LCM 2019 WORKSHOP — ialcce —

Workshop on Life Cycle Management 27-29 October Rotterdam

InfraQuest COMPETENCE CENTRE FOR ROADS & STRUCTURES

Use of remote sensing for optimising the maintenance strategy of road transition zones: a data-driven solution

Ana Teixeira[1*], *Arjan* Venmans[1], *Bruno* Zuada Coelho[1], *Aron* Noordam[1], *Alex* Rohe[1] and *Claudio* Giangreco[2]

[1]Deltares, Delft, the Netherlands
[2]Department of Civil Engineering, University of Salerno, Fisciano, Italy
*Corresponding author: ana.teixeira@deltares.nl

ABSTRACT:

Transition zones between bridges and embankments are the most maintenance-prone locations in the road network of The Netherlands. Loading of weak and compressible soft soil layers causes (differential) settlements, damage and therefore extra maintenance costs for the road owner and delays to road users.

Our goal is to move from standard assessments to data-driven assessments, where the paradigm of how we look at geo-infrastructures (an uncertain and challenging field) is changed by encouraging the use of unconventional data. We believe that data-driven solutions will help network managers making better decisions under uncertainty. The work presented here, provides the proof-of-concept of an innovative multi-source data-driven solution based on the assimilation of remote sensing and in situ testing in numerical geotechnical modelling, with the aim of supporting informed maintenance decisions for road transition zones.

After calibrating the geotechnical model, we can predict the effects of different maintenance strategies. Three strategies/scenarios are considered: (0) “do nothing”, (1) “asphalt fill” once every 10 years, compensating for the previous settlement, and (2) “EPS fill”, replacing 1.5 m of the original sand fill by lightweight material. Combining the analysis and thresholds for differential settlement will support the road owner in making decisions concerning the best strategy. We will demonstrate the procedure with a case study: the N3 in the Netherlands. Also, we will show the sensitivity of the maintenance decision to model uncertainties.

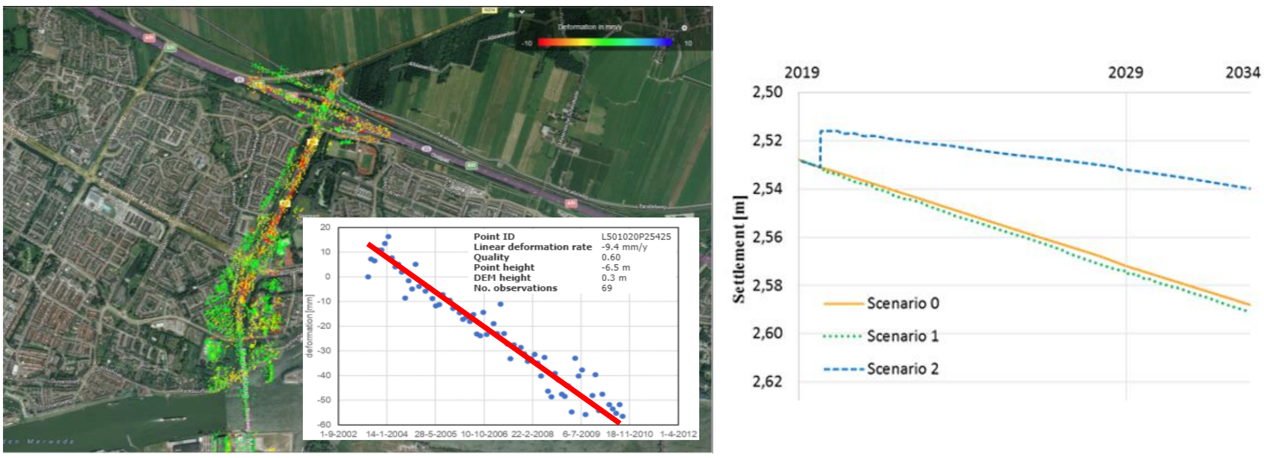

Fig. 1. *Map showing InSAR remote sensing data and timeseries points (left) and calibrated settlements for three scenario’s (right).*

References:

1. Giangreco, C., Venmans, A.A.M., Peduto, D. (2020). DInSAR data assimilation for optimising maintenance at transition zones between bridges and road embankments: a numerical study. Paper submitted at Tenth Symposium on Land Subsidence, 20-24 Apr. 2020, The Netherlands.
2. Noordam, A., Zuada Coelho, B., Teixeira, A. (2019). Data-Fusion in Geotechnical Applications. 3rd International Conferenceon Information Technologyin Geo-Engineering, Sep. 29-02 Oct. 2019, Portugal.

LCM 2019 WORKSHOP — ia lcce —

Workshop on Life Cycle Management 27-29 October Rotterdam

InfraQuest COMPETENCE CENTRE FOR ROADS & STRUCTURES

A data-driven approach to probabilistic budget forecasting

M. (Martine) van den Boomen, H.L.M. (Hans) Bakker, M.J.C.M. (Marcel) Hertogh*

Section Infrastructure Design and Management, faculty of CEG, TU Delft
*Corresponding author: m.vandenboomen@tudelft.nl

ABSTRACT:

This prestentation aims to initiate a practical dialogue on a more data-driven approach to probabilistic budget forecasting. It proposes to represent price uncertainty as a Geometric Brownian Motion (GBM). Available historic price indices [1] provide the uncertainty parameters drift and volatility, which describe a GBM. An illustration is provided in Figure 1. Moreover specific project uncertainty parameters can be obtained from forecasted project cash flows [2, 3]. Hence a Monte Carlo Simulation combines distinct GBMs in probabilistic budget forecasting.

The Dutch SSK standard for project budgeting [4] may benefit from a more data-driven approach. The current best practice works with users' defined confidence bounds and Monte Carlo Simulation to obtain a range of probable time-variant monetary outputs. A challenge in such approach is choosing adequate confidence intervals and probability distributions, as projects have different risk profiles. Another observation is that uncertainty in reality increases with longer time forecasts. The current best practice does not account for these uncertainty dynamics.

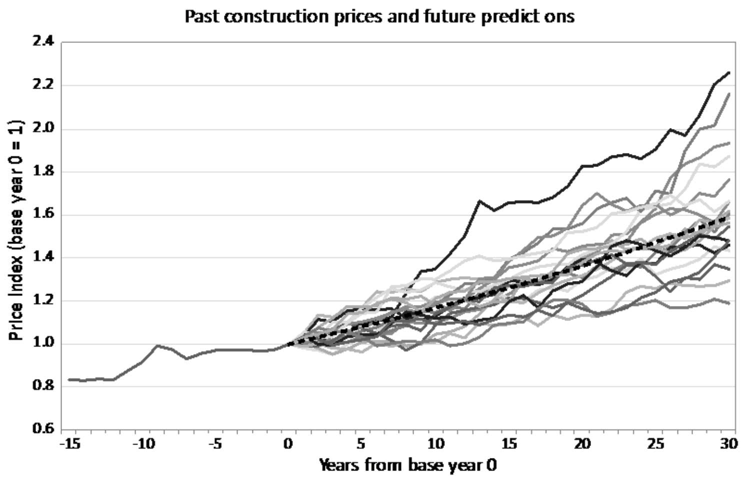

Fig. 1. Geometric Brownian Motion representing the uncertainty of construction costs based on historic price indices. Obtained from [5]

References:
1. CROW. Standaardsystematiek voor Kostenramingen (SSK) 2019 2019-08-28]; Available from: https://www.crow.nl/themas/projectmanagement/kostenmanagement/standaardsystematiek-voor-kostenramingen-(ssk).
2. CROW. Indexen Risicoregelingen GWW. 2018; Available from: https://www.crow.nl/publicaties/indexen-risicoregelingen-gww.
3. Copeland, T. and V. Antikarov, Real Options. A Practitioner's Guide. 2003, UK: The Penguin Group.
4. Mun, J., Real Options Analysis. Tools and Techniques for Valuing Strategic Investment and Decisions. 2006, New Jersey: Wiley Finance Series - Wiley & Sons.
5. Van den Boomen, M., Spaan, M.T.J., Wolftert, A.R.M.., Untangling decision tree and real options analyses: a public infrastructure case study dealing with political decisions, structural integrity and price uncertainty. Construction Management and Economics, 018. 37(1): p. 24-43.

LCM 2019 WORKSHOP — iaLcce —

Workshop on
Life Cycle Management
27-29 October Rotterdam

InfraQuest
COMPETENCE CENTRE FOR ROADS & STRUCTURES

3D Linked Data and BIM for Life Cycle Information Management

Jaap Bakker[1,*] *Maurice* de Kleijn[2]

[1]Rijkswaterstaat, Large Projects and Maintenance, Utrecht
[2]Vrije Universiteit Amsterdam, Spatial Information Laboratory (SPINlab)
*Corresponding author: jaap.bakker@rws.nl

ABSTRACT:

Life Cycle Management of infrastructural assets — *like bidges, tunnels and dykes* — is highly dependent on reliable data. In order to make the right decisions the data needs to be finable, up-to-date and understandable. However, in practice the data about infrastructural assets is seldomly stored in one place and structured following a interoperable standard. Data about these assets has been gathered over long periods of time according to different protocols for various purposes. Much of the data is unstructured and only available as text, without structured semantics. Even if data is structured and semantics are properly defined, there can still be different semantic conventions in different datasets. Geometric representations vary, system boundaries are often not uniformly used and even unique coding systems can be inconsistent over the datasets. Attempts to re-design data structures to a "one fits all" solution often fail, because individual processes have their own standardized semantics throughout the sector. Furthermore, software systems often dictate how data is stored. Most software packages are not per se designed to correspond with the specific data the organization needs. Integrating data structures therefore often result in replacing existing software systems.
Choosing a "one fits all" approach might theoretically sound ideal, but in practice creates a huge barrier to make the step to Life Cycle Management. An alternative methodology is to accept the world as it is, and deal with it in a structured manner. In this presentation we present a solution to integrate internal and external datasets by translating it to linked data in an easy to use 3D viewer. Furthermore we have developed Machine learning algorithms which allows us to generate new knowledge by combining the individual datasets. We have developed a so called "digital twin" which brings together all the asset management data in a user-friendly interface. This paper is the result of an ongoing collaboration between Rijkswaterstaat and the Vrije Universiteit Amsterdam (De Kleijn et al., 2018, SPINlab, 2018).

References:

3. De Kleijn, M., Wilcke, X, Lucas, C., 2018. (Dutch) Innovatie data management asset management Rijkswaterstaat: een strategische verkenning naar 3d linked data en machine learning in het kader van het air-lab Linked data & 3d technology ten behoeve van toekomstig asset management Rijkswaterstaat: een strategische verkenning in het kader van het air-lab, SPINlab VU & Rijkswaterstaat *(document available upon request)*
4. Spinlab Vrije Universiteit Amsterdam 2018. GITHUB - https://github.com/SPINLab

Workshop on
Life Cycle Management
27-29 October Rotterdam

Leveraging Big Data platforms for data and information management

Stephen Wells[1], *Mohammed Idrees*[1], *Hendrik Strydom*[1]

[1]Virtus IT Limited

ABSTRACT:

Few organisations underestimate the power of data to help achieve their business objectives, however using this data to its fullest potential can be a challenge. In an uncertain world, being able to make good decisions swiftly is an operational necessity and for commercial organisations a big competitive advantage.

Today we know what we want to discover and why, but do we know what data we want to look at tomorrow and why? How do we make it easier to access whatever data we need at any point in time to support decision making, innovation and improvement processes? How do we ensure that data science and advanced analytics activities are allowed to deliver value without being hampered by the fact that the underlying data may be distributed across many locations and/or only available for a short moment as it is created by a sensor? How do we assure ourselves of the quality of data that is feeding our Decision Support Systems will contribute to outputs that we can rely on?

These are some of the questions that we will look to address in the context of modern Big Data Platforms. We will refer to our latest Big Data platform reference architecture (Fig 1.) that was used as the basis of work undertaken in Safe-10-T to feed data into the Decision Support Tool.

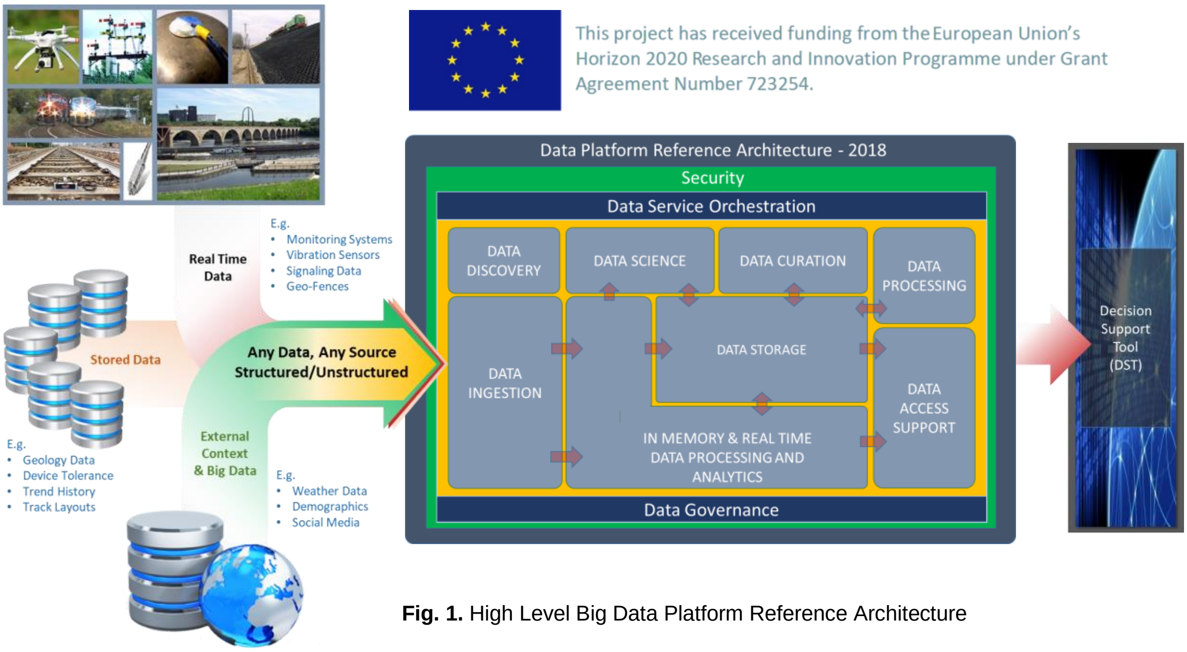

Fig. 1. High Level Big Data Platform Reference Architecture

References:

5. Wells, S. (2019) SAFE-10-T Deliverable D3.2 Report on Integration of Big Data from and to Open Source.

Workshop on
Life Cycle Management
27-29 October Rotterdam

The CEDR-INTERLINK approach towards Asset Information Management

Bart Luiten[1], and *Michel* Böhms[1,*]

[1]Building, Infrastructure and Maritime, TNO, Netherlands
*Corresponding author: bart.luiten@tno.nl

ABSTRACT:

In 2015, the Conference of European Road Directors of Roads (CEDR), on behalf of European National Road Authorities (NRAs), initiated research into the use of Building Information Modelling for information management during the delivery and operation of civil infrastructure. The research aims at improving interoperability within European NRAs and their stakeholders by digitalisation of the sector. The CEDR-INTERLINK research project resulted in a validated basic European Road Object Type Library (EUROTL), using powerful semantic web technology. In 2018 INTERLINK published at www.roadotl.eu their CEDR-INTERLINK Approach and the first basic EUROTL, which NRAs can use to improve their Asset Information Management. The main findings of the project are presented, including a discussion on how this approach could support asset information management over the life cycle, including life cycle cost management.

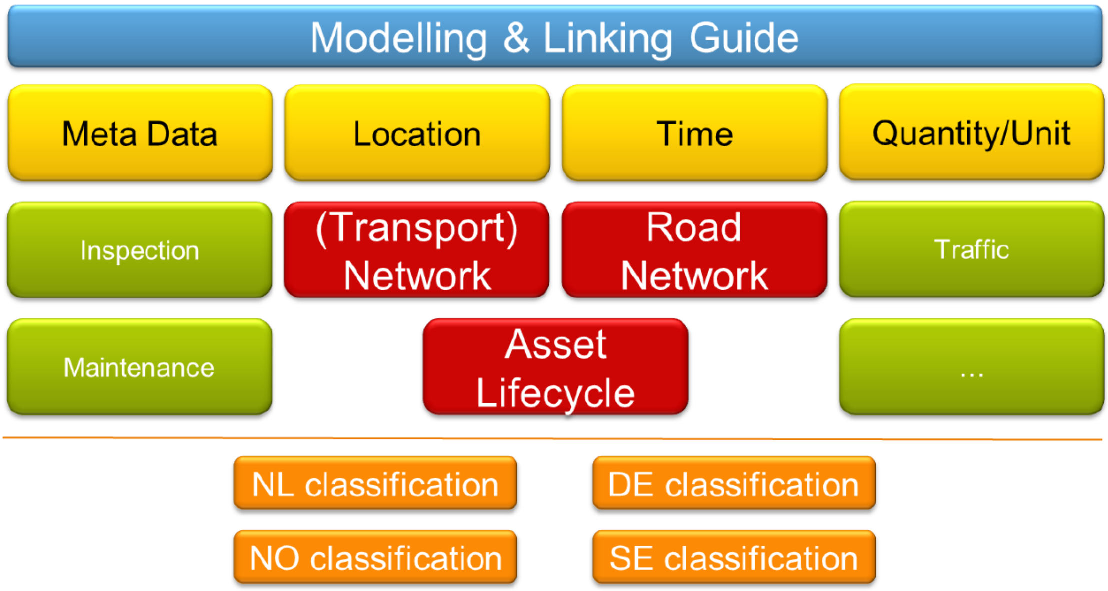

Fig. 1. *Basic European Road Object Type Library*

References:
1. G.T. Luiten, et al, CEDR-INTERLINK Approach with basic European Road OTL, iReport, roadotl.eu/static/ireport/index.html