

# Facilitating maintenance of existing bridges through Digital Twins

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**INFRA  
SWEDEN 2030**

Med stöd från

**VINNOVA**  
Sveriges innovationsmyndighet

 **Energimyndigheten**

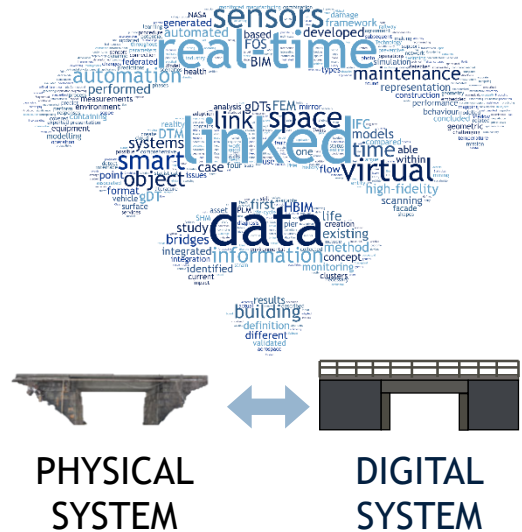
**FORMAS** 

Strategiska  
innovations-  
program

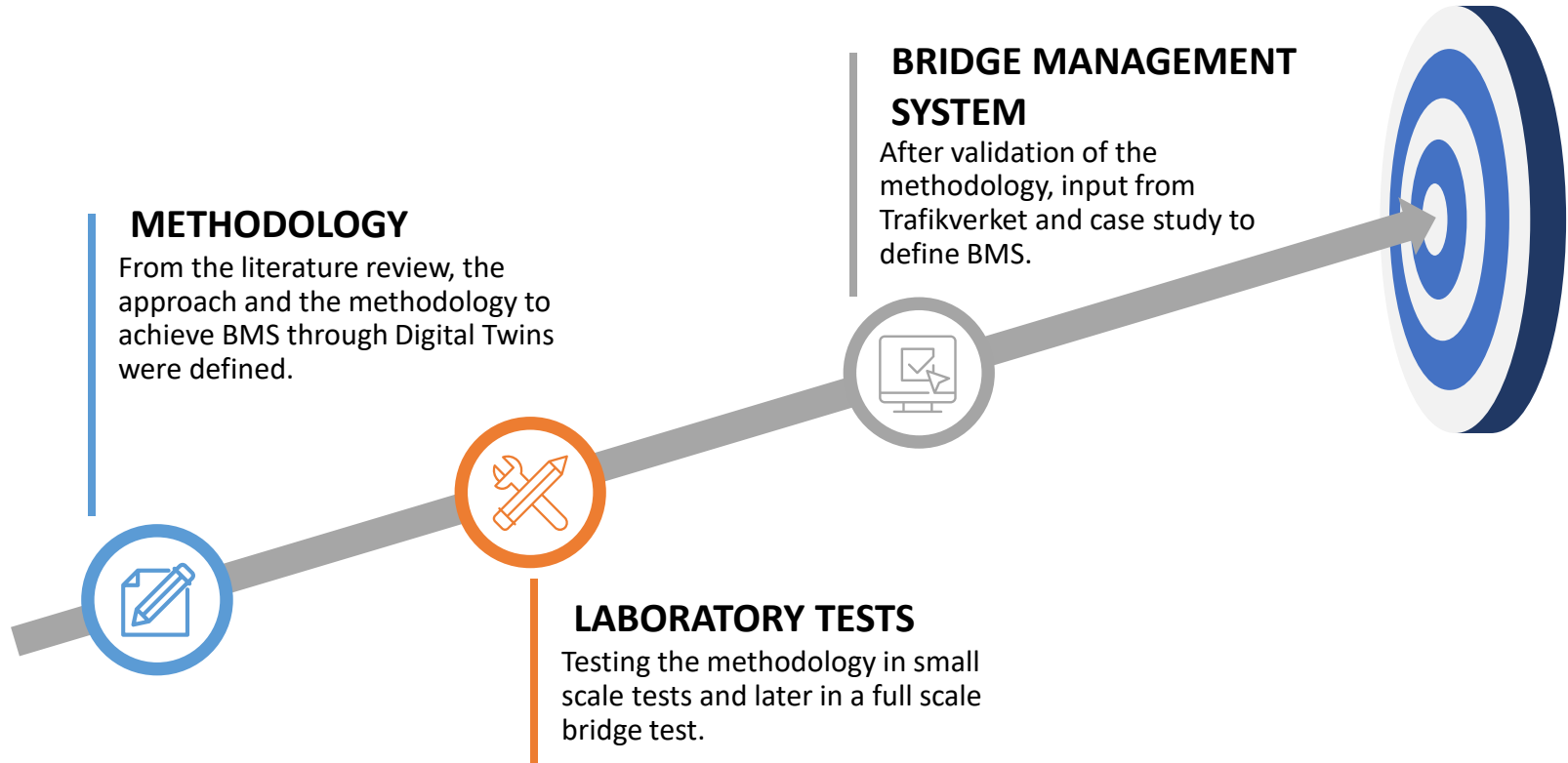
# Purpose of the project

Bridge Management System using digital models and Digital Twins:

- Increasing research on Digital Twins in different industries, but Engineering/Construction is still behind manufacturing and aerospace in the maturity of digital twins.
- Potential for increasing efficiency and automation in bridge management through Digital Twins.



# The project's three most important results

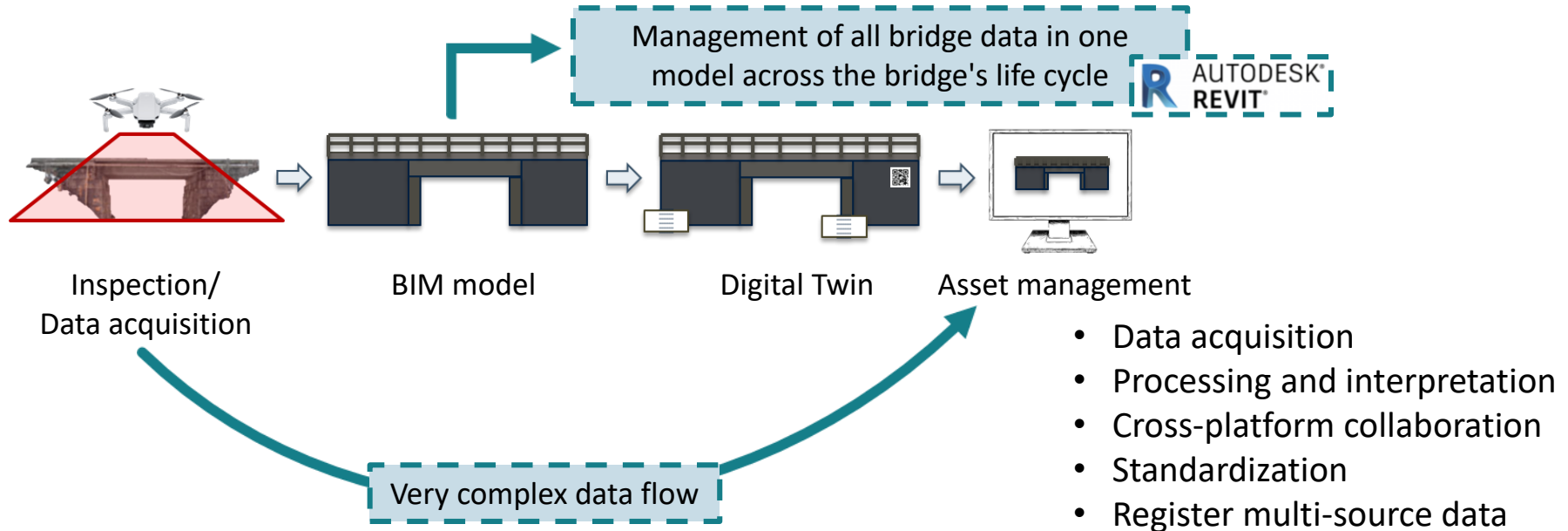


# The project's three most important results



## METHODOLOGY:

Asset management of bridges through Digital Twins:



# The project's three most important results



## METHODOLOGY:

Asset management of bridges through Digital Twins:



Different technologies in recent literature to tackle data transmission and interoperability:



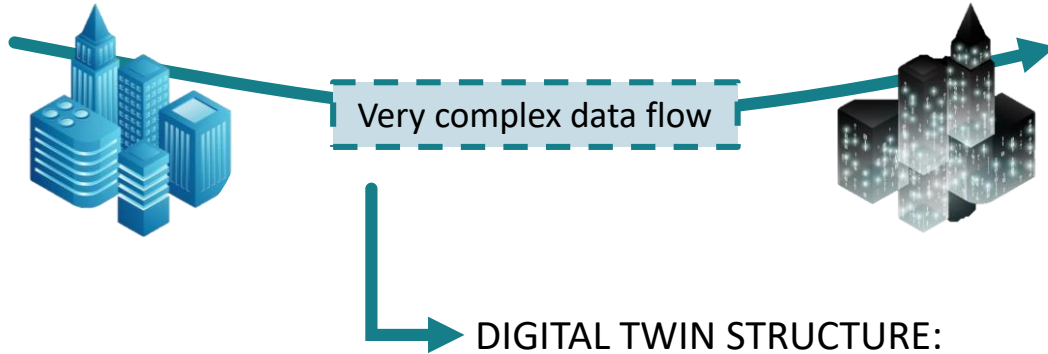
- IFC
- Machine learning
- MATLAB
- Artificial intelligence algorithm
- 3G/4G/5G and WLAN

# The project's three most important results

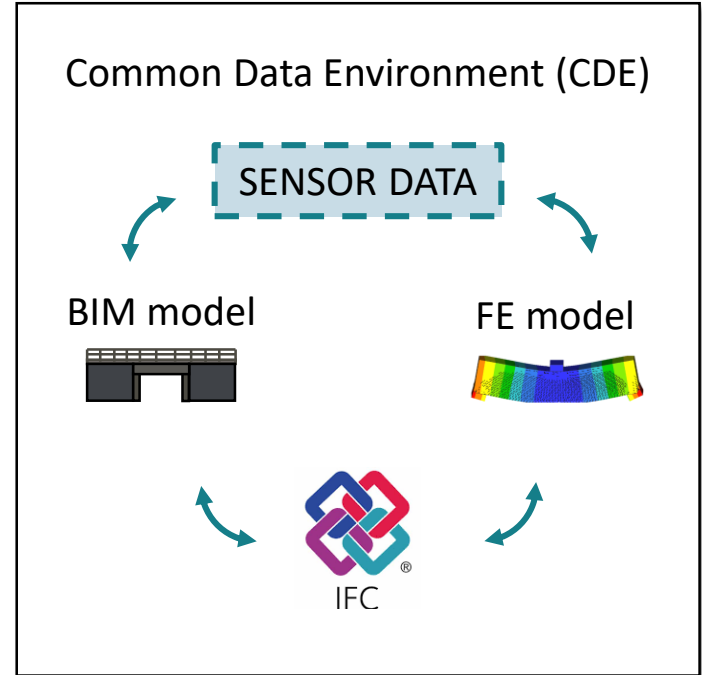


## METHODOLOGY:

Asset management of bridges through Digital Twins:



Neutral format to exchange of data between non-native file types and digital building models.

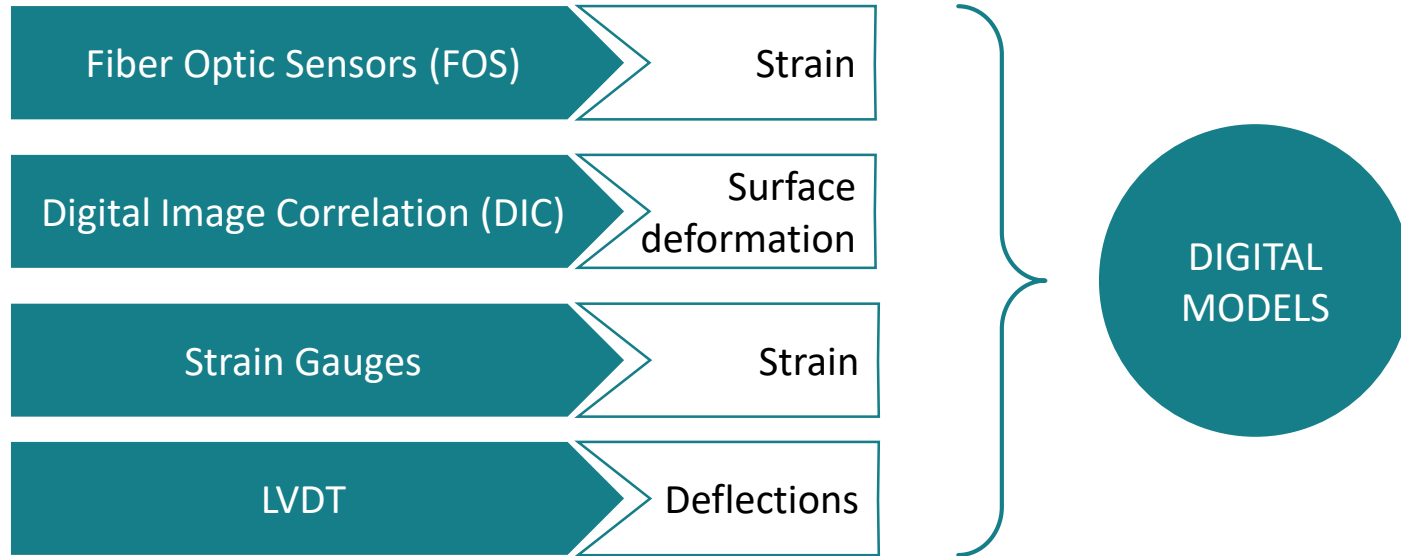


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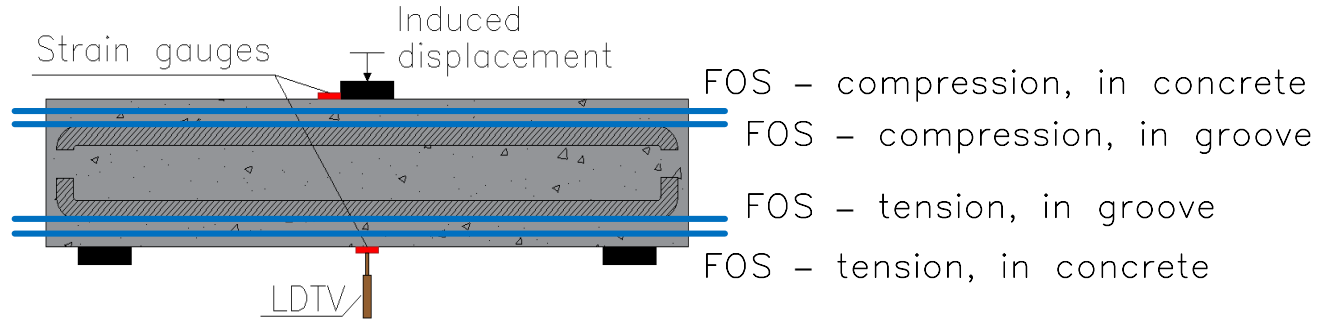


## LABORATORY TESTS: Small scale

Three point bending test in a reinforced concrete beam to evaluate:



# The project's three most important results



## Data from tests:

Strain (tension/compression) x Force	Strain Gauges FE
Strain (groove, tension/compression) x Force	FOS
Strain (concrete, tension/compression) x Force	FE
Displacements x Force	LVDT FE
Surface deformation	DIC



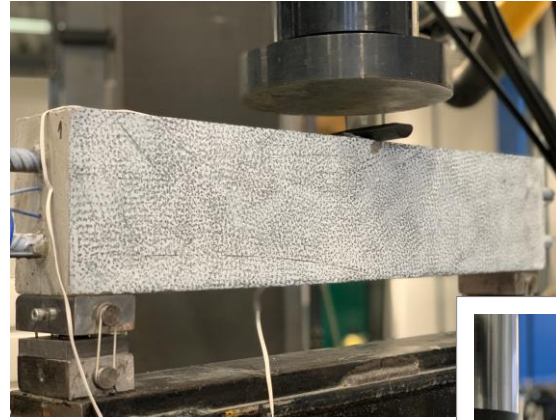
# The project's three most important results



Installing FOS



Casting



Speckle pattern



Cracks

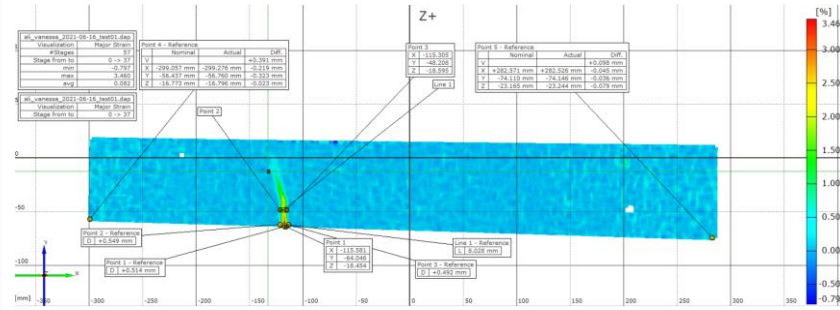
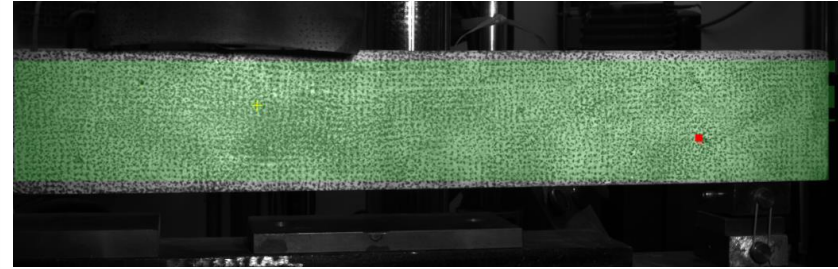
# The project's three most important results



DIC system set up

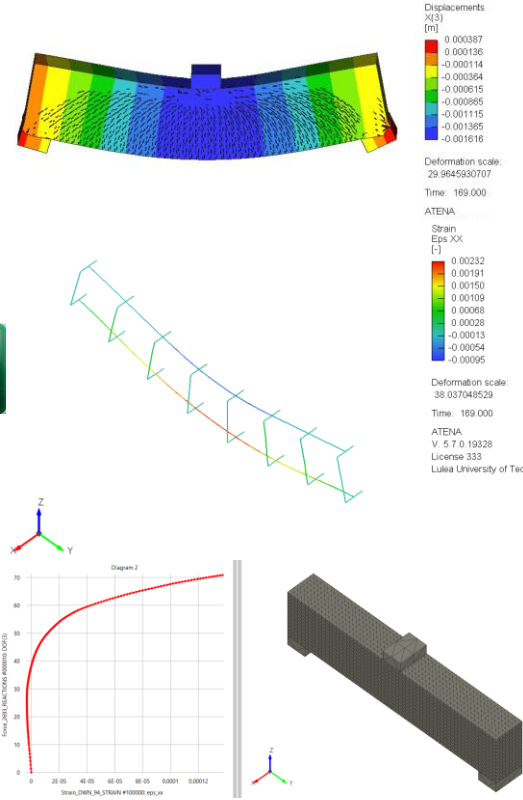
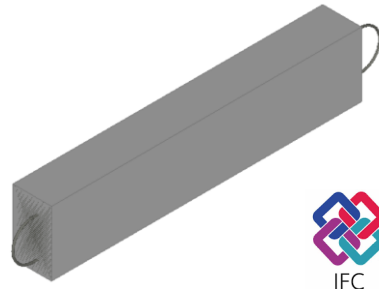
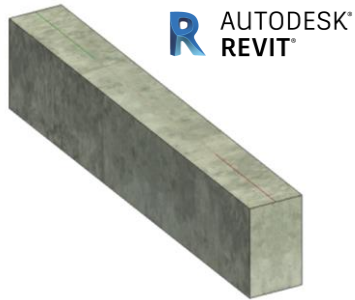
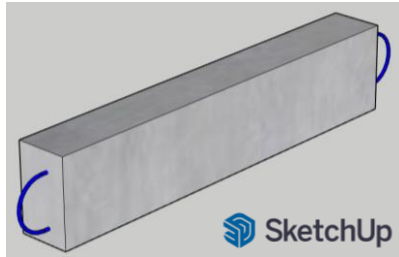


ARAMIS



# The project's three most important results

Digital models:



# The project's three most important results



## LABORATORY TESTS: NDT

- Data acquisition through non-destructive testing (NDT) to evaluate the current condition of the bridge.
- NDT for bridge management: feed as/is model, compare construction plans with real conditions.



Kalix Bridge: NDT



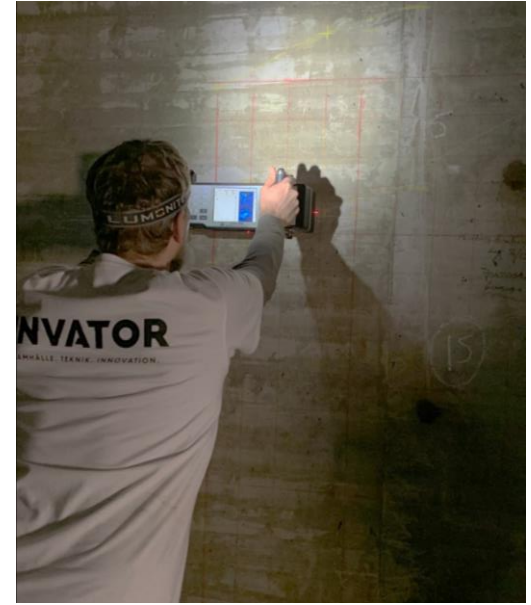
# The project's three most important results



Cover-meter



Cover-meter



ultrasound

# The project's three most important results



GPR



Augmented reality

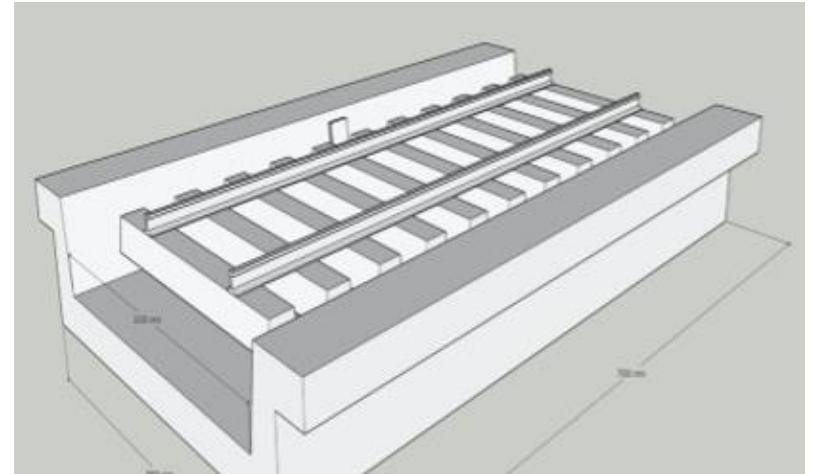
# The project's three most important results



## LABORATORY TESTS: Large scale

Future plans: replicate methodology in full scale Trough Bridge test.

- Fiber Optic Sensors
- Non-destructive tests
- Digital Image Correlation
- Photogrammetry
- BIM model
- FE model

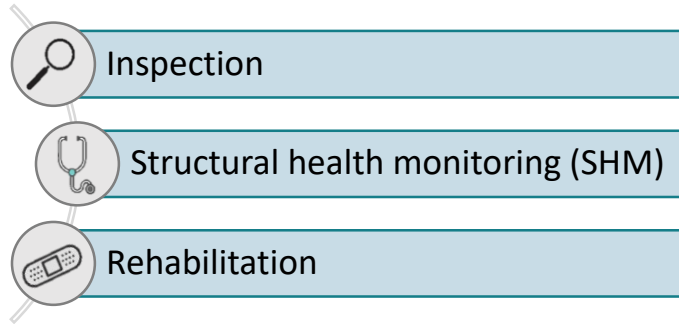


# The project's three most important results



## BRIDGE MANAGEMENT SYSTEM:

### BRIDGE MANAGEMENT



- Fiber Optic Sensors
- Non-Destructive Tests
- Digital Image Correlation
- Photogrammetry
- BIM model
- FE model

Results from:

- Literature review
- Laboratory tests
- Case study
- Input from Trafikverket



Develop system:

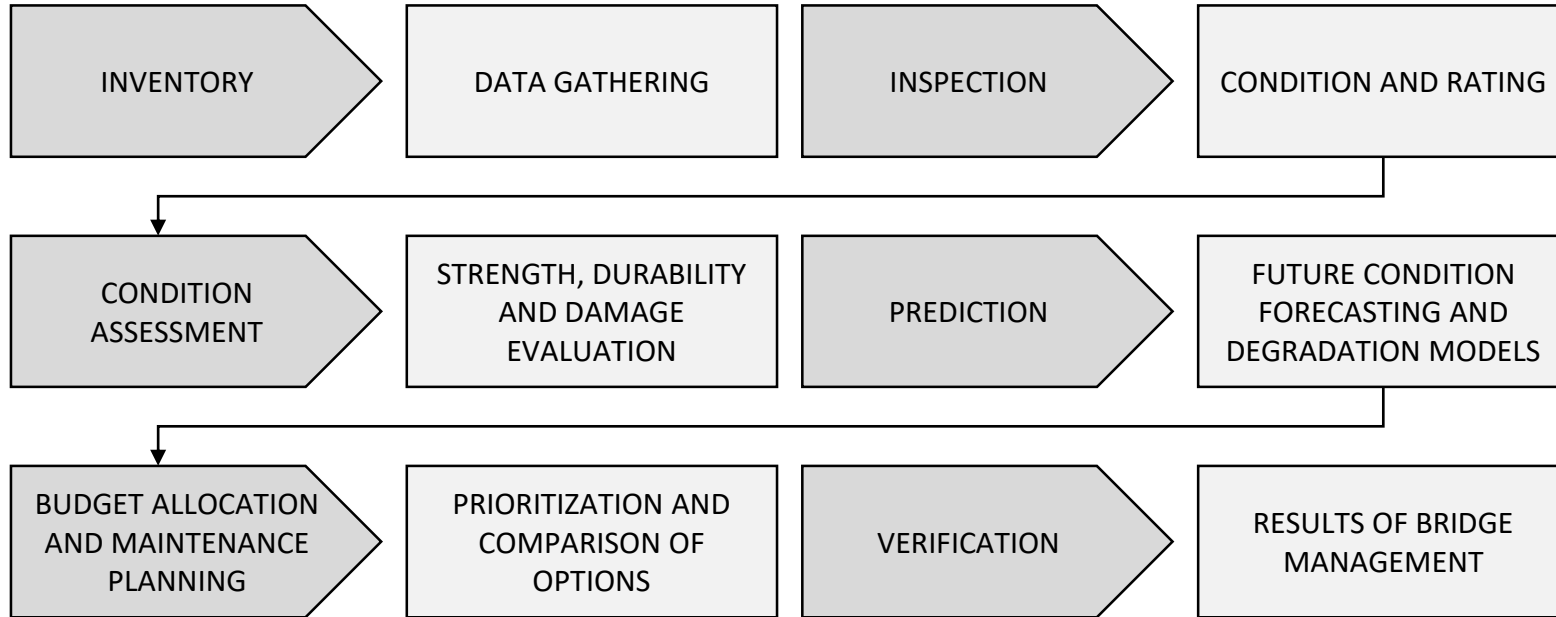




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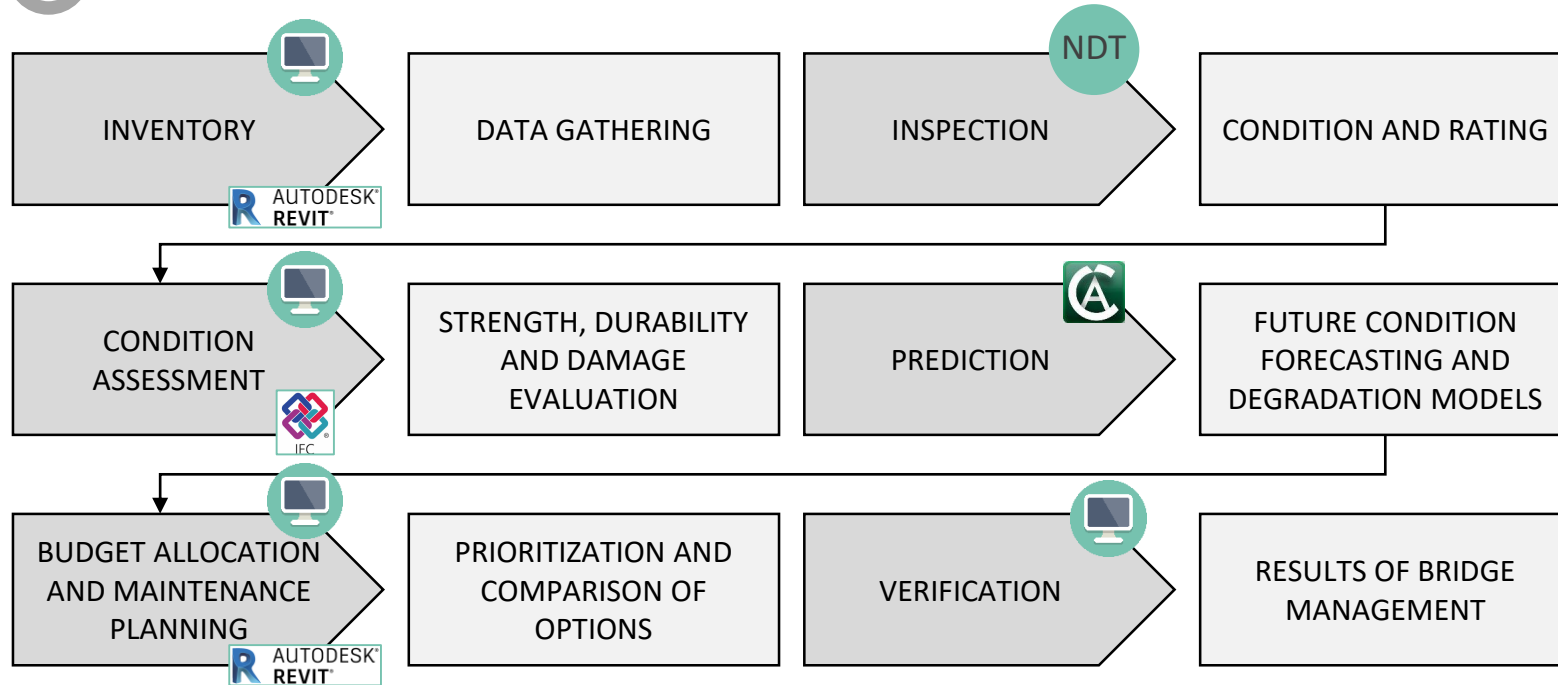


## BRIDGE MANAGEMENT SYSTEM:



# The project's three most important results

## BRIDGE MANAGEMENT SYSTEM:



# Questions



# Questions

- Is it better to have a “one-stop-shop” system or compatibility between software?
- How can existing BMS adapt to the technology?
- What is the contribution to a sustainable environment and society?
- What is the potential benefit of the innovation, i.e. the BMS?
- Which parties are involved in the project?
- What feels most difficult right now?
- What measures are required disseminate results and reach a broader market?

