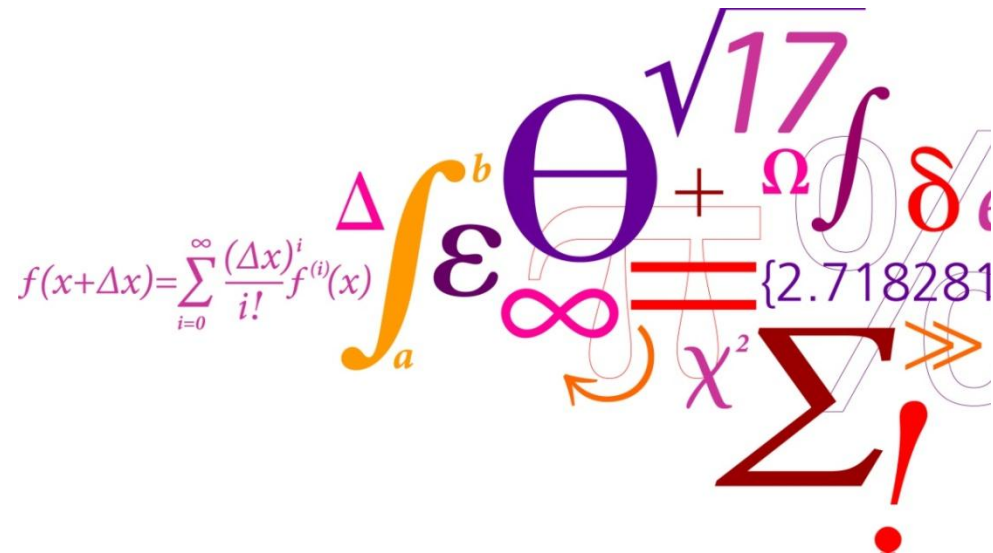


DENMARK-USA WORKSHOP SERIES ON INNOVATION AND DESIGN OF NEXT GENERATION SUSTAINABLE TRANSPORTATION INFRASTRUCTURE

Henrik Stang



Workshops and participants

- **Workshop 1: Modeling of Transportation Infrastructure Sustainability April 23 – 25, 2012 Stanford University, Stanford, California, USA**
 - **Participants: Faculty and PhD students from Stanford, DTU, NTNU, Berkeley and invited speakers**



- **Workshop 2: Integrated Modeling Framework for Assessment of Sustainability of Reinforced Concrete Structures, November 15 – 19, 2012, DTU, Kgs. Lyngby, Denmark**
 - **Participants: Faculty, researchers and PhD students from Stanford, DTU, NTNU, DTI and invited speaker from the Danish Road Directorate**

The underlying hypothesis

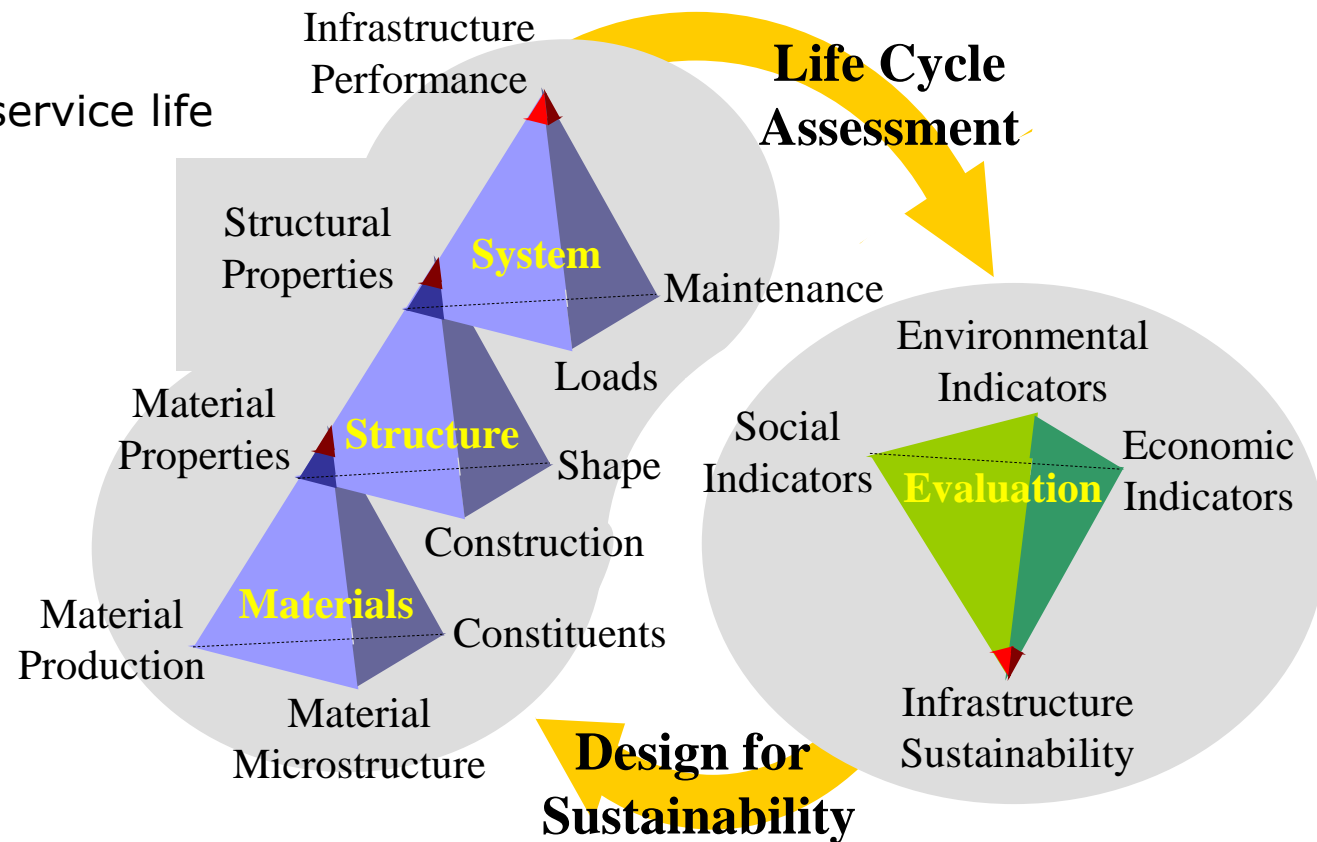
One of the major barriers to innovation and sustainable development is a lack of science-based tools and methods that enable designers to quantify the sustainability benefits (economical, social and environmental) of innovative (transportation) infrastructure technologies and designs while safely and responsibly incorporating them into use.

A key issue in this connection is the lack of science-based tools and methods for assessment of existing structures and their (remaining) service life and service life in general

A FRAMEWORK FOR MULTI-SCALE DETERIORATION MODELLING OF SUSTAINABLE REINFORCED CONCRETE STRUCTURES

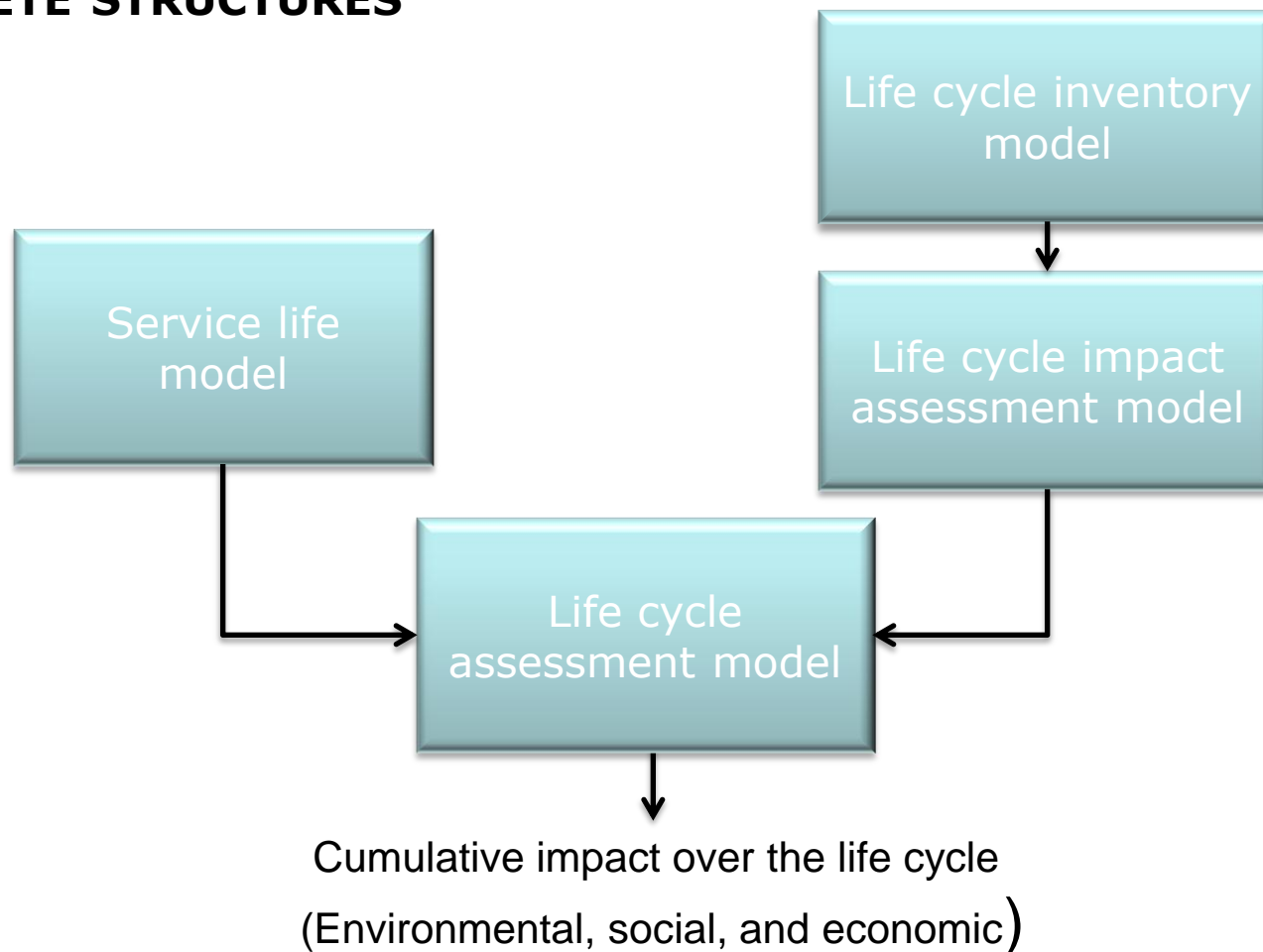
Basis of such a framework are models dealing with:

- material state
- structural state
- deterioration / service life
- sustainability

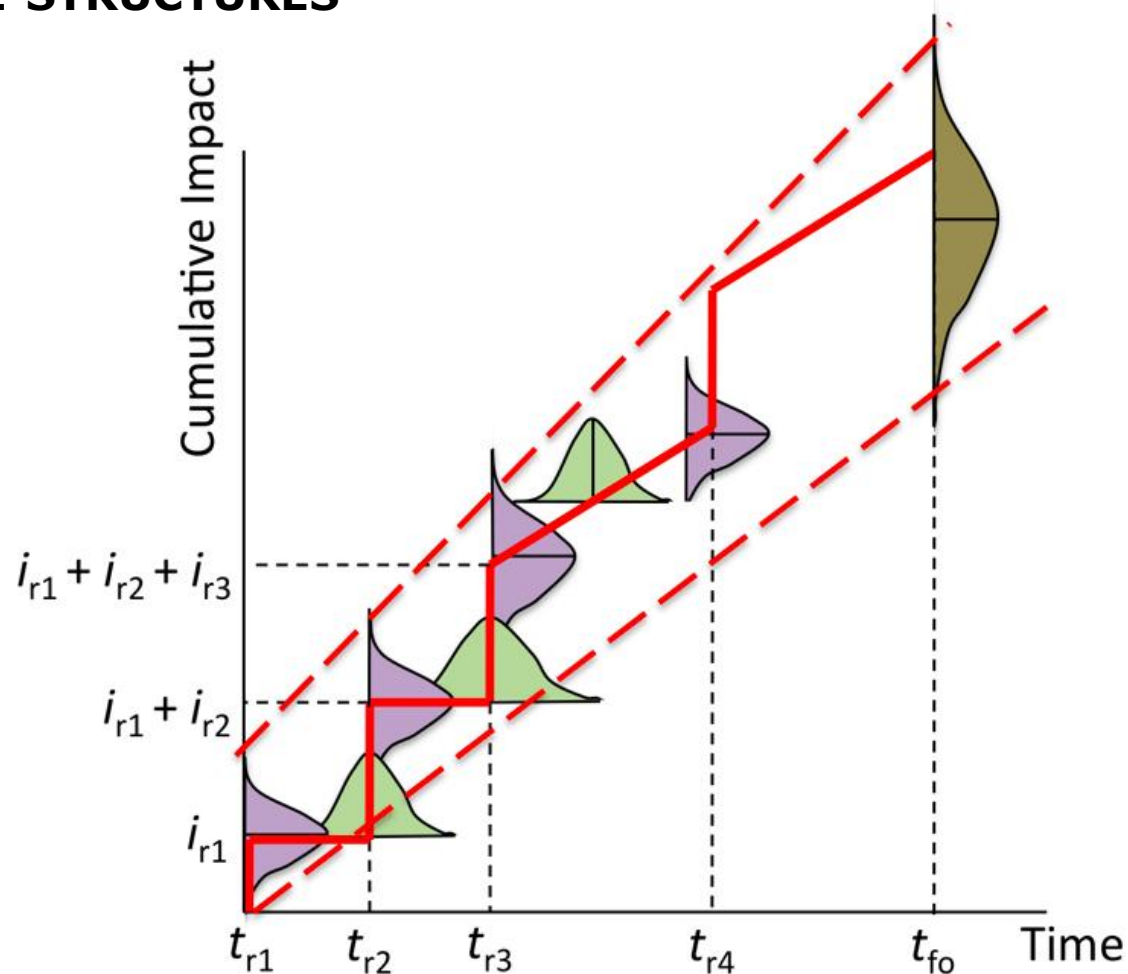


[Geiker, Stang, Lepech 2011,]

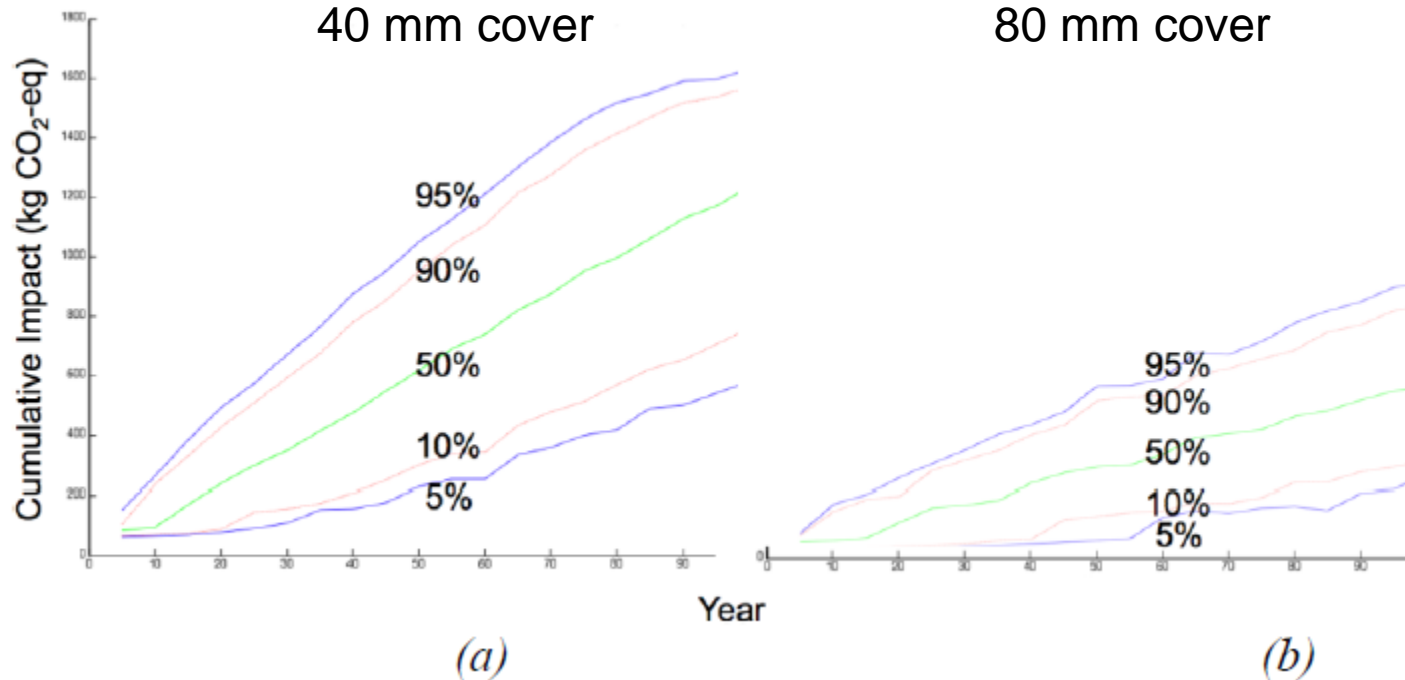
AN OPERATIONAL FRAMEWORK FOR MULTI-SCALE DETERIORATION MODELLING OF SUSTAINABLE REINFORCED CONCRETE STRUCTURES



AN OPERATIONAL FRAMEWORK FOR MULTI-SCALE DETERIORATION MODELLING OF SUSTAINABLE REINFORCED CONCRETE STRUCTURES



AN OPERATIONAL FRAMEWORK FOR MULTI-SCALE DETERIORATION MODELLING OF SUSTAINABLE REINFORCED CONCRETE STRUCTURES – EXAMPLE: CONCRETE COVER THICKNESSES AND CONCRETE COVER REPLACEMENT

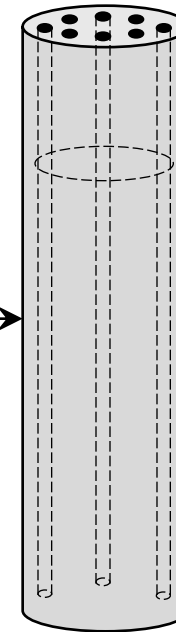
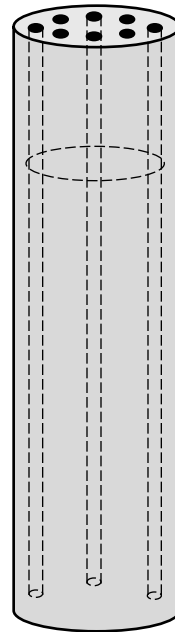


Stang, Lepech and Geiker: "ROBABILISTIC DESIGN FRAMEWORK FOR SUSTAINABLE REPAIR AND REHABILITATION OF CIVIL INFRASTRUCTURE". ICDC 2012

Proof of concept model – the modular approach

Structural Performance
Module (3D)

- Structural Performance
- Sustainability Indicators

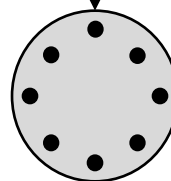


Service Life Prediction
Module (3D)

- Corrosion Rate
- Corrosion Potential
- Type of Corrosion Product

Mechanical Performance
Module (2D)

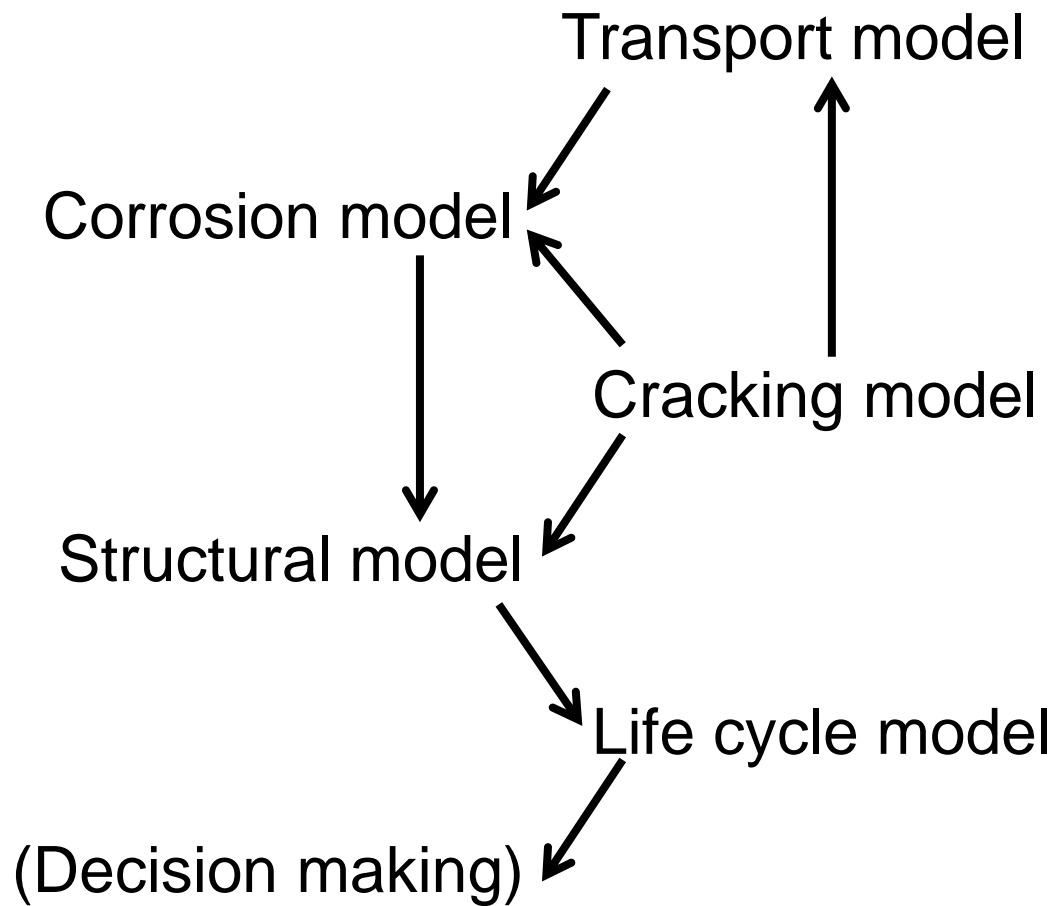
- Corrosion-induced damage



Transport and Chemical
Module (1D)

- State of Heat and Matter
- Chemical Composition
- Changes in Microstructure

Proof of concept model – a different view



Commitment

- Presently commitment (involving existing projects and seeking funding for new) from:
 - Stanford University (sustainability, exposure simulation and structural performance)
 - DTU (transport, corrosion and construction of the unified model)
 - DTI (experimental studies for model calibration and verification)
 - NTNU (transport corrosion and structural performance)
- Foreseen commitment from:
 - Danish road Directorate (real bridge)
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