BSI's emerging PAS series

Enabling safe CAV deployment

The British Standards Institution (BSI) has launched its Safety of Connected and Autonomous Vehicles (CAV) standards programme: BSI CAV Standards programme, with four safety-focussed PASs to be published in 2020. The programme aims to enable and ensure the safe and secure deployment of CAV in the UK. With 2020 being UK's year of CAV trials on public roads, the BSI CAV PAS series will not only provide guidance to CAV developers but also enable the development of public trust.

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Introduction

The move to Connected and Automated Vehicles (CAV) is being driven by the many potential benefits of the technology, such as increased safety, reduced traffic congestion, lowered emissions and potentially increased mobility for those unable to drive or for people with disabilities. However, to reap such benefits it is essential to ensure that CAV technology is safe and is used in a safe manner.

Demonstrating the UK's intention of becoming a premier development location for CAVs, in 2015, the UK government set up a joint policy unit called CCAV, bringing together expertise from the Department for Business, Energy & Industrial Strategy (BEIS) and the Department for Transport (DfT). With £250 million budget supported by matched industry funding, CCAV is working closely with industry, academia, standards bodies and regulators to enable development and ultimately deployment of safe and secure CAV for the efficient movement of goods and people.

A key aspect of ensuring the safe use of CAV is establishing and conveying the capabilities and limitations of the technology to its users, leading to a state of informed safety to enable development of public trust in the technology. A recent CCAV report on public attitudes towards CAVs found that while the public accepts the potential safety benefits of CAV by reducing human error, fatigue, distraction and drink-driving, they consider safety and security of the technology as of paramount importance.

Reflecting the public attitude, the UK government is also committed to ensuring that the introduction of CAVs for commercial operations or testing/trialling purposes is done both safely and securely, to build public and consumer trust and acceptance of the technology. Industry standards have been suggested as key enablers for the development of trust.

The CAV industry is relatively young with innovations emerging from traditional vehicle manufacturers and from exciting start-ups. This makes the standardization activities challenging. Against this backdrop, BSI is supporting CAV development through its CAV Standards programme, focussing on the safety and security of CAVs. Sponsored by CCAV, the BSI CAV Standards programme has brought together some of the brightest and most innovative experts from industry, academia and policy in the UK to create ground-breaking standards through a fast-paced standardization route known as a PAS (Publicly Available Specifications).

Four PASs – PAS 1880, PAS 1881, PAS 1882 and PAS 1883 will be published during 2020. PAS 1880 provides guidelines for the design of CAV control systems; PAS 1881 provides requirements for constructing a safety case for a CAV trial and the evidence required for it; PAS 1882 provides requirements for the data recording on a CAV, and lastly PAS 1883 provides requirements for defining the Operational Design Domain (ODD), i.e., conditions under which the CAV can operate safely.

BSI CAV Standards programme

BSI launched its CAV Standards programme in 2019. This followed research by BSI and the Transport Systems Catapult, now Connected Places Catapult, that highlighted the important role for standards in supporting the development of the CAV industry and UK leadership in the field.

Sponsored by UK Government's Centre for Connected & Autonomous Vehicles (CCAV), the BSI CAV Standards programme aims to enable and ensure safe and secure deployment of CAV in the UK. With 2020 being the UK's year of CAV trials on public roads, BSI's PAS series will not only provide guidance to CAV developers but also enable the development of public trust in CAV technology, an indispensable requirement for the success of this technology.

Standards for emerging technologies like CAVs tend to serve three key purposes:

1. they help consolidate the state of the art by sharing between experts

2. they enable interoperability of products from different manufacturers

3. they potentially keep a check on the introduction of immature or unsafe technology.
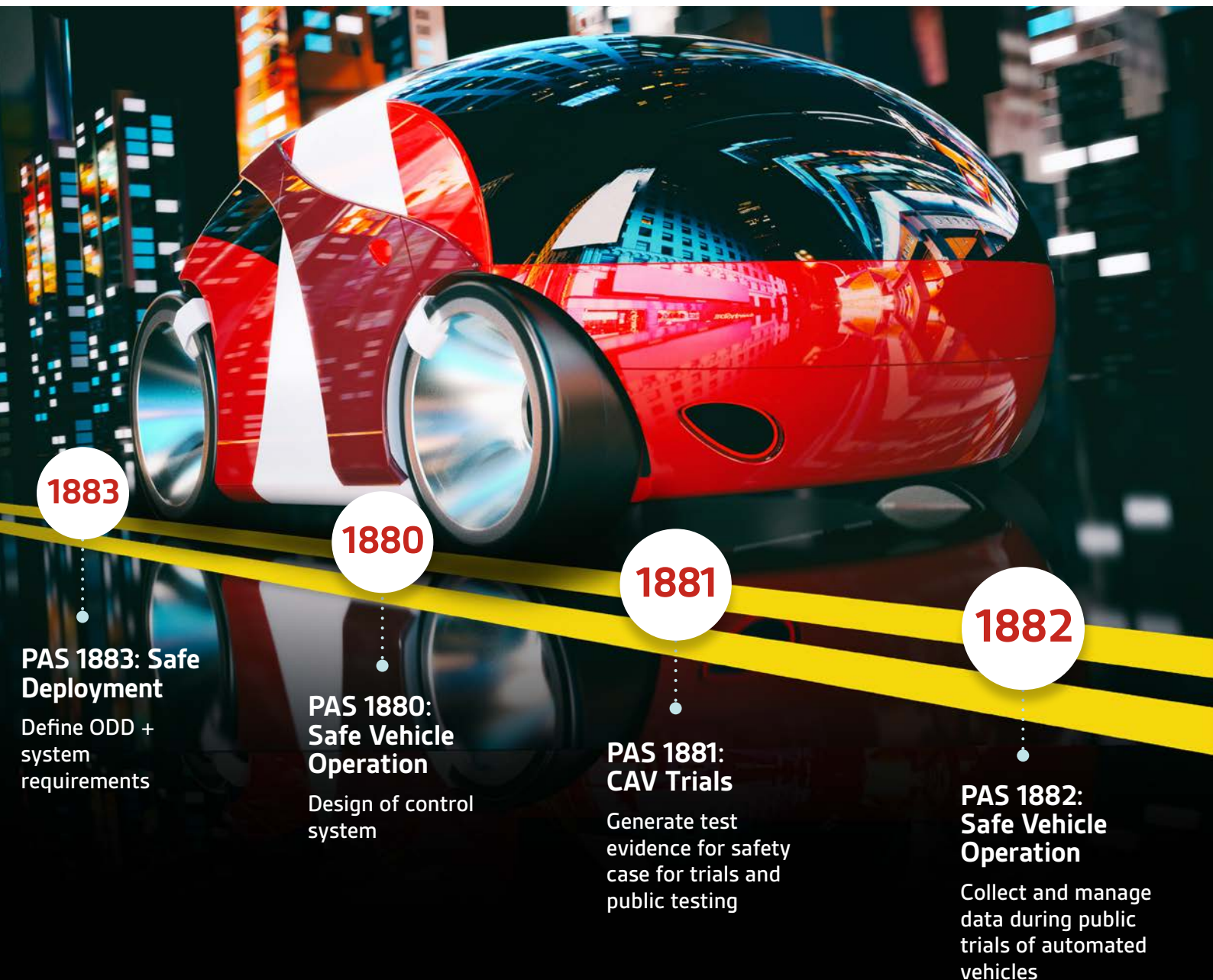
Furthermore, a key priority for the BSI CAV Standards programme was to create strong and robust standards without hindering innovation, especially in an evolving industry like CAV. A robust review and consultation process was therefore adopted involving stakeholder workshops and industry consultations.

Bearing in mind the purposes of the standards and stakeholder priorities, the first four PASs identified in this series are:

- **PAS 1880** (to be published in early 2020): provides a set of initial guidelines for control system design for automated vehicles

- **PAS 1881** (to be published in early 2020): provides the minimum requirements for assuring the safety case for automated vehicle trials and testing

- **PAS 1882** (to be published in summer 2020): provides minimum requirements for data recording on a CAV (akin to a black-box in aeroplanes)

- **PAS 1883** (to be published in late 2020): provides minimum requirements for a hierarchical taxonomy for Operational Design Domain (ODD) definition

The four PASs focus on automation levels 3 and higher as per ISO/SAE 22736. In order to ensure quality and fairness of the standards, BSI also established a CAV Standards Advisory Board to provide governance for the BS CAV Standards Programme.

Figure 1 – Using the Safety PAS series during CAV development

1883

PAS 1883: Safe Deployment

Define ODD + system requirements

1880

PAS 1880: Safe Vehicle Operation

Design of control system

1881

PAS 1881: CAV Trials

Generate test evidence for safety case for trials and public testing

1882

PAS 1882: Safe Vehicle Operation

Collect and manage data during public trials of automated vehicles

How to implement the Safety PASs

The first step in designing a CAV is to understand its ODD – the context in which the CAV is expected to operate safely. Understanding the ODD will guide the identification of system requirements for safe operation of the CAV. It also is key to understanding the types of test scenarios to be used during safety evaluation. PAS 1883 provides a structure for the definition of ODD to ensure that stakeholders have a clear and comprehensive description of when, where and how a CAV will operate safely. For example, for a low-speed shuttle application in a city centre, the ODD definition would include attributes like type of roadways, speed range, environmental conditions and so on.

Once the ODD has been defined, next the full set of functional and system requirements for the automated driving technology needs to be captured. PAS 1880 provides guidance on this process for CAV developers, highlighting key areas that help to ensure CAVs are safe and secure. While ISO 26262 focusses on the developed processes, PAS 1880 focusses on the functionality required in a CAV for its safe operation. It also highlights in the impact of ODD definition on the CAV design and sensor

selection. For example, if an ODD definition includes an area with many tunnels, it might be prudent to use a localization mechanism other than (or in addition to) GPS due to degraded signal strength in tunnels.

Before a CAV is deployed on public roads, evidence needs to be generated about the safety and security of the CAV. A safety case is a body of evidence which demonstrates that the safety risks to all affected parties have been identified, managed and reduced as low as reasonably practicable (ALARP). PAS 1881 provides requirements on how to construct a robust and a transparent safety case for CAVs and the evidence required to support it.

In the event of an incident during public trials, it is essential to record data from the vehicle and its environment to be able to investigate the causes of the incident, not only from an incident investigation perspective, but also from a liability perspective for insurers. PAS 1882 sets out the requirements for a minimum set of data variables to be recorded during public trials, akin to a black-box in an aeroplane.

Benefits of the Safety PASs

BSI's emerging PAS series will provide guidance and a minimum set of requirements for CAV design, testing and trials. This will support the needs of a range of different stakeholders, for example:

- Developers and test beds of CAV technology, vehicle manufacturers and relevant tech companies: to develop products safely and to provide evidence that safety has been considered in line with industry best practice

- Central government, local government and transport authorities: to provide first mover advantage to the UK by rapidly formulating local and national policy in relation to CAV transport systems thereby attracting national and international stakeholders to trial and deploy CAV in the UK

- Communications and digital mapping companies: to provide the infrastructure required for enabling safe deployment and ensuring interoperability

- Academia and research: to provide inputs from latest innovative research to ensure the BSI CAV Standards programme has its foundations in strong research outputs

- The public, by providing confidence in the technologies. In order to ensure CAV technology realises its potential, we need to take society along the journey of technology development (trials to commercial deployment), to build their trust and acceptance by creating a state of informed safety.

What's next...

Standards in an evolving area like CAV can hugely benefit the entire CAV supply chain from component manufacturers to simulation service providers. It is widely accepted that simulation will play a key role in creating the safety evidence for the safety case argument. There is a huge diversity in simulation tools. While indicating innovation, this also makes it challenging for end users to try different solutions. Standards (e.g. in the area of interface definitions) have the potential not only to ensure interoperability but also increase efficiency of development while allowing both simulation service providers and end users to keep innovating in their core expertise. The aim of the BSI CAV Standards programme is to create such an environment throughout the CAV supply chain.

Apart from the four PASs (1880–1883) discussed here, BSI and CCAV in collaboration with stakeholders from industry and academia are also scoping other areas which would benefit from standards. These include cybersecurity, human factors, simulation and a much-needed CAV vocabulary to enable the industry to speak and understand the same language.

David Webb, Head of Innovation at The Centre for Connected and Autonomous Vehicles said:

 "The UK Government is working to harness the potential transformational benefits of Connected and Automated Vehicles (CAV) for society, making journeys safer, more accessible and more reliable. That's why the Government's Centre for Connected and Autonomous Vehicles is investing, alongside industry, in making the UK a global leader in developing, testing and delivering safe and secure CAV technologies, systems and services. Our pioneering work with BSI and world leading experts from the CAV ecosystem is a key element of that investment, developing and publishing a series of Publicly Available Specifications (PAS) focussed on how we set the standard for assuring safety and security. This will cover a wide range of areas, from trials and testing, through to understanding the complexity around Operation Design Domain (ODD) assurance and the requirement to securely share data from the vehicles and services."

The BSI CAV Standards programme is an ambitious and essential step towards ensuring the UK maintains its leadership in the CAV world, especially on testing, safety and security of CAV. With 2020 building up to being the year of CAV trials in the UK, and with the publication of safety PASs, it is expected that all trials will benefit and comply with them to ensure safety and security of the trials.

For more on BSI CAV Standards programme and future PASs, please visit:
CAV Standards Programme

Download your free copy of the CAV standards now at:
bsigroup.com/cav/cav-resources

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Why BSI?

For over a century BSI has championed what good looks like and driven best practice in organizations around the world. As one of the founding members of ISO, we help make sure international standards developed address today and tomorrow's business and social needs, while delivering real benefits to an organization and all its stakeholders.

We work closely with leading manufacturers to ensure their products meet the latest regulations to gain market access. We focus on delivering a testing and certification partnership underpinned by quality, safety, reliability and accuracy aligned to your product development requirements. That's why we're best placed to help you understand standards and to meet the requirements.

From shaping collective best practice with our knowledge solutions to product testing, certification, and environmental health and safety professional services, we are committed to innovating and collaborating with our clients to build a safer more resilient tomorrow – one that protects buildings, assets, the environment and most importantly people.

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