Sensors and Robotics for Bridge Maintenance

DETAILS

SECTOR | Transport

STAGE | Operations and Maintenance

TECHNOLOGIES | Technologies (robotic and sensor automation systems, data management, photovoltaic) to enhance infrastructure monitoring and maintenance and to guarantee sustainability.

SUMMARY

The adoption of technology (digital technologies) in "classic" transport infrastructure, across all stages of the lifecycle - from the planning, design, construction and maintenance - is becoming more and more relevant in order to enhance sustainability, efficiency, safety and longevity of the infrastructure to the benefit of the users and the society as a whole.

In the design, construction and maintenance of a motorway bridge, new technologies can contribute to reduce costs, shorten the construction time, increase quality, efficiency, safety and sustainability with a concrete positive impact over the territory. In the project taken as an example (case study), notably a motorway bridge, different technologies have been adopted such as robotic and sensor automation, systems for infrastructure monitoring and maintenance, special dehumidifying system to avoid the formation of salt condensation and to limit corrosion damage, photovoltaic panels, which produce the energy required for the operation of the bridge's own systems (lighting, sensors). Moreover, a specific database contributes to study and monitor constantly the infrastructure. Data can be also used for the future design of infrastructures of the same type contributing the development of public and private stakeholders' knowledge.

VALUE CREATED

Improving efficiency and reducing costs:

- The installation of photovoltaic panels will cut the energy consumption of the structure, limiting the dependence from external power supplies and thus reducing the costs to be incurred for the operation of the plant.
- The internal part of the structure may present particular thermo-hygrometric conditions, also very different from the external atmospheric ones, given the thermal inertia and exposure to solar radiation of the facility. The difference in these conditions could give rise to surface condensation which, notably in an area close to the sea with highly saline atmosphere, could potentially cause corrosion of the metal surfaces. The dehumidifying system avoids the formation of saline condensation in order to limit the risks of corrosion and at the same time reducing maintenance costs.
- The new bridge is equipped with robotic systems able to support both the advanced structural monitoring and the cleaning of the solar panels and the wind barriers. Robotic automation systems shall ensure the centralized plant supervision and help to limit and monitor the deterioration phenomena and any impacts

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of extraordinary events, and therefore to schedule the bridge maintenance beforehand and contribute to the reduction of maintenance costs.

Enhancing economic, social and environmental value:

- Photovoltaic panels make the bridge energy self-sufficient and reduce its energy consumption.
- Reusing the 100% of the excavation waste of a previous old infrastructure contributes to minimize environmental impact.
- Robots carrying out the structural inspection of the bridge and maintenance of the solar and acoustic panels, minimise the risk and the need for human workers.
- Control and monitoring of the infrastructure seven days a week, 24 hours a day, make it safe and extremely efficient.
- Innovative design of the bridge allows the light to slide off the surface and soften the visual impact and presence that the bridge has in its urban setting. Use of light colors for painting the steel elements makes the bridge bright, harmonizing its presence within the landscape. Use of high fall and wind barrier designed to mitigate the visual impact of the infrastructure within the urban context.
- Innovative solutions adopted also with regards to structural and seismic point of view, limit the size of the structures and especially foundations in a highly urbanized context.

POLICY TOOLS AND LEVERS

Legislation and regulation; Funding and financing:

The development of a sustainable infrastructure require a combination of support and participation at central and territorial governmental level, the commitment of public and private investment and a favourable regulatory framework.

In order to develop quality, reliable, innovative, sustainable and resilient infrastructures, in line with the targets of the UN Agenda 2030 (SDGs) and the Paris Agreement on climate change, the adoption of relevant incentive policies are crucial, including new procedures in order to simplify and speed up the delivery of public works.

Public funding is important, but private sector investment clearly needs to be scaled up. Elements to be strengthened to attract private investments in sustainable infrastructure projects include, among others, the adoption of long-term infrastructure plans, a clear pipeline of bankable and quality projects, fiscal incentives, shared sustainability standards, promotion of new technologies (smart roads programs, digital infrastructures, etc.), better data analysis, capacity building mechanisms and innovative financing mechanisms.

The adoption of technological advanced solutions in the construction phase is a key driver, coupled with an efficient administrative process involving different levels of Public Authorities (i.e. Central Government and line Ministry, Regional Authority, Municipality, Commissioner, etc.) committed to speed-up the administrative procedure and helping to avoid any possible bottle necks.

IMPLEMENTATION

Cost	The adoption of smart technologies in transport infrastructures brings great benefits for the maintenance costs during the long-life of the infrastructure.

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EXAMPLE

The new Genoa bridge over Polcevera river represents a key example of smart and sustainable infrastructure as well as a showcase of Italy's latent engineering and construction talents. Design by architect Renzo Piano and built by a consortium company established by Fincantieri (71,3% of shares owned by CDP) and Salini Impregilo (18,7% of shares owned by CDP), the bridge is a critical traffic artery for northern Italy. The new bridge arises 45 meters above the ground and has a continuous steel deck measuring 1067 meters (3500 feet) totally, with 19 spans, supported by 18 reinforced concrete piers. Work on the new bridge was undertaken at an accelerated pace. A project that would normally take three and a half years was squeezed into just over 12 months. The shape of the deck recalls the hull of a ship, and the gradual reduction of the section towards the ends of the bridge minimises the visual impact. Thanks to innovative, efficient and technological advanced solutions never used before in Italy and notably an innovative model, gathering private sector highest's expertise and public commitment and administrative support, allowed to reach a great result in a very short time. Over 1,000 persons involved in the direct and indirect activities concerning design and building. 202 million euros the total cost for the design and realization of the viaduct.

CDP (the National Promotional Institution of Italy), through its subsidiary CDP Equity (CDPE), acquired 18,68 % share of Salini Impregilo (current renamed Webuild) through equity investments, with the purpose of revitalizing the Italian construction sector and supporting the implementation of strategic infrastructure projects crucial for the economic and social development of the Country.

PERGENOVA S.C.p.A. is the joint venture set up by Salini Impregilo (WeBuild) together with Fincantieri for the design and construction of the Polcevera viaduct on the A10 motorway, the new bridge of Genoa. https://www.pergenova.com/it/index.html

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