Specialist Professional and Technical Services (SPATS) Framework

Connected Vehicle Data Research project

Strategy report

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ATKINS

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Executive Summary

This report sets out our research into connected vehicle data for the Department for Transport (DfT). We developed this strategy by investigating the DfT's hypothesis that "*The intelligence that connected vehicle data provides will be invaluable in helping plan and operate a better road transport network – and at a lower cost. This will provide benefits for the environment, congestion, safety and the economy*."

The report explains the current and near-future opportunities for connected vehicle (CV) data to improve traffic management operations. It describes a framework for realising the benefits of using CV data, including the interventions required.

We undertook extensive consultation and evidence-gathering to understand the current status of CV data use, awareness and perceived barriers. We engaged with a wide variety of stakeholders including national and local authorities, industry bodies, data suppliers, vehicle makers, technology providers and user groups. This exercise confirmed some key challenges to greater use of CV data; some being more perception than reality:

- Skills and knowledge in road authorities
- Lack of resources in road authorities
- Lack of sharing data and skills to obtain efficiencies
- Procurement, IT, governance issues
- Lack of visibility of potential savings and benefits
- Lack of standards or visibility of standards
- GDPR and privacy
- Data quality
- Cyber risks
- Human machine interface (HMI) safety risks
- Lack of contact points with industry
- Lack of vulnerable road user use cases

We also reviewed strategy and policy documentation, reports from the Transport Technology Forum and work internationally to gain an understanding of the current status of connected vehicle data.

As part of this review. we identified that the language around CV use cases can be overly technical and complicated and this does not help road authorities' engagement with CV data. We decided to create a simplified set of CV data services for the UK, based on policy objectives, current needs and state of play:

- Asset management
- Smarter parking
- Probe vehicle data
- In-vehicle messaging
- Signal phase and timing
- Vulnerable road users
- Public transport

We used the results of the literature and evidence review to identify the potential value of different types of CV data, based on this simplified list of services. We identified cashable savings, benefits to the economy, benefits to the wider national gross domestic product (GDP) as well as secondary (non-quantifiable) benefits.

Through this exercise, we demonstrated that the DfT's hypothesis about CV data is correct; greater use of CV data will enable better planning and management of the road transport network, at a lower cost. Significant benefits for the environment, congestion, safety and the economy are achievable through improvements to traffic management and asset management.

The evidence review and value analysis helped us then identify six key themes for the strategy:

1. **Talking Traffic Partnership UK**
   DfT should set up an at-scale demonstrator to stimulate the growth of CV data use and demonstrate the benefits to stakeholders and public.
2. **Establishing and exploiting national facilities**
   DfT should provide national facilities where this will drive progress, for example, national procurements to gain efficiencies and providing a focal point for stakeholder engagement.
3. **Readiness of people and organisations**
   Training and support should be provided for roads authorities, to address skills and knowledge gaps and need for cultural change; both barriers to the greater use of CV data.
4. **Migration and legacy**
   Road authorities should be supported by DfT to make the best use of their existing ITS and asset management technology while migrating to CV data.
5. **Business case and procurement advice**
   Assistance should be provided by DfT for roads authorities, so they can successfully generate investment and procure CV data or services.
6. **National CV data service design guidance**
   Service design guidance and standards should be created to provide road authorities with the information they need to design and implement CV data services.

For each of these, we created an action plan for delivery across 'Now, Next, Later' timeframes for a five-year horizon. The action plans also summarise cost, benefits, scope of each activity and the potential role for DfT. We believe that these six action plans will address the needs of road authorities, helping them overcome the challenges and maximise their opportunities for CV data.

The key conclusions of the investigation and strategy development are:

- There is much untapped data than can be exploited quickly to improve our roads. Smarter parking, reduced congestion and better information are things that people want and are already feasible. The UK is leading globally on the use of CV data for asset management, for example.
- Importantly, there are cashable savings to be made in the short term from both smarter parking and asset management; this is a quick win and will provide an incentive for authorities to make the changes required.
- A cultural change is needed, and commitment to accelerate the use of CV data. Technology not a key barrier; institutions, organisations and business models are. It is clear that there is no need to wait if we focus on data rather than communications; there are already solutions which are good enough, not perfect.
- While there have been many successful trial projects demonstrating this potential, the next step must be on a much bigger scale, with multiple services, a large geographical extent and real drivers. Talking Traffic UK would be the catalyst for the at scale roll out of CV data services, building on the learning from the successful Dutch initiative.
- For this to provide lasting results, authorities need training, support and accessible information to upskill, generate the business cases for the necessary investments and make the required cultural changes. Focussing this support on the seven CV data services will simplify the CV data landscape and provide a common national understanding of what is possible with CV data.
- DfT can also support deployment from a national perspective. In the short term, this could include procuring national CV data feeds to make it easier and less costly for authorities to access data, which will accelerate its use. There will be an ongoing need to drive innovation and develop / promote standards, organise the national access point and be a single point of contact for suppliers and authorities.

The next steps are for the DfT to use this report to engage with internal and external stakeholders (including the consultees of this project) and use those conversations to decide how to deliver this strategy in practical terms.

1. Introduction

1.1. Purpose and scope of report

This report sets out our research into connected vehicle data for the Department for Transport (DfT). The strategy has been developed by investigating the DfT's hypothesis that:

> "The intelligence that connected vehicle data provides will be invaluable in helping plan and operate a better road transport network – and at a lower cost. This will provide benefits for the environment, congestion, safety and the economy."

The report explains the current and near-future opportunities for connected vehicle (CV) data to improve traffic management operations. It describes a framework for realising the benefits of using CV data, including the interventions required.

The capability and needs of traffic management and other relevant systems to store, analyse and provide future predictive capability is considered throughout and is core to the development of the strategy.

The strategy aims to be a call to action addressed to government, identifying what they should invest in to progress CV data at scale. It is a strategy that can be applied nationally, covering local authorities (LAs) and Highways England and it could also be appropriate to the devolved nations.

DfT's aim is that it will form part of a wider government approach, aligning with EC and government strategies and policy including the Future of Mobility Urban Strategy (FOMUS).

The strategy is agnostic about the communications technology to connect the vehicles, and is focussed on connected vehicles rather than automated vehicles, although recognising that CV data services may in future support autonomous driving.

1.2. Context

1.2.1. Definitions

For the purposes of this report the following definitions have been adopted:

Connected vehicle:

Any vehicle that can communicate with other vehicles or infrastructure. For example, the vehicle could be a car, truck, cycle or motorcycle; the transmission could be cellular data, radio, or dedicated short range communications. The information could be presented to the vehicle occupants on a smartphone or integrated vehicle display screen; alternatively, it could be provided to the vehicle systems rather than the driver.

Connected vehicle data:

Any data that is shared between vehicles or with infrastructure. Data sharing is commonly described as V2V (vehicle to vehicle), V2I (vehicle to infrastructure or vice versa) or V2X (vehicle to everything). V2I data can be shared directly with roadside comms devices, or alternatively with control centres or third-party systems using cellular data.

1.2.2. Pillars upon which the strategy is built

Discussion with DfT determined that there are four pillars on which the strategy should be founded:

a. Enable local authorities to align with the widest range of policy objectives
b. Bring efficiencies in the day to day operations of road authorities
c. Exploit organisation-wide (local, regional and national) investment in data technologies
d. Noticeably improve user experiences

The success of the strategy should be measured by how well it addresses these pillars.

1.3. Methodology

There were four stages in the methodology to produce the strategy:

Consultation and evidence review[1]: The first phase was extensive consultation and evidence-gathering to understand the current status of CV data use, awareness and perceived barriers. We engaged with a wide variety of stakeholders including national and local authorities, industry bodies, data suppliers, vehicle makers, technology providers and user groups. We also reviewed strategy and policy documentation, reports from the Transport Technology Forum and elsewhere internationally to gain an understanding of the current status of connected vehicle data.

Value analysis[1]: We used the results of the literature and evidence review to identify the potential value of different types of CV data. We investigated cashable savings, benefits to the economy (through improvements in congestion, safety and emissions), benefits to the wider national gross domestic product (GDP) as well as secondary (non-quantifiable) benefits.

Selection of strategy themes: The evidence review and value analysis helped us start to identify key themes for the strategy.

Identification and prioritisation of action plans: We finalised the list of activities and set out timescales, expected outcomes, and high-level cost estimates.

1.4. Structure of report

Section 2 sets the scene, setting out the requirements driving the development of the CV data strategy. It documents the technology and policy drivers, and the key 'asks' from the consultation exercise. It then summarises the challenges, risks and opportunities for the strategy to address before setting out key conclusions that frame the rest of the report.

Section 3 explains the justification for the proposed strategy. It describes the seven CV data "service groups" that it supports and how they can be the focus for savings and benefits realisation. It introduces our six strategy action plans, how they address the challenges and maximise the benefits

Section 4 presents each of the six action plans for delivery across Now, Next, Later timeframes, and summarises cost, benefits, scope of each activity and the potential role for DfT to play.

Section 5 sets out the conclusions of the report and the recommended next steps.

Appendices A and B supplement section 2. Appendix A contains a list of the consultees we engaged with. Appendix B shows how a CV data strategy can support delivery of the FOMUS principles and how it addresses the key 'asks' from the consultation.

1.5. Glossary

Name	Description
ADEPT	Association of directors of environment, economy, planning & transport
BPA	British parking association
CAM	Cooperative awareness message
C-ITS	Co-operative intelligent transport systems
CONVEX	A UK project involving central government, academia, private sector and local authority organisations to create a data exchange facility focused on mobility.

[1] Detailed results from the consultation, evidence review and value analysis are contained in Deliverable 02: Consultation Report and key findings used in this report where they relate to the strategy. Appendix A contains list of consultees

Name	Description
CROCS	Controller to roadside open C-ITS standard
CV	Connected vehicle
DENM	Decentralised environmental notification message
DfT	Department for Transport
DSRC	Dedicated short range communications
EC	European Commission
eCall	Mandatory in in light vehicles type approved since 2018. Uses GNSS and cellular to alert emergency services with location automatically in the event of an emergency
ERTICO	European road transport telematics implementation coordination organisation
FOMUS	Future of Mobility Urban Strategy
FTZ	Future transport zone
FVD	Floating vehicle data
GDP	Gross domestic product
GDPR	General Data Protection Regulation. A legal framework that sets guidelines for the collection and processing of personal information from individuals who live in the European Union (EU)
GLOSA	Green light optimal speed advice
GNSS	Global Navigation Satellite System. A constellation of satellites providing signals from space that transmit positioning and timing data to GNSS receivers. The receivers then use this data to determine location.
Historical data	Data collected and stored for future use as opposed to real time data.
HMI	Human machine interface
Innovate UK	The UK's innovation agency. Part of UK Research and Innovation, a non-departmental public body funded by a grant-in-aid from the UK government.
IT	Information Technology
IVM	In-vehicle messaging
LA	Local authority
LAMP	Local authority mobility platform
LCRIG	Local council roads innovation group
MaaS	Mobility as a service
MOVA	Microprocessor optimised vehicle actuation; adaptive control of traffic light signals at isolated junctions.
NAP	National access point; can take various forms, such as a database, data warehouse, data marketplace, repository, and register, web portal or similar depending on the type of data concerned and provide discovery services, making it easier to fuse, crunch or analyse the requested data sets.
PT	Public transport
PVD	Probe vehicle data

Name	Description
SBRI	Small business research initiative, brings together government challenges and ideas from business to create innovative solutions.
SCOOT	Split cycle offset optimisation technique; a method of adaptive signal control where vehicles are detected as they approach a signalised junction. This detection, from multiple junctions, is fed into a central system, which models the flow of traffic in the area. This intelligence is used to adapt the phasing of the traffic light signals reacting to the flow of traffic.
SOTN	TTF State of the connected nation report
SPAT	Signal phasing and timing
SPATULA	Signal phase and timing for users local authorities
SRN	Strategic road network
TfL	Transport for London
TTF	Transport Technology Forum exists to give leadership, direction and support and to stimulate investment in innovation and technology solutions. The Transport Technology Forum receives funding from the Department for Transport and InnovateUK to help achieve change and technological innovation with collaborating organisations.
TRO	Traffic regulation order
UTC	Urban traffic control. The method of coordinating traffic signals in a network by the use of timing plans
UTMC	Urban traffic management and control; systems designed to allow the different applications used within modern traffic management systems to communicate and share information with each other.
V2I	Data shared between vehicles and infrastructure
V2V	Data shared between vehicles
V2X	Data shared between vehicles and everything

2. Setting the scene

2.1. Hypothesis to vision

If the hypothesis set out in section 1.1 is correct, we believe the vision for the strategy should be:

Strategy vision: To plan and operate a better road transport network using connected vehicle data.

In this chapter, the justification for this vision is set out considering the technology and policy drivers and the key findings from the consultation exercise.

2.2. Drivers for change

2.2.1. Proven and mature technology

The key driver for change is that connected vehicle technology and data has recently become ready for exploitation, with potentially significant benefits. This is due to increased numbers of connected vehicles, better communications and a more developed market. Some connected vehicle data types are already available and productised for use by road authorities, for example:

- Floating vehicle data can be procured from satnav suppliers such as Google, TomTom and INRIX, for both real-time and historical analysis purposes. These are established services with readily available pricing structures; many road authorities use them already.
- Smarter parking apps are readily used by drivers, providing operational cost savings for several road authorities and a better customer experience.

These services provide benefit for the authorities using them but they are not applied consistently on a wide scale. If these small-scale successes could be extrapolated, far greater benefits could be realised nationally.

There have been many successful trials of asset management and signal phase and timing (SPAT)/ green light optimal speed advice (GLOSA) services, showing that benefits could be realised. However, the pilots have not yet led to widely used applications:

- GLOSA trials have shown potential but the systems require road authority investment in infrastructure changes and the business case is not yet fully established.
- Connected vehicle data for asset condition monitoring has been successfully demonstrated to have potential for large cost savings. However, it is not yet developed in a standardised way and suppliers are not yet offering a wide range of services that road authorities can procure, although there are indications this will be resolved fairly soon.

These examples show that strategic investment is now required to accelerate the uptake of connected vehicle data by roads authorities rapidly and at scale.

2.2.2. Policy and strategy

At government level, the Grand Challenges of the UK Industrial Strategy[2] highlight that data and the future of mobility are global trends that will transform our future and should be tackled ambitiously. This ambition is reflected in publications such as the Government Office for Science report 'A time of unprecedented change in the transport system'[3], the DfT Future of Mobility Urban Strategy (FOMUS)[4], and Highways England's 'Connecting the Country'[5] and 'Technology and RIS2[6]' discussion papers.

Table B-1 in Appendix B shows how a CV data strategy would be fully aligned with the DfT's strategic objectives, as set out in FOMUS.

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[2] https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/industrial-strategy-the-grand-challenges
[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/780868/future_of_mobility_final.pdf
[4] https://www.gov.uk/government/publications/future-of-mobility-urban-strategy
[5] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/666876/Connecting_the_country_Planning_for_the_long_term.pdf
[6] https://www.gov.uk/government/publications/technology-and-ris2

Across local and national government there is a strong impetus to embrace digital data driven services. In 2018 North Highland's 'Local Transport Data Discovery' independent review[7] for DfT, a series of recommendations were made for making data more open to use, share and access across five themes:

1. Local authorities should be helped to focus on making more high-quality data open.
2. The DfT should sponsor identified data projects which encourage and foster better local authority transport services.
3. More effective investment in infrastructure to harvest local authority data, and open data initiatives to improve data sharing.
4. Promote training and skills development within local authorities to develop internal capability.
5. Improve collaboration between local authorities, Highways England and the private sector.

The response to the 2020 COVID 19 pandemic also created a new demand for traffic data for daily reporting of the changing use of road networks. In response to a call from DfT, local authorities provided a variety of data that informed the daily televised ministerial briefings. CV data was a key component. If CV data was collected and analysed in standard ways, rapid analysis of trends in emergencies could be performed more quickly.

2.3. Consultation response

2.3.1. Participant types

The consultation was held with a wide range of stakeholders, including local authorities, Highways England, vehicle manufacturers, data service providers, freight, industry bodies, CV pilot projects, Zenzic, emergency services and the Dutch Talking Traffic Partnership (full list in Appendix A).

2.3.2. Key 'asks' of consultees

The consultees were supportive of the idea of a strategy. In summary their 'asks' for the strategy are:

- Show how CV data aligns with both national and LA policy aims to give a business case (safety, productivity, efficiency, decarbonisation, digitisation, post Covid-19 recovery).
- Tie into policy objectives such as the Future of Mobility Urban Strategy and 'Greening' of Transport.
- Show how CV data can help road authorities do the day job better, improving network intelligence and achieving cost savings.
- Use CV data to provide visibly better services for all road users, not just "connected cars"; freight and VRUs especially.
- Make the most of existing investment in (traffic control, asset management and other systems) using new techniques and data, levering off the data already there.
- Remove silos of data inside and across road authorities and include wider data not just transport (learning the lessons from Covid-19)
- Have a clear single point of contact for vehicle manufacturers and service providers, both for access to data and to engage on future developments.

Table B-2 in Appendix B shows how our proposed CV data strategy would address these asks.

2.3.3. Challenges, risks and opportunities

Through the stakeholder consultation we identified a range of challenges and risks that the strategy needs to address.

Skills and knowledge in road authorities

Local authorities employ staff with a background in traditional traffic management systems to manage their networks, including experts in UTC, UTMC and traffic engineering. CV data use is currently in its early stages, so these staff lack knowledge of the emerging use cases. Some feel that CV data is still cutting-edge technology that will distract them from their main responsibilities, not realising that actually it could make their operations more efficient, freeing up time and resources for other things. People can even be reluctant to explore new technologies which they think might make their more traditional skills less valuable.

We also found a lack of awareness from some authorities about government policy; for example, some were not aware of the FOMUS objectives and the opportunities for CV data to support them. Similarly, people are

[7] https://www.gov.uk/government/publications/local-transport-data-discovery-findings-and-recommendations

not aware of the evidence that other authorities are already benefitting from costs reductions through the use of CV data.

Lack of resources in road authorities

Local authorities have seen staff reductions and budget reductions due to austerity measures in recent years. This means that their staff find it very difficult to make time to investigate new opportunities, especially with their lack of knowledge. Funding of CV technologies is also a problem. The DfT has funded many C-ITS pilots, however these have been relatively small and short term with no ongoing funding after the end of the trial. Another key issue is the established model of capital rather than operational expenditure, preventing the use of CV data as a service.

Lack of sharing to obtain efficiencies

Because CV data use currently occurs on a small scale in a limited number of authorities, the opportunities for sharing data to obtain cost efficiencies are restricted. Lack of communication between different departments or authorities creates silos. This is preventing the procurement of much larger data sets (within authorities or between authorities) which would drive down costs.

Procurement, IT, governance issues

Some standard procurement processes are based on traditional traffic management systems and do not easily allow the use of new data and services. Similarly, IT and data governance requirements can make it difficult to set up new systems. These issues could be overcome but only if the business case is clear enough for people to be willing to make the necessary changes.

Lack of visibility of potential savings and benefits

There are two key issues with the business case for CV data. Firstly, some of the newer data types and services do not yet have sufficient evidence for the business case to be clear, for example GLOSA and asset management. Secondly, for some data types such as smarter parking the benefits have been proven, but many authorities have no awareness of them so do not yet realise they could achieve similar savings.

Lack of standards or visibility of standards

Common standards have not yet been established for some data types, for example asset management data. For many data types, the standards have been created but are not yet well known or understood. Technology integration can be an issue where authorities want CV data to be retrofitted to an existing data source so that the previous investment is not wasted, but this is not always possible.

There are also concerns about the use of proprietary data rather than open data, and multiple proprietary alternatives preventing sharing of data between authorities in a standard way.

GDPR

There is a perception that CV data is difficult to use because of GDPR issues and this is often mentioned as a barrier to using it. However, data suppliers have extensive experience of anonymising data so many use cases do not have any problems relating to GDPR; the problem is actually the lack of understanding. There are some specific use cases which would need careful consideration, such as sharing some safety data specific to individual drivers, but these instances are rare. However, some data suppliers do regard perception of privacy as a key barrier to wider data sharing and so do not provide the full range of data.

Data quality

Some authorities are keen to share their data, and third parties would like to access it to provide in-vehicle driver information, but the data is not yet sufficiently good quality for suppliers to trust it.

Cyber risks

Data storage, transmission and manipulation have potential risks from malicious attack, security breaches or corruption of services that rely upon them.

Human machine interface (HMI) safety risks

Stakeholders expressed concerns about safety risks associated with the HMI used to display CV-based driver information. This relates to information displayed on smartphone applications and retrofitted devices as well as integrated vehicle displays.

Lack of clear point of contact

Vehicle manufacturers and service providers do not know who to contact to engage with road authorities about sharing data or providing services. Ideally, they would prefer a single government contact rather than needing to establish multiple contacts with many different authorities.

Lack of vulnerable road user data use cases

While government policy has strong objectives to prioritise active travel, CV use cases to support these objectives are less developed than for other service groups. There have been limited trials of cycling and pedestrian use cases (although some have been performed in Europe and the US) and few options are visible to road authorities. This has recently become a more urgent problem with the government response to COVID-19, which has more focus on active travel.

2.4. Overview of the current situation – why have a strategy?

Our consultation concluded that there are three main drivers for having a CV data strategy:

1. **The need to deploy rapidly at scale**
   Trials and pilots of CV data usage by road authorities show a great deal of promise. However, they have only been conducted in a few locations with resources and momentum for roll out limited. A step change to be successful at scale deployment is required.

2. **The need to define and promote the technology**
   The concepts of Day 1 and 1.5 C-ITS[8] connected vehicle services are not fit for 2020s or the UK's needs. They can be difficult to comprehend as they are technology led and since their creation some areas, notably parking, have advanced considerably. A simplified list of CV data services is required that promotes wide use of CV data to align with current policy, deliver clear operational efficiencies and improve user experiences.

3. **The need to provide guidance**
   Guidance and assistance to catalyse and sustain use of CV data are required. This ranges from improving procurement of and access to data, training and upskilling of workforces, and assisting authorities to modify their operations to accommodate CV data including how to migrate from current solutions.

[8] C-ITS Platform Phase II Cooperative Intelligent Transport Systems Towards Cooperative, Connected and Automated Mobility. European Commission Report. 2017.
https://ec.europa.eu/transport/sites/transport/files/2017-09-c-its-platform-final-report.pdf

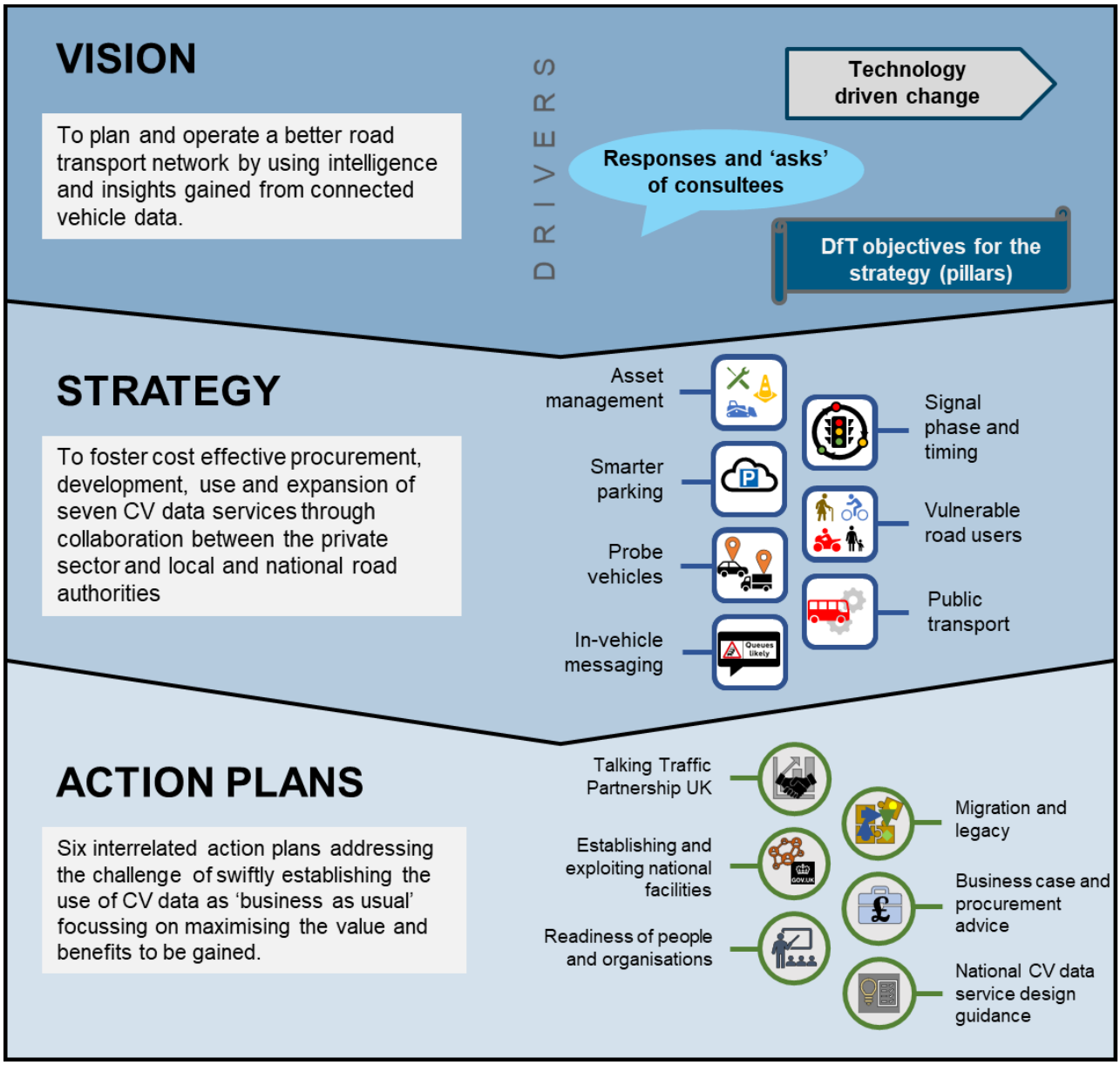
3. Rationale for the proposed strategy

3.1. Overview

In this section, we identify key CV "service groups" and the high potential value of the CV data in those services. Effective delivery of these key services should be the goal of the strategy. This leads on to the themes we propose for the strategy action plans, based on the discussions held and analysis performed. This approach is summarised in Figure 3-1.

We also demonstrate how the strategy addresses the challenges for CV data, aligns with FOMUS and maximises the opportunities.

Figure 3-1 - From vision to strategy to action plans



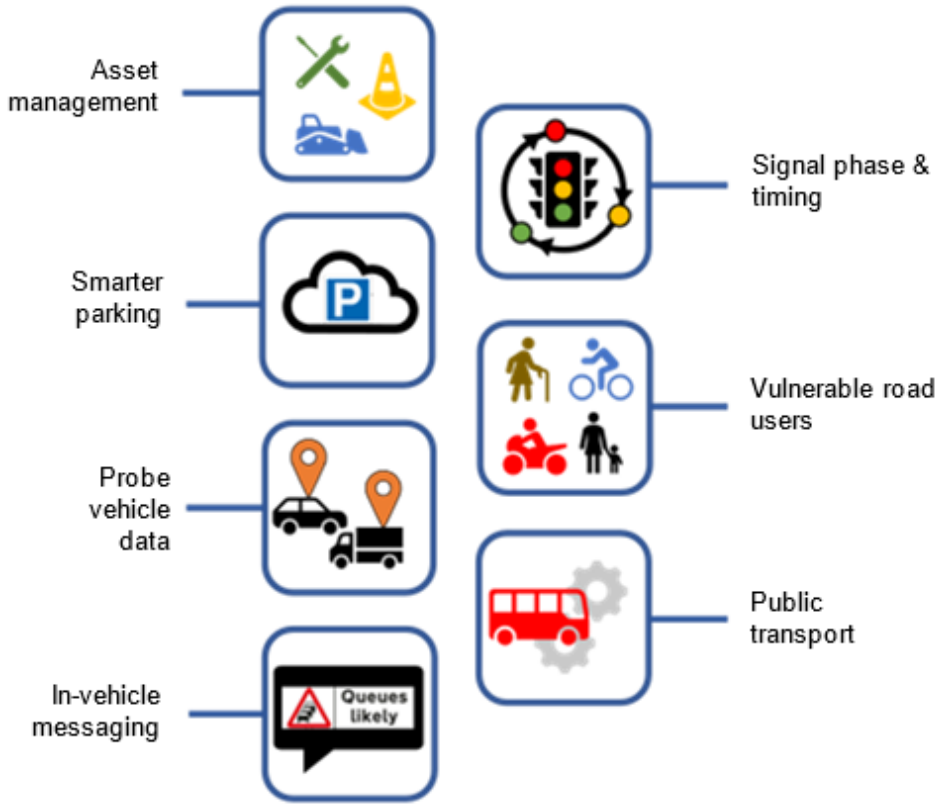
3.2. Identification of high value CV data sets

3.2.1. National CV service groups

For the purposes of this strategy we have identified seven key groups of customer facing CV services, shown in Figure 3-2. We did this by reviewing the C-ITS day 1 and 1.5 services, updating them and adding to them to reflect UK needs and the current state of play. These service groups cover all the services currently used in the UK or likely to be used in the next five years, as well as priority areas for the strategy to support the FOMUS objectives (vulnerable road users and public transport).

The service groups and their associated data types are briefly described in section 3.2.2, with the opportunities for sharing CV data for each. Section 3.2.3 summarises the potential benefits and timescales for each service group.

Figure 3-2 - Seven key national CV service groups



3.2.2. Description of service groups

Asset management

This refers to use of CV data to improve physical roads maintenance. There have been many trials of asset management services but they are not yet widely used. However, suppliers have indicated that they are close to or at market with initial products. The data types include processed asset images from cameras, road surface condition data from accelerometers and crowd sourced defect reports as well as data from vehicles' own sensors.

The asset management services will focus on the use of automatically collected data, combined with machine learning algorithms to augment or even replace typically labour-intensive surveys. It will allow for a much greater range of preventative and pre-emptive repair of assets because problems are identified as they arise, rather than during scheduled inspections. Labour costs will be reduced due to earlier identification of problems and congestion will be reduced due to more efficient repair and maintenance planning.

All road authorities could benefit from significant cost savings if these services become business as usual. This could start to happen within the next 1-2 years, and be rolled out nationally within 5 years.

Smarter parking

Smarter parking is already being used by several authorities, providing administration cost savings and increased revenues. Take-up is good because users like the systems as they can identify locations with spaces available, compare prices and pay for their parking via apps. Electric vehicle charging is a subset of smarter parking; in future integrated kerbside management and intelligently managed parking will be used. Data types include parked vehicle locations (V2I), charging bay locations, occupancy and prices (I2V), and online payment.

With real examples of authorities benefitting from smarter parking, others will follow, meaning the benefits, if rolled out nationally, are clear and could be achieved within 3-5 years.

Probe vehicle data (PVD)

Probe vehicles are equipped with a location device and a communication device; they may also contain other devices such as dashcam or radar and may share data from vehicle systems such as brakes and windscreen wipers. Basic data includes vehicle location, direction and speed. Additional data can include collisions (via eCall) and breakdown locations, weather data, origin-destination data and aggregated real-time speed and journey time data.

Satnav-based PVD is already widely used with services provided by Google, TomTom, HERE and INRIX, for example. Mobile network (cellular) based data has recently gained traction for measuring route journey times, although it provides less accurate location data. Much research has been performed into C-ITS V2X data, which would allow some safety applications (platooning, motorcycle warning, etc.). The C-ITS data types defined in the European ITS vehicular communication standards are the Cooperative Awareness Message (CAM) and Decentralized Environmental Notification Message (DENM).

The cashable cost savings for road authorities using PVD are lower than for asset management and smarter parking; they will mainly be due to reduced maintenance costs as roadside traffic detection infrastructure can be replaced by GNSS PVD to measure vehicle speeds. This is unlikely to start happening widely for 3-5 years. However, there are potentially significant economic savings due to congestion reduction from improved traffic signal optimisation and safety improvements such as using the untapped data from eCall. These economic savings are already starting to be achieved and could increase significantly if rolled out at scale. Congestion reduction could also result in a large GDP increase.

The eCall system has been mandatory on all new cars and light vans type approved for sale in the UK since 2018. The system uses GNSS and cellular communications to alert emergency services to the location of collisions and other incidents, with automatic and manual activations possible. Currently no further use is made of this data apart from by the emergency services.

In-vehicle messaging (IVM)

In-vehicle messaging uses an in-vehicle display to show information to the driver. This is already used in satnavs and other apps such as Waze and Google Maps using the satnav provider's own data. IVM data types include hazard warning data (roadworks, stopped vehicles or queues, obstructions and bad weather conditions), speed limit data, journey time data and dynamic route guidance.

Many warnings could be achieved through cellular comms which is technically feasible now. There are potential high safety benefits from authorities sharing their incident data to facilitate this, as well as congestion reduction as a result of dynamic route guidance around incidents and roadworks. It could take 3 years or more for road authorities to get systems ready to share this data, although some could do it sooner.

Other warnings will in future be provided via V2V communication using direct low-latency connectivity rather than the wider cellular networks; this could take 3-5 years before it can start to provide benefits. V2V communication will take place without much need for road authority involvement.

In the longer term, roadside signs may no longer be required when all information can be provided in-vehicle. However, this will require solutions for vehicles of all ages and safety issues around the HMI will need to be addressed, so could be 15 years away.

Signal phase and timing

SPAT allows the provision of green priority for HGVs or emergency vehicles and green light optimum speed advice (GLOSA). This is a proven technology and has been implemented at multiple sites; however, it is not widely used in the UK and the benefits are not yet fully understood. The data types include MAP data, SPAT messages (I2V) and CAM messages (V2I).

These services could reduce congestion and emissions and could start to be achieved within 1-2 years but this will require driver acceptance as well as road authority investment. It could therefore take several years before it is used widely enough to provide this level of savings.

Vulnerable road users (VRU)

Vulnerable road users (pedestrians, cyclists and motorcyclists) have the highest casualty and fatality rate per mile travelled of all road users. Transport policy has a key focus to improve this and also to encourage active travel, meaning use of connected vehicle data for VRUs must be considered as part of this CV data strategy. Potential use cases include cyclist and motorcycle warning systems. Unfortunately, as they rely on a large number of equipped vehicles for success, VRU services are unlikely to be widely used and providing safety benefits for at least 5 years. Data types include location, speed and direction of cyclists and hazard warning messages for vehicles. The savings will be for the economy as a result of reduced VRU collisions but will be relatively low compared to other services (because the actual number of collisions is low even though the rate per mile is high).

Public transport (PT)

Public transport is one of the oldest use cases for connected vehicle data with bus priority and real time passenger information (RTPI) systems using the location, speed and direction data of buses in real time. The benefits are mainly due to improved journey times for buses and trams and increased use of public transport due to improved traveller confidence. While these benefits are relatively low, PT CV data is widely used by UK roads authorities.

Again, because of the policy focus on modal shift away from cars, PT data should be considered as part of this CV data strategy. One CV intervention being considered by some authorities is to provide drivers with in-vehicle information about PT journey times where they are quicker than car, to encourage modal shift. Other countries are using advanced PT services, such as Singapore where the buses have internet of things (IOT) connectivity[9]. The DfT is currently running the Bus Open Data Service initiative which should provide more data sources to combine with bus data.

3.2.3. Value analysis of the CV service groups

Through our consultation and evidence gathering exercise, we performed a high-level review of the potential economic savings of CV data for the service groups described in Section 3.2.2. The detailed results are contained in Deliverable 02: Consultation Report and provide values for cost savings, benefits to the economy and improvements to gross domestic product. Table 3-1 shows a summary of the benefits identified.

Large cost savings can be gained from smarter parking and asset management allowing road authorities to use the savings elsewhere or make real savings. Smarter parking could provide large annual cost savings immediately and CV data for asset management could be ready within two years. Other data types can provide large savings for the economy through improved safety, reduced delays and emissions. Probe vehicle data could make these savings immediately and in-vehicle messaging within five years. SPAT could also provide economic savings through congestion and emissions reductions.

The savings associated with the use of CV data for VRUs are less clear, but because this is a high priority for DfT, the strategy will consider how this can be improved. Public transport is also a high priority; buses are already well-served with CV data so there is no immediate improvement to be gained. However, the use of CV data is likely to increase for new mobility services so we should consider how the strategy could support this area.

This indicates that the hypothesis we were asked to consider is correct:

> "The intelligence that connected vehicle data provides will be invaluable in helping plan and operate a better road transport network – and at a lower cost. This will provide benefits for the environment, congestion, safety and the economy."

[9] Asia Pacific Country Report, Singapore 2019: http://itsasia-pacific.com/wp-content/themes/its/images/CountryReport_Singapore.pdf

Table 3-1 - Summary of annual values* associated with data relating to seven service groups

Service group	Data type examples	Cashable cost savings for road authorities	Economic savings from congestion, safety, emissions improvements	Timescales
Asset management	Asset images; accelerometer road surface condition data; crowd sourced defect reports	High	Low	1-2 yr
Smarter parking	Parked / charging vehicle location; parking / charging bay location, occupancy, usage; online payment	High	Medium	Now
Probe vehicle data	Vehicle location, heading, speed; average speed / congestion at road location; origin / destination locations; journey times; collisions; breakdown	Low	High	Now
In-vehicle messaging	Hazard warnings; speed limits; incident / congestion advice	Low	High	3-5 yr
Signal phase and timing	SPAT; HGV location, speed and heading; emergency vehicle location, speed and heading	Low	Medium	1-2 yr
Vulnerable road users	Cyclist location, speed and heading	Low	Low	5-10 yr
Public transport	Bus location, speed and heading	Low	Low	Now

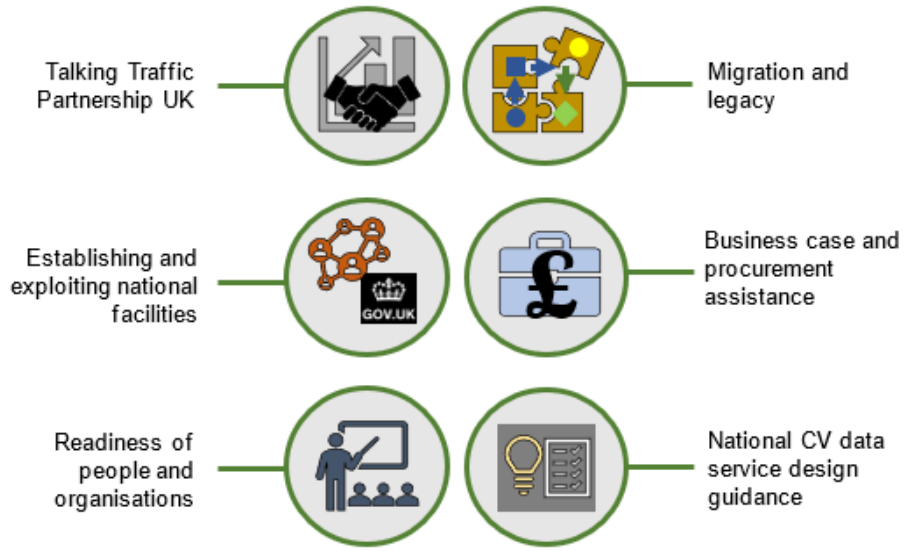
** High: £100Ms, Medium: £10Ms, Low: £1Ms*

3.3. Proposed action plans

3.3.1. Overview of Action Plans

Supporting the uptake of the CV data services described in section 3.2 needs actions targeting how to establish the services and promote wide and regular use. We have identified six action plans which will address the needs of road authorities, helping them overcome the challenges and maximise their opportunities for CV data, see Figure 3-3.

Figure 3-3 - Six proposed action plans



The action plans are described briefly below and in more detail in section 4.

1 Talking Traffic Partnership UK

DfT could set up an at-scale demonstrator to stimulate the growth of CV data use and demonstrate the benefits to stakeholders and public.

This could include large-scale demonstration of multiple CV data services across a region using a public / private partnership model, similar to a successful initiative in the Netherlands (see section 4.1.2). Key activities:

1.1 Talking Traffic Partnership UK; at-scale demonstrator

2 Establishing and exploiting national facilities

DfT could provide national facilities where this will drive progress, for example, national procurements to gain efficiencies and providing a focal point for stakeholder engagement.

Key activities:

2.1 DfT procurement and distribution of data sets such as FVD, to simplify and accelerate the use of data.

2.2 At scale facilitation including being first point of contact for motor manufacturers and suppliers.

2.3 Progression of national access point, including data standards.

3 Readiness of people and organisations

Training and support could be provided for roads authorities, to address skills and knowledge gaps and need for cultural change; both barriers to the greater use of CV data.

Key activities:

3.1 Training courses on CV services and also key issues such as GDPR, cyber, procurement.

3.2 Central resource pool of experts who can work with an authority for a defined period to help them set up a CV service.

3.3 Central pool of business change experts to support authorities with cultural change aspects.

4 Migration and legacy

Road authorities could be given support to make the best use of their existing ITS and asset management technology while migrating to CV data.

Key activities:

4.1 Best practice guidance on migration pathway to help authorities move to CV data for existing systems.

4.2 Digitisation, for example traffic regulation orders to support smarter parking, in-vehicle messaging

5 Business case and procurement advice

Assistance could be provided for roads authorities, so they can successfully generate investment and procure CV data or services.

Key activities:

5.1 Create evidence library for benefits of CV data which authorities can use to create business cases.

5.2 Provide risk and responsibility advice including for cyber and GDPR.

5.3 Link with the local authority mobility platform (LAMP)[10] which provides a collection of guidance notes and processes to support the development of business cases and procurement.

6 National CV data service design guidance

Service design guidance and standards should be created to provide road authorities with the information they need to design and implement CV data services.

It is clear that a weakness of many current projects is that they focus too much on the technology and not the user experience. For services like in-vehicle messaging, if the user experience is not good then

[10] https://www.ttf.uk.net/lamp/

the system will be ignored or turned off – unlike traffic signals it is not mandatory. Hence it is vital that the strategy addresses the service to the user. “Service design” is a term for creating services that deliver desired user outcomes. It is commonly used in the data, digital and technology world and by government and public sector. It ideal for thinking about use of CV data.

Key activities:

6.1 Standards development for CV services.

6.2 CV data service design guidance.

3.3.2. How will these six action plans address the challenges?

The action plans address the challenges described in Section 2.3.3. Table 3-2 shows that each challenge is addressed by at least one action plan, meaning there are no gaps in the strategy. It also shows that many of the action plans address many challenges, demonstrating that there is great value from each theme.

Table 3-2 - How the action plans address the challenges for CV data use

Challenge to be addressed	Talking Traffic UK	Establishing & exploiting national facilities	Readiness of people & organisations	Migration and legacy	Business case and procurement advice	National CV data service design guidance
Skills and knowledge in road authorities	✓		✓		✓	✓
Lack of resources in road authorities		✓		✓		
Lack of sharing to obtain efficiencies	✓	✓				
Procurement, IT, governance issues			✓		✓	✓
Lack of visibility of potential savings and benefits			✓		✓	
Lack of standards or visibility of standards	✓	✓	✓	✓		✓
GDPR			✓		✓	
Data quality		✓	✓	✓	✓	✓
Cyber risks		✓	✓			
Human machine interface (HMI) safety risks		✓	✓			
Lack of contact points with industry	✓	✓				
Lack of VRU use cases	✓					

Appendix B shows how the strategy aligns with FOMUS and how it answers the ‘asks’ from the consultees.

3.3.3. Impact versus effort for the key activities for each theme

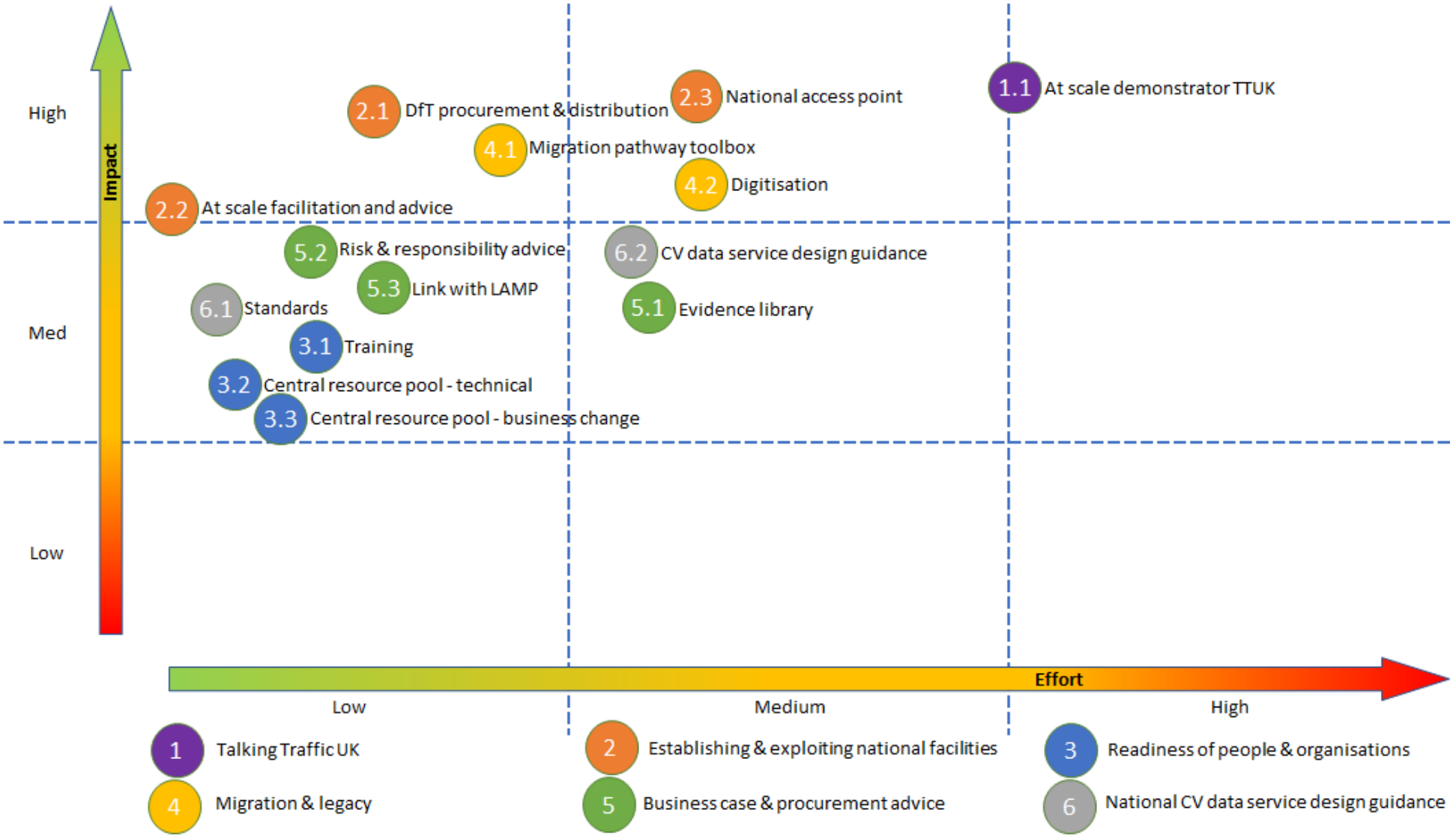
Figure 3-4 shows the relative effort required to perform key activities associated with the action plans, and the relative potential impact of these activities on increasing the use of CV data services.

These were obtained by:

- Using our knowledge and judgement about
  - The effort required for each activity for each of the seven CV services
  - The impact of each activity for each CV service, meaning how it will help to achieve the values for each service as summarised in Table 3-1
- Taking an average across the CV services for each activity

The graphic shows that none of the proposed activities have a low impact, meaning they will all generate a positive return on investment. The key activities are each described further in the action plans, see section 4.

Figure 3-4 - Effort and impact associated with each key activity



3.3.4. How will these six action plans address the CV data service groups?

The themes generally apply across all services; this is to be expected because many of the challenges which the strategy is designed to address apply to all services. There is some variation as explained in Table 3-3.

Table 3-3 - Relationship between action plans and CV data service groups

Effectiveness of each action plan for accelerating CV data use by service group	Asset management	Smarter parking	Probe vehicle data	In-vehicle messaging	Signal phase and timing	Vulnerable road users	Public transport	Notes
Talking Traffic UK	●●●	●●●	●●●	●●●	●●●	●●●	●●●	Accelerate all services; targeted effort required for VRU & PT
Establishing & exploiting national facilities	●●○	●●○	●●●	●●●	●●○	●●●	●●●	Targeted central effort required for VRU & PT. Central procurement of FVD. Central engagement with suppliers required for IVM.
Readiness of people & organisations	●●●	●●○	●●●	●●○	●●●	●●○	●●○	Quick wins from asset management, smarter parking, PVD, SPAT if authorities ready
Migration and legacy	●●●	●●○	●●○	●●○	●●●	●●○	●●○	Lots of existing infrastructure / processes needing migration for asset management, SPAT
Business case and procurement advice	●●○	●●○	●●○	●●○	●●●	●●○	●●○	Business case unclear for SPAT, needs work. Suppliers will support smarter parking, asset management and PVD so less important.
National CV data service design guidance	●●●	●●○	●●●	●●●	●●●	●●●	●●●	Standards and service design guidance required for all services except smarter parking, to provide consistency across services.

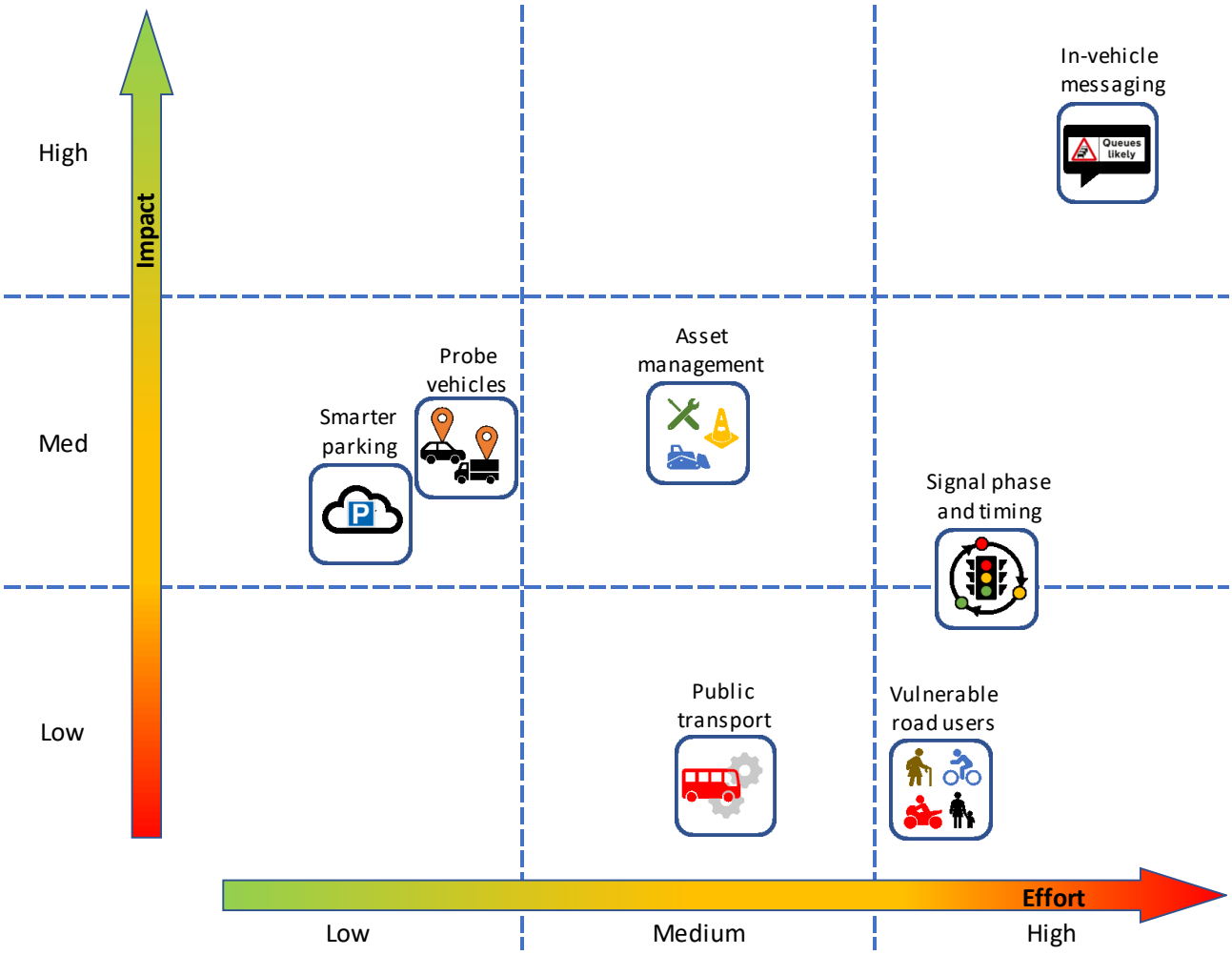
3.3.5. Impact versus effort analysis of CV data services

With our proposed strategy, the effort required to support the seven service groups and the resulting impact is shown in Figure 3-5.

The impact is based on the values identified in the consultation report and summarised in Table 3-1. Effort is determined from a combination of:

- Capital cost
- Number of contact points
- Amount of training and education required
- Amount of in-vehicle equipment required
- Amount of roadside infrastructure changes required
- Amount of communications technology required
- Need for innovation

Figure 3-5 - Impact versus effort for CV data services



The graph shows that for in-vehicle messaging, smarter parking, probe vehicles and asset management, the impact is equal to or higher than the effort required.

For signal phase and timing, the effort is high due to the requirement for equipment changes. The benefits are not fully understood, so a cautious estimate of impact is shown in the graph due to this uncertainty. If evaluation shows more positive impact, the investment will be shown to be more worthwhile.

For VRUs, the high effort is related to the current lack of use cases, meaning that significant investment will be required to progress this area. VRU services would also be likely to require a large proportion of vehicles (including cycles and motorcycles) to be equipped with in-vehicle devices. The benefits are expected to be

relatively low due to the relatively few VRUs in the overall population of road users. However, it is of key strategic importance.

Similarly, public transport is a high priority but has relatively low value visible today, based on the services currently being researched and developed. If we consider the potential societal impacts of increasing active travel and public transport usage, the eventual benefits could be high but there is insufficient certainty about what is possible.

4. Action plans for delivery

4.1. Recommended approach

4.1.1. Summary of Action Plans

The main objective is to promote wide use of CV data in traffic management to maximise benefits. To achieve this, we propose six interrelated action plans. Three are pump priming actions to accelerate adoption at scale of CV data. The others are longer term supporting actions, that may be later subsumed into other initiatives once mature. All help establish and support the seven CV data service groups through user driven service design.

Table 4-1 lists the action plans, assessing the effort and impact of each action, the benefits (cost savings, economic benefit, contribution to GDP growth, secondary 'quality of life') , and an outline cost estimate.

Table 4-1 - Summary of action plans for delivery

	Action Plan	Effort	Impact	Secondary benefits	Cost estimate for 3 years
	Pump Priming				
	Talking Traffic Partnership UK	H	H	H	£100m
	Establishing and exploiting national facilities	M	M/H	M	£30m
	Readiness of people and operations	L	M	L	£4m
	Longer Term Support				
	Migration and legacy	L/M	M/H	L	£10m
	Business case and procurement advice	L/M	M	L	£10m
	National CV data service design guidance	L	M	M	£4m

The action plan tables describe the overall objective, the challenges to be met, its goals and an effort / impact assessment. It then presents three timeframes (now, next, later):

Now: within the next year

Next: within the following year

Later: up until five years from now

The actions are described, and the suggested role for DfT:

What: prepare, establish, support, stop, no action

DfT Role: own, lead, fund, organise, moderate, observe

Overall benefits assessments are provided with supporting text. An outline cost estimate is given and a list of projects, initiatives and funding currently underway provided. Finally, we assess the support given by the action plan to the four pillars/objectives set out by the DfT, as measures of success.

4.1.2. Talking Traffic Partnership UK as the centrepiece

The 'Talking Traffic Partnership UK' initiative is the centrepiece of the strategy and will have the biggest impact. The concept is based on a similar, successful Dutch project, adapted to work in the UK. The Netherlands has faced similar issues to the UK in exploiting CV data, and their solution there is the Talking Traffic Partnership[11], which has invested in a targeted stimulus to industry and the public sector. The total budget is €70m and the project is being delivered between 2018 and 2022, with the capital investment due to complete in 2020.

The Talking Traffic Partnership is a collaboration between the Dutch Ministry of Infrastructure and the Environment, 60 regional and local authorities and national and international private companies. It began in 2017.

The partners are working together to accelerate development and deployment

- (cluster 1) process, enrich and distribution of a wide variety of data
- (cluster 2) convert this into real-time and made-to-measure data sets and information
- (cluster 3) provide this information to a wide variety of road users though their smart phones, PNDs and in-car systems.

This joint co-investment program seeks to enhance the availability of intelligent data for a wide group of road users (cars, trucks, public transport, emergency services, cyclists).

This way, the safety and sustainability of traffic and transport can be enhanced resulting in the reduction of travel times and, eventually, lower public expenditure.

"The Talking Traffic Partnership showcases the Netherlands' strengths: government and businesses are jointly taking responsibility to improve the flow of traffic in urban areas using smart new technologies."

- Minister Melanie Schultz van Haegen Ministry of Infrastructure and the Environment

4.1.3. Supporting action plans to maximise the benefit

To maximise the value of the investment in Talking Traffic Partnership UK, the other five action plans have a key role. They are required to improve technology, upskill people and authorities. Without these activities, the value of the Talking Traffic Partnership UK will not be fully realised after it is finished.

[11] https://www.talking-traffic.com/en/

4.2. Talking Traffic Partnership UK

	**Talking Traffic Partnership UK**	A major at scale investment in new and upgraded technology to make authorities leading practitioners of CV data led traffic management and place the UK at the forefront of the market. To be delivered as a partnership between government, the private sector and local authorities	**Effort** ●●● **Impact** ●●●

Challenges	Creating partnerships with industry to make it work. Upgrading equipment and systems to cater effectively with the growth of CV data and demonstrate the benefits to stakeholders and the public at scale	**Goals**	Put in place the technology to create a local and national CV data driven environment that enables insights and services across the road network.

DELIVERY					
 **Prepare**	Consult widely on how to set up Talking Traffic UK for maximum impact and value, using the Dutch Talking Traffic initiative as a model from which to learn and adapt.	 **Establish Support**	Put in place procurement, support and finance Set up industry partnership agreements Implement Talking Traffic UK Showcase at ITS World Congress, Birmingham 2024	 **Stop**	The budget for Talking Traffic UK will cover a fixed period. Future spending to be at lower levels – partnership to change from supplier / customer relationship to partners with industry able to provide services, to sustain CV data traffic management
DfT Roles(s)	Organise	**DfT Roles(s)**	Own, Fund	**DfT Roles(s)**	Moderate

IMPACTS	**What it means by CV Service**	**Work already underway**	**Pillar Support**
	Existing well-tested services for parking, FVD, GLOSA to be implemented at scale, meaning they could be rolled out nationally later Asset management services should be ready for implementation at scale Implement PVD sharing of incident data in accordance with EU data directive – SRN and wider network Implement specific IVM use cases at scale for hazard warnings etc in partnership with motor manufacturers and / or service providers; use to investigate HMI impacts Take learning from NL and other EU countries to implement specific cycling use cases at scale Implement specific PT use cases (MaaS / bus priority) at scale – potential to link with FTZs	Discussions with Netherlands Scoping of national business case Several candidate areas developing CONVEX as potential data platform Requirements for GLOSA National Parking Platform National Access Point A2/M2 learning Highways England EU data directive	☑ ☑ ☑ Align with policy objectives ☑ ☑ ☑ Bring day to day efficiencies ☑ ☑ ☑ Exploit data tech investment ☑ ☑ ☑ Improve user experience

COST / BENEFIT	**Cost**	**Economic benefits by CV service**	**Secondary benefits**
	£100M - estimate based on Talking Traffic in the Netherlands	High cashable savings likely to be achievable within the TTUK region during the project for asset management and smarter parking; use TTUK evaluation to demonstrate high benefits to support evidence library. Procurement of FVD for entire region has potential for signals optimisation, traffic engineering improvements Benefits from PVD safety data IVM will depend on vehicle penetration / driver take-up. Use TTUK to comprehensively evaluate SPAT impacts as they are not yet understood and use results for evidence library. VRU and PT benefits likely to be low in the timescales	Significant involvement of general public will bring improved understanding and buy-in. Collaborative partnerships established

4.3. Establishing and exploiting national facilities

	Establishing and exploiting national facilities	Procurement, creation and maintenance of national data contracts, access points, data services and standards. Creating economies of scale though a national one stop shop and avoiding multiple small contracts with individual local authority departments for relatively small volumes of data. DfT acting as central point of contact and driving developments in CV data where appropriate	Effort ●●○ Impact ●●●

Challenges	Establishing procurement and access to CV data to provide access to a full variety and volume of CV data	**Goals**	Maximise access to all forms of CV data so that they are used to their potential as data is easily available in a standard format. Stimulate innovation by making it easier to access and discover data. Promote standardisation of datasets and nationwide service provision and delivery to local authorities, service providers and motor manufacturers

DELIVERY	Now	Next	Later
	Consult about national PVD feed and prepare to procure Investigate asset management potential national data solution and national GLOSA hub (e.g. MAP files) **Prepare** Consider national GLOSA specification **Support** Continue to develop NAP and data standards	**Establish** Establish national PVD service and promote access to data – e.g. free access then pay as you grow. Ensure sufficient tools and expertise available for LAs to use data in systems/ processes Use innovation funding to drive development of VRU and PT services in the UK	**Support** Continuing national service, procurements and facilities. May transfer procurement to national platform e.g. CONVEX
	DfT Roles(s) Own, Lead, Fund	**DfT Roles(s)** Fund	**DfT Roles(s)** Own

IMPACTS	What it means by CV Service	Work already underway	Pillar Support
	Procurement of a national FVD service would bring high cost efficiencies. Possibly also asset management data. National access point would be useful for asset management, smarter parking, PVD, IVM and SPAT services. Publishing parking data would be high effort but high value. MAP data could be published for GLOSA. NAP for IVM is high effort but essential. VRU and PT progress will be slow without DfT investment in research and development.	TTF Local Authority data store during C-19 CONVEX National Access Point SBRI research projects Highways England and TfL procurements of PVD LCRIG, ADEPT and other LA projects eCall projects (awaiting access to data) GLOSA national specification	☑ ☑ ☑ Align with policy objectives ☑ ☑ ☑ Bring day to day efficiencies ☑ ☑ ☑ Exploit data tech investment ☑ ☒ ☒ Improve user experience

COST / BENEFIT	Cost	Economic benefits by CV service	Secondary benefits
	Real time FVD data feed – estimate £10M annually based on supplier products NAP and national facilitation – estimate £1M annually	Cashable cost savings from large-scale procurement of real-time FVD feed. Possibly also for asset management. National access point could accelerate the use of IVM and SPAT services, providing safety and congestion benefits to the economy. VRU and PT benefits likely to be low in the next 5 years	Contributes to creating high value services for end consumers by third parties

4.4. Readiness of people and organisations

	**Readiness of people and organisations**	Without people within roads authorities who know how to use and exploit CV data, the benefits will be lost. An 'Academy' is required to provide a programme of structured courses to inform, train and upskill staff with delivering the operational changes resulting from CV data Regional or national funding of temporary additional specialist resources will help authorities set up services using CV data	**Effort** ●○○ **Impact** ●●○

Challenges	Upskilling and freeing up the time of LA staff so that they are all able to exploit the potential of CV data without compromising delivery of current services. Cultural change to be ready to accept new data types	**Goals**	Deliver a programme of comprehensive training to maximise early realisation of benefits from CV data. Provide specialist resources in CV services and business change

DELIVERY	 **Prepare**	Consult on Academy and establish detailed needs and suppliers Look at traffic signal engineering national resource to extend for CV data Tender for Academy contract	 **Establish Support**	Academy provides free courses for LAs, consultancies and industry A central resource pool of experts will support authorities for short fixed periods to set up particular CV services A central resource pool of business change experts will support authorities to make the cultural changes required	 **Stop**	Assess success of Academy Set out plans to stop / re-focus / continue Academy services
	DfT Roles(s)	Own	**DfT Roles(s)**	Fund, Moderate, Observe	**DfT Roles(s)**	Organise

IMPACTS	**What it means by CV Service** Training courses for all data types: • Can start training immediately for smarter parking, FVD and GLOSA. • Training for asset management and IVM will start in the next 1-2 years once services are fully available from suppliers. • VRU and PT training will not be useful until services are available. Additional training in GDPR, cyber, procurement and evaluation supports all data types. Central resource pool particularly useful for parking and SPAT; and in future, asset management and IVM. Central resource pool for cultural change supports all data types	**Work already underway** TTF traffic signal training TTF expert groups Industry support SBRI projects LAMP	**Pillar Support** ☑ ☒ ☒ Align with policy objectives ☑ ☑ ☒ Bring day to day efficiencies ☑ ☑ ☑ Exploit data tech investment ☑ ☑ ☑ Improve user experience

COST / BENEFIT	**Cost** Training - £1-2M Central resource pools (technology and business change) - £1M per year, estimate based on approx. 10 FTE	**Economic benefits by CV service** Immediate cashable cost savings for smarter parking if training encourages authorities to implement it. Similarly for asset management in the near future. Immediate benefits for FVD use (improvement network management / signals optimisation. PT and VRU benefits will be longer term.	**Secondary benefits** Road authority relationships improved through training and knowledge sharing

4.5. Migration and legacy

	**Migration and legacy**	Authorities have made long term investments in public transport, asset management and traffic control systems. Support is needed to make best use of this while migrating to CV data	Effort ●○○ Impact ●●○

Challenges	Integrating with legacy systems. Enabling change where new data types become central to traffic management, but authorities may not yet understand or wholly trust them.	**Goals**	A toolbox for change, guidance and best practice, e.g. for transition of SCOOT and MOVA and existing asset management systems. Digitisation of methods and systems, use of common platforms and facilities to store, access and use CV data across silos. Embedding service design in migration to maximise potential benefits.

DELIVERY	Now	Next	Later
	Support Document solutions for migration of isolated signals, UTC, SCOOT, MOVA, parking, asset management. National GLOSA specification including CROCS (controller to roadside open C-ITS standard). Continue to engage with asset management suppliers to understand timescales for at scale CV data products and services.	**Support** Develop and promote standards to support migration, provide guidance and share best practice • SCOOT, MOVA, and stand-alone signals optimisation • Replacement and augmentation of traffic detectors with PVD • Digitisation of TROs • Digital asset management using CV data services	**Stop** Continue to horizon scan – perhaps through TTF.
	DfT Roles(s) Own, Lead	**DfT Roles(s)** Fund, Organise	**DfT Roles(s)** Moderate

IMPACTS	**What it means by CV Service**	**Work already underway**	**Pillar Support**
	GLOSA services accelerated if there is a clear way forward for SCOOT, UTC, MOVA. Asset management services accelerated if clear methods to integrate CV data with existing processes and systems. Digitisation of TROs will support parking, intelligent speed adaptation and roll-out of automated vehicles. VRU and PT services will benefit from integration with SCOOT / MOVA / SPAT.	SBRI projects LAMP C-ITS projects NAP/ CONVEX CROCS eCall	☑ ☑ ☑ Align with policy objectives ☑ ☑ ☑ Bring day to day efficiencies ☑ ☑ ☑ Exploit data tech investment ☑ ☑ ☑ Improve user experience

COST / BENEFIT	**Cost**	**Economic benefits by CV service**	**Secondary benefits**
	Migration pathway toolbox - £2M Digitisation of TROs - £5M	Smarter parking cashable savings can be realised sooner as a result of TRO digitisation Asset management cashable savings can be realised sooner with migration pathway Maximised benefits of previous investments in traffic management and asset management technologies	Digitisation contributes to greater organisational efficiency in road authorities.

4.6. Business case and procurement advice

	**Business case and procurement advice**	Having a clear business case will help road authorities invest in CV data and transition existing services. This needs evidence of benefits to be captured from previous, current and future evaluations. It also needs indicative costs for deployment. This could be done in conjunction with LAMP as part of a national, coordinated and collaborative strategy.	**Effort** ●○○ **Impact** ●●○

Challenges	Many authorities do not understand how CV data could support them. Existing procurement can be incompatible with CV data, and capital vs revenue LA spending is not ideal for CV data.	**Goals**	CV data becomes “part of the day job” with common understanding of good (or poor) investment for local use cases and user requirements. Moving the public sector towards partnership approach, data / information as a service.

DELIVERY		Develop national business case for each service group e.g. asset management Investigate PT and VRU data as under-established Link with Academy to promote understanding Use existing evidence to provide accessible evidence via LAMP		Update evidence libraries with emerging evidence. Provide best practice evaluation advice and enforce evaluation of DfT-funded pilots. Provide advice about ballpark costs, risk and responsibility as well as expected benefits Investigate common procurement issues and identify solutions		Merge into long term LAMP support
	Prepare **Establish**		**Support**		**Support**	
	DfT Roles(s)	Lead, Fund, Organise, Own	**DfT Roles(s)**	Fund	**DfT Roles(s)**	Organise

IMPACTS	**What it means by CV Service** Evidence already available for smarter parking and PVD but needs collating and sharing more widely. Additional evidence required for asset management, IVM and GLOSA; Talking Traffic UK can support this, e.g. through SPATULA. Significant effort required to investigate options for VRU and PT services and identify benefits. Risk and responsibility advice will support PVD and IVM in particular. Procurement advice will support all CV services. Evaluation guidance will allow benefits to be properly captured	**Work already underway** SOTN Report LAMP and National Business Case ADEPT/ BPA/ LCRIG work NAP/ CONVEX Innovate UK competitions SPATULA	**Pillar Support** ☑ ☑ ☑ Align with policy objectives ☑ ☑ ☒ Bring day to day efficiencies ☑ ☑ ☑ Exploit data tech investment ☑ ☑ ☒ Improve user experience

COST / BENEFIT	**Cost** Developing business cases for each service - £1M. Procurement, risk and responsibility advice - £1M. Further trials and evaluation where insufficient data - £5M	**Economic benefits by CV service** High for smarter parking; also, asset management once services are fully available. Medium for FVD if business case support allows authorities to reduce roadside infrastructure. Use TTUK evaluation to demonstrate high benefits. Potentially high future savings for PVD and IVM if clear business case demonstrated for safety, congestion and emissions benefits	**Secondary benefits** Wider understanding of CV data benefits for general public. Alignment of investment with policy objectives

4.7. National CV data service design guidance

	**National CV data service design guidance**	This service design guidance for introducing and using CV data should complement the Academy and provide best practice. It will outline what needs doing, when, and how to prepare; to plan, operate and support appropriate CV data. This includes promotion of standards.	**Effort** ●○○ **Impact** ●●○

Challenges	Provision of active and supported guidance and standards that help local authorities to use CV data.	**Goals**	Provide the 'recipe book' for purchasers, to explain and convince non-technical decision makers of the best action for them. Develop a service design that works across the nation. Maintain and promote standards.

DELIVERY

Now		Next		Later	
Prepare **Establish** **Support**	Create user requirements for the guidance through consultation and modelling Work with GDS, ADEPT, Highways England and others to plot common course of action Set out the common objectives for using CV data as part of business as usual Library of CV data standards, guidance and research (link with National Facilitation activity	**Establish** **Support**	Interactive web or downloadable version of guidance Service design approach used for multiple requirements across geographic, administrative and technical boundaries Stimulate innovation and development in CV data	**Stop or Support as required**	Assimilate service design guidance support into LAMP / TTF Review in light of experience
DfT Roles(s)	Lead, Organise, Moderate	**DfT Roles(s)**	Own/Fund	**DfT Roles(s)**	Fund

IMPACTS

What it means by CV Service	Work already underway	Pillar Support
All CV data services will benefit from individual service design guidance and standards. Overall service design 'big picture' is central to economies of scale (e.g. in data storage and analytics platforms) and cross-silo understanding.	LAMP CONVEX ERTICO 'C-ITS for Dummies' TTF Expert groups LCRIG SPATULA GLOSA specification	☑ ☑ ☒ Align with policy objectives ☑ ☑ ☑ Bring day to day efficiencies ☑ ☑ ☑ Exploit data tech investment ☑ ☑ ☑ Improve user experience

COST / BENEFIT

Cost	Economic benefits by CV service	Secondary benefits
Service design guidance - £1M Standards development - £1M per year	All CV data services will benefit from service design approach Economies of scale possible from service design approach (across silos / across services)	Service design approach will provide better user experience Easily accessible up to date information about CV data services will provide useful reference materials for many people

5. Conclusions and next steps

The consultation and analysis in this project have clearly shown that greater use of CV data will enable better planning and management of the road transport network, at a lower cost. Significant benefits for the environment, congestion, safety and the economy are achievable through improvements to traffic management and asset management.

A large and increasing number of vehicles are connected, meaning they will provide benefits before autonomous vehicles while also providing much of the data required by them. In fact, there is much untapped data than can be exploited quickly to improve our roads. Smarter parking, reduced congestion and better information are things that people want and are already feasible. The UK is leading globally on the use of CV data for asset management.

Importantly, there are cashable savings to be made in the short term from both smarter parking and asset management; this is a quick win and will provide an incentive for authorities to make the changes required.

A cultural change is needed, and commitment to accelerate the use of CV data. Technology not a key barrier; institutions, organisations and business models are. It is clear that there is no need to wait if we focus on data rather than communications; there are already solutions which are good enough, not perfect.

While there have been many successful trial projects demonstrating this potential, the next step must be on a much bigger scale, with multiple services, a large geographical extent and real drivers. Talking Traffic UK would be the catalyst for the national roll out of CV data services, building on the learning from the successful Dutch initiative.

For this to provide lasting results, authorities need training, support and accessible information to upskill, generate the business cases for the necessary investments and make the required cultural changes. Focussing this support on the seven CV data services will simplify the CV data landscape and provide a common national understanding of what is possible with CV data.

The Department can also support deployment from a national perspective. In the short term, this could include procuring national CV data feeds to make it easier and less costly for authorities to access data, which will accelerate its use. There will be an ongoing need to drive innovation and develop / promote standards, organise the national access point and be a single point of contact for suppliers and authorities.

Appendices

Appendix A - List of consultees

The organisations consulted for this project were:

40two
5GAA
A2/M2 Project
ADEPT
AECOM
AESIN
Aimsun
Appyway
ARTSM
AVL
Barehill Limited
Bittern Consulting
BMT
British Parking Association
Buckinghamshire County Council
BVRLA
Capita Real Estate and Infrastructure
Cheshire West and Chester Council
Chiltech
City Logik
City of York Council
Clearview Intelligence
Convex
Coventry City Council
CPC
DEFRA
Dynniq
Ford
GAIST
Google
Here
Hertfordshire County Council
Highways England
Highways Term Management Association
Hull City Council
Humanising Autonomy
IDT
Innovate UK
INRIX
ITS UK
Jaguar Land Rover
JCT
Justpark
Lancashire CC
LCRIG
Manufacturing Technology Centre
Milton Keynes Council
MTC
Nicander
Ordnance Survey
RAC Foundation
Realsafe technologies
SBD
Shadow Focus
Sheffield City Council
Siemens
Skyrise
SMMT
STREETWISE project
Surrey County Council
Talking Traffic Netherlands
TfL
TfGM
TfWM
The Floow
The IET
Tomtom
TOPAS
Trakm8
Valtech
Viasala
VISTEON
Vodafone
Warwickshire CC
Warrington Borough Council
West Berkshire Council
Zenzic

Appendix B - Alignment of strategy with FOMUS and 'asks' from the consultees

This investment would be fully aligned with the DfT's strategic objectives, as set out in the Future of Mobility Urban Strategy (FOMUS). The table below shows how this can be achieved.

Ref	Principle	How the CV data strategy can support
1	New modes of transport and new mobility services must be safe and secure by design.	Strategy considers cyber and GDPR; also HMI issues for in-vehicle messaging.
2	The benefits of innovation in mobility must be available to all parts of the UK and all segments of society.	Strategy based on the need for solutions to be feasible for all vehicle types (not just cars) and all ages (not just new models). It identified the need to prioritise PT and VRUs, e.g. through innovation funding.
3	Walking, cycling and active travel must remain the best options for short urban journeys.	Strategy considers how to accelerate VRU applications which are currently underdeveloped.
4	Mass transit must remain fundamental to an efficient transport system.	PT CV data is already well-established but strategy identifies that future opportunities will need investment as a priority, e.g. through innovation funding.
5	New mobility services must lead the transition to zero emissions.	The strategy shows that CV data can reduce congestion; it also considers link between connected and electric vehicles.
6	Mobility innovation must help to reduce congestion through more efficient use of limited road space, for example through sharing rides, increasing occupancy or consolidating freight.	The strategy identifies that CV data can support new mobility services.
7	The marketplace for mobility must be open to stimulate innovation and give the best deal to consumers.	The strategy promotes open data and the need to ensure open competitions.
8	New mobility services must be designed to operate as part of an integrated transport system combining public, private and multiple modes for transport users.	The strategy identifies that CV data can support new mobility services.
9	Data from new mobility services must be shared where appropriate to improve choice and the operation of the transport system.	The strategy promotes open data.

The strategy also addresses the 'asks' from the consultation:

Asks from consultees	How the strategy addresses them
Show how CV data aligns with both national and LA policy aims to give a business case (safety, productivity, efficiency, decarbonisation, digitisation, post Covid-19 recovery).	The alignment of the strategy with FOMUS is shown in **Error! Reference source not found.**. The business case and procurement advice action plan will help authorities align with local and national policy objectives.
Show how CV data can help road authorities do the day job better, improving network intelligence and achieving cost savings.	Training, best practice guidance, business case and procurement advice and service design guidance action plans will all help authorities understand how CV data can benefit them.
Use CV data to provide visibly better services for all road users, not just "connected cars"; freight and VRUs especially.	The strategy is designed to work for all road users, being agnostic to communications technology and including prioritisation of VRUs and public transport service.
Make the most of existing investment in (traffic control, asset management and other systems) using new techniques and data, levering off the data already there.	The migration and legacy action plan is designed to enable authorities to use existing systems while migrating to CV data use.
Remove silos of data inside and across road authorities and include wider data not just transport	The Talking Traffic UK, national facilitation, and readiness of people and organisations actions plans will all help to remove silos.
Have a clear single point of contact for vehicle manufacturers and service providers, both for access to data and to engage on future developments.	The national facilitation action plan will ensure that DfT acts as a central point of contact, drives innovation and supports national access point.

Specialist Professional and Technical Services (SPATS) Framework

ATKINS

Member of the SNC-Lavalin Group

Jacobs