedback and guidance to encourage habits like smooth acceleration, maintaining optimal speeds, and minimising abrupt breaking.	Behaviour change in drivers to a more fuel-efficient way of driving.
Create efficient last mile delivery initiatives.	AI systems that can predict delivery demand, load optimisation, fleet capacity, and route patterns, cross-referenced with traffic data and weather patterns to provide accurate and efficient delivery routes.	Delivery vehicles take the most efficient routes possible, reducing fuel consumption and emissions.

Potential future applications of AI **Delivering and maintaining low-carbon infrastructure**		
Challenge	**AI solution**	**Outcome**
Understand the carbon impact of construction material choices.	AI systems that use predictive modelling to calculate carbon consumption for a specific construction project.	Help designers and contractors to measure the carbon impacts of their schemes and make whole-life carbon estimates.
Support operators to validate carbon information submitted by suppliers.	AI systems that collect data from websites, government policies, and other relevant databases and use this information to analyse if the carbon information provided by suppliers is correct.	Operators can confidently decide whether a product has the carbon impact it claims it does.
Design low-carbon infrastructure.	AI systems that use whole-life carbon data, design options and geographic information systems (GIS) to generate low-carbon infrastructure designs.	Engineers and designers have quick access to low-carbon design options to use in decision-making and planning.
Minimise material waste.	AI systems that collect and analyse data on the materials used for a construction project and identify the most efficient way to use these materials that minimises waste.	Minimal reliance on new materials.

5. What is needed to accelerate AI uptake?

5.1 Skills and understanding

A recent report into AI in the transport and logistics sector found that there is currently a data skills shortage within our sector, with subsectors such as freight being particularly badly affected. This is driven by high competition for workers with expertise in both data and sectoral skillsets such as hardware production and manufacturing. The report noted that these shortages are also apparent in the regulatory space, where the lack of staff with technical expertise may be a further obstacle to developing effective governance.

In 2021, the Office for AI published the findings of its research into the UK AI labour market, which found that:

- Half of surveyed firms' business plans had been impacted by a lack of suitable candidates with the appropriate AI knowledge and skills.
- Two thirds of firms (67%) expected that the demand for AI skills in their organisation was likely to increase in the next 12 months.
- Diversity in the AI sector was generally low. Over half of firms (53%) said none of their AI employees were female, and 40% said none were from ethnic minority backgrounds.
- There were over 110,000 UK job vacancies in 2020 for AI and data science roles.

When it comes to the transport sector, local authorities and national bodies are key to delivering, managing, and maintaining much of our infrastructure that enables the movement of people and goods. Because of this, it will be vital that any national advancements in technologies, such as AI, ensure that the capabilities of local authorities are not left behind.

There are currently varying levels of technical skills across local authorities, which will dictate the pace at which AI is adopted, including skills in data governance, data management, data privacy, data engineering, and data science.

One of the first steps for local authorities will be to discover their current data landscape and to draw out the needs and requirements through use cases that can be prioritised and trialled.

5.2 Funding and investment

Implementing AI projects can be costly, and securing funding for research, development, and implementation can be a challenge, especially for smaller organisations and local authorities.

Local authorities are currently facing significant fiscal constraints: inflation and spiralling energy costs have impacted budgets considerably against remaining pressure to ensure the delivery of statutory services. Thus, many may well not have the financial and staffing resources to invest in the technology necessary to enable AI use within their organisations. Local authorities will therefore need specific funding to invest in AI technologies, guidance to support the delivery of AI, and procurement advice to contract these technologies effectively.

5.3 Open data standards

As we have highlighted throughout this report, data is key to the success of AI to ensure accurate and unbiased outputs from AI systems.

However, there are current challenges when it comes to using data for AI, such as:

- **Data gaps** – identifying what data has not been collected or is missing.
- **Data collection** – knowing what and how much data to collect and the best methods to do this.
- **Data storage** – knowing how to store the data we have and find the data we do not have.
- **Data analysis** – knowing how to draw meaningful conclusions and present them effectively.

Open data standards can help the transportation industry (as well as other key industries in the UK) to overcome these challenges by defining what data we record and how we represent it.

Open data standards are documented, reusable agreements that help people and organisations to publish, access, share, and use better-quality data.[11]

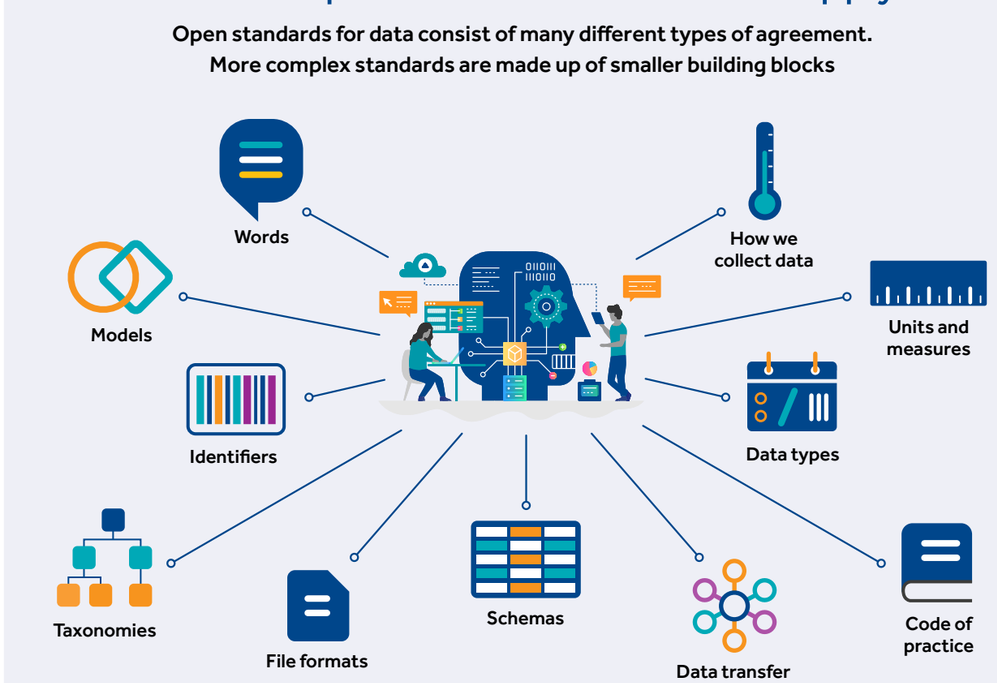
It should be clear that open data standards are not the same as open data. Data can be configured to meet the agreement of rules of an open data standard but still be kept with an organisation's secure data environment.

Where open data standards have been used, they allow those with access to the data to develop new ways of understanding and using it. Multiple different companies can then access open data to provide different solutions or insights. To give an example, the General Transit Feed Specification (GTFS) is used by applications such as City Mapper for integrated transport views of cities.

Figure 5 suggests areas that open data standards could apply to. Not all of these areas may need to be covered, but they should be considered when planning to use open data standards.

A mix and match approach can be used, utilising different standards for each element rather than looking for one standard that covers all areas.

Figure 5: Areas that open data standards could apply to. Image adapted from the Open Data Institute, 2018, the open standards for data guidebook. Place of publication: The Open Data Institute. Available from: https://standards.theodi.org/ [Accessed 25/10/2023]



[11] Open Data Institute, What are open standards for data?

Examples of open data standards from outside the UK:

- **The European Data Act makes more data available for use and sets up rules on who can use and access what data for which purposes across all economic sectors in the EU.[12]**

  The implementation of this act will make access to data (such as performance and use of products, non-personal data, data used in contractual agreements) by consumers, businesses, and public authorities mandatory.[13]

- **Regional Integrated Transportation Information System (RITIS) by the Eastern Transportation Coalition is a platform that consolidates transportation-related data from multiple agencies, standardises it, fuses it, and makes it available both in real time and in historical analytics.[14]**

5.4 AI strategies and policies

Accelerating AI adoption in the highways and transport sector will require a combination of strategies and policies that promote innovation, collaboration, data sharing, and responsible AI development.

In March 2023, the UK government published and consulted on an AI regulation whitepaper, which sought to progress the AI capability of the UK by bringing clarity and coherence to the regulatory landscape.

The whitepaper put forward five cross-sector principles, to be issued on a non-statutory basis and implemented by existing sector regulators, that will ensure all existing and developing AI technologies are safe, fair, and reliable.

In response to the whitepaper, CIHT highlighted that these cross-sectoral principles were lacking in their consideration of the importance of data and how it is collected.

Building on the work already set out in the National Data Strategy, CIHT believes we need to work towards regulations and standards that ensure that the data collected by the transport sector is:

- Fit for purpose, recorded in standardised formats on modern, secure, future-proof systems
- Held in a condition that means it is findable, accessible, interoperable, and reusable, and accords with open data standards where possible.

The DfT has already made good progress in recognising the power of data through its Transport Data Strategy. However, when surveyed, most people who responded either roughly knew what the strategy was about or recognised the name but did not know what it was about* (only 7% said they had read it and would be confident to talk to peers about it).

Clearly, more needs to be done to disseminate these messages from DfT to the transport sector. Next steps for DfT should also involve developing an AI transport strategy that builds on the Transport Data Strategy by:

- Identifying areas where AI can have immediate impact and initiate pilot projects to demonstrate the feasibility of these solutions
- Promoting collaboration with other industries for the purpose of data sharing and developing an AI ecosystem
- Developing training programmes to equip the existing workforce with the necessary AI skills
- Publishing guidelines for ethical AI development and deployment within the transport sector.

[12] The European Data Act

[13] The Data Act: new EU rules for data sharing

[14] RITIS & PDA Suite

* For further insights into the results of this survey, please see the Appendix.

6. Reflections and recommendations

Reflections

The highways and transportation sector is at the early stages of its AI journey:

- We cannot predict with any certainty how AI will develop or in what direction it will go, making projections hard.
- There are already emerging AI technologies that can help the highways and transportation sector become safer, more efficient, and better at planning/forecasting. However, these technologies are yet to be widely adopted.
- The first step to getting the highways and transportation sector "AI ready" and adopting AI more widely will be to ensure we are collecting, storing, and sharing the data necessary to make AI successful.

Collaboration will be key:

- Many local authorities and organisations will be at different levels of maturity when it comes to data and AI. Collaboration can help to mitigate the risk of being an early adopter for local authorities, and to enable other authorities to learn from their experiences.
- Data sharing will be key to ensure AI is fed all the relevant information it will need to make informed, unbiased decisions and outputs. This will rely on organisations within the transport sector, and further afield, working together.

AI can bring value to transport decarbonisation by:

- Accelerating modal shift to public transport and active travel. For example, this could be through the creation of reliable databases on sustainable transport use; optimising traffic flow in favour of active travel and public transport; and monitoring the condition of active travel infrastructure.
- Decarbonising road transport and how we get our goods. For example, by aiding in site selection of public EV chargepoints; managing grid capacity for EV charging; reducing congestion and improving traffic flow; and improving road safety to avoid traffic incidents.
- Delivering and maintaining low-carbon infrastructure. For example, by predicting asset life cycles; analysing the integrity of existing assets; and recommending low-carbon infrastructure.

Recommendations

CIHT believes the highways and transportation sector must harness the power of data:

- There needs to be a greater consideration of not just the role data plays in supporting AI technologies but also how it can be used to enhance the experience of transport users. This should be reflected in the AI regulations and standards published by the UK government.
- The government must work towards creating regulations and standards that ensure that the data collected by the transport sector is:
  - Fit for purpose, recorded in standardised formats on modern, secure, future-proof systems
  - Held in a condition that means it is findable, complete, accessible, interoperable, and reusable, and accords with open data standards where possible.

CIHT calls for more support for AI in public services:

- Local authorities and national bodies will be key to rolling out AI in public services such as transport, and so should be given appropriate funding, guidance, and procurement frameworks to do this successfully.
- A platform or community will be needed to share knowledge and best practice.

CIHT believes the highways and transportation sector needs more awareness of AI:

- A clear evidence-based approach to policy developments is critical, particularly when it comes to public understanding around the adoption of new and emerging technologies within the transport sector. Regulators and organisations such as CIHT should work together to ensure that unbiased evidence on the pros and cons of AI is well communicated and shared widely. Working across the sector to inform and educate people will build a healthy relationship between users and AI.
- The highways and transportation sector needs to build public trust in AI and demonstrate that it is incorporating AI into the sector in the safest and most ethical way possible. A Transport AI Advisory Group should be established, who will focus on public opinion, confidence, and outreach.
- The highways and transportation sector needs leadership from DfT in the form of an AI Transport Strategy that builds on the Transport Data Strategy by:
  - Identifying areas where AI can have immediate impact and initiate pilot projects to demonstrate the feasibility of these solutions
  - Promoting collaboration with other industries for the purpose of data sharing and developing an AI ecosystem
  - Developing training programmes to equip the existing workforce with the necessary AI skills
  - Publishing guidelines for ethical AI development and deployment within the transport sector
  - Looking beyond our borders to see what international learning could help us in the UK, including the strategic roll-out of data regulations and data-sharing platforms.

Appendix and survey results

During August 2023, CIHT conducted a survey looking into The Future of Transport Data. This survey was completed by 50 individuals from the highways and transportation sector, the majority of whom work within the UK, with additional responses from transportation professionals working in Ghana, Qatar, Australia, India, and Malta.

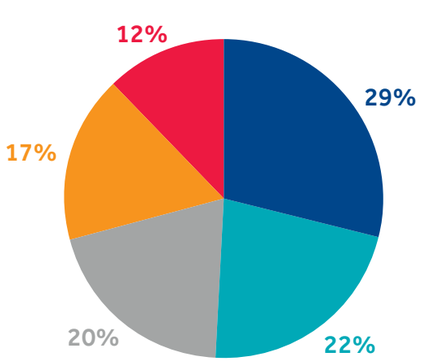
When asked what transport data the respondents use for their work, most people selected data on traffic flow and congestion, with environmental impact being the least selected answer. This could reflect the ease of use and availability of this data, with traffic flow and congestion being regularly monitored through traffic counts and CCTV cameras, whereas there are comparatively few established methods for measuring environmental impact.

A1: Answers given by survey respondents when asked what transport data they commonly use and how they collected this

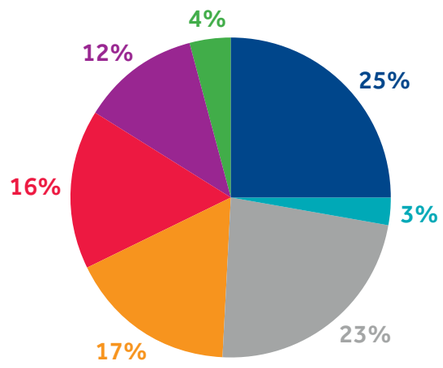
When asked how the data that respondents use is collected, the most stated method was through surveys (road infrastructure and condition surveys, third party survey companies, interview surveys, manual surveys, drone surveys, traditional traffic surveys, and video surveys). Other forms of data collection included sensors, government sources (DfT, Office for Road and Rail, National Highways, public transport data, local authorities, and census data), and user data (floating vehicle data and mobile phone data).

Part of our Future of Transport Data survey sought to understand how familiar the respondents were with DfT's Transport Data Strategy. Here we found most respondents either roughly knew what it was about or had heard the name but did not know what it was about.

What data do we comonly use?



How is transport data colleted?



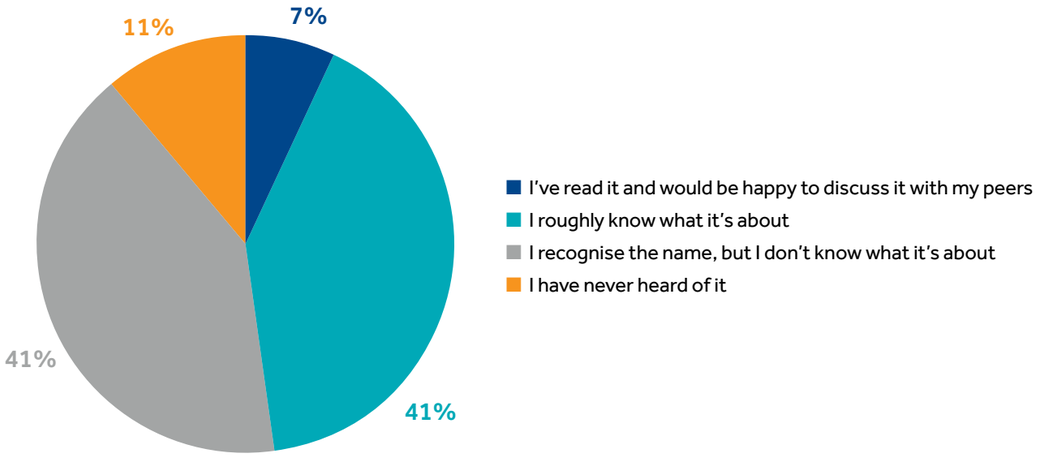
A2: Answers given by survey respondents when asked how familiar they are with the Transport Data Strategy

We then asked our survey respondents to indicate how strongly they agreed or disagreed with the seven data principles DfT set out in the Transport Data Strategy.

From this, it was shown that the respondents most strongly agreed with the principle "data and algorithms should be used ethically" and most disagreed with the principle "data should be protected and appropriately governed, maintaining public trust, while not using security and privacy as blockers to innovation where privacy protecting solutions can be found".

However, it should be noted that the overall response to all the data principles was positive.

How familiar are you with DfT's Transport Data Strategy?

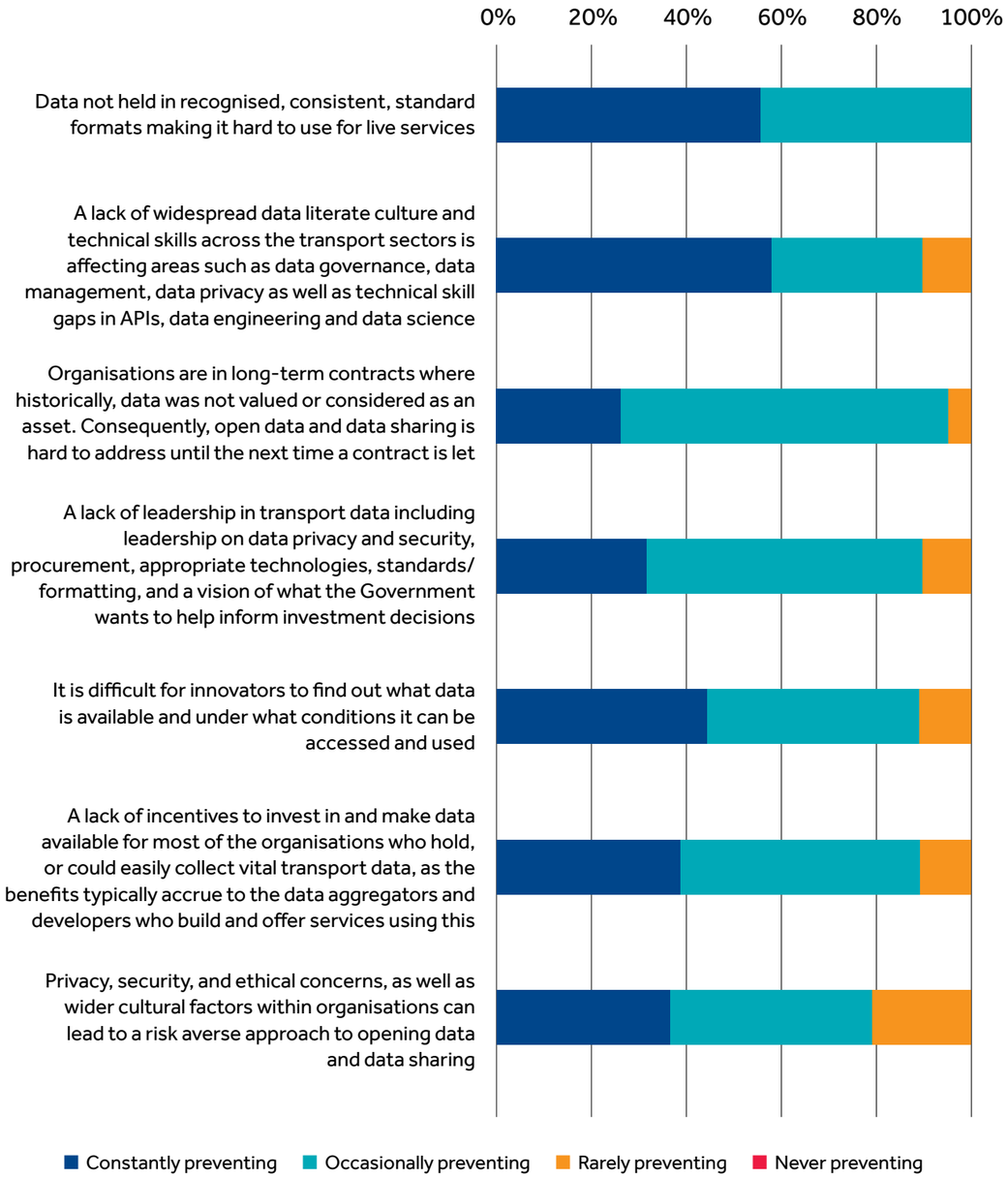


A3: Answers given by survey respondents when asked how strongly they agree with the seven data principles outlined in the Transport Data Strategy

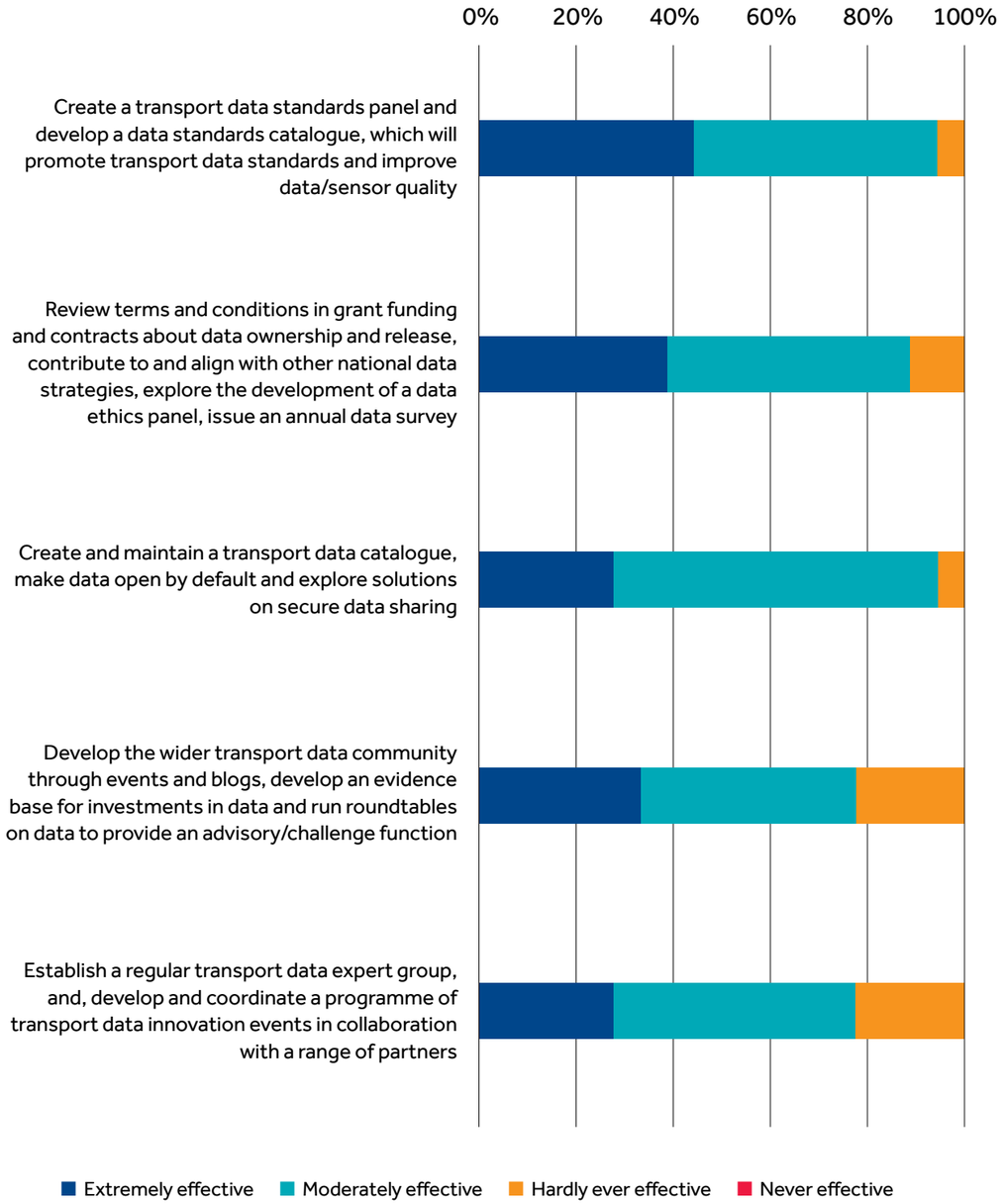
When it came to assessing the barriers outlined by DfT, the majority of respondents found that these barriers were constantly or occasionally preventing the transport industry from more widespread innovation.

A4: Answers given by survey respondents when asked how often the barriers outlined in the Transport Data Strategy prevent the transport industry from widespread innovation

Finally, when it came to assessing how effective the actions identified by DfT will be at overcoming these barriers, most respondents felt they would be effective.



A5: Answers given by survey respondents when asked how effective they believed the actions outlined in the Transport Data Strategy to be



About CIHT

CIHT provides strategic leadership and support to help our members develop, deliver, and maintain sustainable solutions for highways, transport infrastructure, and services that:

- **Address the challenges of climate change**
- **Support the economy**
- **Help address societal inequalities**
- **Reduce environmental degradation**
- **Respond to a changing world**

We bring members together to share, learn, and feel confident about addressing these challenges through the application of good practice, by embracing innovation and by acting with integrity. It is through this and the values that CIHT can demonstrate and deliver on thought leadership and shaping the highways and transportation sector for the public benefit.

Whether you are a student, apprentice, work in the private or public sectors or are a company director, CIHT has a place for you and a commitment to fulfilling your professional development needs throughout your career.

www.ciht.org.uk