

# Digital Roads Prosperity Partnership Impact Theme

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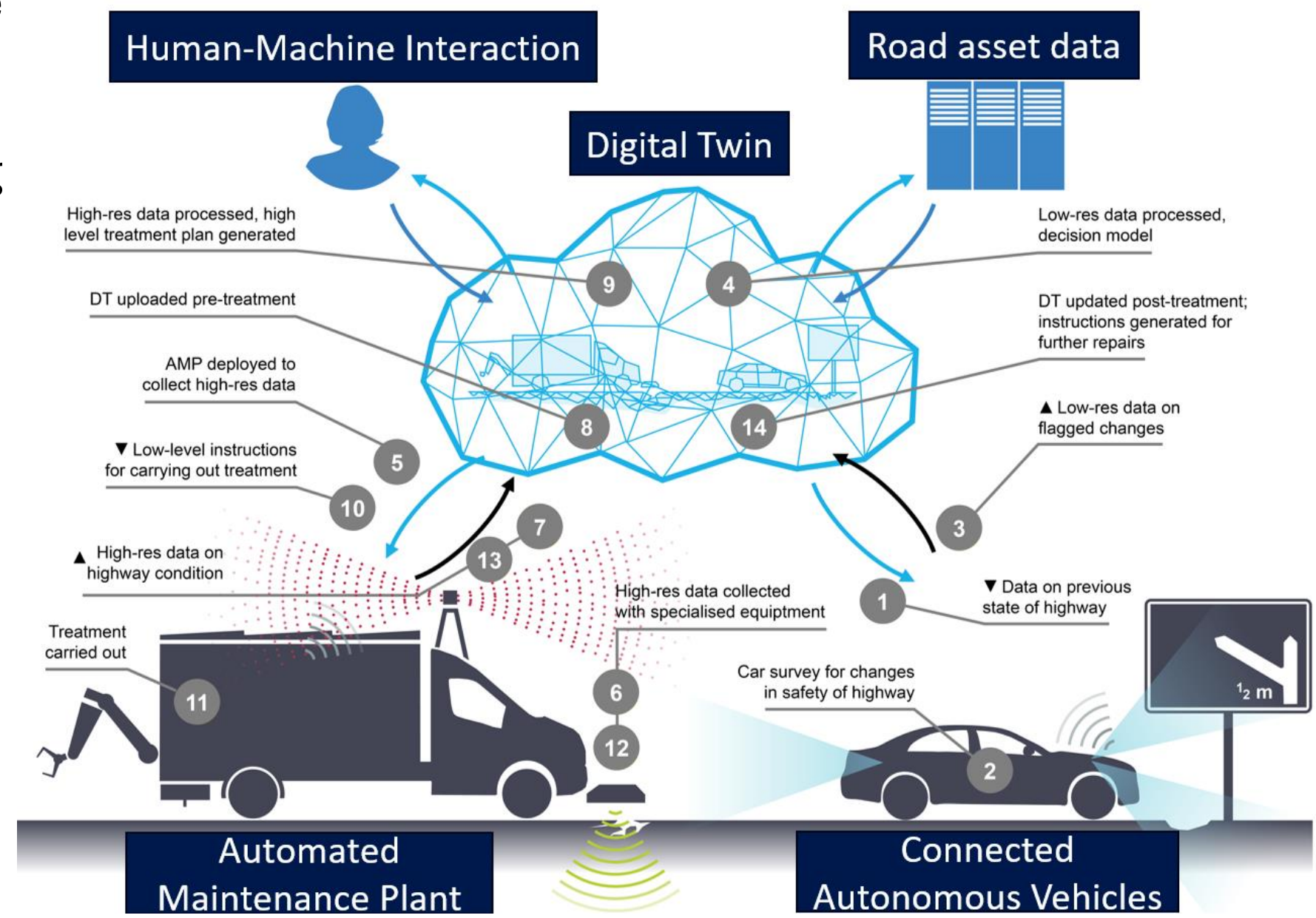
The Digital Roads impact theme has been broadly looking into converting the Digital Twin (DT) research work from Theme 1 into a functioning prototype, including exploring the relevant business models for its commercialisation, and into transitioning the Autonomous Maintenance Plant (AMP) being conceptualised and simulated in Theme 2 into a physical platform prototype.

The impact theme is also responsible for dissemination of the DR research and development work, including the preparation of white papers, research papers, EPSRC submissions, and award applications.

The main updates over the past 12 months include:

- Developing a backbone DT based on dataset prep work in yr 1
- Deriving a business model/canvas for DT commercialisation
- Using AMP simulations to inform the physical AMP prototype
- Applying for or receiving awards and recognition, e.g. BBC coverage

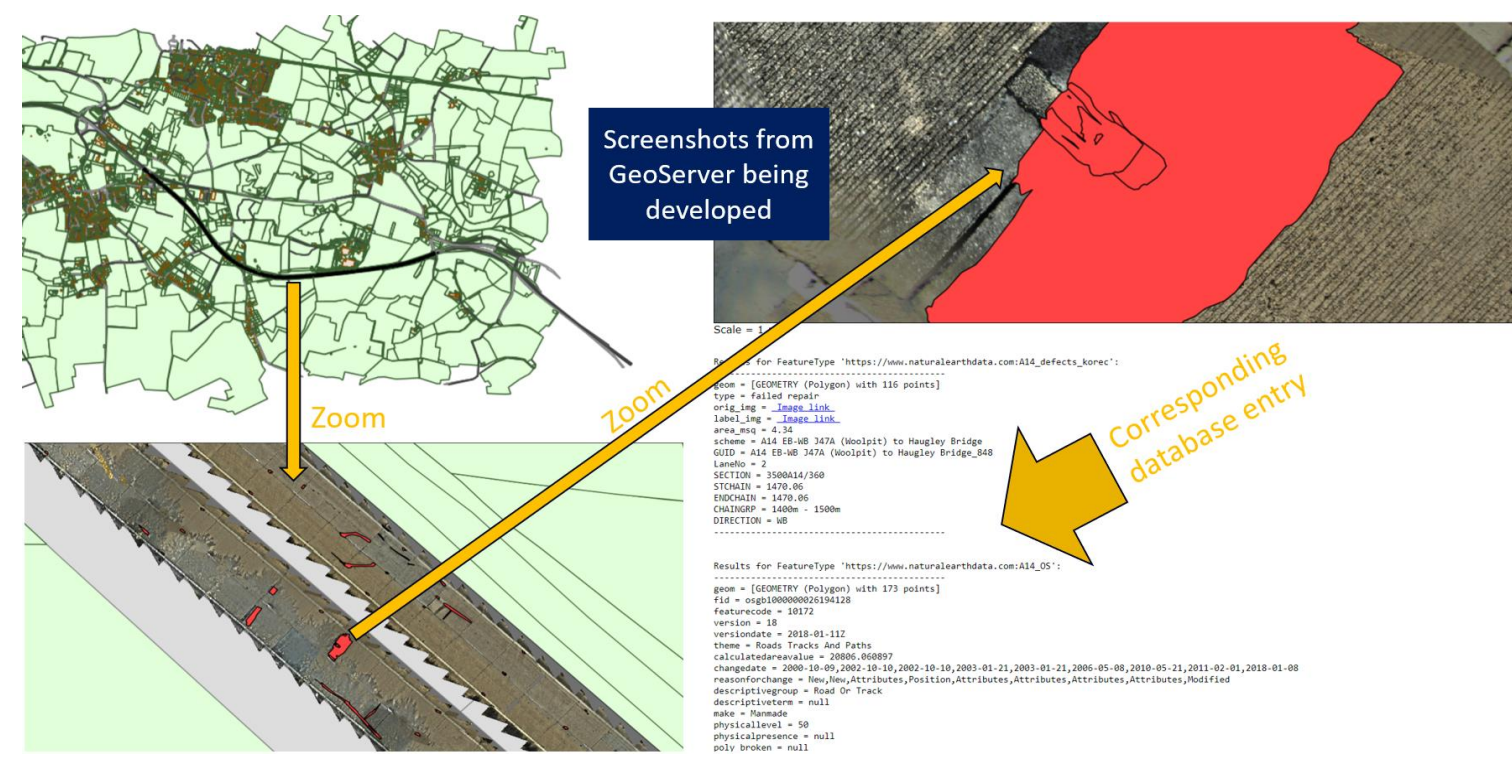
## Digital Roads Platform



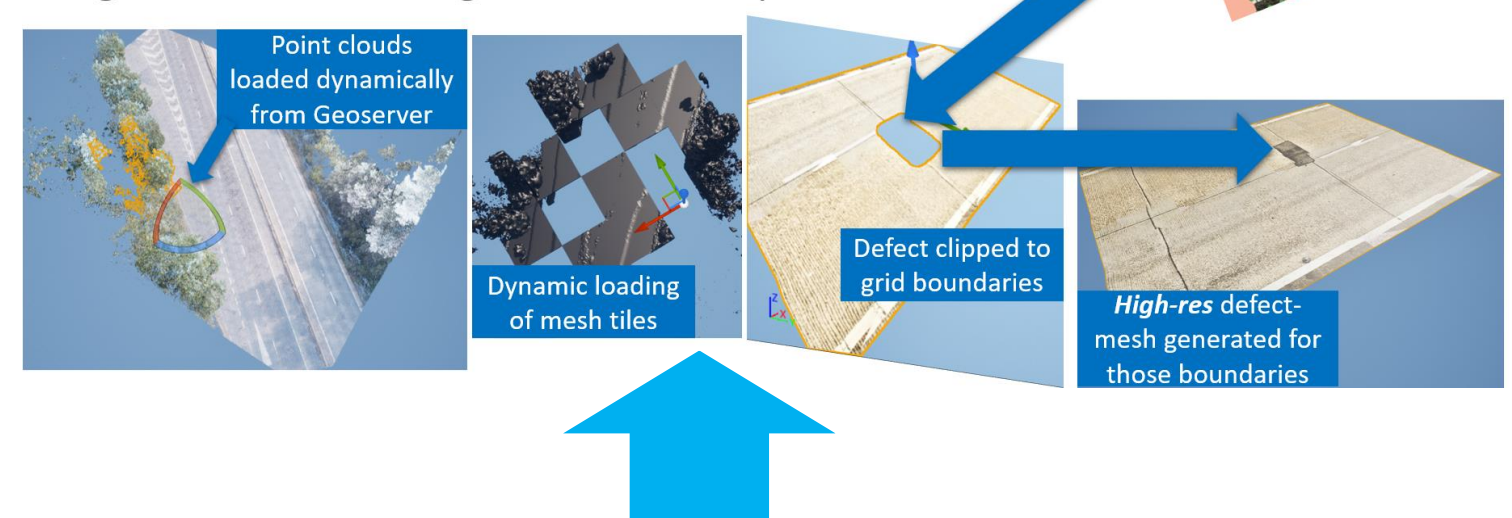
**Outcomes**

- Spinoff: **Didimi**
- Road Dataset
- Proud to be shortlisted for The IET Excellence and Innovation Awards 2024
- BBC NEWS**
- 2nd place
- ICSR'24

### Develop a backbone DT platform



- DT's GeoServer has a basic visualisation capability
- Linked Geoserver and UnrealEngine for better visualisation
- Able to send HTTP requests to get specific regions and data modalities stored in the GeoServer's database
- Allows being selective about resolution (e.g. defects in high-res and remaining road in low-res)



### Deriving a DT business model

- A business model canvas & initial DT business model is being developed
- This is to look into things such as market size, revenue streams, costs
- Will facilitate DT commercialisation
- BM will need input from NH's internal customers

**Market size**

- The UK construction sector is a major part of the economy, employing 3.7m people (over 9% of the workforce). In 2022 almost £70k construction firms were operating in the UK, with 234 of them employing 500 or more workers, and 1,842 employing 60 or more.
- BIM is necessary being adopted in the industry. A 2017 survey showed 62% of UK construction firms (using 2200 users using BIM). In 2020, 73% of industry professionals surveyed reported using the technology, a sharp rise from 13% in 2011, when 43% were unaware of BIM (compared to 1% in 2005).
- The UK has a strong infrastructure pipeline, with £14 billion in planned roadworks between 2023, including £19 billion annually to transport, including road infra.

**Revenue streams**

- Offer basic services to users for free
- Offer premium subscriptions with advanced features to highway authorities and infrastructure managers
- Offer expert consultancy services to help clients optimise technology to improve their processes
- Conduct training programs to ensure users are self-reliant along with providing robust customer support to assist if needed
- Provide systems integration services to connect the DT of software systems through APIs, e.g. vehicle metadata
- Sell advertising space on the DT platform to relevant businesses
- Sell aggregated and anonymized data analysis outputs

**Financial resources**

- Grants: EPSRC/IAA, UK Smart Grants, H2020, DTI Investment Bank (EIS) Funding, LEPS, SBRP and hubs, e.g. Construction Innovation Hub
- Partners & Industry collaboration: Cambridge Enterprise
- Partnering with non-competing companies: autonomous for financial support or pilot
- Angel & VC investors: Cambridge Innovation Capital, Cambridge Synovate, Genesys, Whittlehill, 3i Group
- Leasing purchase, Business Loans

**The DT**

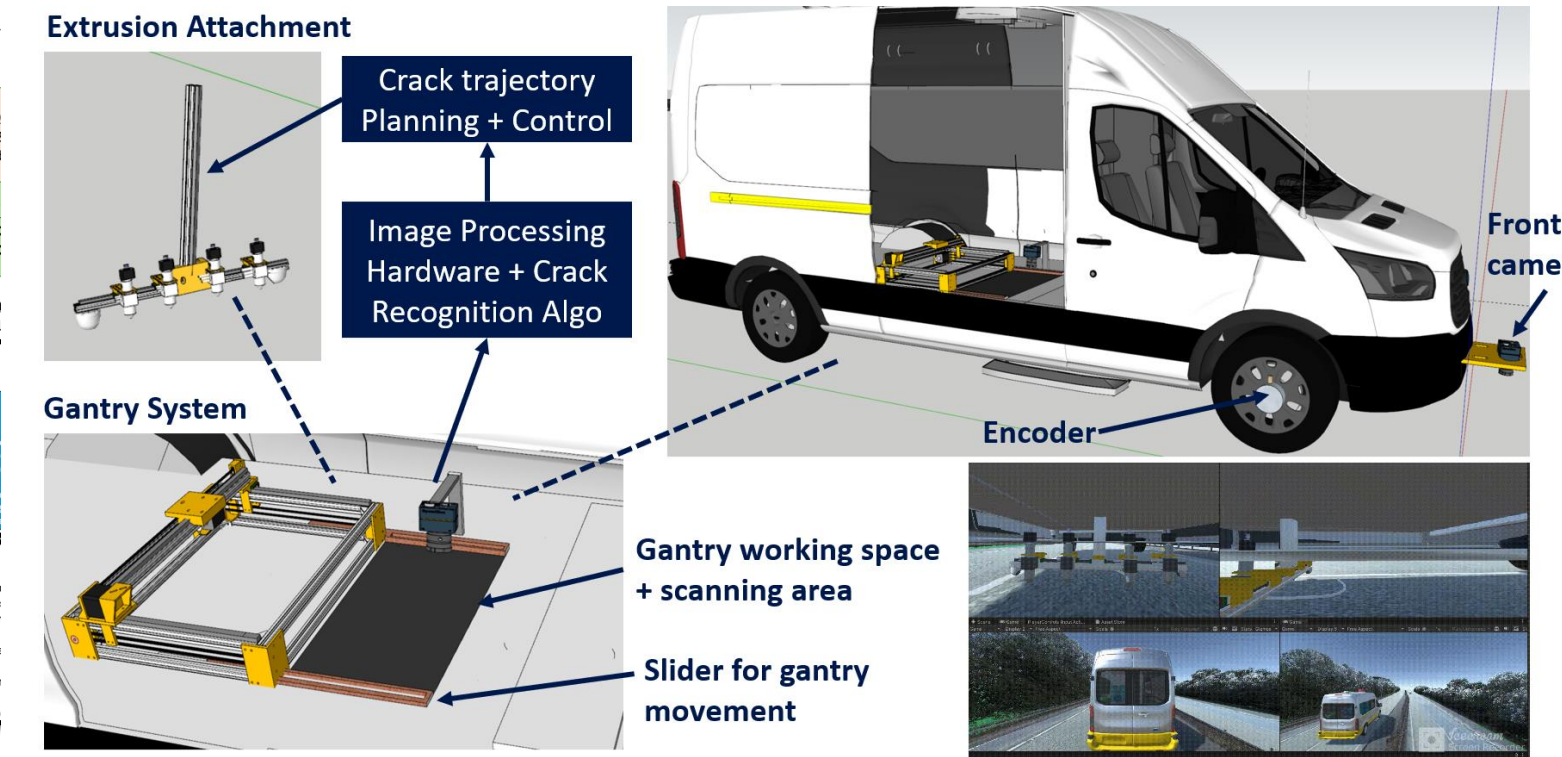
A cloud based Digital Twin (DT) platform comprising a database that stores a dynamic digital representation of physical road assets, offering a range of services through APIs for: (i) updating the database with the latest data relating to the physical assets (e.g. weather and CAV sensor readings), (ii) expressive querying of the database to both retrieve stored information (e.g. the historical condition of a given road segment as a cropped 3D image) and generate new information or predictions (e.g. generate road treatment instructions or predict the condition of a road segment in 12 months); and (iii) subscribing to information updates of events (e.g. being notified when a defect becomes critical).

**Cost structure**

- Salary and other overheads
- Energy and bandwidth costs
- Costs for maintenance or field work
- Data storage
- Server & network services
- Sales & marketing costs
- IP & legal & compliance
- Liability insurance
- Cyber security

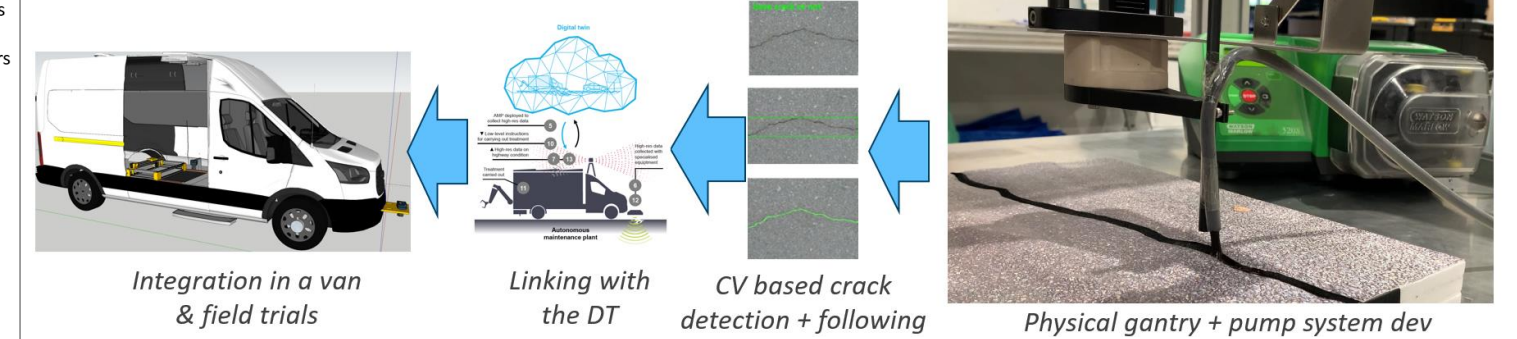
Key Partners	Key Activities	Key Propositions	Customer Relationships	Customer Segments
<b>What are your key partners to get competitive advantage?</b> Car manufacturers Regulator (e.g., NH) Contractors Infrastructure owners Tech companies Omniverse Autodesk Revit Bentley Microstation Trimble Tekla AVEVA LFM Edgewise hardware suppliers cloud server vendors University of Cambridge Investment partners Innovate UK Entrepreneur 2 Cam Innov Capital UK government dept. External data providers Advertisers, ad agencies	<b>What are the key steps to move ahead to your customers?</b> Design the architecture Align with the data model Develop pipeline to integrate with car companies & regulators Human/software interfaces Creating common standards Customer support Product promotion R&D Freemium model Data processing	<b>How will you make your customers' lives happier?</b> DT for infrastructure & buildings More communication about the state of the road More reliable prediction for safety/navigation/travel time Better use of car data Online storage & backup Freemium model Data processing	<b>How often/will you interact with your customers?</b> Meetings Events Conferences, academic and industrial Webinars Sharing trial products Networking events Customer support for premium customers C2C support in forums	<b>Who are your customers? Describe your target audience.</b> Contractors Car manufacturers Regulator (e.g., NH) Infrastructure owners, eg NH Tech companies UK government departments Insurance companies Advertisers & ad agencies Universities, learning centres Freelancers, architects, engineers, structural engineers Financial institutions

### Develop the physical AMP concept



- Cold bitumen injection is novel w.r.t. overbanding
- Robotic injection is less slippery, neater for drivers, removes workers from traffic; cold bitumen is safer
- Injection reduces material waste & carbon impact

#### Next steps:



### Dataset preparation (year 1)

The above DT was made possible by the CAM Highways dataset, prepared through work done in the first year.

#### Dataset prep: Inputs

- Multiple point clouds for different runs along same segme
- Point clouds need to be 'registered' together
- High res images from downward camera
- Easier to see defects than in pano images
- Images map to point cloud road segments
- Thermal for pavements
- No alignment to other data
- 2D and 3D GPR through KOREC
- Needs to be transformed to PCs
- Can show issues below surface
- Good modality to spot assets
- Images map to PC segments
- Tricky to align with point clouds

#### Dataset prep: Example Outputs



### What next?

Plan for the coming 12 months. Tasks can be found in the DR Technical Annex.

Task	Activity
T3.1.1	Work with T1 team to progressively develop a backbone DT platform <ul style="list-style-type: none"> <li>• Create a platform that allows simulation, and interfacing with work done by FR fellows</li> </ul>
T3.1.5	Derive the most suitable business model for the cloud DT platform <ul style="list-style-type: none"> <li>• Finalise the BM work, and include feedback from relevant National Highways stakeholders</li> </ul>
T3.2.4	Purchase & integrate material application components onto a van to form a full-scale AMP <ul style="list-style-type: none"> <li>• Build an initial version of the automated extrusion system in the lab w.r.t. van dimensions</li> </ul>
T3.2.6	Develop road surveying guidelines for low- and high-resolution surveying <ul style="list-style-type: none"> <li>• Use existing knowledge in internal publications to inform future surveying practice</li> </ul>
T3.3.3	Acquire available CAV datasets to simulate low-res data capture and sharing with the DT <ul style="list-style-type: none"> <li>• Continue to talk to relevant companies to get low-level CAV data, e.g. pavement images</li> </ul>
T3.4	Ongoing dissemination tasks <ul style="list-style-type: none"> <li>• Submit papers currently being internally reviewed; come up with a dissemination plan</li> </ul>