Exploring the minimum viable product (MVP) of a digital twin for road inspection and maintenance

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Background & Motivation

- Shallow modelling of road assets in current AMS
- Fragmented information systems and data silos
- Inefficient and inconsistent project data delivery
  Digital Twins (DT) Technology offers a promising information management approach.
- Lack of understanding of application values
- Lack of unified data standards and generic system architecture.

Objectives

1. Surveys to understand current barriers and potential use cases of highway digital twins.
2. Develop foundation data models (FDM) and reference data libraries (RDL) for DT systems.
3. Develop integration architecture (IA) to support connected DT data ecosystems.
4. Evaluate the DT system prototype with real-world case studies.

Research Summary

- Conducted interviews and questionnaire surveys.
- Developed initial versions of metadata models (FDM, RDL).
- Developed a distributed system architecture framework
- Developed workflows for highway organisations to implement data federation.
- Developed workflows for end users to conduct cross-system data retrieval and information production.
- Developed a prototype of distributed twin system that consists of federation middleware layer, GUIs, and subsystems.
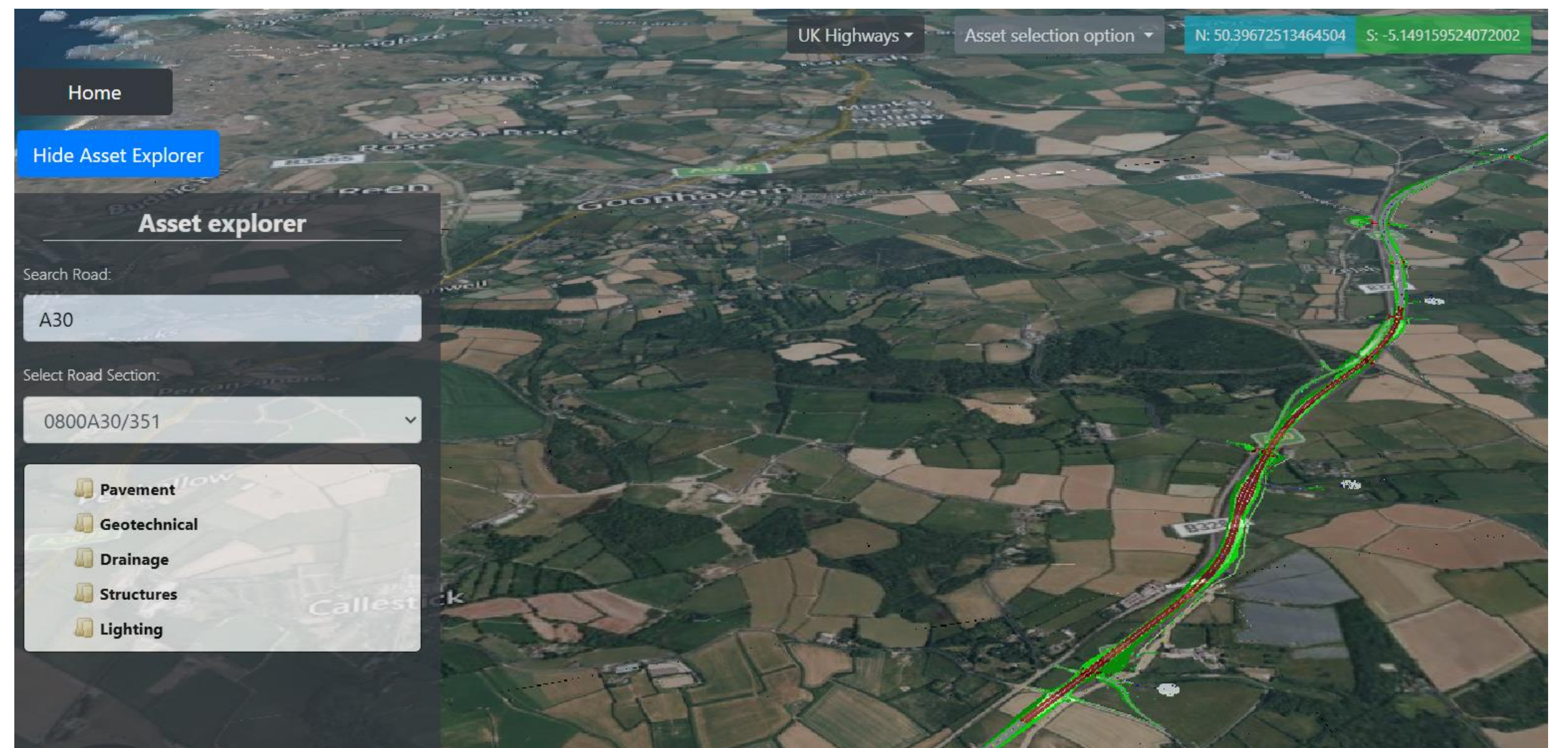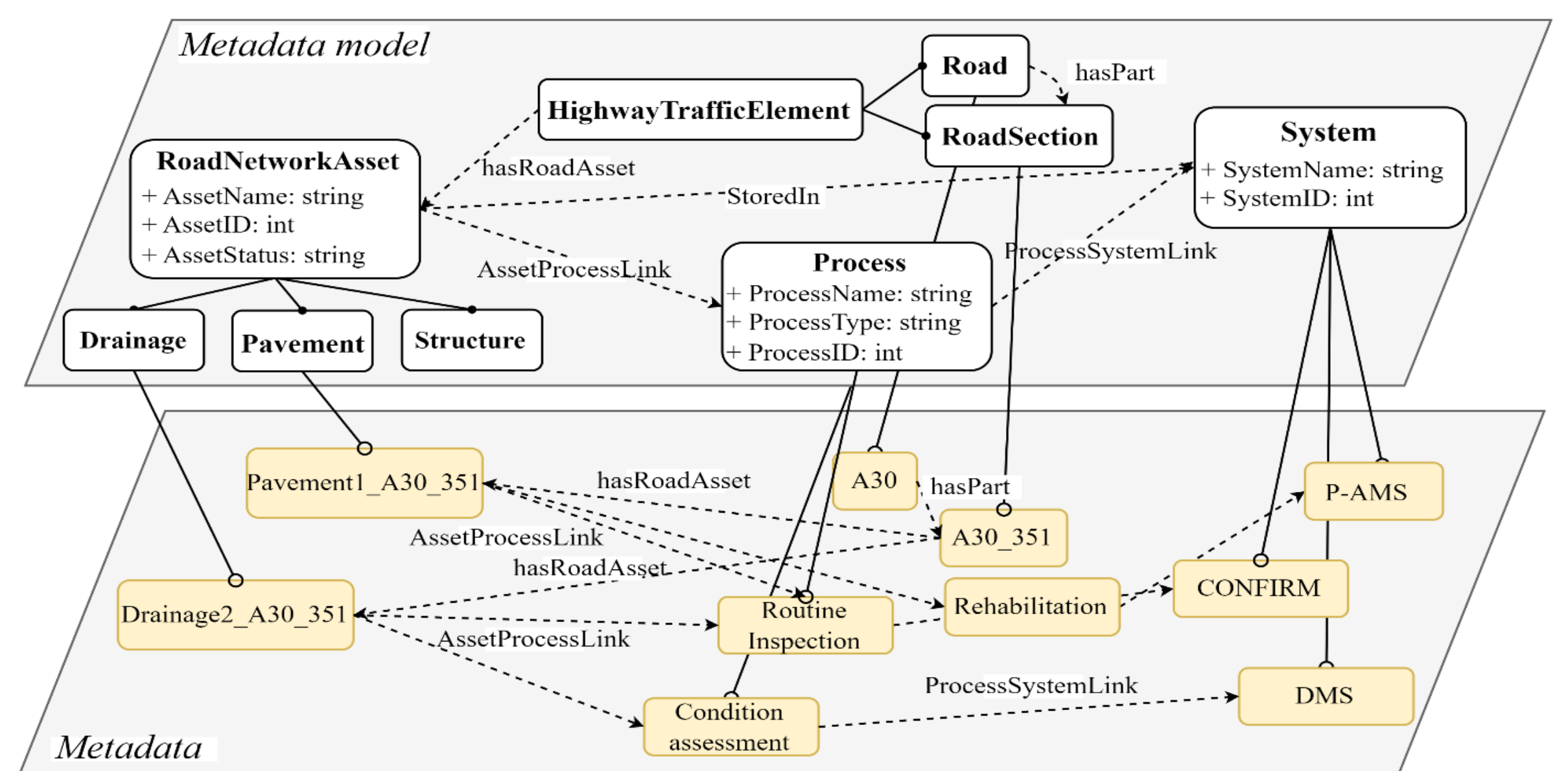
What next?

Explore MVP of highway DTs:
1. Data models completion.
2. Federated query mechanism.
3. Distributed system architecture design.
4. Integration of existing systems.
5. Development of use cases.
6. Performance evaluation.
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Acknowledgements

References

1. **M. Yin**, V.K. Reja, R. Wei, B. Sheil, I. Brilakis, How Can Digital Twins Be Used in Highway Maintenance? A Questionnaire Survey for Industry Practitioners, (2024).