The Impact of Digital Twin on Transportation Infrastructure Monitoring & Maintenance

General Session. The Impact of IoT and CAV on Motorway Operations
Salzburg, Sept. 7th
Sinelec SpA – Gavio group
Domenico Zagari
GAVIO GROUP OVERVIEW

2.6 billion Euro AGGREGATE REVENUES

10,000 EMPLOYEES

AN INTERNATIONAL PLAYER IN THE MAJOR INFRASTRUCTURE WORKS WITH STRATEGIC FOCUS ON DEVELOPING THE GREENFIELD CONCESSIONS BUSINESS

THE FOURTH TOLL ROAD OPERATOR IN THE WORLD

A LEADING OPERATOR IN INTEGRATED TRANSPORT AND LOGISTICS

Over 4,000 km of roads under concession in Italy and Brazil:
- 1,423 km of roads in Italy
- 2,640 km of roads in Brazil

3 leading brands in the international nautical market.
GAVIO GROUP COMPANIES
SINELEC gathers together the technological expertise of the Group in the fields of Tolling and Intelligent Transportation Systems, Telecommunications and IT solutions.

The experience gained in more than twenty years in developing, installing and maintaining advanced technological solutions in the highway sector makes SINELEC one of the key technology players able to lead the future digitalization process of transportation infrastructures.
Transportation Industry will have to manage social and economical impacts of Traffic Growth

1. LOST PRODUCTIVITY
US$1.4trn
World Economic Forum cost estimate for traffic jams worldwide

2. CLIMATE CHANGE
22% of total OECD CO₂ emissions are from vehicles

3. PUBLIC HEALTH
1/3 of fine particulate matter in urban areas is emitted from vehicles, playing a causative role in heart attacks, strokes and respiratory illnesses

4. ROAD ACCIDENTS
1.25m people die each year, while 20m-50m are injured, according to the World Health Organisation

Sources: World Economic Forum; World Health Organization; OECD
…considering the disruptive forces that are transforming the mobility ecosystem
Transportation Infrastructure must become “Intelligent” to manage future challenges

Enable Interconnection among people, vehicles and Infrastructures
Manage in a dynamic way the roads
Be ready for CAV
Digitalize assets (IoT solutions) to enable Predictive Maintenance

Advanced Intelligent Transportation System and IoT will enable next generation transportation infrastructure
A **Digital Twin** is a living digital simulation that brings all the data and models together and updates itself from multiple sources to represent its physical counterpart.

Do Not substitute but it integrates itself between current approaches.

Transforming the way to manage monitoring and maintenance of the infrastructure.

It is a decision-making support tool that provides optimal and real-time information to road operators.

Choose between maintenance strategies the best for a specific event.

Helps in planning rights maintenance interventions.
Infrastructure monitoring: current approach

- Visual inspection

- Traditional instrumental survey

Highly subjective nondestructive evaluation technique: results of these inspections can be highly variable and are dependent on many factors. Journal of Nondestructive Evaluation September 2002, Volume 21.

Subjected to the experience of the civil engineers, Analysis limited to a particular effect, Limited to a little amount of sensors in a limited time Limited on space
Infrastructure monitoring: new approach

- BIM
- Clouds of sensors
- DATA + Models
- Digital Twin
- Strategy actions
- Analytics
- Permanent Solution DATA

PREDICTIVE MAINTENANCE

Designs + Models + Deployment MAP of IoT sensors
Example of IoT architecture

DIGITAL TWIN

STRUCTURAL SENSORS
- Deformation
- Inclination
- Vibration
- Seismic event
- Temperature
IoT Sensors

Concrete Strength During construction, meters in support columns determined when they were ready to bear weight.

Strain Two types of devices measure shortening or stretching of the concrete.

Movement Sensors track movements in expansion joints, which could be caused by temperature changes.

Temperature Gauges measure the temperature on the concrete so it can be correlated to changes in curvature of the bridge.

Vibrations Sensors note changes that could indicate damage to the bridge.

Corrosion Metal pieces embedded in the travel surface send alerts before salt begins corroding reinforcing steel.

Ice When conditions are right for ice to form, sprinkler heads in the pavement spread an anti-icing solution.
Smart Road - Context

- Recently ANAS – the biggest public Italian concessionaire launched SMART ROAD program

- The value of the program is around 1B€, till 2030 and cover over than 3000km.
The first stage of investment is 250M€
Smart Road - Vision

- Safe trips, assisted or autonomous drive
- Safe roads, continuous and monitored maintenance
- Prompt emergency interventions with Real Time info-mobility
- New user services
- Intelligent sensors monitoring of road infrastructures: traffic, freights, environment, infrastructures
- Central Control Platform to provide an integrated view of SMART ROAD digital ecosystem
Smart Road - Scope

- Multi Protocol Label Switch data Network
- Wi-Fi Services in Motion
- Vehicle to Infrastructure DSRC ITS G5
- Green Island Energy solution
- Dynamic lane management
- Infrastructure Monitoring through IoT sensors

STARTED in July 2018
Thank you
for your attention