



FACILITATING MAINTENANCE OF EXISTING BRIDGES THROUGH DIGITAL TWINS

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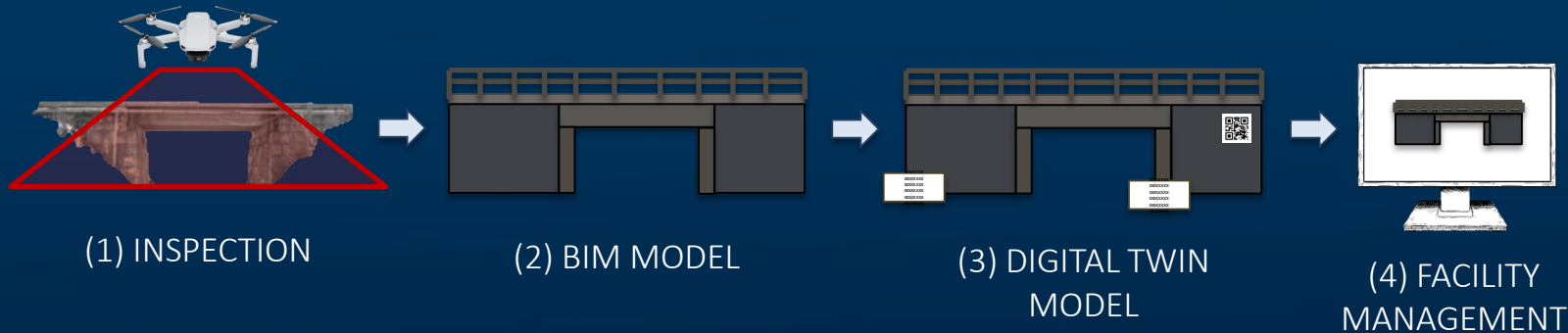
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PURPOSE OF THE PROJECT

Develop a system to manage existing bridges using digital models (BIM and Digital Twins) in order to add more automation, efficiency and accuracy to the process.



IMPORTANCE OF THE PROJECT

Highly important in any transportation system

Advances in automated technology for bridge inspection

Long life spans



BRIDGES

Challenges in current bridge management systems

Are monitored with some regularity to ensure preservation

Challenges in current bridge inspection process



PROGRESS

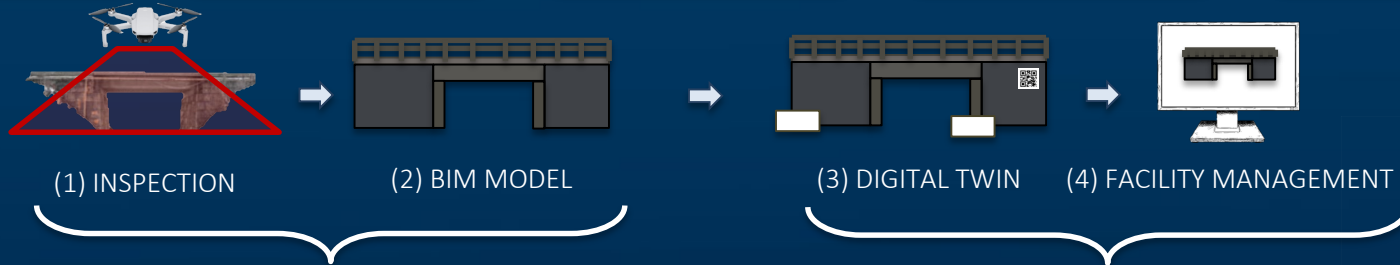
LITERATURE
REVIEW

METHODOLOGY
FOR THE SYSTEM

TEST
METHODOLOGY:
LAB

TEST
METHODOLOGY:
CASE STUDY

DEVELOP SYSTEM



A great deal of research exists

Rather new in the construction industry

STATE-OF-THE-ART LITERATURE REVIEW

Synthesize the most recent research and best practice

Diagnosis on what has been done and gaps to be explored



LITERATURE REVIEW

Systematic approach for a thorough review:

1. Strings of research → 16 combinations
2. Database → SCOPUS
3. Assessment of the articles → 3 filters

BIM

BRIDGES

DIGITAL TWINS

FACILITY
MANAGEMENT

MAINTENANCE

("BIM" OR "Building information modeling");

("Bridge information modeling" OR "BrIM" OR "Bridge" OR "Bridges");

("Digital twin" OR "Digital twins" OR "DTM");

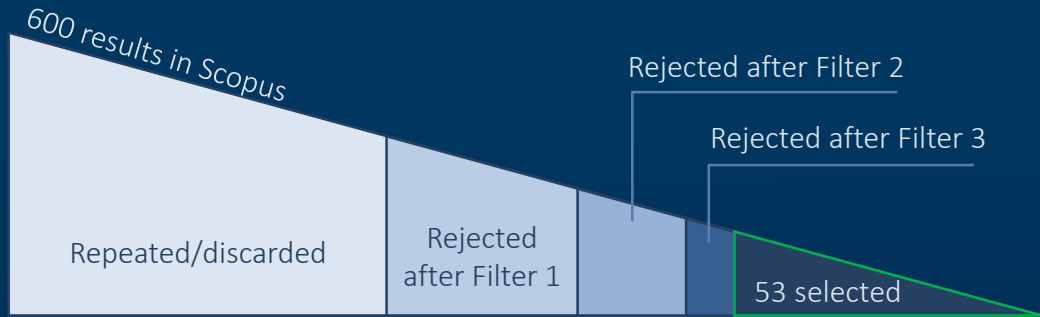
("Facilities management" OR "Facility management" OR "inspection" OR "monitoring");

("Maintenance" OR "assessment").

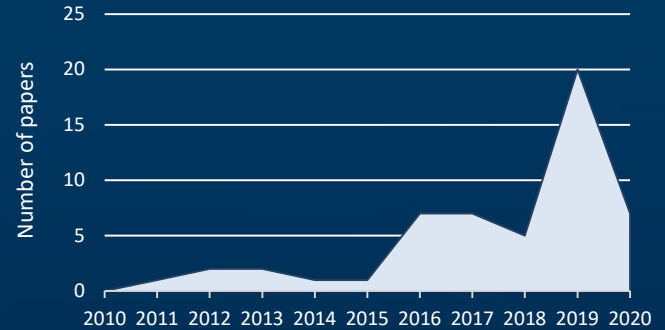


LITERATURE REVIEW

Systematic literature review:



Distribution of selected papers over 2010-2020



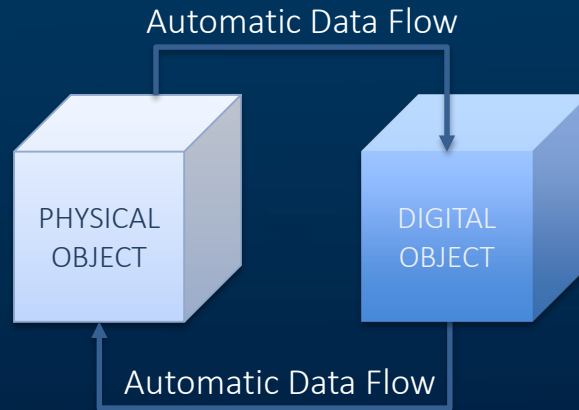
Publication of initial results from research:



RESULTS

A general definition and an agreement over digital twins' features has not been reached yet (Cimino et al., 2019). It is common to come across the digital twin nomenclature being used to describe 3D digital models without relevant automated data flow.

Digital Twin:



RESULTS

Digital Twin: how to do it?

Strategy encountered in the literature: separate models, or separate layers, to comprise the different types of data in a digital twin.



RESULTS

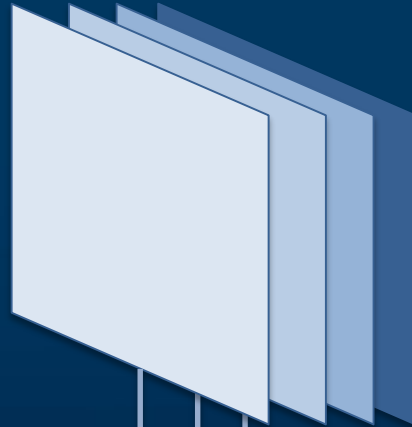


Inspection: automated process using a combination of accurate technologies



BIM model:

Generated mostly automatically from the inspection point clouds. Containing geometry, materials, defects, monitoring points and data, access conditions, etc.



Facility management:
Management of the whole life cycle. User-friendly interface including alerts when certain parameters reach warnings levels.



ORIGINAL DRAWINGS



BIM MODEL
CURRENT CONDITION



FEM MODEL
MONITORING POINTS
ANALYSIS AND PREDICTIONS

DATA FROM
INSPECTIONS



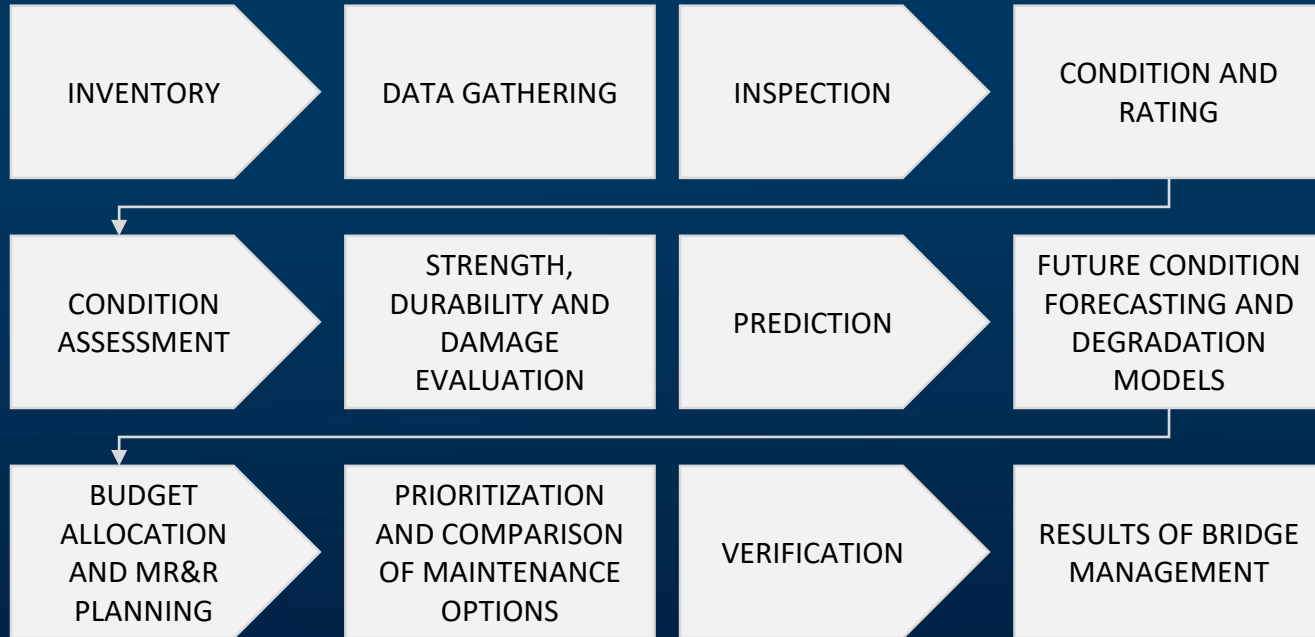
Digital Twin:

Should be automatically updated with the monitoring data from the site and bilateral communication.



RESULTS: FACILITY MANAGEMENT

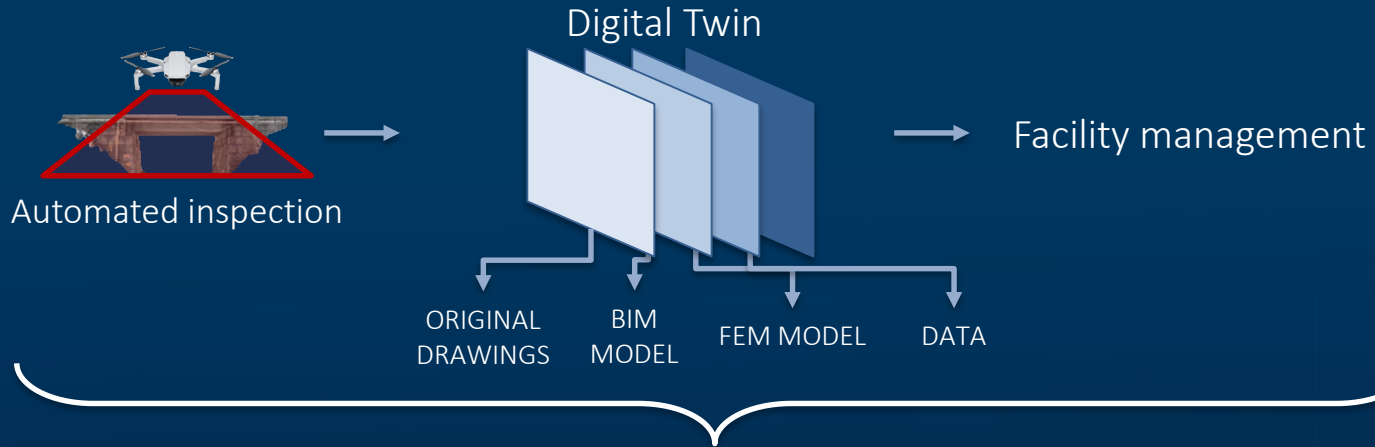
ACTIVITIES IN A BRIGE MANAGEMENT SYSTEM:



DIGITAL TWIN



FUTURE STEPS



Test the methodology
in the laboratory

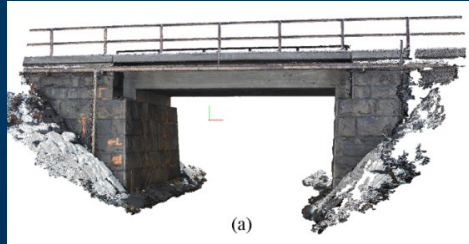


Case study: real bridge



FUTURE STEPS: CASE STUDY

Pilot project:



Scanned bridge:
photogrammetry techniques



First scanning – year 1



Second scanning – year 2

FUTURE STEPS: CASE STUDY



First scanning – year 1



Second scanning – year 2

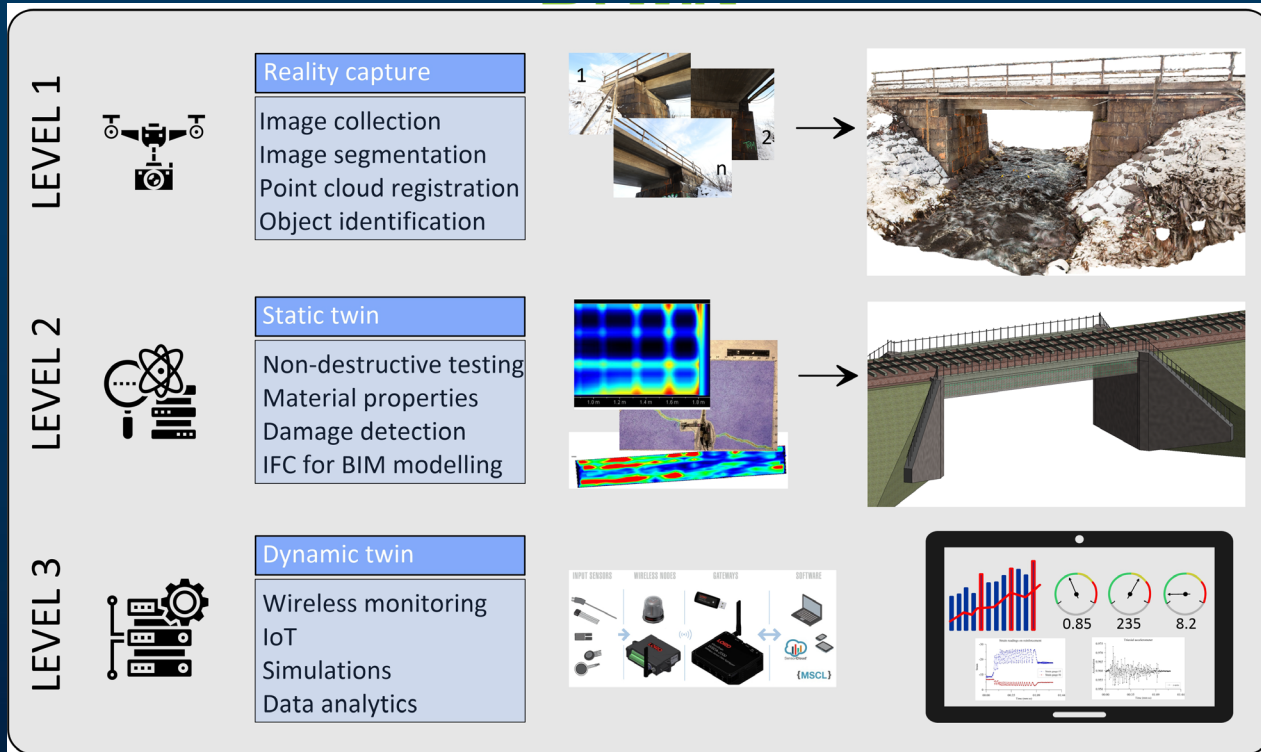
Follow-up: monitoring data for the digital twin

- Deflections
- Settlements
- Surface damages over time



FUTURE STEPS: CASE STUDY

DIGITAL TWIN





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DISCUSSION

- Who could use this kind of bridge management system?
 - Bridge management agencies, consultants...
- What could be their specific demands for such a system?
- Storage of a very large amount of data: could this be an issue?
- Cybersecurity: could this be an issue?

