Digital Roads

Digitally Enabled – Connected – Data Driven

Safer Construction and Operations - Faster Delivery- Better Customer Experience

Digital Roads 2025 Roadmap

July 2021

Introduction

> " **Digital roads harness data, technology and connectivity to improve the way the strategic road network is designed, built operated and used.** "

This will enable a safer SRN, faster delivery, and an enhanced customer experience for all. Digital Roads aligns with our imperatives and is structured around three core themes, all of which are digitally enabled, connected and data driven.

Digital Roads themes:

Digital Design & Construction

Digital Operations

Digital for Customer

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Purpose of this document

This document sets out the key activities and steps that are required to achieve our Digital Roads vision for 2025.

About this document

The key activities and steps required to achieve the Digital Roads vision are mapped to each of the ambition statements (see Digital Roads Brochure). The high level steps are captured in a summary roadmap and the individual steps required to achieve each ambition statement are captured in more detailed roadmaps.

This roadmap presents an indicative timeline of key activities and steps. This will be a living document that will be routinely updated to reflect progress against our 2025 Digital Roads vision.
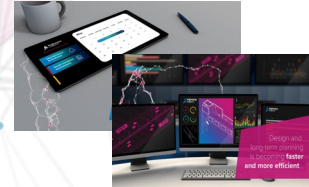
We welcome involvement and collaboration from a wide range of stakeholders and recognise this is critical for the delivery of our 2025 Digital Roads vision.

For more information please contact:
DigitalRoads@highwaysengland.co.uk

Click to access Digital Roads 2025 Summary roadmap ▶

This roadmap is part of a suite of Digital Roads documents, which set out the latest National Highways thinking and approach for Digital Roads:

The Digital Roads Video

Sets out the Digital Roads vision for 2025, structured around the three themes. The video highlights the benefits of Digital Roads for our customers.

Digital Roads Brochure

Outlines the structure and additional detail which makes of the Digital Roads vision for 2025, based on: 3 themes, 9 sub themes and 35 ambition statements.

This document

Digital Roads Interactive Roadmap

Sets out the key activities and steps required to achieve our Digital Roads vision for 2025
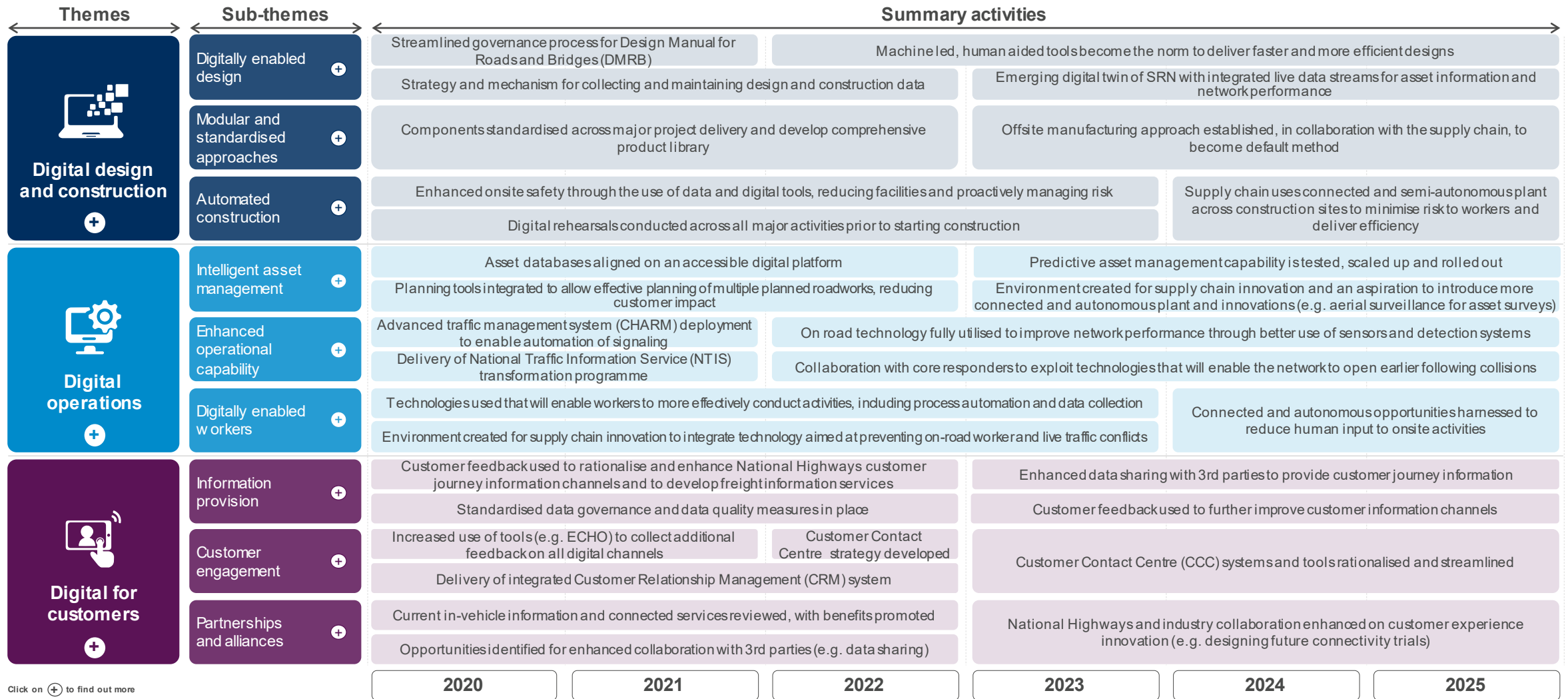
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Summary roadmap

Summary roadmap presents key building blocks to realising our 2025 Digital Roads vision. For visualisation, some dates and durations have been shifted or condensed.

Summary roadmap ▶

Summary roadmap

Themes	Sub-themes	Summary activities

Digital design and construction

- Digitally enabled design
  - Streamlined governance process for Design Manual for Roads and Bridges (DMRB)
  - Strategy and mechanism for collecting and maintaining design and construction data
  - Machine led, human aided tools become the norm to deliver faster and more efficient designs
  - Emerging digital twin of SRN with integrated live data streams for asset information and network performance
- Modular and standardised approaches
  - Components standardised across major project delivery and develop comprehensive product library
  - Offsite manufacturing approach established, in collaboration with the supply chain, to become default method
- Automated construction
  - Enhanced onsite safety through the use of data and digital tools, reducing facilities and proactively managing risk
  - Digital rehearsals conducted across all major activities prior to starting construction
  - Supply chain uses connected and semi-autonomous plant across construction sites to minimise risk to workers and deliver efficiency

Digital operations

- Intelligent asset management
  - Asset databases aligned on an accessible digital platform
  - Planning tools integrated to allow effective planning of multiple planned roadworks, reducing customer impact
  - Predictive asset management capability is tested, scaled up and rolled out
  - Environment created for supply chain innovation and an aspiration to introduce more connected and autonomous plant and innovations (e.g. aerial surveillance for asset surveys)
- Enhanced operational capability
  - Advanced traffic management system (CHARM) deployment to enable automation of signaling
  - Delivery of National Traffic Information Service (NTIS) transformation programme
  - On road technology fully utilised to improve network performance through better use of sensors and detection systems
  - Collaboration with core responders to exploit technologies that will enable the network to open earlier following collisions
- Digitally enabled workers
  - Technologies used that will enable workers to more effectively conduct activities, including process automation and data collection
  - Environment created for supply chain innovation to integrate technology aimed at preventing on-road worker and live traffic conflicts
  - Connected and autonomous opportunities harnessed to reduce human input to onsite activities

Digital for customers

- Information provision
  - Customer feedback used to rationalise and enhance National Highways customer journey information channels and to develop freight information services
  - Standardised data governance and data quality measures in place
  - Enhanced data sharing with 3rd parties to provide customer journey information
  - Customer feedback used to further improve customer information channels
- Customer engagement
  - Increased use of tools (e.g. ECHO) to collect additional feedback on all digital channels
  - Customer Contact Centre strategy developed
  - Delivery of integrated Customer Relationship Management (CRM) system
  - Customer Contact Centre (CCC) systems and tools rationalised and streamlined
- Partnerships and alliances
  - Current in-vehicle information and connected services reviewed, with benefits promoted
  - Opportunities identified for enhanced collaboration with 3rd parties (e.g. data sharing)
  - National Highways and industry collaboration enhanced on customer experience innovation (e.g. designing future connectivity trials)

| 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |

Click on (+) to find out more

Please note that for visualisation, some dates and durations have been shifted or condensed. Detailed (ambition statement level roadmaps) are presented in the following sections.

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Digital design and construction

Our activities will be increasingly automated, modular and conducted off-site. This will result in safer production, reduced network disruption, increased productivity and smoother journeys for our customers.

Detailed roadmap ▶

Digital design and construction – Ambition statements

Ambition Statements: Digital design and construction ⊗

Our activities will be increasingly automated, modular and conducted off-site. This will result in safer production, reduced network disruption, increased productivity and smoother journeys for our customers.

The following ambition statements set out our vision of how digital technology will enable us to achieve 2025 Digital Roads vision.

Digitally enabled design

1. **Digitised requirements** - Our design and construction requirements will be digitised, enabling automated design and seamless integration of connected construction activities (estimation, sequencing and costing).

2. **Effective management and exploitation of data** - We will create and make greater use of available data (e.g. topographical and environmental information) to reduce the need for pre-construction site visits and investigations.

3. **Machine-led, human aided tools** – These will be used to create automated designs and improve accuracy.

4. **Digital twin** - The foundation of Digital Twin will be utilised on projects through the collation and federation of existing data to support network planning and decision making.

Modular and standardised approaches

1. **Modularised and off-site fabrication -** These will become the default where practical, minimising disruption on the network and delivering a more sustainable approach.

2. **Standardised components** - We will increase the use of standardised components in our designs (based on our digitised construction requirements) in order to maximise efficiency.
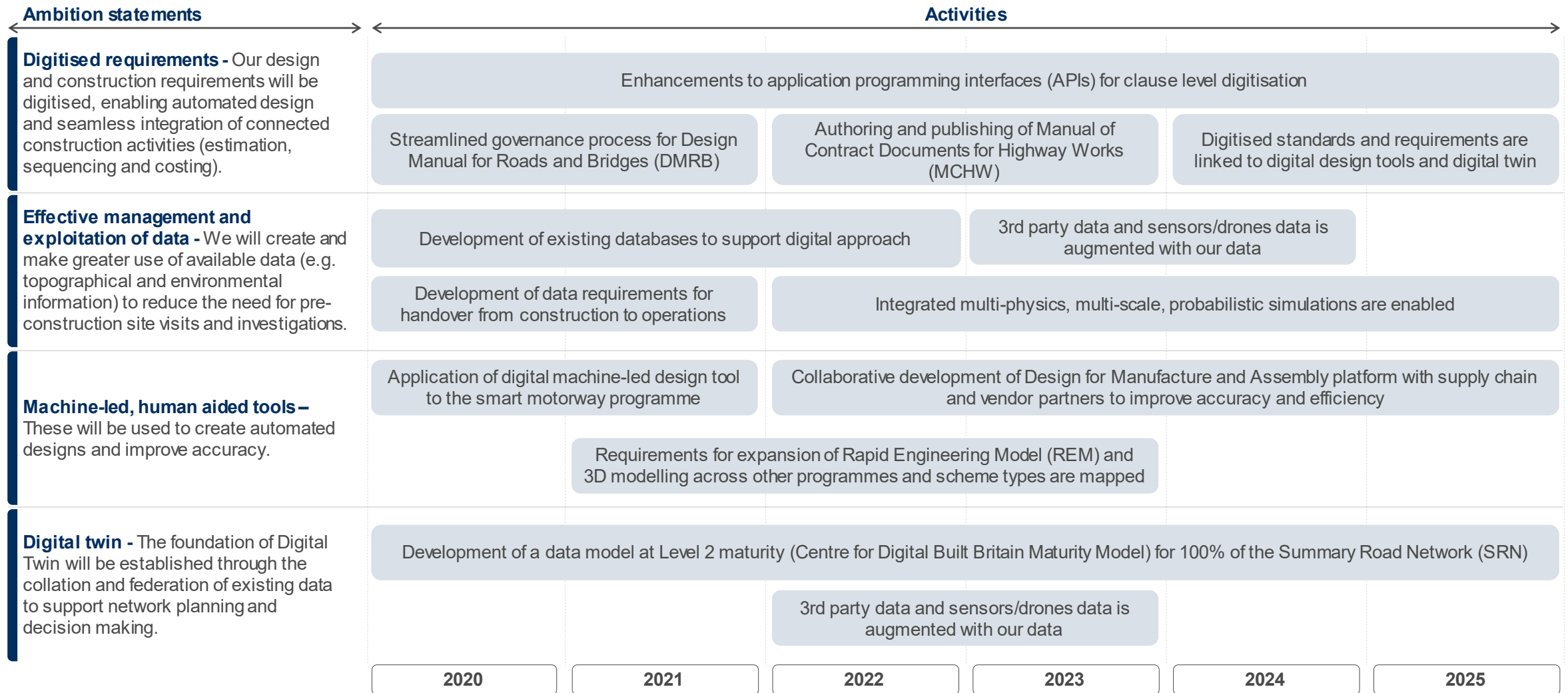
Automated construction

1. **Connected and semi-automated plant (CAP) -** We will reduce plant/site operative conflicts through increased use of connected and semi-automated plant for construction, which would be remotely-operated (potentially off-site) and support 'just in time delivery'.

2. **Enhanced safety on-site** - Sites will become less labour intensive using digital safety tools e.g. briefings and digital rehearsals to reduce the risk exposure of on-site workers.

3. **Digital rehearsal** - We will rehearse site activities using digital simulations to minimise disruption to construction and assembly.
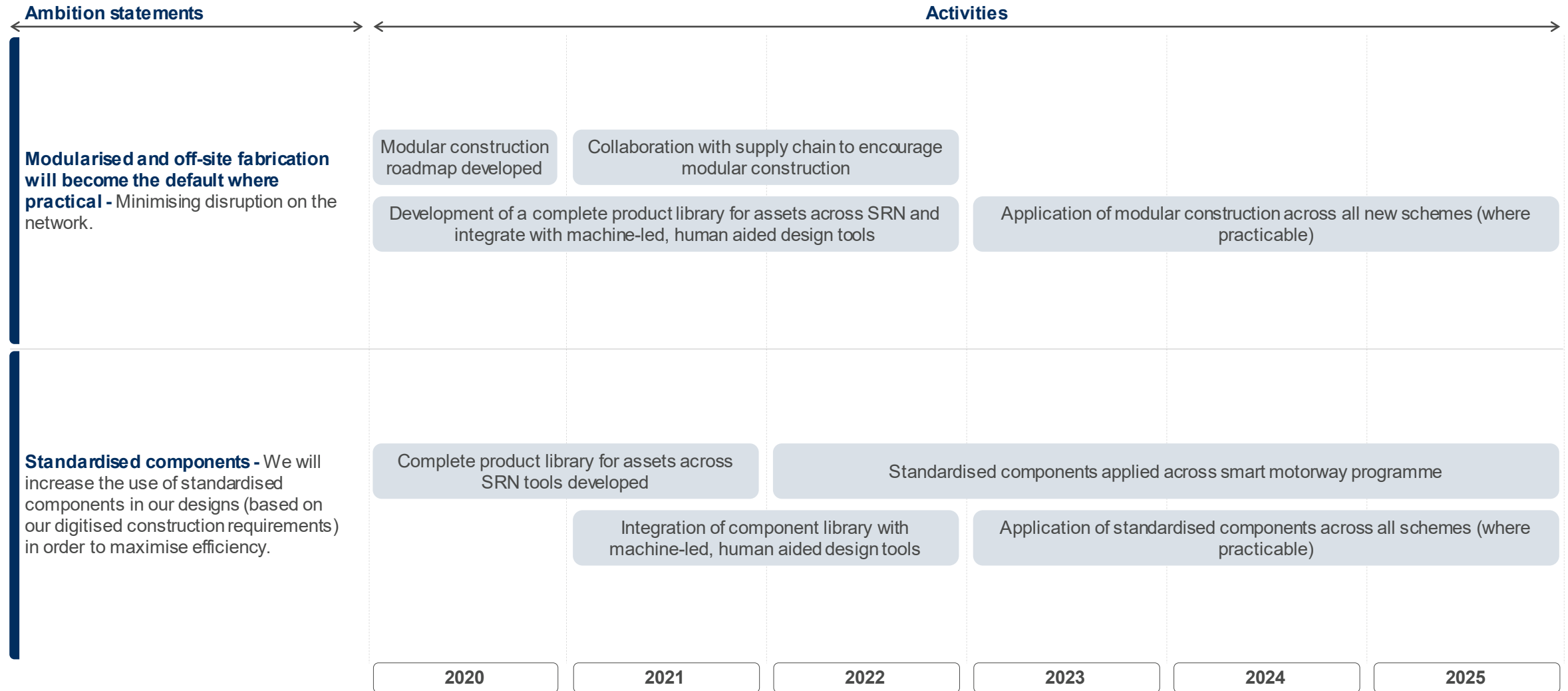
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Digitally enabled design

Ambition statements

Activities

Ambition statements	Activities					
Digitised requirements - Our design and construction requirements will be digitised, enabling automated design and seamless integration of connected construction activities (estimation, sequencing and costing).	Enhancements to application programming interfaces (APIs) for clause level digitisation					
	Streamlined governance process for Design Manual for Roads and Bridges (DMRB)		Authoring and publishing of Manual of Contract Documents for Highway Works (MCHW)		Digitised standards and requirements are linked to digital design tools and digital twin	
Effective management and exploitation of data - We will create and make greater use of available data (e.g. topographical and environmental information) to reduce the need for pre-construction site visits and investigations.	Development of existing databases to support digital approach			3rd party data and sensors/drones data is augmented with our data		
	Development of data requirements for handover from construction to operations		Integrated multi-physics, multi-scale, probabilistic simulations are enabled			
Machine-led, human aided tools – These will be used to create automated designs and improve accuracy.	Application of digital machine-led design tool to the smart motorway programme		Collaborative development of Design for Manufacture and Assembly platform with supply chain and vendor partners to improve accuracy and efficiency			
		Requirements for expansion of Rapid Engineering Model (REM) and 3D modelling across other programmes and scheme types are mapped				
Digital twin - The foundation of Digital Twin will be established through the collation and federation of existing data to support network planning and decision making.	Development of a data model at Level 2 maturity (Centre for Digital Built Britain Maturity Model) for 100% of the Summary Road Network (SRN)					
		3rd party data and sensors/drones data is augmented with our data				
	2020	**2021**	**2022**	**2023**	**2024**	**2025**

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Modular and standardised approaches

Ambition statements

Activities

Modularised and off-site fabrication will become the default where practical - Minimising disruption on the network.

Modular construction roadmap developed

Collaboration with supply chain to encourage modular construction

Development of a complete product library for assets across SRN and integrate with machine-led, human aided design tools

Application of modular construction across all new schemes (where practicable)

Standardised components - We will increase the use of standardised components in our designs (based on our digitised construction requirements) in order to maximise efficiency.

Complete product library for assets across SRN tools developed

Standardised components applied across smart motorway programme

Integration of component library with machine-led, human aided design tools

Application of standardised components across all schemes (where practicable)

| 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |

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Automated construction

Ambition statements

Activities

Connected and semi-automated plant (CAP) - We will reduce plant/site operative conflicts through increased use of connected and semi-automated plant for construction, which would be remotely-operated (potentially off-site) and support 'just in time delivery'.

- Existing contracts and legislation to facilitate use of CAP are reviewed
- CAP levels defined to identify expected capabilities and any necessary adaptions
- Supply chain encouraged to further develop CAP solutions and increasingly deploy CAP technologies in the construction of all major projects
- Revisions to contracts, standards and data-sharing frameworks to facilitate the introduction of CAP

Enhanced safety on-site - Our sites will increasingly become paperless (with fewer operatives), utilise digital safety briefings and reduce the need for on-site facilities.

- Guidance to standardise data use and IT systems on sites
- Robust data collection across all sites (project data and supply chain data)
- Widespread deployment of advanced analysis of site data to enable decision-making and risk management
- Full automation and digitisation of data entry on site (where practicable)

Digital rehearsal - We will rehearse site activities using digital simulations to minimise disruption to construction and assembly.

- Lessons learnt from trials of digital rehearsals captured and collated
- Framework of digital rehearsals requirements and tools established
- Capability for Digital rehearsal developed across National Highways and the supply chain
- Digital rehearsals adopted as standard across all major construction activities

| 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |

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Digital Operations

Our operations will leverage data to drive increasingly pre-emptive interventions - resulting in improved asset resilience, increased asset life and a safer, smoother running network.

Detailed roadmap ▶

Digital operations – Ambition statements

Ambition Statements: Digital operations

Our operations will leverage data to drive increasingly pre-emptive interventions - resulting in improved asset resilience, increased asset life and a safer, smoother running network.

The following ambition statements set out our vision of how digital technology will enable us to achieve 2025 Digital Roads vision.

Intelligent asset management

1. **Predictive asset management –** We will apply artificial intelligence and machine learning techniques to enable predictive asset management decision making.
2. **Data and Systems –** We will maximise the value of the data and systems to enable effective asset management.
3. **Digital surveillance** – We will increase the use of aerial surveillance for inspections, particularly where access requires working from height, to improve safety.
4. **Roadworks planning –** We will effectively plan the interaction between multiple planned roadworks. This will enable us to better understand their impact.
5. **Automated and autonomous plant** - We will create the environment for increased use of automated and autonomous plant for asset maintenance activities to improve safety outcomes.

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Enhanced operational capability

1. **Control room technology** - Our updated control room technology will provide greater oversight and control of the network.
2. **On-road technology** – We will fully utilise our current on-road operational technology and 'fine tune' its use to improve network performance.
3. **Sensor technology and data science -** These will be deployed to forecast demand, weather, environmental, traffic and asset conditions, enabling us to pre-emptively prepare and respond.
4. **Reduced closure impact** – We will exploit digital technologies to proactively restrain and divert upstream demand. We will also optimise the flow of traffic through the dynamic use of monitoring equipment and electronic signs.
5. **Improved detection** – We will ensure quicker response times to unplanned incidents through improved detection, automatically updating signs and signals, and through proactive, integrated resource management.
6. **Emergency services -** We will provide emergency services with the data they need to open the road earlier following a collision, capturing timely evidence through the use of CCTV cameras, aerial surveillance and the latest 3D laser scanning collision investigation equipment.

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Digitally enabled workers

1. **IT equipment** - On-road workers will be provided with IT equipment that allows them to conduct their jobs as effectively as possible.
2. **Reduce on-road worker and live traffic conflict -** We will support our supply chain to reduce on-road worker / live traffic conflict creating an environment to exploit technologies to eliminate site incursions.

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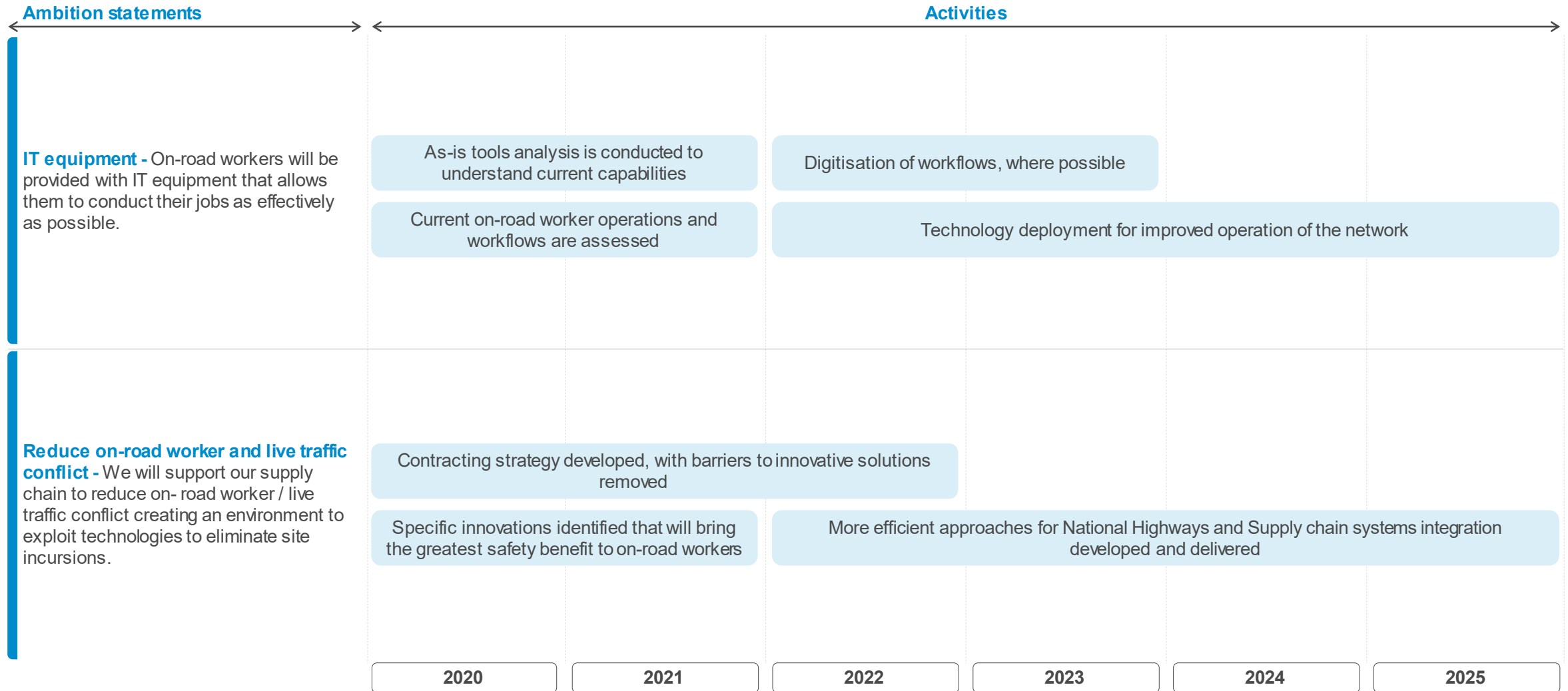
Intelligent asset management

Ambition statements

Activities

Predictive asset management – We will apply artificial intelligence and machine learning techniques to enable predictive asset management decision making.

- Detailed objectives developed
- Business cases developed
- Technology requirements for predictive analytics identified
- Minimum viable product to test use cases is delivered
- Dynamically adapt the use cases from the lessons learnt
- Predictive asset management capability is scaled up and rolled out

Data and Systems – We will maximise the value of the data and systems to enable effective asset management.

- Asset management (inc. data requirements) strategy developed
- RACI for systems and asset data agreed
- Mapped 'to-be' database states
- New database structure implemented
- Data and systems enable intelligent asset management approach
- Data quality management and reporting processes embedded across National Highways and the supply chain

Digital surveillance – We will increase the use of aerial surveillance for inspections, particularly where access requires working from height, to improve safety.

- Implementation of security assessment and updated policy document
- R&D scope development
- Governance defined
- Dedicated drone information repository developed
- 3rd party interface agreements
- Auditing and monitoring function are embedded within the organisation
- Additional R&D scope development

Roadworks planning – We will effectively plan the interaction between multiple planned roadworks. This will enable us to better understand their impact.

- Processes for planning and design (incl. Major Projects interfaces) streamlined and standardised
- Planning tool enabling integrated view of programme progress is used
- Updated cross stakeholder decision support model to optimise plans

Automated and autonomous plant - We will create the environment for increased use of automated and autonomous plant for asset maintenance activities to improve safety outcomes.

- Existing contracts and legislations to facilitate use of CAP are reviewed
- CAP levels defined to identify expected capabilities and any necessary adaptions
- Supply chain encouraged to further develop CAP solutions and increasingly deploy CAP technologies for maintenance activities
- Revisions to contracts, standards and data-sharing frameworks to facilitate the introduction of CAP

2020	2021	2022	2023	2024	2025

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Enhanced operational capability

Ambition statements

Activities

Control room technology - Our updated control room technology will provide greater oversight and control of the network.

- Advanced traffic management system (CHARM) deployment to enable automation of signalling
- Enhanced tools to track network performance and resource deployment and inform operational decision-making
- An end-to-end control approach that provides role clarity and definition of command, control and communication responsibility is built
- Digitisation of National Highways workflows and interfaces with supply chain

On-road technology – We will fully utilise our current on-road operational technology and 'fine tune' its use to improve network performance.

- Advanced traffic management system (CHARM) deployment to enable automation of signalling
- Gap analysis of on-road technology and implementation of development roadmap
- Usage of current operational technology assessed
- Current on-road operational technology is fully utilised

Sensor technology and data science - These will be deployed to forecast demand, weather, environmental, traffic and asset conditions, enabling us to pre-emptively prepare and respond.

- TOC deployment to enable remote asset monitoring and maintenance
- Enhanced National Highways capability to analyse asset performance and make risk-based decisions
- Advanced sensor technologies rolled-out
- Data and technology requirements to enable proactive data maintenance approach defined
- Evidence-based predictive maintenance plans created, using data insights as standard

Reduced closure impact – We will exploit digital technologies to proactively restrain and divert upstream demand. We will also optimise the flow of traffic through the dynamic use of monitoring equipment and electronic signs.

- Advanced traffic management system (CHARM) deployment to enable automation of signalling
- Improved core capability to exploit digital tech across National Highways and supply chain
- Development of Artificial Intelligence (AI) & Machine Leaning (ML) based decision tool to support automated incident response
- Refined AI & ML based decision tool to support automated incident response

Improved detection – We will ensure quicker response times to unplanned incidents through improved detection, automatically updating signs and signals, and through proactive, integrated resource management.

- Advanced traffic management system (CHARM) deployment to enable automation of signalling
- Stopped Vehicle Detection goes live across the smart motorway network
- Delivery of National Traffic Information Service (NTIS) transformation programme

Emergency services - We will provide emergency services with the data they need to open the road earlier following a collision, capturing timely evidence through the use of CCTV cameras, aerial surveillance and the latest 3D laser scanning collision investigation equipment.

- 3D laser mapping used to collect incident information
- Development of AI & ML based decision tool to support automated incident response
- Refined AI & ML based decision tool to support automated incident response

2020	2021	2022	2023	2024	2025

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Digitally enabled workers

Ambition statements

Activities

IT equipment - On-road workers will be provided with IT equipment that allows them to conduct their jobs as effectively as possible.

As-is tools analysis is conducted to understand current capabilities

Digitisation of workflows, where possible

Current on-road worker operations and workflows are assessed

Technology deployment for improved operation of the network

Reduce on-road worker and live traffic conflict - We will support our supply chain to reduce on- road worker / live traffic conflict creating an environment to exploit technologies to eliminate site incursions.

Contracting strategy developed, with barriers to innovative solutions removed

Specific innovations identified that will bring the greatest safety benefit to on-road workers

More efficient approaches for National Highways and Supply chain systems integration developed and delivered

| 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |

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Digital for Customers

Our customers will be better informed and have trust in the journey information they access, ensuring that they feel safe and in control of their journeys.

Detailed roadmap ▶

Digital for customers – Ambition statements

Ambition Statements: Digital for customers   ⊗

Our customers will be better informed and have trust in the journey information they access, ensuring that they feel safe and in control of their journeys.

The following ambition statements set out our vision of how digital technology will enable us to achieve 2025 Digital Roads vision.

Information provision

1. **Close to real-time** - The information we provide to our customers will reflect journey experience and network performance in as close to real-time as possible.
2. **Consistency** - Customer information provision on key All-Purpose Trunk Roads will be improved making this more consistent with the level of service provided on our motorways.
3. **Digital channels** - Customers will be kept informed in-journey about disruption and alternative available routes through a range of digital channels.
4. **Roadside technology** - We will assess the impact of in-vehicle communication growth on our roadside technology, being clear on a plan for the future across the SRN.
5. **Signs and signals** - Better use of variable signs and signals to manage traffic flow more efficiently.

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Customer engagement

1. **Customer contact** - Our call centre staff will have access to fit-for-purpose information that enables them to provide excellent customer service.
2. **Better quality data** - We will receive better quality data from our customers, which enhances our own asset and operational data to inform decision making.
3. **Network trials** - Large scale connectivity trials will be informed by customer insights and preferences to improve customer experience and ensure the most appropriate digital channels are utilised.
4. **Working with vehicle manufacturers** – We will improve customer awareness of the technology in their vehicles to improve their experience on the network.

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Partnerships and alliances

1. **End-to-end journey support** - By working with local highways authorities and other transport operators we will provide our customers with more integrated journey information and a complete picture of network performance.
2. **Better information for the freight and logistics sector** - We will work closely with wayfinding services to improve the quality of information accessed by our customers with a strong focus on the benefits for the freight and logistics sector.
3. **Network changes** - Wayfinding service providers will be notified when new road configurations and important features (such as Emergency Areas) are operational, so that these can be reflected in the third-party applications used by our customers.
4. **Innovation** - We will work with the supply chain and wider private sector to identify and test new opportunities to improve customer service.
5. **Future connectivity** - We will work with industry partners to support larger connectivity trials and the testing of in-vehicle communication.

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Information provision

Ambition statements	Activities					

Close to real-time - The information we provide to our customers will reflect journey experience and network performance in as close to real-time as possible.

Delivery of NTIS transformation programme	Delivery of the information and data strategy
Standardised data governance and data quality measures in place	Enhanced data sharing between National Highways and third parties

Consistency - Customer information provision on most-used All-Purpose Trunk Roads will be improved making this more consistent with the level of service provided on our motorways.

Delivery of upgrades across the APTR (expressways) with optimised use of technology (inc. VMS) to enhance information provision to customers

Development of Connected Services roadmap for the transition to in-vehicle communications	Opportunities to share data with third parties to improve information provision across APTR are established

Digital channels - Customers will be kept informed in-journey about disruption and alternative available routes through a range of digital channels.

Customer feedback used to rationalise and enhance National Highways customer journey information channels and to develop freight information services	Further improvement to National Highways information provision channels based on customer feedback	
Opportunities to receive and use third party data to improve customer experience on the network identified	Partnership requirements are defined	Additional data is shared with third parties to keep customers informed in-journey

Roadside technology - We will assess the impact of in-vehicle communication growth on our roadside technology, being clear on a plan for the future across the SRN.

Development of Connected Services roadmap for the transition to in-vehicle communications	Plan for minimising physical roadside assets of the future developed
Use cases for how connectivity will contribute to customer information provision defined	Consortia with key stakeholders to shape the future connectivity solutions

Signs and signals - Better use of variable signs and signals to manage traffic flow more efficiently.

New messages on electronic signs introduced	Pre-programmed signal settings to automate signs with known events such as roadworks or major sporting events
Advanced traffic management system (CHARM) deployment to enable automation of signalling	

2020	2021	2022	2023	2024	2025

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Customer engagement

Ambition statements   **Activities**

Customer contact - Our call centre staff will have access to fit-for-purpose information that enables them to provide excellent customer service.

Delivery of integrated Customer Relationship Management system

Development of Customer Contact Centre future strategy

Customer Contact Centre future strategy delivered

Better quality data - We will receive better quality data from our customers, which enhances our own asset and operational data to inform decision making.

Increased use of tools (e.g. ECHO) to collect additional feedback on all digital channels

Cross stakeholder collaboration and data sharing to understand customer experience on the Network

Enhanced customer research and segmentation analysis to maintain up-to-date understanding of customer needs

Network trials - Large scale connectivity trials will be informed by customer insights and preferences to improve customer experience and ensure the most appropriate digital channels are utilised.

Evaluation of additional customer use cases of connectivity through insights from connectivity trials

Customer preferences used to shape the design criteria for future connectivity trials

Enhanced understanding of how connectivity contributes to safety, delivery and customer experience

Consortia with key stakeholders to shape the future roadside connectivity solutions

Working with vehicle manufacturers – We will improve customer awareness of the technology in their vehicles to improve their experience on the network.

Engagement with manufacturers through industry associations to identify specific customer benefits of emerging in-vehicle technology

Evaluation of next steps and delivery of communications to educate customers on potential benefits of in-vehicle technologies

| 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |

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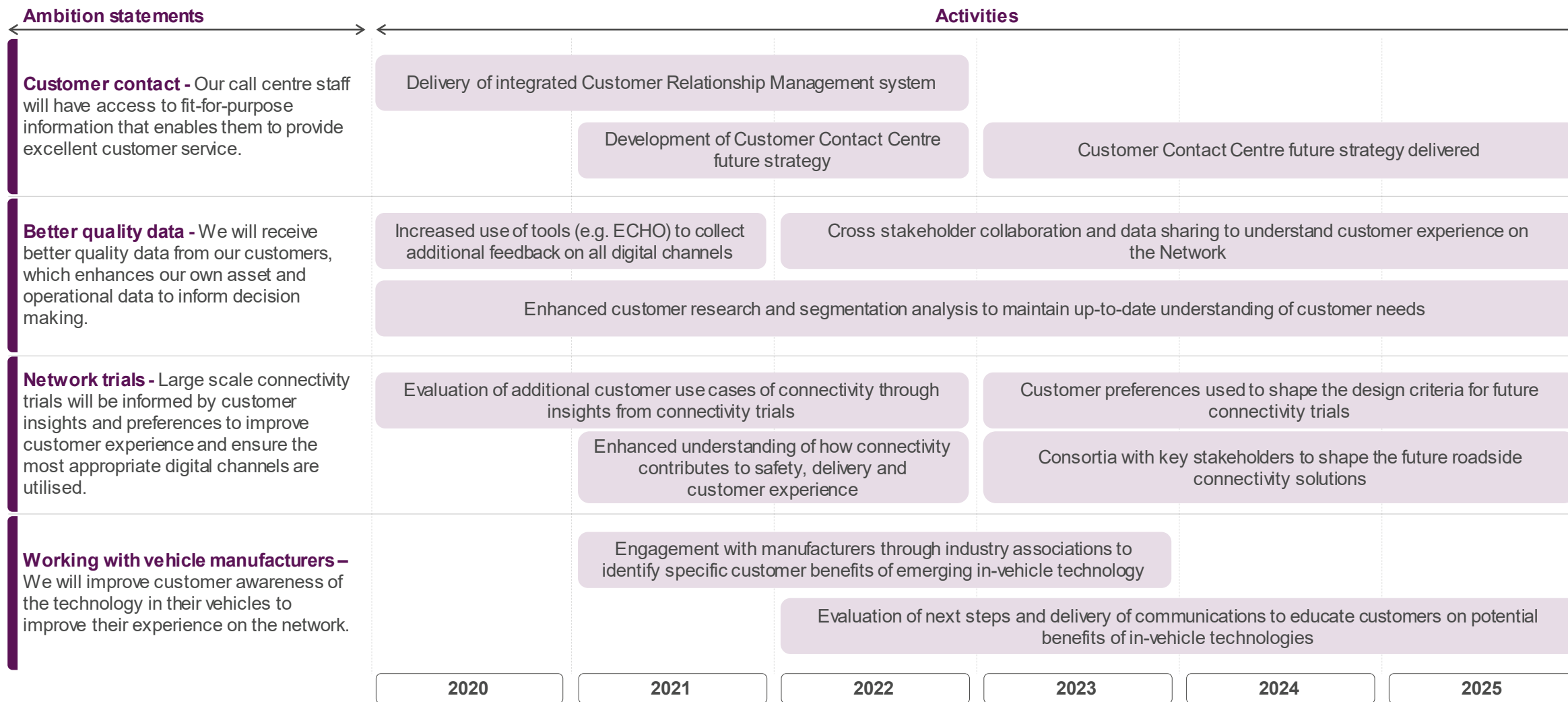# Partnerships and alliances

Ambition statements

Activities

End-to-end journey support - By working with local highways authorities and other transport operators we will provide our customers with more integrated journey information and a complete picture of network performance.

Identification and delivery of opportunities for greater collaboration with local roads authorities to enhance customer experience

Collaboration with local authorities to review and improve diversion routes

Better information for the freight and logistics sector - We will work collaboratively with the freight and logistics sector to improve the quality of information accessed by them.

Definition of optimum approach for sharing data with third parties (open data vs dedicated relationships)

Definition of required third-party partnership legal, technical and commercial requirements

Additional data shared with third parties to keep customers informed in-journey

Collation and implementation of customer feedback to improve the Traffic England service

Iterative improvement of Traffic England service based on customer feedback

Network changes - Wayfinding service providers will be notified when new road configurations and important features (such as Emergency Areas) are operational, so that these can be reflected in the third-party applications used by our customers.

Identification of opportunities to receive and use third party data to improve customer experience on the network

Development of dedicated third party engagement capability

Additional data shared with third parties to keep customers informed in-journey

Innovation - We will work with the supply chain and wider private sector to identify and test new opportunities to improve customer service.

Design of innovation competitions focused on customer experience

Collaboration with industry to support innovation competitions which improve customer service

Customer experience factored into supply chain innovations

Future connectivity - We will work with industry partners to support larger connectivity trials and the testing of in-vehicle communication.
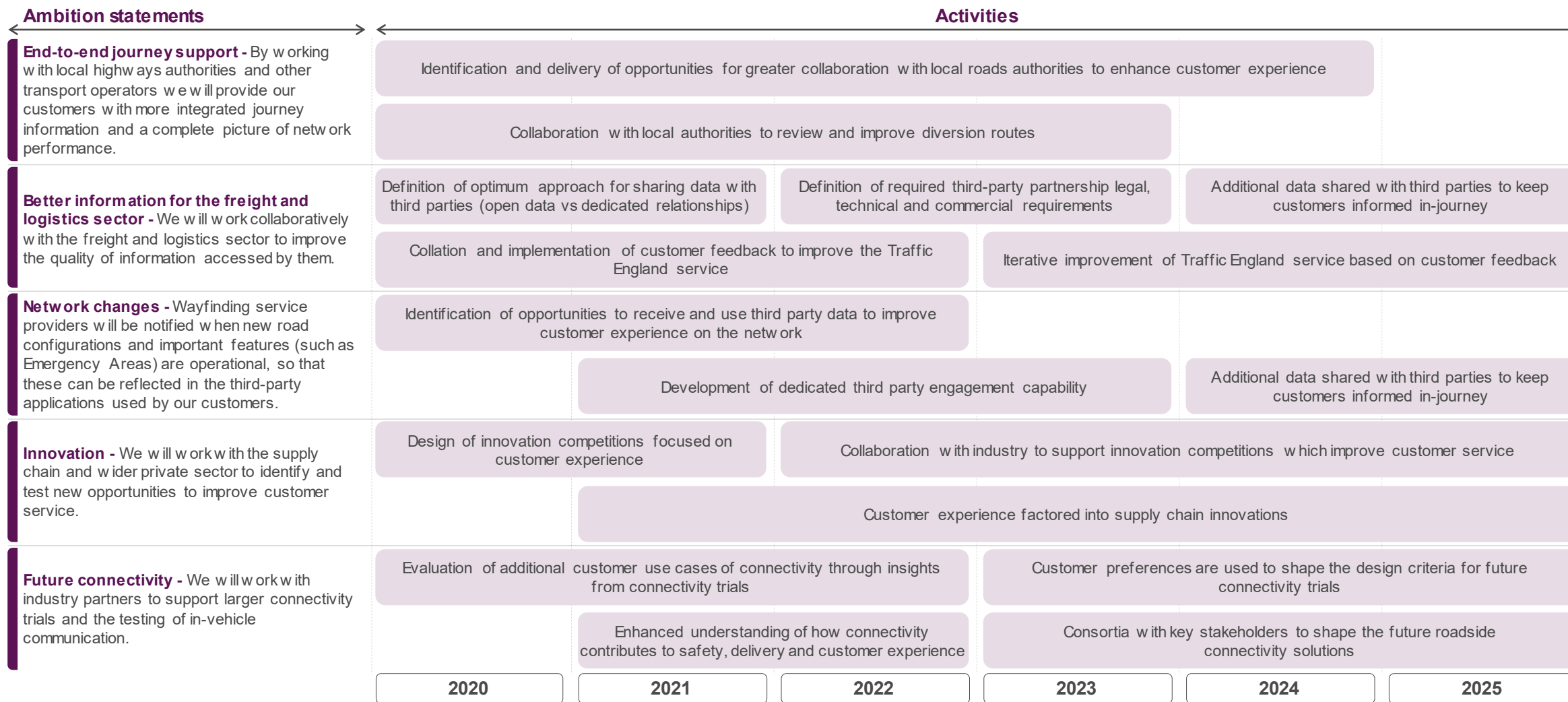
Evaluation of additional customer use cases of connectivity through insights from connectivity trials

Customer preferences are used to shape the design criteria for future connectivity trials

Enhanced understanding of how connectivity contributes to safety, delivery and customer experience

Consortia with key stakeholders to shape the future roadside connectivity solutions

| 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |

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Digital Roads 2025 outcomes

Efficient and timely delivery of our 2025 Digital Roads roadmap will enable safer construction and operations, faster delivery, and better customer experience.
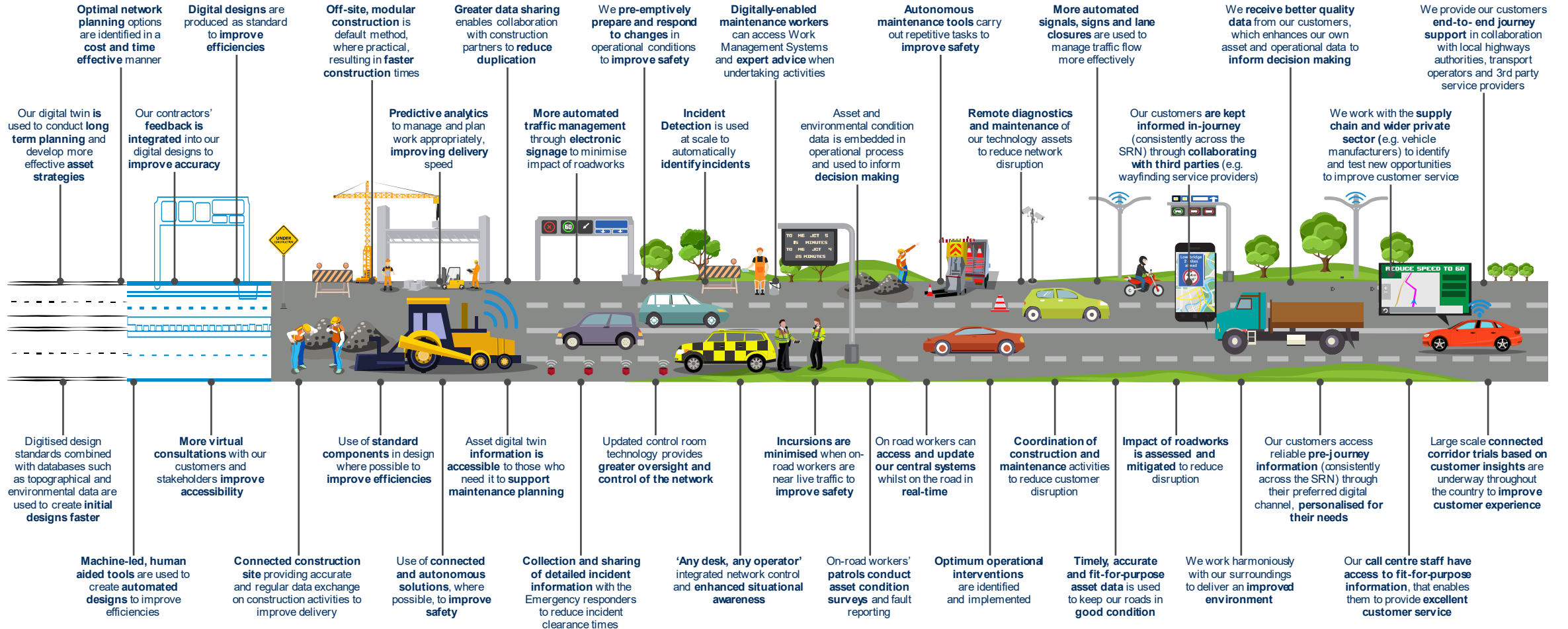
Digital Roads 2025 outcomes

Efficient and timely delivery of our 2025 Digital Roads roadmap will enable safer construction and operations, faster delivery, and better customer experience.
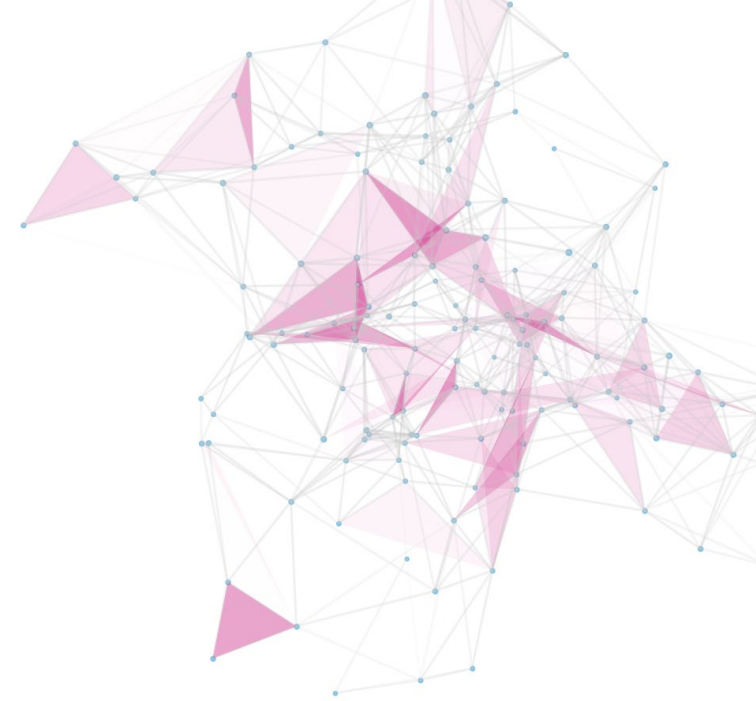
Optimal network planning options are identified in a **cost and time effective** manner

Digital designs are produced as standard to **improve efficiencies**

Off-site, modular construction is default method, where practical, resulting in **faster construction** times

Greater data sharing enables collaboration with construction partners to **reduce duplication**

We **pre-emptively prepare and respond to changes** in operational conditions to **improve safety**

Digitally-enabled maintenance workers can access Work Management Systems and **expert advice** when undertaking activities

Autonomous maintenance tools carry out repetitive tasks to **improve safety**

More automated signals, signs and lane closures are used to manage traffic flow more effectively

We **receive better quality data** from our customers, which enhances our own asset and operational data to **inform decision making**

We provide our customers **end-to-end journey support** in collaboration with local highways authorities, transport operators and 3rd party service providers

Our digital twin **is** used to conduct **long term planning** and develop more effective **asset strategies**

Our contractors' **feedback is integrated** into our digital designs to **improve accuracy**

Predictive analytics to manage and plan work appropriately, **improving delivery** speed

More automated traffic management through **electronic signage** to minimise impact of roadworks

Incident Detection is used at scale to automatically **identify incidents**

Asset and environmental condition data is embedded in operational process and used to inform **decision making**

Remote diagnostics and maintenance of our technology assets to reduce network disruption

Our customers **are kept informed in-journey** (consistently across the SRN) through **collaborating with third parties** (e.g. wayfinding service providers)

We work with the **supply chain and wider private sector (**e.g. vehicle manufacturers) to identify and test new opportunities to improve customer service

Digitised design standards combined with databases such as topographical and environmental data are used to create **initial designs faster**

More virtual consultations with our customers and stakeholders **improve accessibility**

Use of **standard components** in design where possible to **improve efficiencies**

Asset digital twin **information is accessible** to those who need it to **support maintenance planning**

Updated control room technology provides **greater oversight and control of the network**

Incursions are minimised when on-road workers are near live traffic to **improve safety**

On road workers can **access and update our central systems** whilst on the road in **real-time**

Coordination of construction and maintenance activities to reduce customer disruption

Impact of roadworks is assessed and mitigated to reduce disruption

Our customers access reliable **pre-journey information** (consistently across the SRN) through their preferred digital channel, **personalised for their needs**

Large scale **connected corridor trials based on customer insights** are underway throughout the country to **improve customer experience**

Machine-led, human aided tools are used to create **automated designs** to improve efficiencies

Connected construction site providing accurate and regular data exchange on construction activities to improve delivery

Use of **connected and autonomous solutions**, where possible, to **improve safety**

Collection and sharing of detailed **incident information** with the Emergency responders to reduce incident clearance times

'**Any desk, any operator**' integrated network control and **enhanced situational awareness**

On-road workers' **patrols conduct asset condition surveys** and fault reporting

Optimum operational interventions are identified and implemented

Timely, accurate and fit-for-purpose asset data is used to keep our roads in **good condition**

We work harmoniously with our surroundings to deliver an **improved environment**

Our call centre staff have **access to fit-for-purpose information**, that enables them to provide **excellent customer service**

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Glossary

CAP	Connected and Autonomous Plant – Please refer to Highways England's 2035 CAP roadmap to understand opportunities, challenges and key activities required to achieve productivity improvements.
CCC	Highways England's Customer Contact Centre
CHARM	Next generation Advanced Traffic Management system being rolled out at National Highways to replace the current system (HATMS).
Data and information strategy	Highways England's vision for data and information management
Digital twin	System-wide, digital representation of our SRN built on a solid foundation of reliable, accurate and real time data feeds. Our long term ambition is to create a digital replica of our SRN, embedded with detailed information on design and operation of our assets, used to monitor the SRN in real-time and provide predictive analytics. This will require multiple live and historical data sources both from our assets and inputs from 3rd parties. Up-to-date data from all available smart assets will enable an understanding of live network status, thereby enabling more informed and strategic decisions around the management of assets, and aligning demand and capacity faster during varying operational contexts on the network (e.g. major events), as well as to continuously improve network operations.
DMRB	Design Manual for Roads and Bridges that contains all current standards, advice notes and other documents relating to the design, assessment and operation of trunk roads, including motorways. These will be digitised as part of the Digital Roads work.
MCHW	Manual of Contract Documents for Highway Works incorporates the requirements of EU legislation, which are mandatory for all public procurement bodies.
NTIS	National Traffic Information Services - NTIS interfaces with a number of systems from different suppliers to obtain knowledge of Highways England's network of roads in England. It then collates and processes all of this data and intelligence to provide users of the services with the information they need, as quickly and as easily as possible, to help them make informed decisions about travel.
REM	Rapid Engineering Model is a digital workflow that is collaboratively enabled, and has the functionality to analyse digitally captured topographic and environmental data; evaluate suitability of data analysis; automate design layout following the inputted design rules and optimise the design layout according to specific project criteria.

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