

A large concrete bridge structure, possibly a cable-stayed bridge, spans across a body of water. The bridge features massive concrete piers and a wide deck. A small drone is visible in the sky near the bridge. The foreground shows a rocky shoreline with waves crashing against it. The sky is clear and bright, suggesting a sunny day.

# Next Generation AI and Asset Management for Civil Infrastructure

**Claus Klint**

Worldwide Industry Sales Leader, Civil Infrastructure

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# Welcome



# Civil Infrastructure



**Bridges**




**Roads**




**Rail**



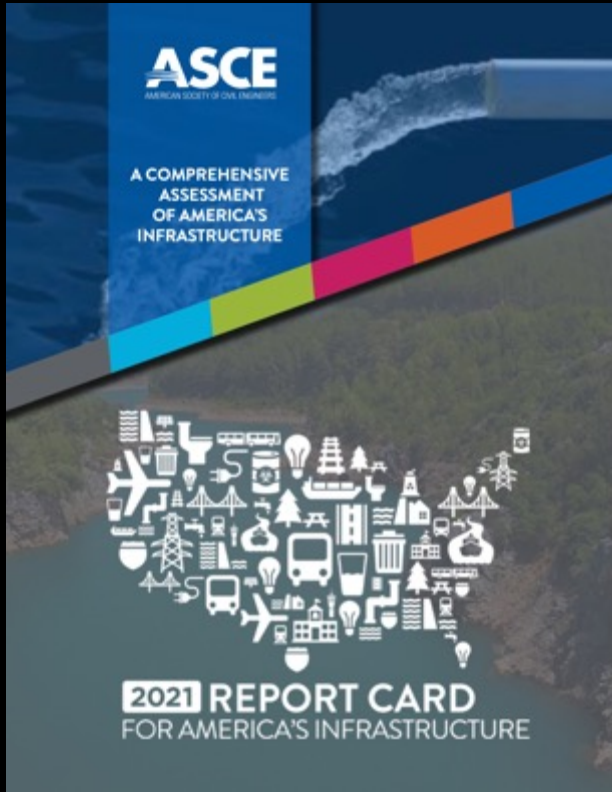
**Ports**



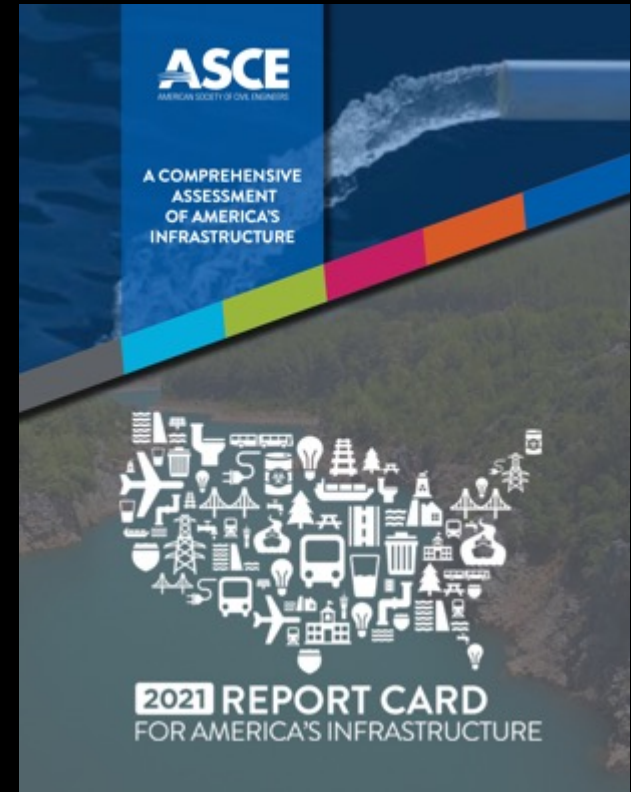
**Transit**







<https://infrastructurereportcard.org/wp-content/uploads/2020/12/2021-IRC-Executive-Summary.pdf>



[https://infrastructurereportcard.org/wp-content/uploads/2020/12/National\\_IRC\\_2021-report.pdf](https://infrastructurereportcard.org/wp-content/uploads/2020/12/National_IRC_2021-report.pdf)



# 2021 Infrastructure Report Card Summit



# \$50B

**2 Billion man-hours spent yearly  
on manual inspection of bridges**

**Civil Infrastructure – One of the most asset  
and labour intensive industries**

**\$2.2T**

**Backlog on more than 1 million structures**

**\$75B**

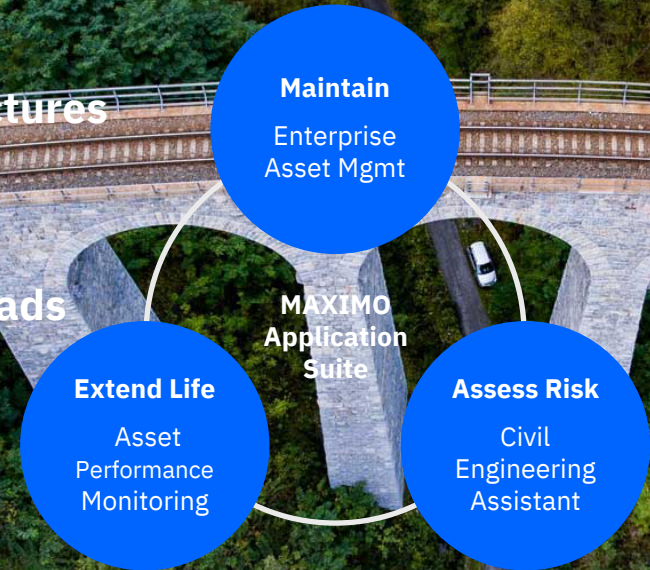
**US Operation and maintenance of roads**

**178M**

**trips over structurally deficient bridges**

**40%**

**of roads are in poor or mediocre condition**

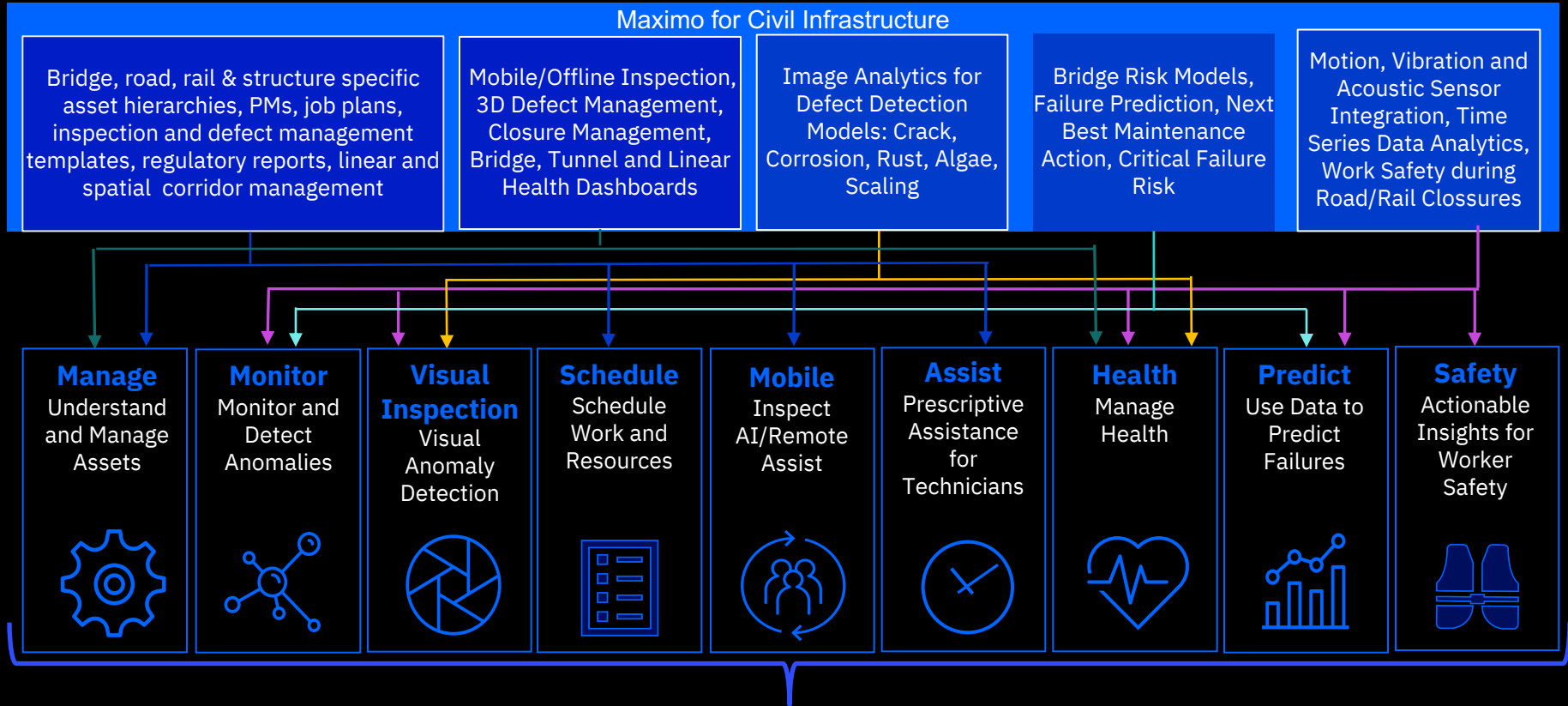




# IBM Maximo® for Civil Infrastructure

# Industry Solution based on Maximo Application Suite

Current & Roadmap Capability



# Industry Challenges:



**Risk of failure:** Structures operating beyond their designed life, huge backlog of needed repairs



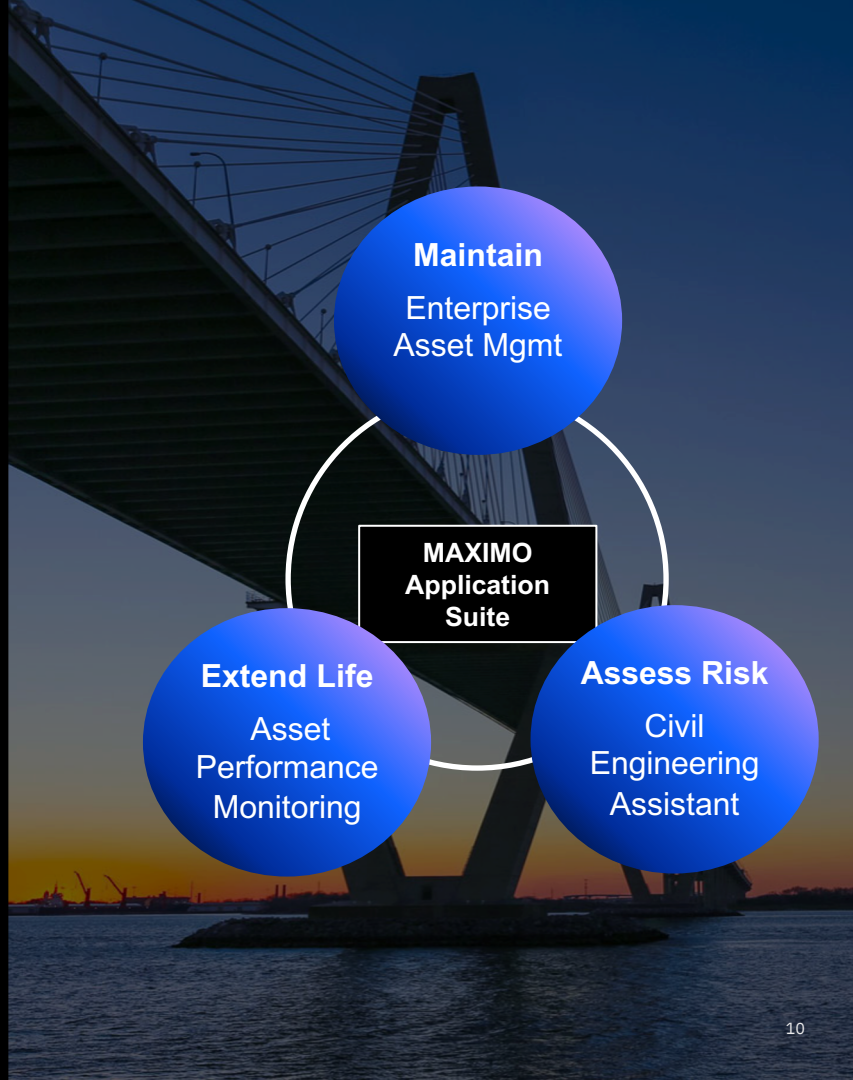
**Maintenance costs rising:** Manual inspections, increasing volume of maintenance tasks



**Improve sustainability:** Extend the expected life time of structures



**Compliance with rules and regulations**





# Sund $\approx$ Bælt

*Sund  $\approx$  Bælt*





  
The Storebælt Link

  
The Øresund Link

  
The Femern Link

# STRATEGY AND AMBITION

**Vision: Sund & Bælt aspires to be the leader in building, operating and financing user-paid infrastructure that strengthens mobility in Denmark and Europe**

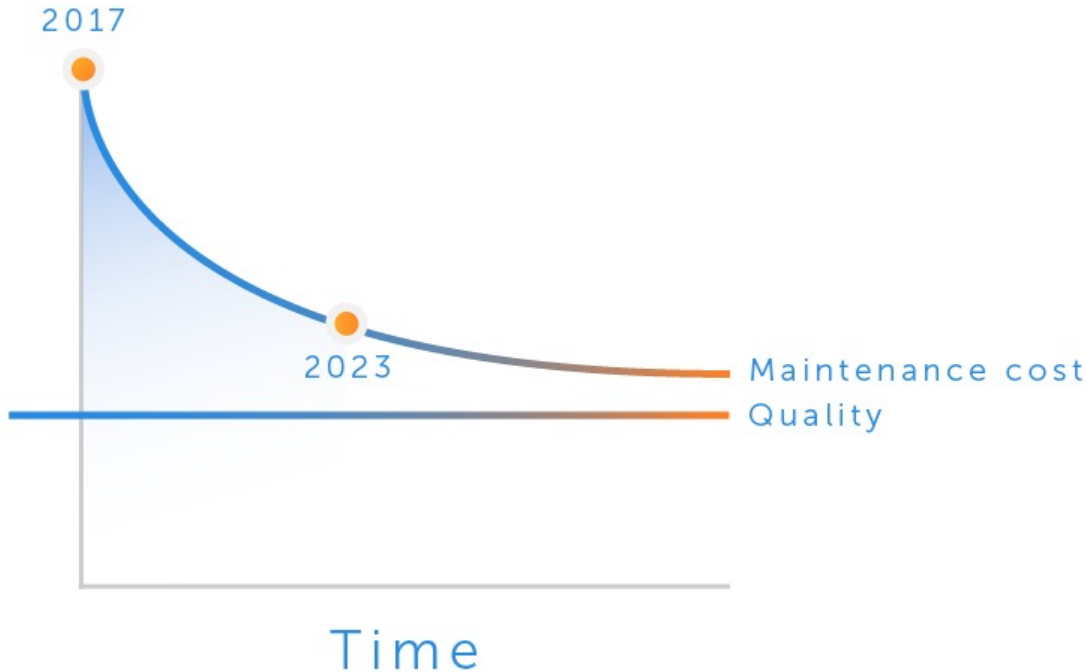


Secure 2% annual productivity

- Ensure optimal TCO in new installations
- Collection of experience and benchmark data
- Sharing knowledge and collaborating



# AMBITION FOR ASSET MANAGEMENT



- Reduce operational cost 2% per year until 2023
- Keep constant cost level after 2023 despite ageing assets
- Maintain quality and accessibility

# From time-based to predictive maintenance

## Optimize

- Improve Models
- Continuous Learning



## Predict

- AI Based
- pre-emptive



## Act

- Execute Processes
- Manage Activity



## Monitor

- Correlate Data
- Manage Operations

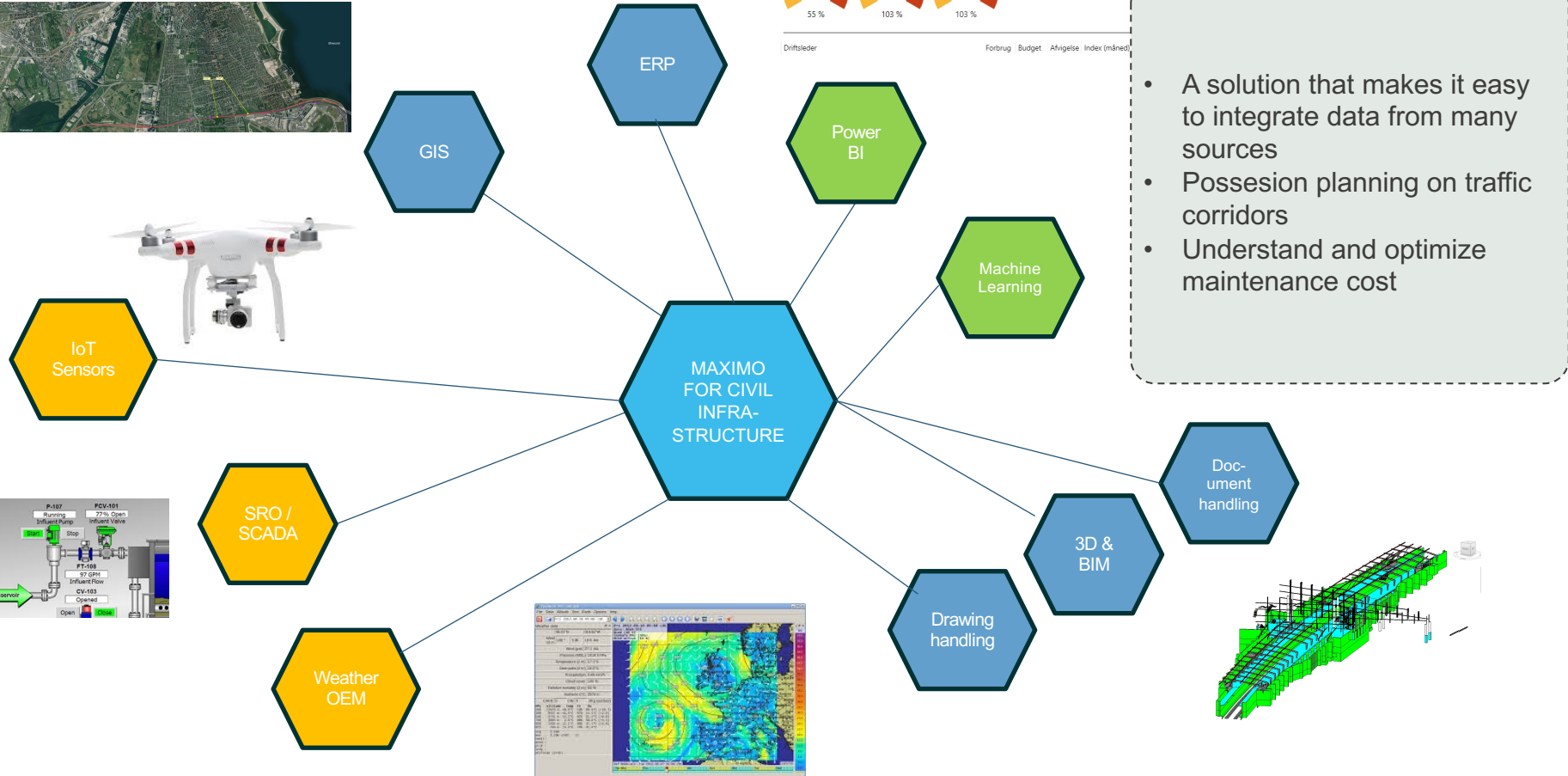
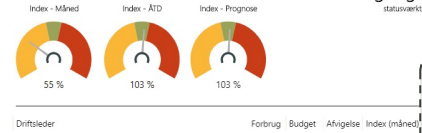
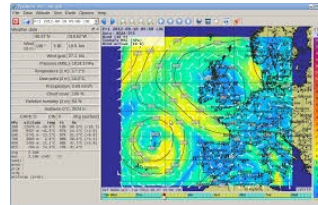
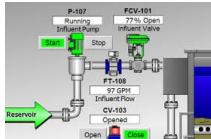
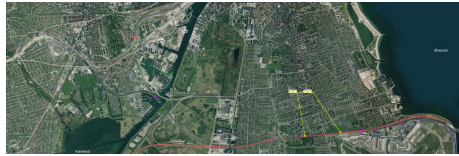


## Connect

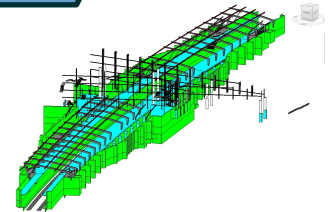
- Instrument Infrastructure
- Consolidate data



# INTEGRATING DATA



- A solution that makes it easy to integrate data from many sources
- Possession planning on traffic corridors
- Understand and optimize maintenance cost





# CONCRETE INSPECTION ON STOREBÆLT LARGESCALE CONSTRUCTIONS

- General inspection of concrete structures on the East Bridge is challenging on the following constructions:



- Pylons

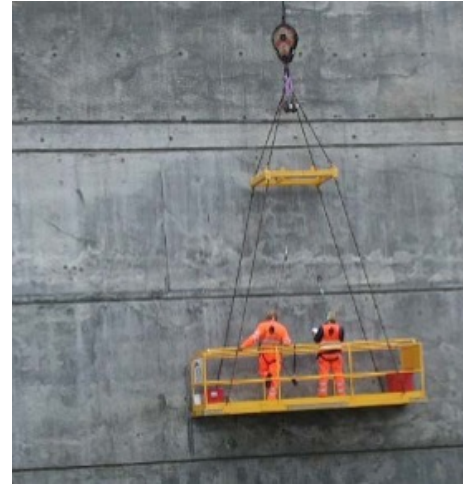
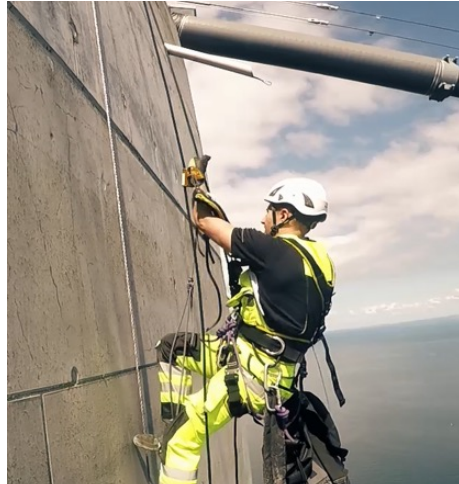


- Anchor blocks



- Piers
- Steel/Main cable/Catenary hanger

# WHAT WE DID BEFORE



- Manual inspections
  - From the floor/ground
  - Lifts/platforms
  - Access facilities
  - Rope

- Registrations
  - Paper
  - Digital (DB / APP)

- Challenges
  - Traffic
  - High costs
  - The weather
  - Slow soluble
  - Hard to document





AI is used to automate drone flight patterns and capture images of the entire bridge.





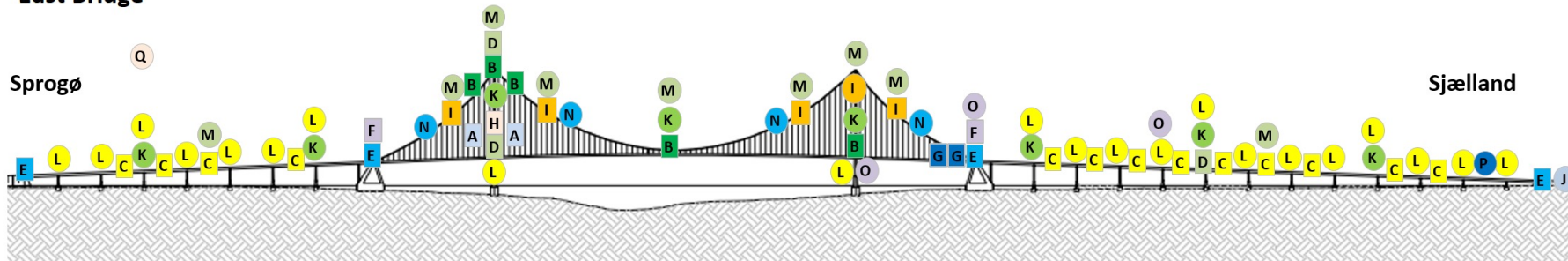


Civil engineers provide continuous feedback to the models, making AI Automation faster and more accurate, bridge after bridge.



# STRUCTURAL HEALTH MONITORING

## East Bridge



## Existing sensors (incl. 2019 expansion)

- |  |   |   |
|--|---|---|
| <b>A</b> Hanger vibrations (accelerometers)  | <b>D</b> Weather stations                 | <b>G</b> Strain gauges on orthotrope bridge deck                    |
| <b>B</b> GPS                                 | <b>E</b> Displacement sensors at bearings | <b>H</b> Digital image correlation (DIC) sensors monitoring hangers |
| <b>C</b> Sensors on tuned mass dampers (TMD) | <b>F</b> Sensors on hydraulic buffers     | <b>I</b> Dehumidification of main cables                            |

## New monitoring proposal

- |   |   |  |
|---|---|--|
| <b>J</b> Axle loads (A1)                        | <b>M</b> Accelerometers (A4)            | <b>P</b> Light influx sensor, rain sensor (A7) |
| <b>K</b> Intelligent cameras on traffic (A2)    | <b>N</b> Acoustic emission sensors (A5) | <b>Q</b> Power consumption (A8)                |
| <b>L</b> Inclination of pillars and pylons (A3) | <b>O</b> Corrosions sensors (A6)        | <b>I</b> Temperature of structural parts (A9)  |

# Building bridges to better insight

Sund & Bælt finds value in intelligent infrastructure

by Ryan Bertrand  
6-minute read

<https://www.ibm.com/case-studies/sund-and-baelt/>



### Sund & Bælt achievements

- Costs of operation and maintenance (O&M) to decrease 2% year over year until 2023
- Expected lifetime of bridge increased from 100 to 200 years

### Maximo is Helping

- Compliance with rules and regulations
- Common Asset Hierarchies
- Consistent procedures
- Full awareness of all assets and better control of contractors

### Research is engaged

- Automated Drone flights
- Visual analytics of concrete defects





**autostrade** *per l'italia*

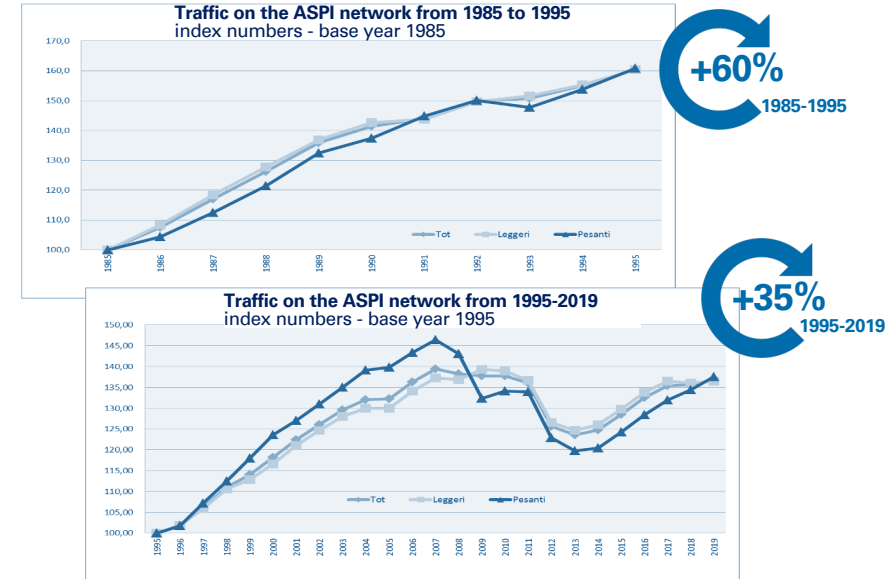


# The context: Complexity of Italy's motorway network

## Average age of principal motorways section managed by ASPI



## Traffic evolution on the network



There is a need to rethink to the Italian service infrastructure over the next years, with a focus on the renovation and modernisation

With the recovery post COVID-19 pandemic, there will be a transition of the mobility model that must be addressed on time

# Digitalization of Asset and Organization

## Digitalization of Assets



*Installation of IoT sensors, drones/robot deployment*

***Improved effectiveness of controls on the Network***

(e.g., drones for visual inspections)

***Rapidity of maintenance based on predictive analysis***

(e.g., based on sensors installed in major works)

Opex and Capex, 2020-23, € Million

100+



Digitalization of Assets

80-100



Digitalization of the Organization

## Digitization of the Organization



*Digitization of 100% of key processes*

***Information transparency*** (e.g., unique data infrastructure, cloud/big data systems architecture)

***Internal process speed*** (e.g., Digital Factory on key processes – performance management, procurement, maintenance)

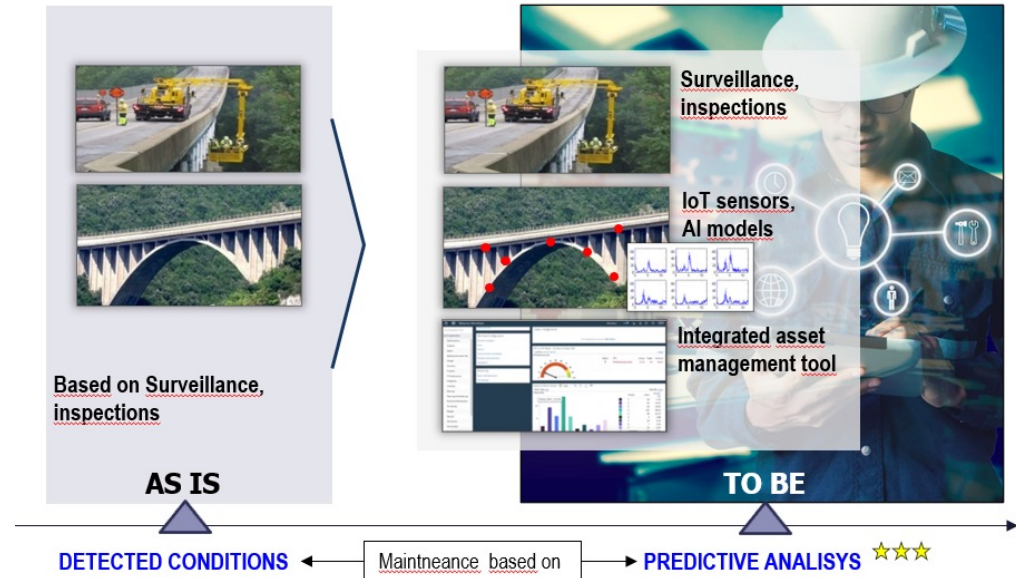
# ARGO

- Project Argo based on Asset Management Platform (IBM Maximo for Civil Infrastructures) allows to:
  - Consolidate information on key components of infrastructures to surveillance, maintenance and sensors
  - Digitalize the process of surveillance/maintenance
  - Ensure the traceability of information
- Argo integrated Platform manages :

- Bridges and Viaducts (about # 1.970 artworks)
- Overpass (about # 1.800)
- Tunnels (about #590)
- Safety barriers
- Noise reduction barriers



## Project «ARGO»



Relevant project not only for infrastructure management, but also to establish ASPI as a leader in the use of technology through a consolidated partnership with MOVYON and IBM for implementation in national and international new contexts



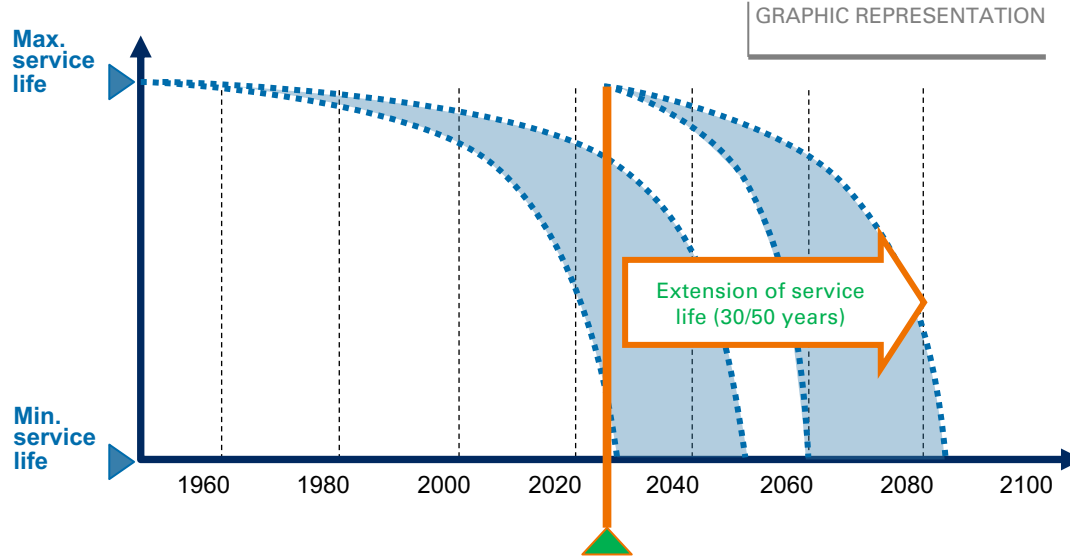
# Objective: a new modernised network

**~50%**

of bridges and viaducts built **before 1970**  
(and ~93% before 1990)

**~35%**

of km of tunnels built **before 1970**  
(and ~78% before 1990)



Investment program enabled by a thorough effort for the "assessment" of works of art, started in 2019

**100%**

of the assets subject to "assessment" and intervention



**Bridges and Viaducts**



**Tunnels**



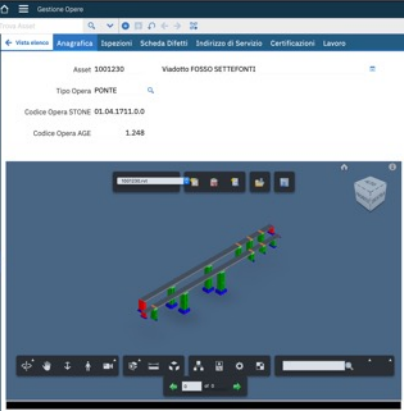
**Barriers**  
(safety noise remediation)



**Plants**

# One single system currently managing 700k components (170 for each infrastructure) integrated with AINOP (Italian Gov. Database of Opere d'Arte)

1. Infrastructure **hierarchy** definition
2. Data base creation, real **digital infrastructure database** archive based on IBM Maximo
3. Data governance tools and **data/process controls** implementation
4. **BIM Model generation** from data stored in the solution
5. **Inspection plan** and – in a while – maintenance plan, assuring “**near real time**” data update (improving controlling system)
6. Natively integrated with **AINOP – Ministry of Transportation**
7. **CdA** (Class of Attention) calculation from asset data in line with local regulations



Operazioni parziali associate a Viadotto FOSSO SETTEPONTI

Asset	Codice STONE	Denominazione	Longhezza opera
1504696	01.04.1711.0.1	VITTO SETTEPONTI D	312,7
1504695	01.04.1711.0.2	VITTO SETTEPONTI S	299,2

Campana VITTO SETTEPONTI D

Campana	Fondazioni	Pila	Spalle	Archi	Impalcato	File di appoggio	Giunti	Apparecchi storici
0	11	4	2	0	11	14	13	0
1	3	1	0	0	1	3	3	0
2	1	1	0	0	2	1	1	0
3	1	1	0	0	3	2	2	0
4	2	1	0	0	2	3	3	0

Parti d'opera campana 2 - VITTO SETTEPONTI D

Asset*	Descrizione	Tipo asset	Descrizione tipo asset	Da Campana	A Campana	Nr. Struttura
1504696	FONDAZIONE-D-4	A	FONDAZIONE	2	2	3
1504719	GIUNTO-D-4	G1	GIUNTO	2	2	4
1504734	PILA-D-2	B	PILA	2	2	2
1504749	IMPALCATO-D-2	E	IMPALCATO	2	2	
1504758	IMPALCATO-D-3	E	IMPALCATO	2	2	

Componenti di FONDAZIONE-D-4


Asset*	Descrizione	Tipo asset	Descrizione tipo asset	Da Campana	A Campana
1504804	PLINTO-1	A1	PLINTO	2	2

Opera Globale

Opera Parziale

Parte d'Opera

Componente



Codice Opera

STONE

01.04.17311.0-0

Descrizione

Viadotto FOSSO SETTEPONTI

Classe di attenzione (cdA)

248,383

Numero Campana (tot)

13

Codice Opera AGE

1.248

Tipo Opera

sottopassante >10m

Kin di riferimento

248,383

Numero Parti d'Opera (tot)

108

Codice ADP

Categoria Opera

OPERA MAGGIORE

Tipo opera

PONTE

Numero Componenti (tot)


627

Codice ASCAT

Stato opera

IN ESECUZIONE

Keyplan



Asset

1001230

Società

AUTOSTRADE PER L'ITALIA S.p.A.

Data apertura al traffico

03/12/90

Tronco

TRONCO 4 FIRENZE

Data ultima ispezione

Autostrada AD1

MILANO-NAPOLI

Ramo AD1

MILANO-NAPOLI

Allegati #

Sync ONBASE

OnbaseC201

OnbaseC202

Localizzazione

Dati ambientali

CDA

Attributi

Origine

1 - 1 di 1

Comune

Barbarino di Mugello

2

Destinazione

1 - 1 di 1

Comune

Barbarino di Mugello

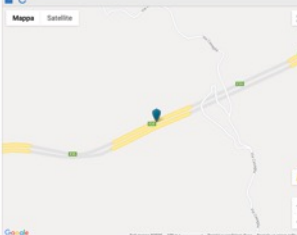
2

Coord. GPS Lat. 44.074694000

Coord. GPS Long. 11.219971000

Mappe

Satellite

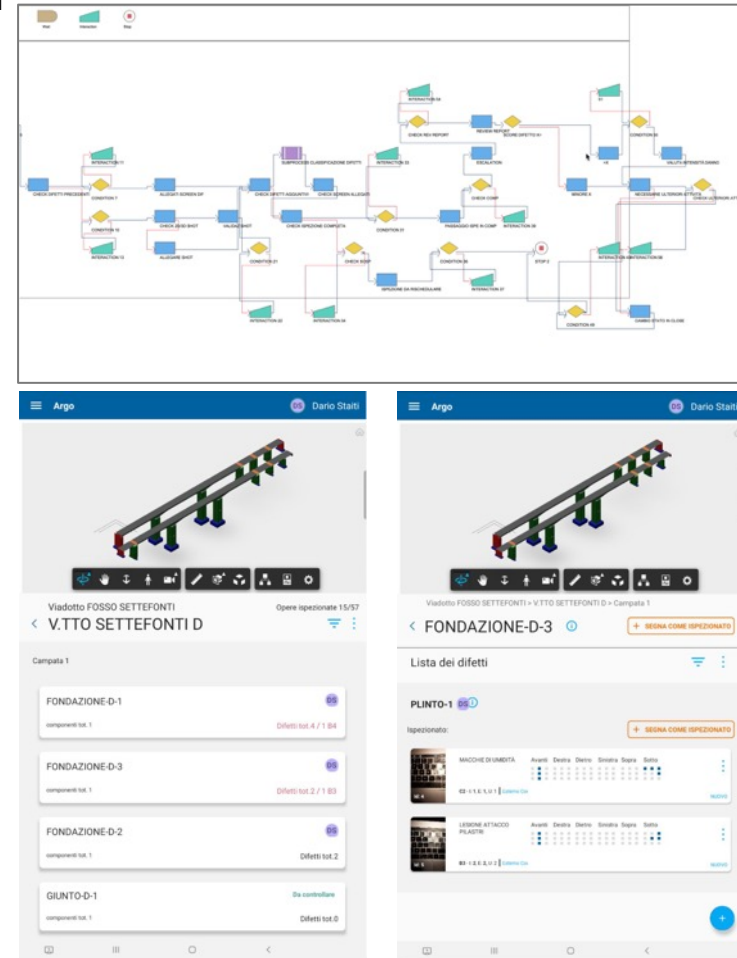




# Structured data and processes, controlled and aligned with guidelines of CSLP

# Dedicated Mobile App to support on-site inspection

1. **Inspection process** definition **aligned with CSLP** (Consiglio Superiore dei lavori Pubblici) **guidelines**
2. Each process step is **controlled by an approved workflow** and can only be taken in charge by designed roles
3. The **Mobile Application** support the inspector showing the activities that need to be performed, controlling the process
4. Each **element to be inspected is proposed to the inspector** who need to record the defect or the absence of defects
5. Each registered defect on components must have **a precise localization** and have its **own associated picture**
6. Real-time control of the execution – the inspection cannot be closed if **each component** has not been **inspected**
7. The **BIM Model** helps the inspector to identify and locate the assets to be inspected





# IoT sensors pilot on selected infrastructure

1. **Infrastructure characterization** through international experts and in collaboration with Italian Universities
2. **Scientific Committee** organized from top Italian universities to coordinate experimental activities and structural monitoring
3. **Analytic Model** defined by the Scientific Committee
4. Data will **flow in the system**, monitoring the infrastructure health and supporting the decision making process

Figura 9.1 Impalcato\_PRE-intervento su Selle Gerber

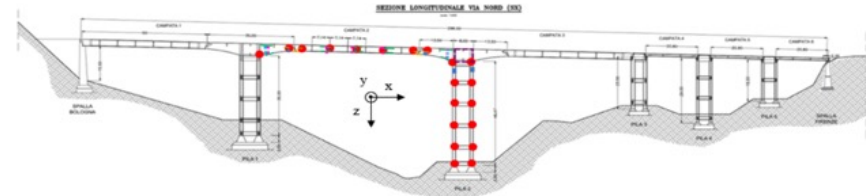
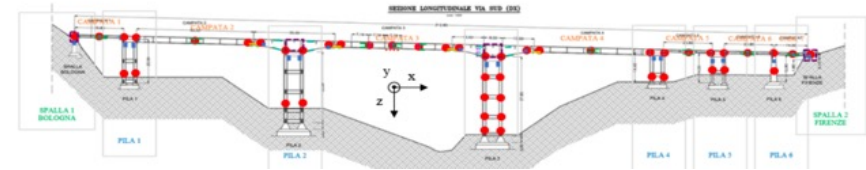


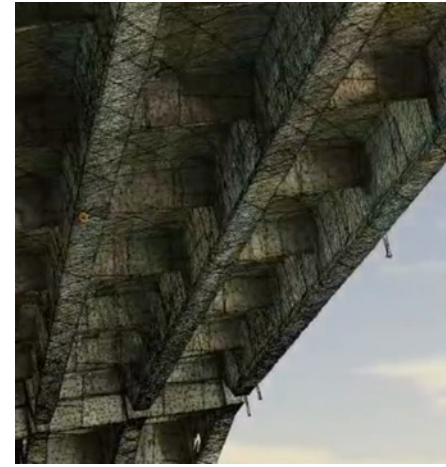
Figura 9.2 Sezione longitudinale Via NORD (SX)\_PRE-intervento su Selle Gerber



# Drones will capture data to build the Digital Twin of the infrastructure

# AI will analyse pictures and suggest the inspector a defect classification

1. Drones will generate the “**Digital Twin**” of the infrastructure which can be “overlapped” to the **existing** simplified **BIM Model**
2. Operators can **execute inspections remotely** thanks to the visual detailed reconstruction and/or analyze components that usually need special vehicle (e.g.: on bridges)
3. The **Artificial Intelligence** analyzes images provided by the drone and **is capable to identify and classify the defects**, updating the database
4. The technology is helping the inspector to do his assessment



# A singular focus on the road ahead

IoT and AI technologies  
transform roadway  
maintenance

by Michelle Cloutier  
7-minute read

[https://www.ibm.com/case-studies/autostrade-italia/?mhsrsrc=ibmsearch\\_a&mhq=autostrade](https://www.ibm.com/case-studies/autostrade-italia/?mhsrsrc=ibmsearch_a&mhq=autostrade)



Autostrade expects to provide more current Risk Assessment

- Instrumentation allowing better data to assist engineers in assessing risk

IBM Research providing advanced analytics and automated model creation for defect detection and analysis. Automated scanning to reduce manual inspection effort

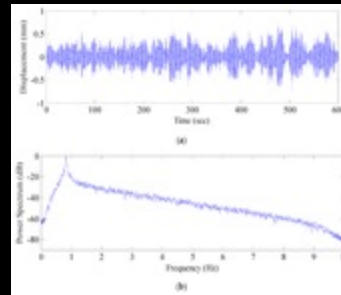
## Learn-by-doing:

Civil engineering know-how

- Definition of structural health thresholds per asset
- Definition of sensor installation templates
- Definition of best actions for each case
- Definition of maintenance criteria and regular schedule

Calibration, Understanding, Modeling

- Sensor data pre-processing and calibration
- Structural modeling
- Interpretation and understanding of data




Alerts		
Section	Risk	When
● Canina Nord Sezione Traversali	8	May/25/2017 22:00
Section	Risk	When
● Canina Nord Sezione Traversali	7	May/25/2017 22:00
Section	Risk	When
● Canina Nord Sezione Traversali	5	May/25/2017 22:00





# Think 2021: Next Generation AI and Asset Management for Civil Infrastructure



**Claus Klint**  
Worldwide Industry Sales Leader,  
Civil Infrastructure at IBM

[View full profile](#)

**Claus Klint**  
Worldwide Industry Sales Leader, Civil Infrastructure at IBM  
2h · 🌐

Join me at the **IBM Think 2021** event May 11th for Americas and May 12th for APAC, Japan and EMEA.


I am thrilled about hosting the session Next generation AI and Asset Management for Civil Infrastructure featuring two of the most visionary and innovative CEOs in the industry.

**Mikkel Hemmingsen** CEO **Sund & Bælt Holding A/S** and **Roberto Tomasi** CEO Autostrade per l'Italia share their experiences on how drones, Artificial Intelligence, Internet of Things and Asset Management have transformed their operations and will change the industry.


Think 2021 is virtual and free. Enroll here=> <https://ibm.co/3tY0xVR>

[#IBM](#) [#Think2021](#) [#Maximo](#) for Civil Infrastructure [#infrastructure](#) [#sustainability](#) [#IBMIOT](#) [#AI](#) [#Hybridcloud](#)


Next Generation AI and Asset Management for Civil Infrastructure



Claus Klint  
Worldwide Industry Sales Leader



Mikkel Hemmingsen  
CEO Sund & Bælt



Roberto Tomasi  
CEO Autostrade per l'Italia

<https://gateway.on24.com/view/orion/embeddable-player/dist/index.html?eventid=3263748&sessionid=1&key=8BE2E95AE465523D6EC45207E0F6C7FA&format=fhvideo1&source=standalone&mode=launch&usercd=455054322&showCode=eliteibmsterling&showId=857379&eventuserid=45505>

# Rail Operators Clients

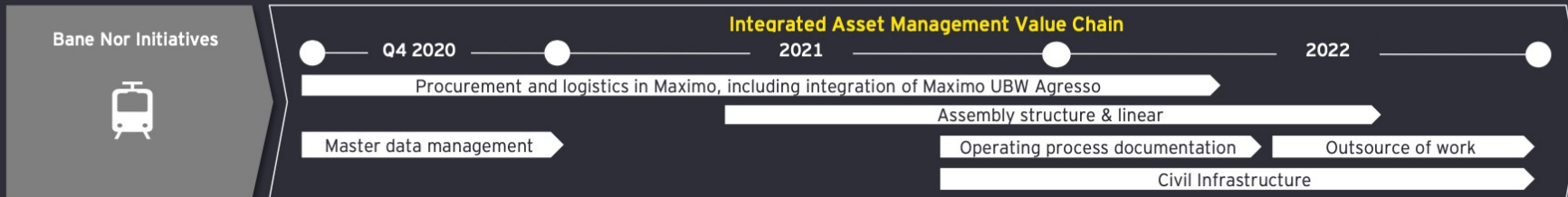


# Civil Infrastructure at Bane NOR

## Saving up to \$120m annually in operations & maintenance



...Roadmap for Civil Infrastructure implementation aligned with Bane Nor's existing asset management initiatives



### Main challenges facing Bane NOR today

- ▶ Multiple, different systems for projects and asset management
- ▶ No cost element in the asset management system
- ▶ No common strategy for asset management
- ▶ Low level of business process insights
- ▶ Manual processes and manual inspections



# Civil Infrastructure

## Transforming end to end asset management



Helping Bane NOR in their road to Asset Management – a \$2.5m win for Nordics, powered by IBM

### Client objectives:

- ▶ Develop Asset Management Strategy
- ▶ Optimize processes
- ▶ Implement single system to manage assets
- ▶ Capture costs in system
- ▶ Implement Civil Infrastructure solution
- ▶ Make better informed financial decisions
- ▶ Improve the Operation and Maintenance by 5-10% (Budget 2021 approx \$1.2 billion)

### Why Bane NOR selected EY?

- ▶ Long standing relationship with Bane NOR
- ▶ Commercially competitive
- ▶ Strong Maximo skill and competence
- ▶ Both technical and business consultants

### Reach performance and health improvements of...

Defect management  
15-30%



Improvement in capture rate through direct linkage to inspections

Work scheduling  
15-30%



Reduction in scheduling effort through graphical assignment and optimisation engines

Scheduled maintenance  
10-30%



Reduction in planned work post any warranty period based on adoption of condition based monitoring

Streamlined inspections  
5-15%



Cost reduction through streamlining allocation and recording of inspections

Mobile based work execution  
5%



Cost reduction by having your work orders in the pocket

Manage asset information  
5-12%



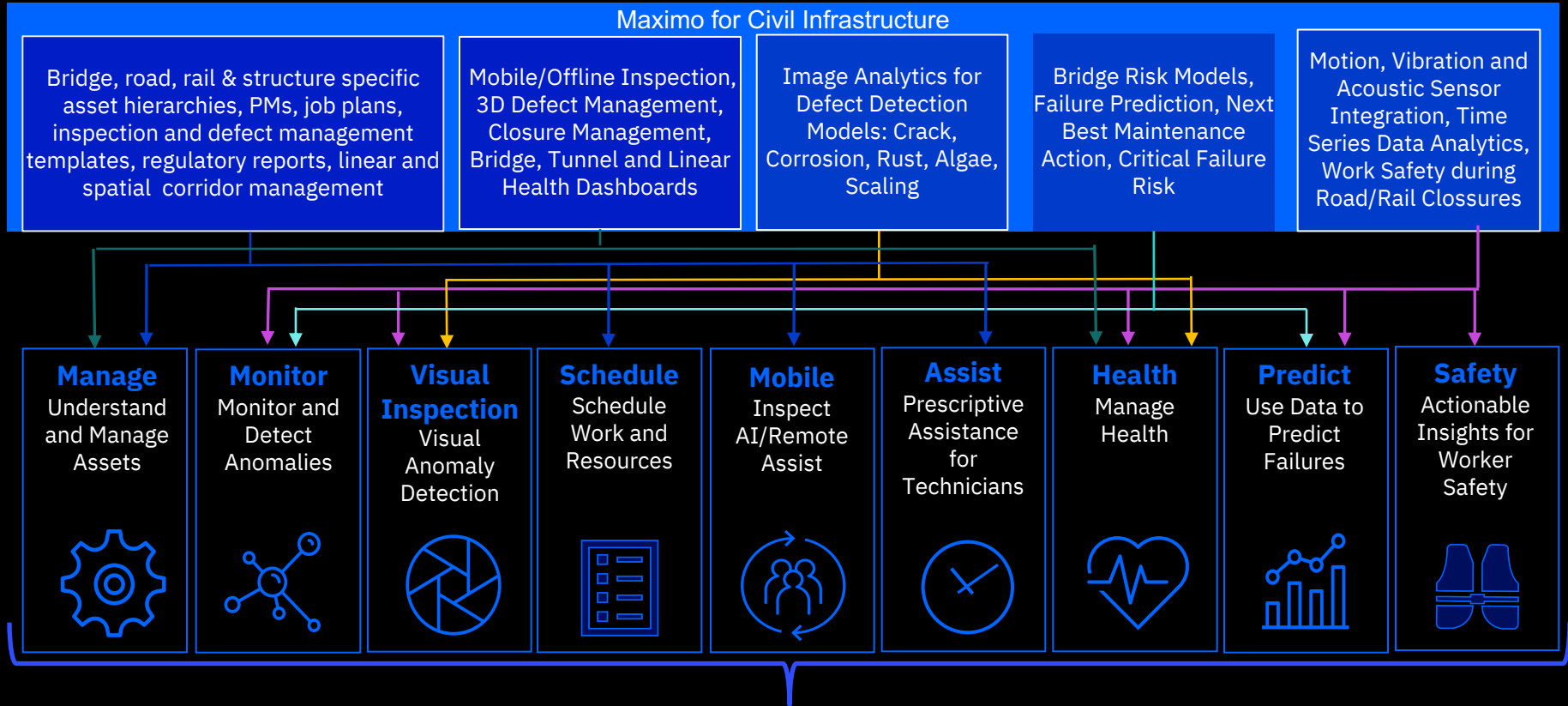
Cost reduction based on adoption of single system of records



# IBM Maximo® for Civil Infrastructure

# Industry Solution based on Maximo Application Suite

Current & Roadmap Capability



**Application Suite**

# Thank you

