

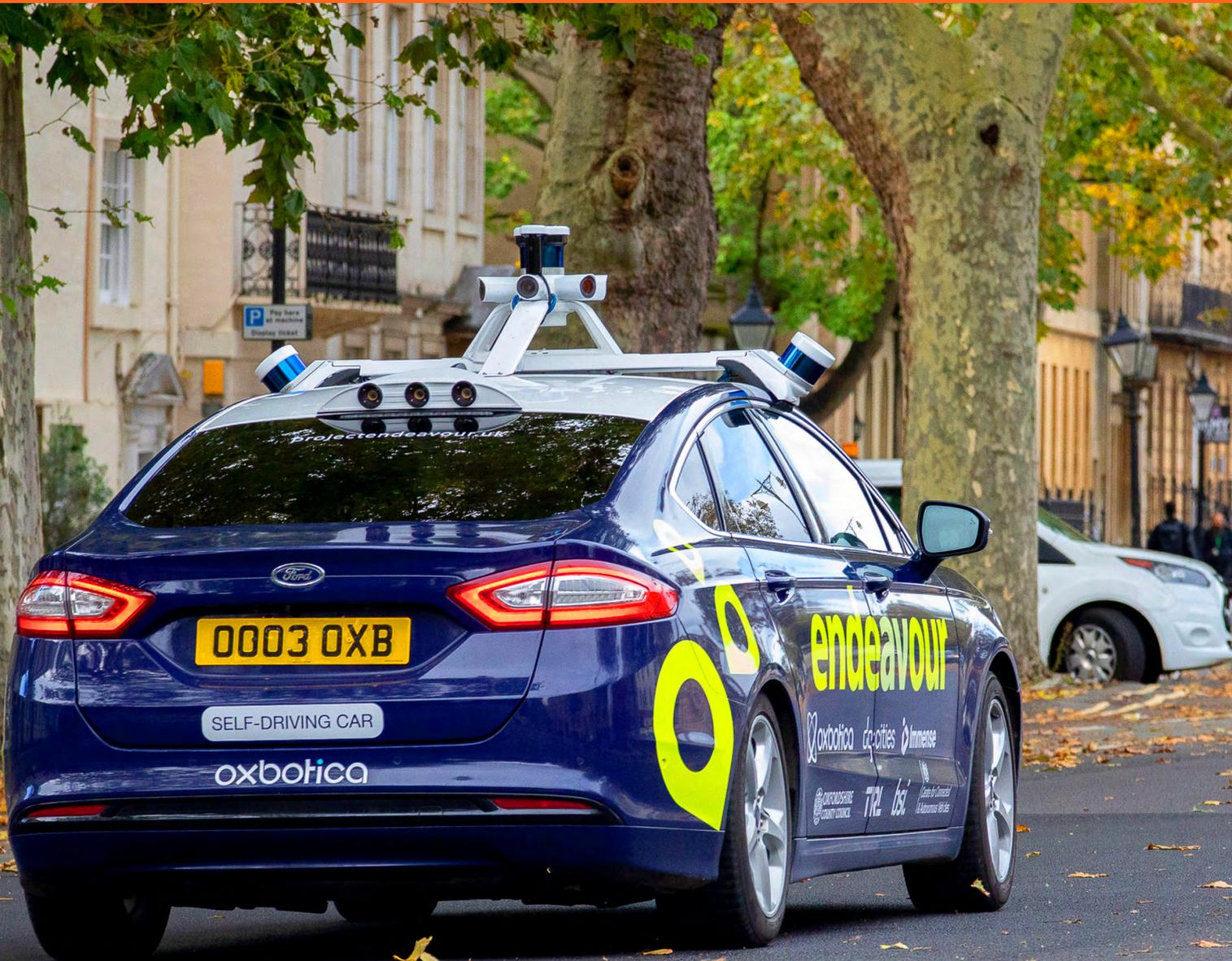
# Assuring the safety of connected and automated vehicle trials on the public highway

Guidance for local authorities



# Foreword

This document is one out of a suite of three stakeholder specific guidance documents on the safety assurance of trials. This document is aimed at local authorities (LAs) who have been engaged with by trialling organisations regarding the testing and trialling of connected and automated vehicles (CAVs) within the UK. This includes those LAs who are consulted by Trialling Organisations in line with the requirements of the [DfT Code of Practice for automated vehicle trialling](#), or those who are more actively involved in projects that are conducting CAV trials. The other two documents in the suite are aimed at trialling organisations and insurers. These documents have been developed by TRL as a key output from our work on CAV safety assurance within [Project Endeavour](#).



# 1. Introduction

## 1.1 . What is safety assurance and what are the requirements for local authorities (LAs)?

### 1.1.1 What is safety assurance and why is it important?

As CAVs are evolving, there is an increasing demand to test and trial them on the UK road network. Demonstrating the safety of CAV trials is vital to ensure that there is strong public confidence in CAVs and related mobility services. As such, ensuring best practice approaches to safety assurance during public trials is key to the successful introduction of CAVs onto UK roads.

Safety assurance can be defined as a method of demonstrating that a CAV under test has the required processes and controls in place to ensure that the risks have been assessed and mitigated to as low as reasonably practicable (ALARP). The safety assurance process can also be a useful opportunity for stakeholders to share information and learn from one another, which ultimately helps drive innovation.

### 1.1.2 What does safety assurance mean for LAs?

For CAV trials, trialling organisations (TOs) should provide safety assurance to several key stakeholders and decision-makers. LAs are one of the key stakeholders for CAV trials. The [Department for Transport's \(DfT's\) Code of Practice \(CoP\) for automated vehicle trialling](#) advises TOs to liaise with local authorities prior to trials and testing on UK roads.

For LAs, CAV safety assurance means that a CAV technology has achieved an acceptable or tolerable level of safety for operation in publicly accessible areas under their jurisdiction. LAs currently have no responsibility to approve the safety of a CAV trial that occurs on roads under their jurisdiction. However, many LAs want to take a proactive approach to engaging with CAV trials, and to better understand how CAV safety is being managed by the TO. While they would not take responsibility for approving or refusing the trial on the grounds of safety, many LAs would like to understand whether CAV trials are being conducted in line with UK law and current best practice. New mobility is also increasingly becoming a part of local road safety strategies. As a result, LAs have found it beneficial to be engaged with trial CAV safety, in order to better understand how their road safety priorities may be impacted by the widescale introduction of CAVs in the future.

Current best practice for trial safety assurance is the development of a safety case. A safety case is a structured argument supported by body of evidence that demonstrates all the safety risks have been identified and appropriate controls have been put in place to minimise the risk of harm. The safety case also demonstrates compliance with all relevant standards, guidance and legislation. However, there is currently no expectation for an LA to review a safety case in detail to better understand safety, and it is likely that many LAs will not have the technical expertise within their organisation to interpret the information within a safety case.

## 1.2 What progress has been made to date in safety assurance for CAV trials?

### 1.2.1 Safety assurance requirements, standards and guidance documents

**Figure 1** provides a snapshot of some of the key requirements, standards and guidance documents that have been produced related to general trial safety and the specific requirements of a safety case.







Figure 1: CAV safety regulations, standards and guidance landscape

The requirements, standards and guidance documents of most relevance to safety assurance include:

- [The DfT Code of Practice for automated vehicle trialling](#) – this code of practice provides guidance on trialling automated vehicle technologies on public roads or in public places in the UK. It makes recommendations on how to maintain safety and minimise potential risks. There is also guidance on how to improve the transparency of trials and how to engage with the public, authorities and other relevant bodies when planning trials.
- [BSI PAS 1881 Assuring the Safety of Automated Vehicle Trials and Testing](#) – this standard is intended to support the safe testing and trialling of CAVs. It specifies best practice for safety cases for automated vehicle trials and development testing in the UK to demonstrate that activities can be undertaken safely.

The team at TRL has played a key role in developing current guidance and standards for CAV trials. We co-authored [BS PAS 1881 – Assuring safety for automated vehicle trials and testing](#) and the [Zenbic Safety Case Framework for CAV testing and trialling](#) across all the UK testbeds.

## 1.2.2 Safety assurance within CAV testing and trials

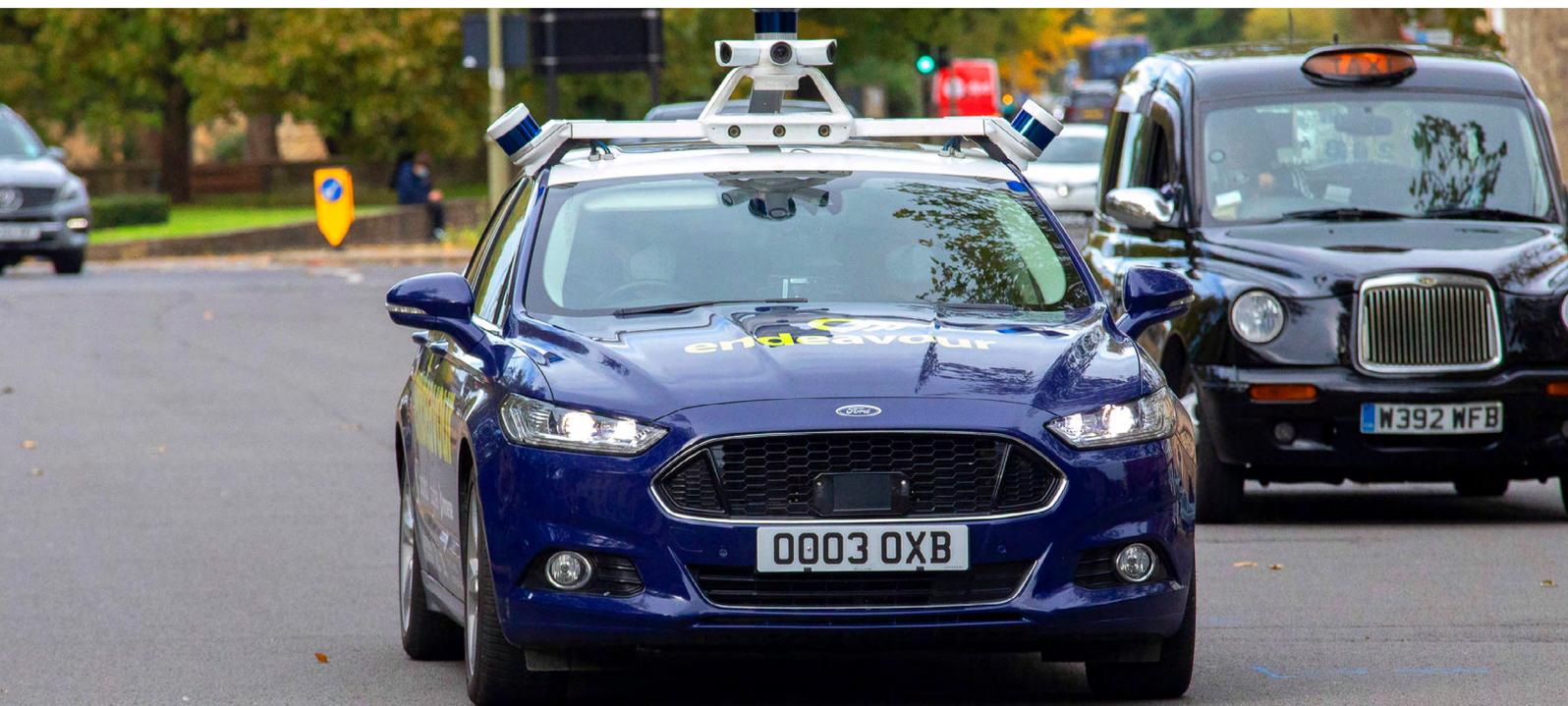
Alongside the development of safety assurance documentation, there has been extensive testing and trialling activity underway within the UK. At TRL, we've been gaining experience in safety assurance due to our involvement in a wide range of these trials including [GATEWAY](#), [Streetwise](#), [DRIVEN](#) and the [HelmUK HGV platooning trials](#). TRL also led the build of the [Smart Mobility Living Lab \(SMLL\)](#) in London – the UK's most advanced real-world connected environment for testing future mobility technologies. For the [SMLL](#) we have put all the necessary processes in place to ensure that any trials are conducted safely and in line with current best practice, guidance and standards.

Exposure to diverse projects of different scales and nature has allowed us at TRL to develop deep technical understanding of a range of elements related to safety assurance including: creating and reviewing safety cases, undertaking risk assessments, developing risk mitigation strategies, supporting trials, conducting emergency response tests, and establishing testbed procedures.

## 1.3 Project Endeavour – improving safety assurance for future CAV trials

[Project Endeavour](#) is a collaborative, consortium led project, part-funded by the Centre for Connected and Autonomous Vehicles (CCAV) and delivered in partnership with Innovate UK. It is a mobility project designed to fast-track the introduction of connected and automated vehicle (CAV) services across the UK and maximise the potential of this new technology to shape the future of mobility. TRL is a key partner in Project Endeavour and we are bringing our safety and compliance expertise to deliver a dedicated safety assurance workstream. The focus of this workstream is to improve the level of understanding of safety assurance among all stakeholders. Also, to promote the adoption of a streamlined and consistent approach to safety assurance amongst stakeholders to help reduce barriers to trialling and innovation across the UK.

To help define the activity within the safety assurance workstream on Project Endeavour, TRL conducted a series of interviews with stakeholders involved in CAV trials including trialling organisations, highway and local authorities, testbeds and landowners, insurers and insurance bodies. Their input is gratefully acknowledged. The aim of this engagement was to find out more about their current involvement and capabilities in conducting and supporting CAV trials, their future aspirations, and the areas in which we may assist them in fulfilling those aspirations. This stakeholder engagement identified that there were some key gaps in knowledge and inconsistencies in the approach taken towards safety assurance of CAV trials. To address this, one output of the project is to develop bespoke stakeholder specific guidance documents for trialling organisations, local authorities and insurers.



## 1.4 What this guidance document is and what it includes

This guidance document is aimed at LAs involved in CAV trialling within the UK.

Within our engagement with LAs, we found there was a wide variation in experience CAV trialling. Some LAs had already hosted CAV trials, whilst others were interested in hosting trials but didn't yet have a development plan in place to achieve these goals. Furthermore, there was a large inconsistency in the approach taken between LAs in terms of the safety assurance of CAV trials.

This guidance document aims to:

- Help LAs identify how they can best understand how CAV trials are managed safely and in line with best practice.
- Provide uniform guidance and approaches for those LAs who chose to engage more effectively with TOs about CAV safety.

This document concludes by outlining some further services which TRL is able to offer to help further assist LAs who may wish to better understand the safety assurance of CAV testing and trialling activities.



## 2. The role of local authorities

The DfT's CoP for automated vehicle trialling places responsibility for the safety of trials on the TO. However, it is recommended good practice for LAs to be provided with adequate safety assurance so that they can fulfil their responsibility to maintain safety within their remit. As such, LAs need to be assured that CAV trials on their roads are safe and do not introduce intolerable risks to other road users.

LAs may be directly involved in a trial as a partner in a consortium. In this case, while their role is still largely the same, they are much more closely associated with the project. In which case, they may have held a greater responsibility for managing the safety of a trial. For a trial being conducted independently by a TO, the LA is not required to take a formal stance on the safety of a trial, however the LA may expect to understand whether the trial is being conducted in line with best practice (see **Figure 1**).

### 2.1 How local authorities can facilitate safe CAV trials

LAs can help facilitate CAV trials by reducing barriers to testing in their environment, whilst still being assured that a trial is being conducted safely. This section outlines actions that LAs can take to better facilitate safe CAV trials.

#### 2.1.1 Readiness to host CAV trials

It is recommended that LAs looking to facilitate CAV trials ensure that their region or jurisdiction is ready for such trials. [Project CoExist](#) is aimed at preparing stakeholders, including LAs, for a transition towards road networks shared by increasing levels of CAVs. Their [Automation-ready Framework](#) is designed to support local authorities in reducing uncertainties and building up the capability to make structured and informed decisions about the comprehensive deployment of Cooperative Connected and Automated Mobility (CCAM).

Since CAV trials are possible (under the Code of Practice) on all public roads, LAs may have trials being conducted in their area, whether they directly support it or not. The Automation-ready Framework may also help LAs who are in this position to better understand CCAM and how they may plan for deployment in the future. LAs may wish to consult this framework to understand how they might best improve their readiness to facilitate CAV trials.

#### 2.1.2 Reviewing the safety assurance for a CAV trial

LAs often have thorough knowledge and understanding of road safety and local hazards but not necessarily the expertise to review CAV systems and ensure their safe operation.

Since LAs are not thought to be responsible for reviewing and approving the safety of a trial, careful consideration should be taken when engaging with TOs on matters of safety. LAs are advised to engage on safety related matters so that they can:

- understand whether best practice is being applied to the trial;
- provide input and local knowledge; and
- better understand CAV safety prior to widescale deployment.

However, this engagement should not extend to the review and acceptance of any safety information provided. This may lead to an increased onus on the LA to dedicate resources and technical expertise to manage safety and may increase the LA's liability in the event of an incident. As per the Code of Practice, this responsibility to ensure safety sits with the TO.

In order to best engage with TOs, and to best address these challenges, the recommended approaches for LA's to be assured on the safety of a trial are:

- An in-depth review of the trial safety case from an independent third party – The independent third party may be contracted by the TO to review the safety case which supports the engagement with the LA, thus giving additional confidence that best practice approaches to safety are being taken. Alternatively, the LA may be involved in a project consortium for the trial or commission their own trial and may require an independent review to be conducted directly.

- A self-declaration by the TO – A high level approach that is suitable for engaging on matters of safety but not directly reviewing and approving a CAV trial. This would be suitable for many cases where TOs are conducted trials independently.

Guidance on these and other potential approaches are described in more detail in **Section 3**.

### 2.1.3 Supporting policies and procedures

LAs may include CAV as part of their overarching transport strategy. This could be extended to incorporate aspects of CAV trials, with the aim of ensuring that those involved in the trial, and those that may be affected by the trial, remain safe during trialling process. The policy statements should inform the TO of the LA's requirements to ensure that the trial is conducted safely. They should be designed to promote good practice and ensure that the latest regulations, standards, and the LA's safety assurance processes are complied with.

The policy statements should cover general guidelines including the latest UK CAV and health and safety legislation, current best practice/guidance and standards for CAV trials, expected content of the operational safety case, and security and safety guidance. They should also include information to aid the TO when developing an emergency response plan, such as key information required for a rapid and effective response to emergency situations.



# 3. Trial safety engagement process

The process of engaging with TOs on a CAV trial could be time consuming and resource intensive, and ultimately could put inappropriate liability on the LA, if not done appropriately. This section discusses a procedure that LAs could adopt during a trial safety review to help LAs understand CAV safety and engage effectively whilst still keeping the requirements for managing safety with the TO. **Figure 2** outlines the trial safety review process detailed in the rest of this section.

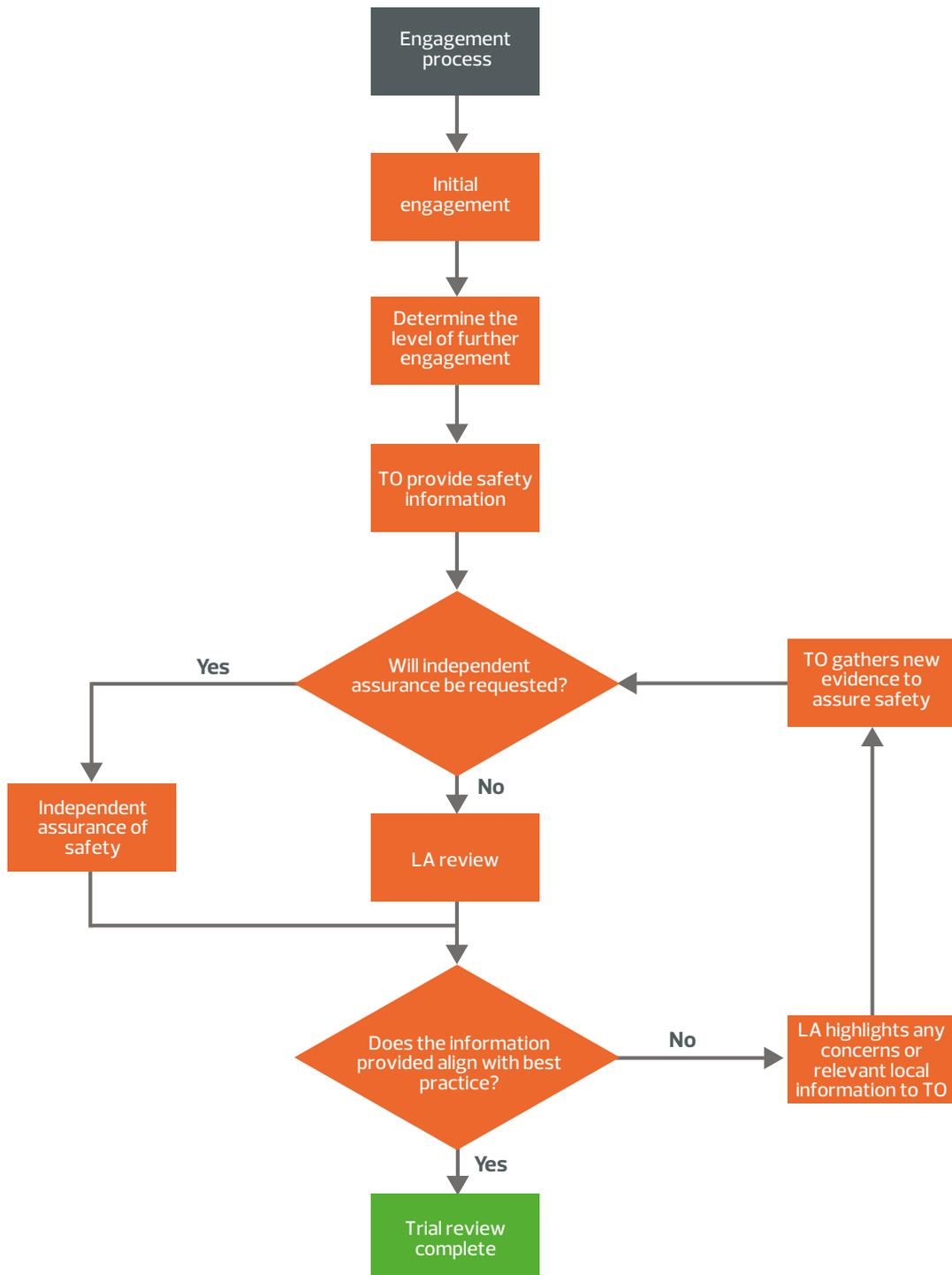


Figure 2: The review process

## 3.1 Initial engagement

The trial safety review process should begin as soon as initial contact is made between the LA and the TO intending to arrange a trial. During this initial engagement the LA might ask for an overview of the proposed trial, which may include basic information on the type of vehicle, the CAV functionality to be tested and the route requirements.

The LA might then connect the TO to wider stakeholders that might be affected by the trial such as the emergency services. The LA should also provide the TO with any pre-requisites, procedures, policies, and local information pertaining to the area that would assist them in trial planning and safety case development. This would facilitate early understanding of the LA's trial safety requirements.

## 3.2 Determining the level of further engagement

The level of engagement between the TO and the LA might depend on:

- The LA's involvement in the trial; and
- The complexity of the trial.

### 3.2.1 LA's involvement in the trial

During the initial engagement it might be possible for the LA to be more involved in the project as a consortium partner or as a project sponsor. In which case the LA may have a higher level of duty of care. As such, an LA may require a higher level of safety assurance.

If they are not involved as a project partner, an LA may not wish to, review and accept a safety case (either independently or using a third party). In this case, another process is required to engage on safety matters effectively.



### 3.2.2 Complexity of the trial

Based on the description of the trial received from the TO during the initial engagement, the LA can be informed of the final use case and complexity of the trial.

The complexity of a trial will likely depend on a number of factors such as:

- The research aims
- How proven or mature the technology is
- The complexity of the road environment
- The extent of public involvement

The complexity of a trial is an indication of the level of risk associated with it. It is a key factor in determining the appropriate nature and level of controls and risk mitigations that are required to be implemented in the trial by the TO. Trial complexity, as defined by the TO should also be considered by the LA when deciding their approach to the safety review. The level of detail in the safety case for such trials is often significantly higher for more complex trials and might require expert consultancy to be reviewed effectively. Therefore, the LA may wish to request that the TO provides an independent review.

The [Zenic Safety Case Framework: Guidance Edition for Reviewers](#) gives guidance on how to assess the complexity of a trial based on a number of trial attributes such as the vehicle, the trialling environment and the level of safety driver control.

## 3.3 Review approaches

The CoP strongly advises engaging with LAs, but there is currently no guidance on what extent this engagement should be. LAs should ultimately consider setting their own standards for engaging with CAV trials, in order to meet their specific requirements and ensure consistency within the LA.

The possible approaches that LAs may take are:

- Undertake, or request a detailed review of the trial safety case;
- Self-declaration of trial safety by the TO; or
- Minimal engagement.

Each approach is discussed below.

### 3.3.1 Detailed safety case review

The safety case is the key evidence for demonstrating the safety of a trial. It should demonstrate that all safety risks have been identified and appropriate controls have been put in place to minimise them and the risk of harm. The safety case should be tailored to the trial activity and the trialling area. It should consider the interaction of the CAV under trial within its operating environment, including the route, the safety operator, the wider trial team, passengers and other road users. The level of detail required in the safety case requested by the LA should be proportionate to the chosen approach for safety assurance review.

A detailed technical review of the safety case by the LA may provide increased safety assurance for the trial. The LA may be able to undertake the review of the safety case themselves – if someone within the LA has the expertise to do so. Otherwise, there might be a requirement to enlist the support of a third-party organisation to undertake this review. The funding of this independent review would however need to be considered.

The limitation of conducting a detailed safety case review is that it could require significant time and resource and LAs might not have the technical expertise to fully appraise the safety of a trial. Also, it is important to note if an LA reviews and approves a safety case, then they might be partially liable if an incident occurs. Furthermore, there is no requirement for an LA to approve a safety case in order for a trial to proceed under the Code of Practice. As such, this is not a recommended approach when engaging with TOs who wish to trial independently on an LA's roads.

This approach may be suitable, when an LA is acting as a project partner or is directly contracting a trialling organisation. In these instances, the LA may be more accountable for managing safety. In which case the LA should set out the requirements for safety case review within such a project.

### 3.3.2 TO self-declaration

A self-declaration essentially means that the TO self-declares the safety of their trial. TOs could do this by answering a series of high-level trial assessment questions on the safety of their trial in order to confirm that best practice is being applied. In response, TOs would supply supporting safety information to the LA. The TO should be required to declare that the trial will comply with any LA policies and procedures, safety best practice, and relevant UK laws. The trial assessment questionnaire should aim to provide both legal and safety assurance through questions including but not limited to the following categories:

1. Operational safety
2. Safety Driver/Operator competency
3. Vehicle build and legal compliance
4. Route safety
5. Automated driving systems safety
6. Data and cyber security
7. Safety monitoring, reporting and continuous improvement
8. Passenger/trial participant safety.
9. Public engagement



A trial self-declaration process is being developed by Oxfordshire County Council (OCC), supported by SMLL and TRL. The approach being developed allows for simple and easy engagement between LAs and TOs using high-level questions based on the current best practice, guidance and standards. This self-declaration approach would place most of the liability on the TO since they essentially declare the safety of the trial. It requires significantly lower resource commitments compared to the detailed technical review approach but still allows LAs to engage effectively with TOs and gain valuable information about CAV trial safety. Further details about OCC's approach is given in

#### Section 4.

TRL is currently developing a safety assurance software tool for multiple different stakeholders that would support stakeholder engagement on CAV trials. This tool could be used to support self-declaration approaches and other review processes for Local Authorities as well as other key trial stakeholders. Further information on this tool is detailed within **TRL services**.

### 3.3.3 Minimum engagement

Currently, another approach is to only offer minimal engagement with a TO regarding a trial. This type of engagement would only require minimal effort for the LA but would also mean that the LA does not have an understanding of trial safety. While this is a possible approach, it is not recommended. This is because:

- The LA would fail to understand whether trial safety is being managed within best practice;
- The LA could not raise any concerns and would not understand how the safety of local residents are impacted; and
- The LA would not benefit from an improved understanding of CAV safety prior to widescale deployment of the technology.

## 3.4 Independent assurance of safety

In order to better assure safety, a TO may commission an external expert organisation to independently review the safety case of a trial. An independent reviewer would conduct a thorough technical review of trial safety documentation in order to identify whether a trial is being managed safely and in accordance with best practice and UK law. Any recommendations would be fed back to the TO in order to improve their management of safety. It can be beneficial also for LAs to engage with an independent reviewer (if one has been commissioned by the TO) in order to understand directly and transparently whether a trial is being managed in line with best practice. Information from the independent reviewer could also be used to support any information provided through the self-declaration approach.

Where possible, it is recommended that LAs request an independent reviewer to be involved for any projects for which the LA is a partner. This would allow LAs to be assured that a detailed review of safety is being conducted by a competent organisation and safety is assured.

## 3.5 Other considerations

Stakeholder engagement with a number of LAs has identified a number of other considerations including:

- High-level reviews might be preferable where the LA might not have the expertise to perform in-depth reviews.
- An external expert organisation can provide an additional layer of independent safety assurance and more detailed technical review. This approach is widely used across stakeholders currently hosting CAV trials.
- It is important to ensure that best practice is being followed, including compliance with the [DfT CoP](#), [BSI PAS standards](#) and [Zenbic Safety Case Framework](#). This allows for a common understanding of requirements between TOs and other stakeholders and simplifies the provision of safety assurance.
- Along with safety, the LA should assess the applicability of the trial in solving the challenges/objectives of the city/region.
- Where possible, the review process should be integrated with existing safety work done by the authority, such as road safety audits. This local safety knowledge is invaluable for ensuring the safety of a trial.
- LAs should identify and suggest the use of suitable trial routes using road safety local knowledge and experience; such routes might identify low risk areas or more challenging environments to better facilitate trials safely.

## 4. Case Study – Safety Assurance at Oxfordshire County Council

Oxfordshire County Council is responsible for delivering services to the more than 600,000 residents. These services include education, public health, highway maintenance, town and country planning and much more.

Oxfordshire County Council is dedicated to improving the lives of its residents through the introduction of new, innovative technologies. As part of this, the council is championing the introduction of Connected and Automated Vehicles (CAVs) into the UK.

Pioneering schemes such as [DRIVEN](#), [MultiCAV](#), [CAVL-4R](#), [OmniCAV](#), and now [Project Endeavour](#) have been launched in Oxfordshire. Oxfordshire County Council is the first council in Britain to not only include self-driving vehicles in its Local Transport Plan (LTP4 – 2016), but also the first to establish its own team dedicated to autonomous vehicles. For [Project Endeavour](#), Oxfordshire County Council is working with the project partners to establish its trial safety assurance and engagement process to support trials in Oxfordshire.

Excessive safety assurance requirements may introduce a barrier to testing which could have a negative impact on the innovation and development of CAV technologies and may also dissuade testing organisations from engaging fully with local authorities on safety. Importantly, safety assurance requirements involving the review of a safety case and subsequent approvals by the local authority may also increase their liability in the event of an accident.

Oxfordshire County Council is developing an engagement process for trialling organisations (TOs). This process takes a proportionate approach to trial safety assurance.

This approach uses a high-level questionnaire derived from best practice standards, guidance and regulations. This allows Oxfordshire County Council to fulfil its safety responsibilities while streamlining the process for TOs.

This approach allows for communication between the local authority and the TO so that there is a common understanding of the local authorities' legal and safety requirements and also facilitates transfer of pertinent safety information between the two parties. These processes, in development by the council, Smart Mobility London Living Lab (SMLL) and TRL, are starting to lower the barriers to CAV innovation while still maintaining best practice for safety assurance.

As these processes are trialled and developed further, Oxfordshire County Council aims to establish it as best practice so that it can be replicated elsewhere in the UK.



# TRL services

TRL has significant safety assurance expertise which has been developed through experience in several CAV trials. Therefore, TRL are well-placed to support LAs in a variety of safety assurance activities for CAV trials as described below. To find out more about our Team and the Services we offer, please email [enquiries@trl.co.uk](mailto:enquiries@trl.co.uk).

## TRL Connected and Automated Mobility – Safety Assurance Tool (TRL CAM–SAT)

TRL led the build and set up of the [Smart Mobility Living Lab \(SMLL\)](#) in London, part of CAM Testbed UK. One key activity within this was to develop a range of safety assurance procedures for the SMLL including an onboarding process for new CAV trials to the test bed.

Based on this experience TRL have developed a software concept called CAM–SAT (TRL Connected and Automated Mobility – Safety Assurance Tool). This tool focuses on supporting safety assurance and engagement for a number of different stakeholders. This can be used to guide and support local authorities when engaging with TOs, to ensure a consistent and simple approach to understanding CAV trial safety.

The specifications for the tool were drawn specifically from the challenges identified during the consultation with stakeholders on safety assurance as part of project Endeavour.

The tool provides an end-to-end engagement process that allows for stakeholders and TOs to communicate safety information simply and effectively. This enables the transfer of fundamental information regarding the proposed CAV trial to the LA to aid understanding of the trial and whether best practice is being followed. The tool can be used to support the TO self-declaration approach outlined in **Section 3.3.2**, to avoid review of technical content and liability concerns. The tool allows stakeholders to configure their own engagement requirements, which can be updated at any time. These updates can be supported by TRL to ensure that emerging best practice is reflected.

Also include within the tool is:

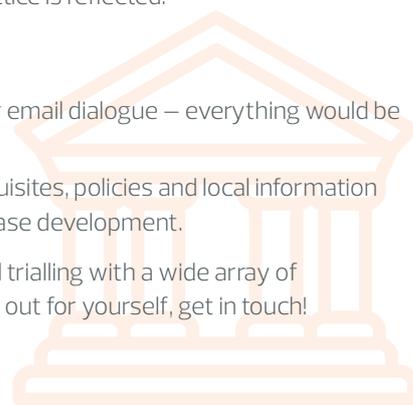
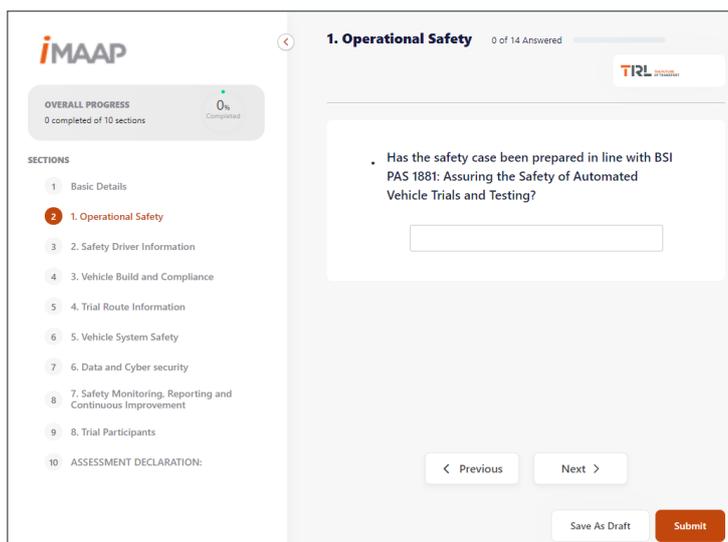
- The ability to upload supporting documentation – avoiding the requirement for email dialogue – everything would be stored in the same place.
- An area for local authority to host information for CAV trialling e.g. any pre-requisites, policies and local information pertaining to the area, that would assist them in the trial planning and safety case development.

CAM–SAT is in its early stages and we will be refining it through engagement and trialling with a wide array of stakeholders, including Local Authorities. If you are interested in trying CAM–SAT out for yourself, get in touch!

## Training for local authority staff

TRL can develop and deliver training to LA staff regarding the questions and acceptable responses for the trial assessment questionnaire as detailed in **Section 3.3.2**.

Training can also be provided on how to assess safety cases and current good practice for safety assurance for CAV trials. TRL can tailor training to meet the needs of the LA.



## Development of trial policies and procedures

TRL can develop a series of policies and procedures for CAV trials. These policies will ensure that all trials within the LA's jurisdiction are compliant with relevant legislation, standards and guidance and will support the LA with onboarding trial organisations

## Independent safety case review

TRL has previously developed and reviewed safety cases for a range of CAV projects including GATEWAY, Streetwise, DRIVEN and the HelmUK HGV platooning trials. TRL also co-authored BS PAS 1881 – Assuring safety for automated vehicle trials and testing as well as the latest Zenic Safety Case Framework.

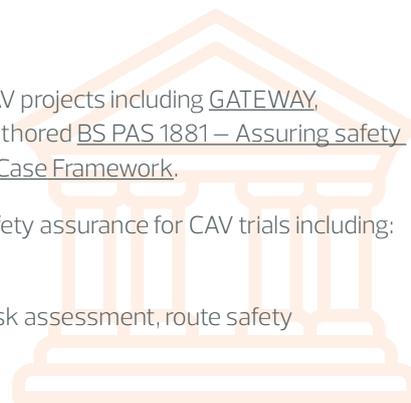
Based on this experience, we are ideally placed to provide independent safety assurance for CAV trials including:

- Independent review of entire safety cases
- Independent review of specific safety case elements (e.g., operational risk assessment, route safety assessment, emergency response plan, operational guidance).

## Compliance audits

TRL can provide audit services to ensure that TOs are operating in adherence with their safety case, specific safety case elements or guidance, or to a defined process or procedure. This might include checking training records, ensuring an appropriate public abridged safety case is published, and ensuring adherence with mitigations outlined in the risk assessment.

We can also monitor and audit compliance with the safety case during trial activities to ensure that all operational guidance and controls are being followed, including reviewing evidence of safety monitoring.



t +44[0]1344 773131  
e enquiries@trl.co.uk  
w www.trl.co.uk

TRL Crowthorne House, Nine Mile Ride,  
Wokingham, Berks, UK, RG40 3GA

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