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Why DAFNI ?

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DAFNI Technical Challenges of the Infrastructure Research

- Scaling up
 - o More data
 - Higher resolution
 - More compute resources
- Data integration and exchange.
 - Share data between infrastructure models
 - Security respected
 - Common standards for interchange and interoperation
 - o Common Metadata standards
- Integration between models
 - Capture the interdependencies
 - Integration across scales Nation to Item
 - Integration across sectors
- Supporting an ecosystem of Digital Twins
 - Integrated data infrastructure
 - Connections to sensors and "real-time" I/O
 - Analysing large-scale historic data to propose decisions





Integration across sectors





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DAFNI as a Community Hub

- A Place for sharing data and models
- A Place to support collaborations
- A Place as a legacy



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DAFNI provides to the Infrastructure Research Community

- A hybrid high-performance computing platform
- A secure repository for heterogeneous national infrastructure data and models.
- A collaborative platform to research and develop multi-system models of infrastructure assets and systems
- A place to make data and models available for long-term accessibility



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What DAFNI can offer

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Data & Analytics Facility for National Infrastructure

Providing a computing platform to improve decision making for national infrastructure

UK's next generation platform to support research into infrastructure decisions: planning, investment, design and operation.

- £8M investment 2017-2021 under the UKCRIC programme
- 12 partner universities
 + STFC as development and hosting partner

Partnerships between Academia, Government, Industry





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DAFNI Functionality



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DAFNI as a Information Infrastructure

- DAFNI provides a Data Hub
 - \circ Data sharing
 - Data integration
 - Data curation
- The DAFNI NID provides
 - A trusted secure space to hold and access data
 - Importing from and linking to other data sources
- A metadata framework for the data catalogue
 - DCAT 2.0
 - $\circ~$ Common search and access



A platform for integrating and combining data

- DAFNI's NID provides basis for representing data from different sources
 - Extensible to sectors: water, energy, transport ...
 - Support an Ontological framework for data
- A data store but not all data needs to be held centrally





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NIMS: Supporting user models

- Upload models from anywhere into a model repository
 - Models "containerised" using Docker
 - Independent of code and operating systems
 - \circ Sharing models
 - o Within the same security framework
- Models can then be run on the HTC cluster
 - o Kubernetes orchestration of containers
 - o Scale up models for more compute
 - Access to data in the NID
 - \circ Access to visualisations
- The NIMS allows workflows to be constructed
 - $\circ \quad \text{Chaining models together} \\$
 - Coupling models together
- Key feature of providing an Infrastructure Ecosystem
 - Coupling different sectors
 - o Coupling different scales









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How is DAFNI being used?

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Projects on DAFNI: Supporting and extending models



DAFNI

A map showing the probability catchments of Penryn station after adding a new station in Helston Station demand model, University of Southampton Map showing the CAMCOX corridor and the movement of people given a change in households, jobs and GVA SIMIM model, University of Leeds





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DAFNI UK Infrastructure Transitions Research Consortium (ITRC)

From 2011 the UK Infrastructure Transitions Research Consortium (ITRC) has developed:

The NISMOD national system-of-systems model (energy-transportdigital-water-waste) for infrastructure **planning** in Britain

 NISMOD was used in the UK's first National Infrastructure Assessment

National modelling of climate **risks** to infrastructure networks

- Used to inform the Environment Agency's long term investment strategy for flood defences
- Analysis for the National Infrastructure Commission's resilience study

NISMOD is being migrated to a new £8million **facility** DAFNI: the Data and Analytics Facility for National infrastructure





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OPEN OpenCLIMATE IMPACT FRAMEWORK

- New project led by University of East Anglia
- Assess the risk of climate change
 - Flooding
 - Health risk from extreme heat
 - \circ $\;$ Agriculture and biodiversity $\;$
- Affect of approaches to adaptation
- Towards CCRA4
- Multi-systems modelling approach
- Working with DAFNI to provide
 - A framework for combining models together
 - A place where users can go to access and run workflows
 - A legacy where models can be accessed for the longterm





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702/2002 Printy of Sheffield

DAFNI Pilot study - Traffic Digital Twin in Sheffield



Use traffic data from the Sheffield Urban Observatory

- 640 sensors that report traffic flow (no. of cars/min)
- Time resolution: 5 min
- Build AI-based model
 - updates in real-time for each sensor
 - predicts evolution of traffic (ex: 30 min ahead)
- Create a digital replica of the Sheffield traffic
- Identify areas where congestion will occur



Use cases:

- Traffic monitoring system that predicts congested areas
- Real-time traffic flow optimization



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Engineering and Physical Sciences Research Council

The

Of

University

Sheffield



Christian Genes,

Daniel Coca

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OAFNI Summary

An environment for research collaboration

For researchers, government and industry exploring new ideas in modelling

DAFNI Platform offers:

- A HTC platform supporting research and technology transfer
- Data sharing within a common information infrastructure
- Scaling and coupling models
- A long-term legacy for keeping such models accessible

Still work to be done:

- Digital Twin Pilots
- Experimenting with a more dynamic data management framework
- Data Ontology Support

Supporting sustainable development of infrastructure for our regions, cities, rural areas and down to the household level.







Engineering and Physical Sciences Research Council





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