

**COSTAIN**

# Technology for connected places



Improving people's lives with  
smart infrastructure solutions

# We improve lives with smart infrastructure solutions

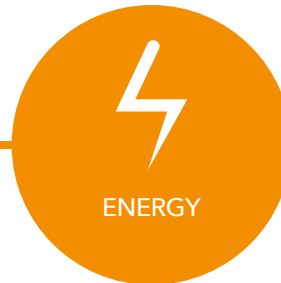
## What we do

We deliver integrated smart solutions to meet urgent infrastructure needs across the UK.

## Why we do it

We help to safeguard the security, increase the capacity, improve customer service and drive efficiency in our clients' infrastructure programmes.

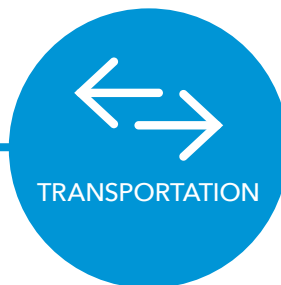
### We power communities



### We keep the water flowing



### We keep the nation moving



## How we do it

Our expertise in the integration of technology, consultancy, asset optimisation and complex delivery positions us at the forefront of a rapidly-changing market environment.



Technology



Consultancy



Intelligent Asset  
optimisation



Complex  
delivery



Intelligent  
Mobility



Digital  
Infrastructure



Smart  
Places



Digital  
Operation



## Intelligent mobility



Connected and autonomous vehicles (CAV) are anticipated to fundamentally change the way we live, work and travel. The potential connection of millions of mobile assets across the network, leading to automated transport on our roads will revolutionise future mobility and because future vehicles will of necessity be powered by renewable and alternative energies, this will also revolutionise the generation, distribution and consumption of energy.

- Providing Smart Infrastructure Solutions for CAV is a core part of Costain's future highways strategy. CAV will increase capacity and improve customer service delivering benefits to our clients and their customers.
- Costain is already involved in projects for CAV testing in urban areas (across the Midlands and the South East). There will be opportunities to expand this to inter-urban and rural areas. Costain is developing software and services for infrastructure to vehicle communications.

Our vision of a connected future includes the two-way communication of data from fixed and mobile assets. Our ability to deliver benefits through these communications include:

- Data driven operations
- Creating smart, connected corridors
- Creating open testing environments for CAV
- Sharing data in the right way



### CASE STUDY | V2G

**Project:** The Integrated Transport and Smart Energy Solutions for Major Urban Developments (ITSES) was a feasibility study that utilised the planned infrastructure development of Old Oak Common and Park Royal in West London to understand the integration of vehicle to grid technology within current infrastructure.

**Our role:** Costain integrated a team of experts from academia and industry such as Cenex, National Grid, Transport for London, University of Reading, Cambridge University, Transport Systems Catapult and Nuve.

**Outcomes:** The project provided insight into adapting and utilising an existing technology to provide a buffer for excess renewable energy and looking at the feasibility of applying this into a UK Smart City development. Costain used its expertise in V2G and EV to provide bespoke asset integration analysis and business case modelling. Bringing together decades of experience in the transport, infrastructure and energy industry we delivered a visual integration plan which considered aspects such as city planning, energy network, mobility, infrastructure integration and commercials.



## Connecting design, operations and efficiency to optimise solutions for connected places

Costain leads the way on data capture and management, subsequent insight and design, helping our clients and ourselves to make appropriate risk-based investment decisions based on fact in order to prioritise expenditure to derive the most value.

### Costain's data insight activities:

- Add value by informing risk assessments which can be used to prioritise investment
- Predict and help prevent failure of critical assets, irrespective of whether those assets are: human (your workforce), information, physical, financial or intangible assets such as reputation or branding.

### Our advanced data science delivers radical service improvements

Costain leads the way on data capture, management and actionable insight to improve infrastructure design, delivery, operations and maintenance.

- We take a holistic view: people, assets, money and reputation
- We analyse multi-dimensional datasets to spot trends
- We apply extensive domain knowledge to interpret those trends
- We help prioritise investment based on risk and reward
- We help predict and prevent failure of critical assets

Costain delivers the outcomes our clients value. For example, for East Sussex Highways:

- We almost eliminated Red Claim costs; saving £1.57mn/yr
- We reduced complaints by 83%
- We improved safety by halving reactive maintenance

| Element                                   | 2016*                      | 2017**    | Benefit                             |
|---|----------------------------|-----------|-------------------------------------|
| Red claims                                | £1.6m                      | £26k      | <b>£1.57m saving</b>                |
| Emergency reactive crew responses         | 32                         | 16        | <b>-50%</b>                         |
| Street lighting power                     | 46,875kWh                  | 37,500kWh | <b>-20%</b>                         |
| Corporate complaints                      | 142                        | 25        | <b>-82%</b>                         |
| Complaints vs compliments                 | 2:1                        | 1:3       | <b>Happy Customers</b>              |
| Service performance indicators (SPI)      | Limited SPI data available | 105%      | <b>Happy Customers</b>              |
| Response time target met                  | 50%                        | 98%       | <b>Happy Customers</b>              |
| Customer logging of defects (via website) | Not available              | 25%       | <b>Call costs -33%</b>              |
| Training courses delivered                | Not available              | 108       | <b>Our Customer Centric Service</b> |

\* prior to transformation \*\* year following transformation



# Costain approach to systems engineering and systems thinking

Costain's systems approach focusses on outcomes, including resilience and future-proofing. This includes applying systems thinking to understand where to deploy capital expenditure to achieve the most effective outcomes, and systems engineering to ensure that the selected interventions achieve those outcomes.

Systems thinking encourages teams to consider the broad picture, including the interconnectivity of the assets, the required outcomes and those factors that will affect the performance of the whole system. This helps focus capital expenditure on asset-level interventions that ensure the improvement of the overall system; for example, reducing the costs of future technology updates, or increasing desired behaviours within the system.

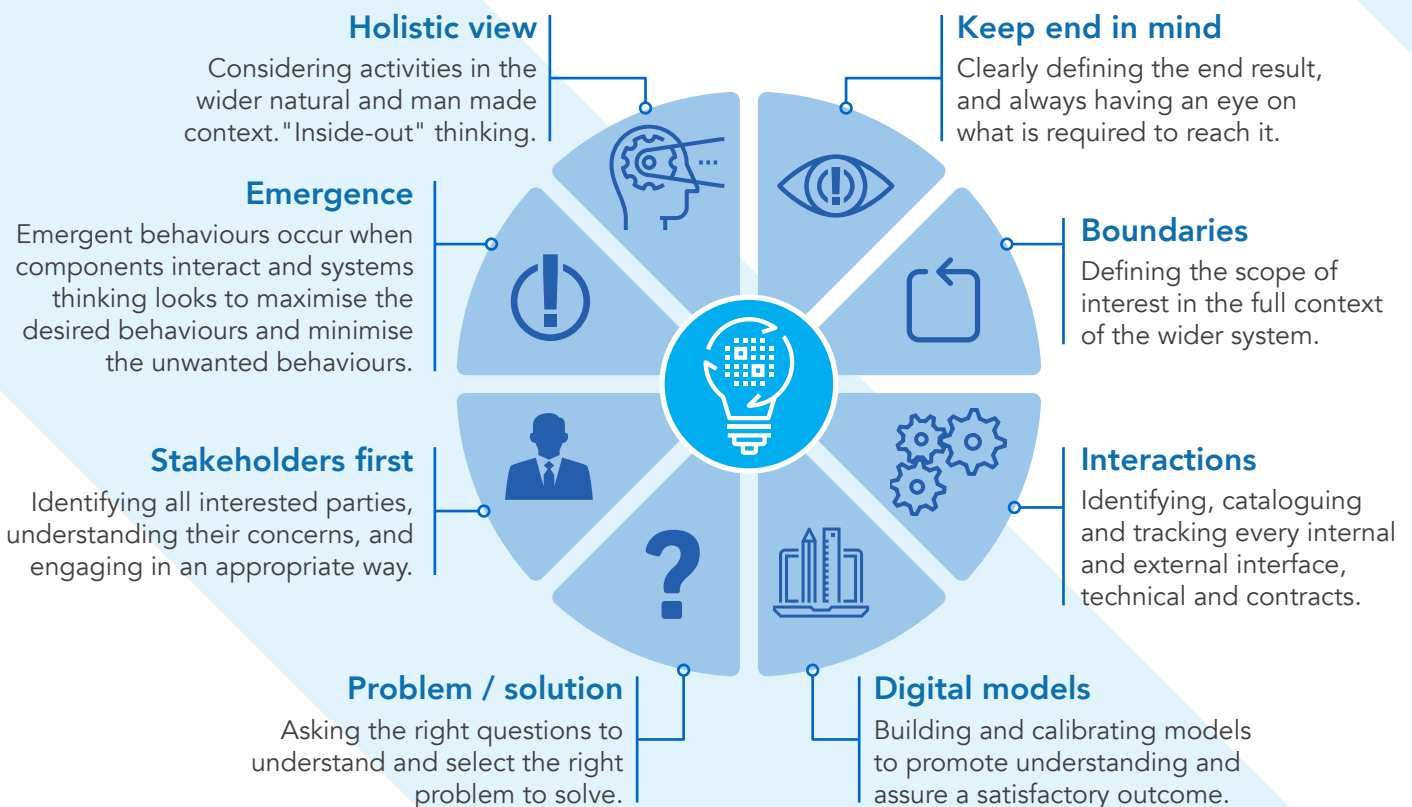
Systems engineering ensures return on investment by continuing the systems approach into asset improvement projects, capturing and developing the specific requirements and continuously assuring them against the related outcomes.

Costain is helping clients in highly regulated industries achieve greater returns on investment by applying our systems approach.

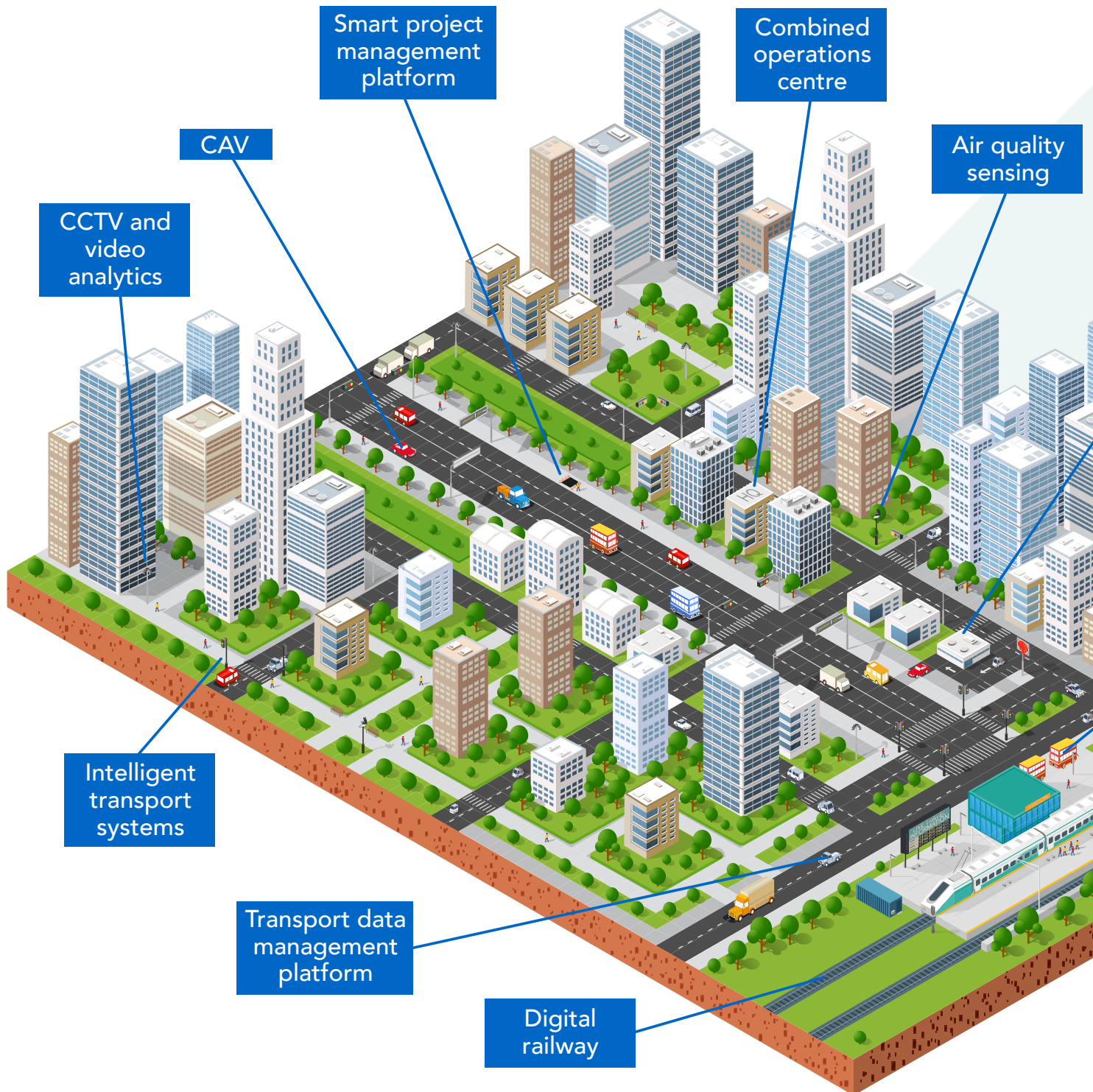
## Benefits:

- Improved business case for capital spending
- Regulator confidence through progressively demonstrating traceability between plan and outcomes
- Design systems that are resilient to failures and natural events
- Reduce costs through improved productivity
- Reduce cost of technology integration and future upgrades
- Support the early development of investment programme
- Plan for the whole life of assets from procurement to disposal

## Systems thinking

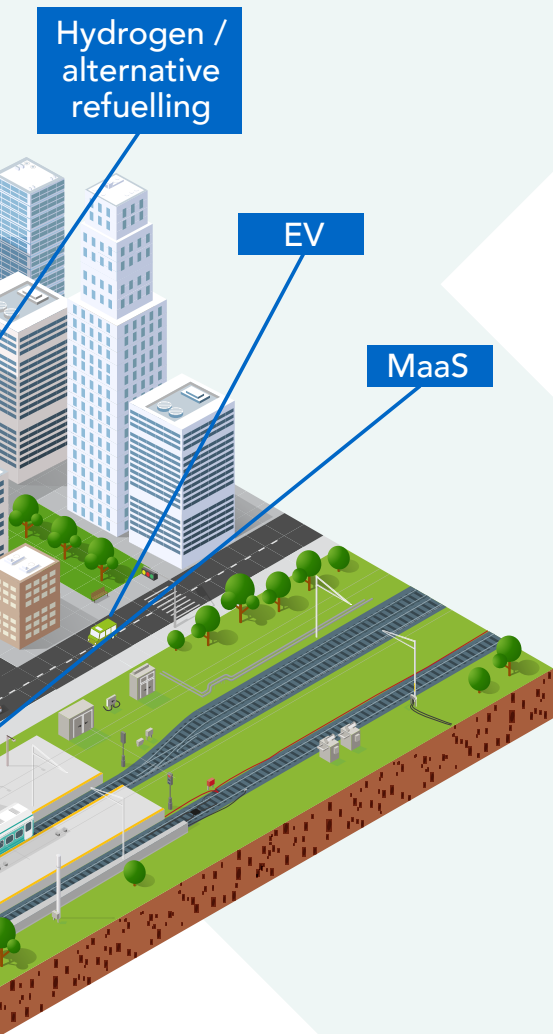


The impact of increasing connectivity on our existing services is one that is hard to predict. Our infrastructure we currently have will need upgrading, new infrastructure will need to be implemented and new business models will need developing. These upgrades will provide benefits to society wellbeing and increasing economic growth. They will also help the UK to become more productive and efficient and help manage and maintain infrastructure or provide a more seamless customer experience. The future mobility services are demonstrated in the below graphic.





What we do know is that the implemented and new service environment as well as efficient by using technology e. A selection of Costain's



**Increase Capacity** – changing consumer demands, consumer use, technology, population growth, business change, and environmental conditions are some of the pressures driving changes in mobility as demand outstrips supply.

**Enhance service** – the end users of our infrastructure will have even greater demands, changing needs, higher expectations, increased speed of service and influence as to how the end service is delivered to them. Providers of infrastructure are committed to and financially incentivised to improve customer service in terms of quality of service, reliability of service, cost of service and impact of service.

**Ensure security** – critical to the continuing prosperity and growth of the UK economy, and wellbeing of the UK population, is security of supply in having an effective fit-for-purpose transport system, and a sustainable energy supply, both of which directly impact mobility infrastructure and services.

**Achieve efficiency** – the Government, regulators and the public all have a common expectation that costs for transportation and energy will not increase but decrease, despite the need for asset replacement, asset improvements, and service quality upgrades.



## Digital infrastructure

To enable connected future there are several technologies that will need to be installed from wireless connectivity, CAV, intelligent CCTV analytics to sensors and management platforms.

Our team of technology leaders have spearheaded technology roll out on some of the UK's largest infrastructure projects, including:

- The Huntingdon and Peterborough compressor upgrade, which is the single largest capital project currently being undertaken on the gas network.
- London Bridge redevelopment project, the £1bn station transformation which was named the greatest London infrastructure project of 2017 by the Institution of Civil Engineers (ICE).
- The multi award winning £15bn Crossrail project stretching 118Km right through the heart of London.
- Eight2O, the largest water alliance in the UK delivering £3bn of capital work upgrading the UK's water infrastructure with Thames Water.

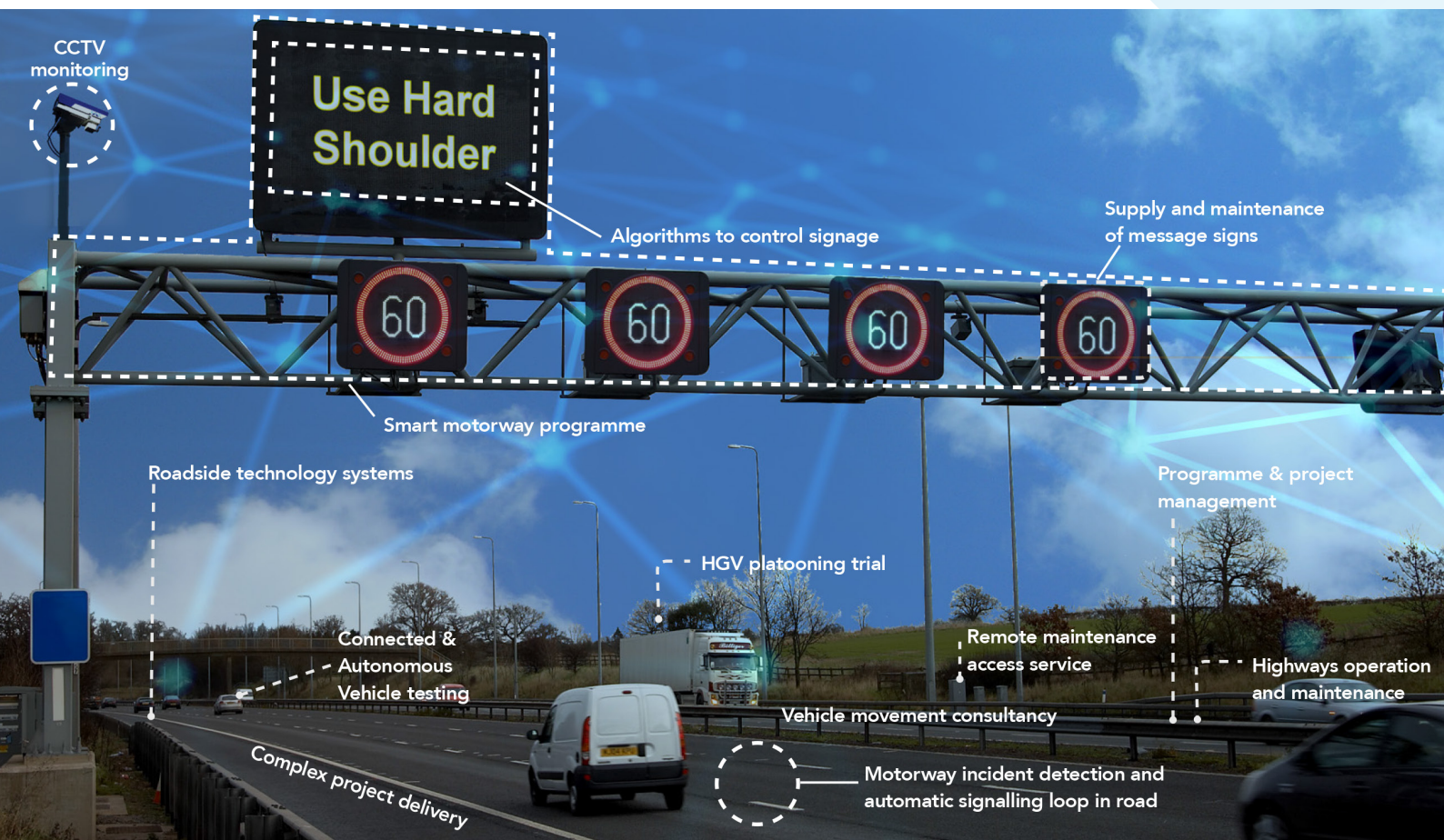
Costain has extensive experience in securing critical national infrastructure.

Examples of systems which we have provided systems for including design, install, commission and maintain include:

- Thelwall Viaduct Security System
- Avonmouth Bridge North
- Avonmouth Bridge South
- M6/M5 Spaghetti Junction Pier Protection System
- Exe Viaduct Security System
- Orwell Bridge

Our security solutions include Passive infra-red/ Radar detection networks, video analytics, thermal and visible light CCTV and alarm systems such as fence, door and presence alarms. Typically alarms are received at the Highways England regional control centre via the Costain VC-Anywhere CCTV alarm interface and then raised via Costain's regional control centre CCTV systems. For off-grid areas we are able to supply green-power such as fuel cell, solar panel and other similar solutions.

**Costain has extensive experience in developing and deploying CCTV and telecommunication technology.**







## Costain video management system

Digital Video Network Protocol (DVNP) is an open protocol developed by Costain, originally for Highways England, Metropolitan Police, and Transport for London, but now an open protocol for the use of any interested parties, with the aim of simplifying and expanding the ability of CCTV systems to securely share their resources.

### Key Features

**Scalable** - Every DVNP deployment creates a link to other sharing parties, with separate routes for incoming and outgoing video, meaning that every deployment is extremely scalable.

**Future proof** - DVNP has been designed to make future changes easy to implement, without breaking backwards compatibility with previous deployments.

**Secure** - The DVNP interface operates over https, using the same encryption widely used in other secure web services such as online banking. This encryption ensures that it can safely operate over the public internet, although it can also be deployed on private networks, or across VPNs.

### Digital CCTV solution provided to Transport for London:

- A dual resilient Installation split across two geographical sites for automatic failover
- 1,000 Operator Interfaces (OIFs) to be connected across multiple sites throughout London
- Concurrent use of all cameras to 400 OIFs
- Real time digital video format transcoding
- Intelligent video decoding
- Multiformat digital video recording and multiformat video walls.
- Stills image web publication capability
- Low latency Web Client for streaming video.

### Telecommunication systems

Costain has a multi-discipline 'in-house' telecoms design team that has the ability to work across all sectors. Costain specialises in physical systems design, where operational technology (e.g. sensing, monitoring and controlling) converges with Information Technology (e.g. data information, systems process and storage).

Our personnel are also experienced in creating specialist new electronics and software, and integrating both hardware and software to ensure we deliver solutions that solve our client's operational challenges, even for their most demanding and mission critical operations.

In addition to our in-house systems design configuration, build and testing capability (to validate and troubleshoot integration), we are also experienced in security management undertaking stringent end-to-end penetration testing in order to mitigate the risk of cyber-attack. Costain is an ISO 20001 and cyber essentials accredited organisation.

We have many years' experience of developing secure systems for our Government clients and this is especially so where operational technology / information technology convergence features as part of that design.

### Costain's in-house telecoms design capability encompasses:

- System design (physical) • Installation design
- Assurance • Integration & interface management
- SCADA • PA/GA • Customer information screens
- Signage of field assets • Design of media converters
- Systems design configuration • Cyber-security
- Telecoms towers and masts • Design of equipment Cabinets • Rack build • Factory acceptance testing
- Outsourcing management for installation surveys, installation and commissioning • IP networks (LAN/WAN) • CCTV • Development of software & protocols to allow legacy system integration

## CASE STUDY | Protecting the Dartford Crossing

**Prior to the removal of the Dartford River Crossing toll booths, non-compliant vehicles that were either over-height, over-width, over-length or carrying hazardous goods were detected by toll booth operators. Yet Highways England's decision to remove all toll-booths on the Dartford Crossing to ease congestion meant that a system was required to detect and extract non-compliant vehicles to protect the tunnels.**

Using a combination of innovative equipment and technologies, including our unique orange plate vehicle detection system and over-width/over-length detectors, our traffic management "safety cell" is able to detect non-compliant vehicles. These vehicles are then extracted into a marshalling area and prevented from damaging the tunnels.

The use of the traffic management cell enabled the 50mph free-flow system to operate efficiently, whilst protecting the tunnels and public from over-height and hazardous goods vehicles. The system detected and stopped an average of 20 non-compliant vehicles per day.



## Digital operations

### Building information modelling (BIM)

We implement Level 2 BIM on our contracts using **BS1192** and **PAS1192:2** which implement a robust process **for the management of all CAD data** and associated deliverables, including Work In Progress (**WIP**), **Shared** information, **Published** documentation and **Archived** as-built documentation, whilst providing the methodology for a BIM-enabled contract.

### GIS – Geographical Information Systems

#### Data management

Enhance interoperability through collaboration and transformation of geospatial data.

- **Transformation and collaboration**

Spatial data exists in various formats which can present challenges when consuming it in different systems. These formats include GIS, CAD, XML, 3D, BIM, Web services as well as spreadsheets and databases. Through ArcGIS and FME we have the tools and expertise to maximise data interoperability to ensure it can be transformed and used across a range of data systems.

Costain's GIS solutions facilitate collaboration. On our East Sussex Highways contract, engineers and project managers can now access environmental data pertinent to key projects far more quickly and easily using ArcGIS Enterprise.

- **Geocoding and georeferencing**

Data which exists in spreadsheets and tables can be mapped using a process called geocoding. Geocoding is the computational process of transforming a physical address description to a location on the Earth's surface and plotting it on a map.

We also provide georeferencing as a service by using accurate location data to align PDFs, scanned maps and raster data to a map coordinate system. A map coordinate system is defined using a map projection which is a method by which the curved surface of the earth is portrayed on a flat surface.

- **Integrated aerial solutions**

Costain's GIS Enterprise is a central platform where aerial information including drone imagery and point cloud data can be integrated with other spatial data.

### Visualisation and understanding

#### Easily visualise and understand spatial data

- **Online and open source**

Using the Esri platform and open source solutions we design and create simple, easy to use online map applications. Data is organised and symbolised to clearly communicate location information with popups readily available for further interrogation of asset attribution.

- **3D GIS and BIM integration**

We combine 3D BIM models and 3D CAD drawings to visualise assets in a GIS environment, providing geographical context for infrastructure projects. This enables delivery teams to efficiently and effectively share substantial amounts of data to different professionals in a collaborative way.

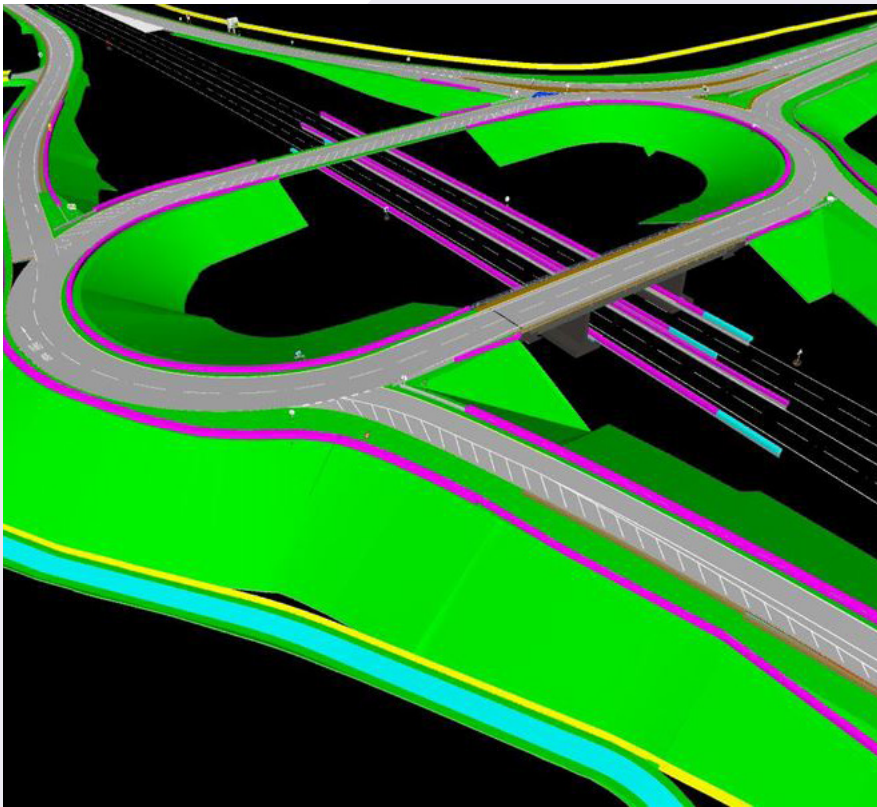
- **Dynamic dashboards**

Using dashboards, we deliver operational intelligence to enable informed design decisions. We deploy dynamic dashboards which reflect the status and performance of events, people, and assets in real time. Our clients can easily monitor key performance indicators through visual elements such as maps, charts, gauges and graphs.

- **Spatial analysis**

Through the use of spatial analysis tools e.g. hotspots, patterns, proximity, nearest location, we help clients answer questions and make important decisions. We understand the best analysis tools for each scenario and advise clients on how to interrogate their data to gain valuable insights.

*Through Geographic Information Systems (GIS) Costain helps clients collect, manage, analyse and understand their spatial data, facilitating better planning, more informed decision making and more integrated project delivery.*





**COSTAIN**



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