



Home Office

Home Office Science Centre for Applied Science and Technology

An Introduction



“ The team at CAST have provided excellent support throughout the data improvement exercise for CAID [the child abuse image database], whilst also responding efficiently to ad hoc queries, providing a granular level of detail when required and advising on best practice for processes. This work has been instrumental in improving the quality of data for CAID and uploading the information onto the database itself. ”

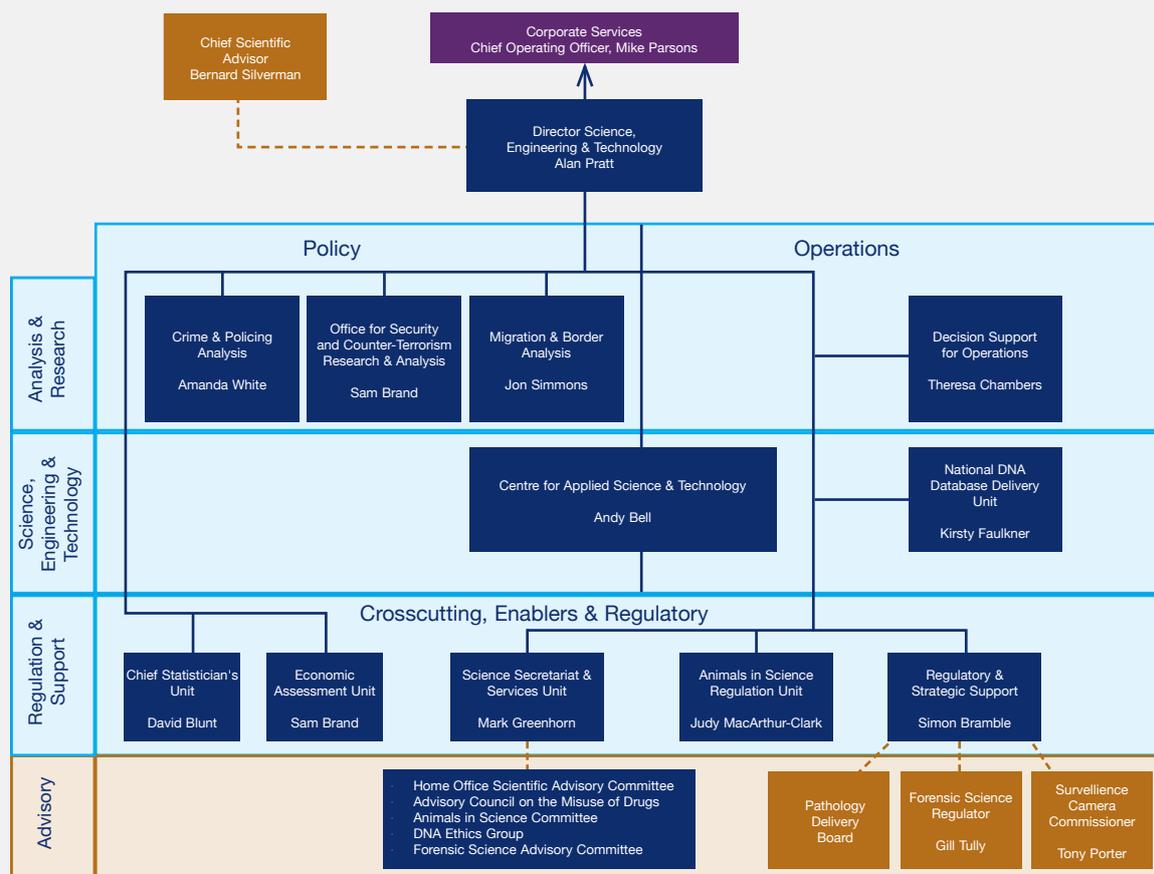
“ Thank you for the information about the Fingermark Visualisation Manual. Here in the Danish Laboratory we purchased the electronic version right after it was released and it fulfilled our expectations. Well done to you and your colleagues. ”

“ The innovative idea that you implemented using ground penetrating radar allowed us to gauge the wall depth ... this was essential for the next phase of the operation. Without your assistance, and that of the National Crime Agency we could not have progressed with the technical side of the operation. Over and above your technical expertise, the fact that you were willing to deploy as part of a covert team in cold, damp conditions demonstrated an extremely high level of professionalism and commitment. ”

Home Office Science

Science is essential to the Home Office and its partners to inform policy and enable effective operations

Home Office Science brings together the department's scientists, researchers and analysts and has a vital role in underpinning the Home Office's work, both policy and operations, with the best science and technology available.



Home Office Science has a unique workforce of physical scientists and engineers, economists, social and operational researchers, statisticians, and veterinary, medical and biological scientists. It aims to:

- shape and support the policy stance taken by the Home Office through the provision of a credible evidence base;
- support operations and frontline delivery through the application of science and technology;
- provide effective regulatory functions in our defined areas of responsibility;
- stimulate innovation and drive economic growth through science, engineering and technology.

It works to achieve these aims by:

- delivering an effective and efficient service to our customers;
- engaging with relevant stakeholders across government, in other agencies, in industry and academia, and internationally;
- developing, supporting and making best use of our high quality workforce.

THE CENTRE FOR APPLIED SCIENCE AND TECHNOLOGY

A unique team of scientists and engineers at the heart of the Home Office providing expert advice, innovation and frontline support

The Centre for Applied Science and Technology (CAST) is the primary science and technology interface between Home Office ministers and policy makers, frontline delivery partners, and the suppliers of science and technology. Understanding the policy and operational context of Home Office business allows it to operate where others cannot for reasons of impartiality, national security or market failure.

It supports the full range of Home Office interests in policing and tackling crime, counter-terrorism, border security and controlling immigration. Its extensive in-house skills and expertise, coupled with access to industrial, academic and international networks, ensures that it is able to provide the right advice and support, irrespective of the problem.

CAST's expertise and activities are focused into capability areas that serve the range of Home Office interests in:

- contraband detection;
- crime prevention and community safety;
- digital investigations;
- forensics;
- identity assurance;
- protective security;
- public order;
- surveillance.

CAST operates from several locations in England, two of which (Sandridge and Langhurst) have specialist facilities.

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Horizon Scanning

Conducting horizon scanning activities to identify the technologies that may create future threats and opportunities

The world lives in a time when technology is changing more rapidly than ever before and is becoming increasingly available to the general population. Some estimates indicate that, by 2017, over 3 billion people worldwide will own a smartphone. Given the explosion in social media use, what effect will such a population of smartphones have?

Envisioning the future is a good way of building resilience into everyone's work. To this end, CAST conducts horizon scanning activities and runs a horizon scanning service to identify the changes, often technological, that may create future threats and opportunities to the way that the Home Office and other government departments deliver their business and develop policies. It also helps our frontline partners to maintain a technological edge.

CAST actively encourages its staff to engage in technology watching to assist in keeping up with technological advances. The application of a technical breakthrough in one area to a previously unconnected area can lead to step changes in advancement and a myriad new solutions to problems. CAST aims to instil this way of innovative thinking into its staff by dedicating 10 per cent of staff time to innovation, technology watching and horizon scanning.



Preventing Terrorism

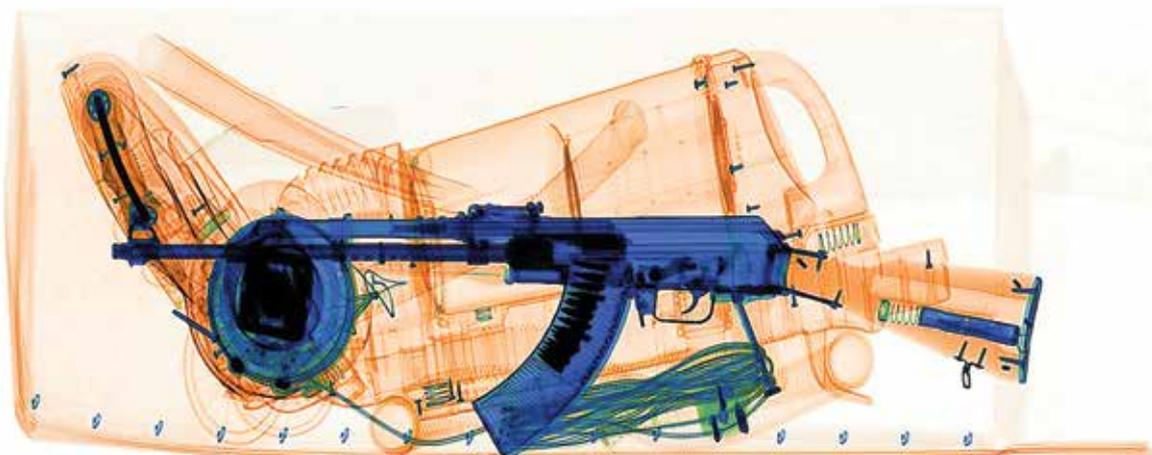
We work to increase our capabilities to detect, investigate and disrupt terrorist threats

Case Study – The Centre for Applied Science and Technology is at the forefront of protecting the UK borders from terrorist threats

The terrorist threat is constantly evolving. Technology must not only keep up, but provide the capability to tackle diverse new threats as yet unseen. CAST solves this problem in a number of ways. Using our specialist scientists and engineers in conjunction with our expert networks we help generate, evaluate and down select the most innovative approaches to detect and mitigate these threats. Using this approach recently we have identified ways in which the UK border can be made even more secure in the future using new technology and new concepts.

Of course, the very fact we need to have secure borders is only part of the solution. What if we could identify threats well ahead of the border? That is why CAST is working internationally to ensure the safety of UK citizens by investigating the feasibility of exploiting all data available to identify threats. In this way we can constantly update our response to be even more impactful. It could also provide law enforcement a richer picture to act upon - denying and disrupting terrorist networks and understanding their methods of operation.

The examples above represent a small fraction of CAST's overall efforts. All act together to ensure the security and prosperity of the UK and its citizens.



Case Study – The Centre for Applied Science and Technology Front Line Services Surveillance Team

The CAST Front Line Services Surveillance Team assists the police at major events by providing technical solutions to security issues. Short-term video and thermal CCTV cameras are installed by the team at events including party political conferences, international diplomatic conferences and some international high-profile sporting events. The presence of CCTV cameras identifies security breaches, records crimes and acts as a visible deterrent.

Following a request from a police force the team starts with an initial meeting at the event venue to discuss the force's requirements and assess any potential problems. This includes identifying which CCTV images are to be transmitted from the venue and where these images should be received. Often this involves picking up existing CCTV feeds from the venue and surrounding area and supplementing these with additional cameras supplied by CAST. Issues to address can typically include interfacing securely with commercial and police networks and overcoming the challenges in getting high definition images to off-site multi-agency control rooms. CAST provides all the required IT equipment including the monitors to display and record the captured images. Using Internet Protocol (IP) encoders the existing venue camera images are converted to IP and then egressed from the venue to the control room using a combination of the police IT network infrastructure and CAST's own wireless radio transceivers. There is also the option of using optical fibre for network connectivity where long distances in rural environments are required and the terrain makes wireless options impossible.

Further visits and pre-build at CAST's laboratories allow potential solutions to be tested before deployment. It is at this stage that any network configuration issues are addressed. CAST also provides training to those operating the CCTV systems. The team remains on site for the duration of the event to solve any technical issues that may arise.

The work of CAST contributes to UK security at major events. It also has a real impact on police resourcing during these events. The provision of one camera feed into a control room saves many hours of police time and the associated costs.



Controlling Immigration

We identify and assess technologies that aim to enhance our border security

Case Study – Biometrics at the border

Assuring the identity of travellers and citizens is essential to the efficient delivery of Home Office services, especially for law enforcement and border security.

CAST is at the forefront of developments in identity technologies and their use to secure the UK's borders and manage immigration. Whilst fingerprints and DNA are well established in law enforcement, at borders it is facial images that are the key to assuring the identity of travellers. There are challenges not only in deploying automated systems but also for the human examiners and border officials involved in the end to end process of managing travellers.

CAST is working with international partners across government, industry and academia to steer the development of Face Recognition technology and establish effective training methods for human facial comparison. The procurement and deployment of biometric e-gates at UK borders is one such example of where CAST provided advice to ensure that security was not compromised by the introduction of automated processes.

Working with bodies such as the International Organization for Standardization (ISO), CAST leads on biometric standards development to ensure interoperability, promote best practice and influence industry's development of technologies where there are niche requirements. Specifically, CAST's work on Face Recognition from video is enabling the development of systems that impose fewer constraints on the individual than is currently the case with e-gates.

Recognising individuals on the move or at a distance are examples of emerging technologies that will help to manage increasing volumes of people transiting UK borders, maintaining high levels of security with minimal inconvenience for the legitimate traveller.



Case Study – Maritime surveillance and protection of the United Kingdom’s borders

The UK considers maritime security to be the advancement and protection of the UK’s national interests, at home and abroad, through the active management of risks and opportunities in and from the maritime domain. Its purpose is to strengthen and extend the UK’s prosperity, security and resilience and to help to shape a stable world.¹

Within the National Strategy for Maritime Security, a key objective is to protect the resources and population of the UK and its Overseas Territories from illegal and dangerous activity, including serious organised crime and terrorism.

Currently, coastal security and defence for the UK is delivered by a host of different government departments, agencies and providers, giving rise to a complex operational environment. Strategically, the UK has an aspirational aim to secure and defend the UK’s coastline through one central command, rather than the disparate structure that it currently functions under.

Working in partnership with Border Force, CAST is seeking to support this ambitious endeavour through identifying and tackling the variety of technological challenges that may be encountered. These challenges come about not only in the practical formation of such a command, but also at a technical level, in terms of how the functions are executed.

CAST has facilitated cross-government workshops resulting in horizon scanning outputs that include a number of innovative technological concepts and potential solutions to support these objectives. This work is shaping future perspectives of coastal surveillance. Through CAST’s Security Innovation and Demonstration Centre (SIDC) it will continue to stimulate the market to seek commercial solutions to the challenges.

¹ National Strategy for Maritime Security – May 2014.



Promoting Growth

UK security exports have doubled over the last five years. CAST is working to ensure that the UK security industry stays at the forefront of the global export market and at the same time contributes to the safety and security of the UK.

The Centre for Applied Science and Technology hosts the annual 'Security and Policing' event jointly with UK Trade & Investment.

The UK is recognised as a world leader in the field of security, the development of cutting edge technology and for its extensive experience and expertise in training. Since its inception over 30 years ago the Security and Policing event has provided a platform for professionals from the UK and across the world to engage with the very highest level of security expertise. The event continuously develops in size and scope and supports the Security and Resilience Growth Partnership (SRGP), which was established to create a strong relationship between HMG and the security sector, to deliver HMG's security requirements and grow UK prosperity through supporting exports. In 2014, UK security sector exports rose to £3.4 billion from £3.2 billion in 2013, allowing it to retain its position as the sixth largest exporter globally.

Security and Policing is aimed at the police, law enforcement and security professionals who are tasked with security, civil protection and national resilience. The event showcases world-leading products and services, taking advantage of the unique opportunity to bring together people with operational needs and companies with the relevant solutions, within a secure environment. It currently attracts around 400 exhibitors and international delegations from over 50 countries.

- In 2014, the UK security sector directly employed an estimated 270,000 people in the UK.
- The global security market in 2014 was valued at around £650Bn. Security sector growth is anticipated to increase from 11.5% to 16.3% over the 2014-19 period.



CAST's Langhurst site is home to the Security Innovation and Demonstration Centre (SIDC)

The Security Innovation and Demonstration Centre (SIDC) is the primary route for the delivery of the Security and Resilience Growth Partnership's (SRGP) objectives. The SRGP's oversight board is jointly chaired by the Minister for Security and the Chair of the Security and Resilience Industry Suppliers Community (RISC).

SIDC brings together government, industry, academia and practitioners, such as the police, to identify security and policing challenges and create innovative solutions enabling the rapid development and use of technology. By doing so it creates opportunities for British security companies overseas and promotes the UK security industry's capabilities and expertise. By acting as a unifying force across Government's complex security related innovation, design and development landscape it will deliver in a number of ways:

- It will identify significant domestic and international opportunities for the security sector and generate intelligence about them
- It will identify, support and exploit innovative solutions to key security challenges
- It will showcase outstanding UK security sector capabilities for domestic and international customers and investors

SIDC creates realistic working environments to demonstrate the benefits of technologies in cutting crime and protecting the public. These include:

- The future of the digitally enabled police officer, which provides a real-time, rapid investigation of a serious crime as it unfolds. The scenario features a range of existing technology such as body worn video and tablet computers, and includes a 3D imaging system and hand-held scanner to transmit fingerprint and footprint images back to a police control room.
- The Future Borders Experience, which is a demonstration of how the use of future technology for detection and screening – such as biometrics, behavioural analysis, and advanced data analytics – can help smooth the experience of border crossing for legitimate purposes. The Experience showcases one possible version of the future border using British based SMEs. The technology demonstrated allows passengers to move through an airport largely unhindered unless they meet certain risk criteria determined through discreet body scanners, radiology, chemical and biological sensors, as well as behavioural analysis. “Secure areas” are established through the use of finger vein technology, allowing only cleared individuals to progress. This allows genuine travellers to pass through ports swiftly whilst officers focus on those who are attempting to do the UK harm.
- ‘Frontline. Online. Anywhere’ guides visitors through a people trafficking scenario and includes a range of future law enforcement capabilities which demonstrate how new and existing identification and verification technologies, the secure transfer of information via mobile devices to and from front line officers, and access to a range of online services via mobile devices, can lead to improved policing outcomes and early incident resolution. Technologies include a concept police car, data analytics and secure networks, biometrics, and applications for mobile devices, all integrated into a single demonstration.

CAST works together with end users, academia and industry to ensure that the UK continues to benefit from the European-funded research programme, Horizon 2020

The Horizon 2020 (H2020) programme is a European-funded research programme that covers a wide range of topics determined by the EU Commission to be of societal importance to the citizens of Europe. The programme will run from 2014 through to 2020 and has an overall budget of €80 billion. Within the programme, the 'Secure Societies' theme is aimed at improving the security of Europe through innovative research. The broad topics within the scope of this theme are: disaster resilient societies; fighting crime and terrorism; border and external security; and digital security.

H2020 operates as a collaborative programme that requires a minimum of three partners from EU Member States. These partners are typically from academia and industry, but increasingly there is a demand for end-user engagement as bids are assessed on impact. This is a competitive process and there are no guarantees that all proposals will lead to a funded project. The timescales involved in H2020 follow an annual cycle and projects typically last for three years.

CAST has made significant progress in engaging with the H2020 programme with active participation as partners in 13 project proposals covering key areas of CAST activity including:

- advanced forensic techniques for the examination of crime scenes and real time transfer of information;
- the examination of hazardous scenes using advanced technology with sensor arrays to detect chemical, biological, radiological and nuclear and enhanced nuclear material;
- novel biometric technologies at the border;
- applying forensic techniques to the analysis of information on the internet;
- detection of contraband using stand-off technology; and
- tools for the analysis of large volumes of data.



Cutting Crime

CAST's scientists are working hard to reduce the harm caused by drugs

Case Study – The Forensic Early Warning System project

In recent years the UK has seen the emergence of new drugs that have similar effects to drugs that are nationally and internationally controlled. These drugs are collectively called new psychoactive substances (NPS). They have been designed specifically to fall outside of the Misuse of Drugs Act 1971 and are sold as 'legal highs'. Small changes are made to the structure of drugs, which means they are not controlled and the police have little legislative power to take action against them (e.g. arrest). They have the potential to pose serious risks to public health and safety and can even be fatal. The short-term harms of NPS can include paranoia, psychosis and seizures; their long-term harms are often unknown. There has been a rapid increase in the number and range of new substances with greater ease of availability. At a time when traditional drug use such as cannabis is declining, NPS pose a significant challenge to the Government.

The Forensic Early Warning System (FEWS) project has been run by CAST since its pilot in 2010. The project aims to identify NPS in the UK through collection plans in a variety of areas including prisons, festivals, online and high street 'head shops'. FEWS has been working with forensic providers to increase the capability in the UK of identifying NPS by providing reference standards (pure samples of a material) and creating a platform for information sharing of new or unknown substances. The work CAST does in the FEWS project is fed into the Advisory Council on the Misuse of Drugs, which uses it to decide on control measures for new drugs. Using its knowledge and experience in this area CAST has supported the delivery of a new forensic capability in the UK for the Psychoactive Substances Bill which will come into effect in 2016. This Act controls the supply of drugs based on the psychoactive effect they have on the body, rather than their chemical structure. To prove psychoactivity a new type of testing is required and CAST is working with a wide range of stakeholders to put this testing in place and ensure that it can stand up to judicial challenge.

The work of CAST under the FEWS project has increased the UK's knowledge of NPS and is leading to the control of these harmful substances.



Case Study – Mobile drug testing technology

CAST has taken the technical lead to increase the efficiency of the police in testing drivers for suspected drug driving

Drug driving causes tremendous harm; it can destroy lives of individuals and families and devastate communities. In 2014 there were 55 fatal road traffic collisions and 264 serious injuries in which the driver's impairment due to an illicit drug was judged to be a contributory factor. Tackling this important road safety issue is a priority for the Government.

CAST was the technical lead on a joint Home Office and Department for Transport project that allows the police to use saliva drug testing technology to help to combat drug driving. This technology allows the police to screen for THC (cannabis) and cocaine in a driver's saliva at the roadside.

The law allows the police to carry out a 'preliminary drug test' on a sample of saliva from a suspected drug driver to see if they have a drug in their body. The police can only use a drug testing device that is 'of a type approved' by the Secretary of State. The type approval process is underpinned by rigorous laboratory tests to make sure that the device is accurate, reliable, and detects the drugs it should, but does not react to common chemicals that may also be found in saliva. Working in an ISO 17025 accredited laboratory facility at CAST, our team carried out thousands of individual laboratory tests to ensure that devices meet the stringent performance requirements of the type approval process.

CAST's work in this area has, for the first time, allowed the police to have saliva-testing technology to test suspected drug drivers at the roadside. As well as saving the police time and money, using this mobile technology will help to promote road safety by supporting drug driving enforcement.



Case Study – Digital investigations

Digital data sources are having an increasing impact on the traditional crime scene. The Centre for Applied Science and Technology is rising to the rapidly growing challenge of the digital crime scene

Digital media is increasingly associated with a wide variety of crime. CAST's work in digital investigations is designed to be relevant both to policing in the investigation of crime, and to a much broader group of investigators including those working within Immigration and Borders. All of these face similar challenges in being able to identify individuals online from their digital footprint and to obtain robust digital evidence of their activity that can be used in prosecutions. CAST is focusing on two key areas:

- digital forensics; and
- open source intelligence.

As part of our digital forensics work we are looking at novel tools and techniques that can be deployed to recover digital evidence from the increasing variety of devices that may be found at any crime scene. Devices may include the latest smartphone or tablet on which multiple apps are installed, games consoles, smart TVs, or even vehicle electronics systems. We are looking at commercially developed tools that can be deployed by frontline officers and specialist techniques that could be used by digital forensics practitioners in more challenging and complex cases.

CAST's work on open source intelligence has included developing methods for practitioners to assess the vast range of 'free' tools that are used in searching for, collating and analysing information online. Many of these tools are free at the point of use, but using them may carry risks in terms of privacy (for example, the data they may share with the tool provider or others), legality and reliability. We are also helping investigators to understand what online footprint they themselves may leave when carrying out internet investigations.

To deliver against these broad challenges we will be using both our in-house technical skills and working in partnership with industry and academia, developing and collating the most up-to-date knowledge and then disseminating it to those who can deploy it operationally.





CAST's ISO17025 accreditation covers fingerprint enhancement, testing of preliminary drug testing devices, testing of breath alcohol screening devices and evidential breath alcohol analysis instruments.

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