

# CASE STUDY: A BRIDGE MONITORING SYSTEM FOR THE ITALIAN NAVY



## About the Customer

The customer represents the engineering headquarters of the Navy of the Italian Republic, one of the six branches of the Italian Armed Forces. The Italian Navy has a strength of about 30,923 active personnel with approximately 184 vessels in service. The three main bases of the Italian Navy, each equipped with a military shipyard, are located in La Spezia, Taranto and Augusta.

## Project Summary

Our Industries eXcellence team collaborated with the Italian Navy on a groundbreaking initiative for smart infrastructure focused on the San Francesco di Paola naval swing bridge of Taranto in Apulia, Italy. To help the Italian Navy optimize the processes by which the performance of the bridge was being monitored and maintained, our team built and deployed an innovative bridge monitoring system leveraging Internet of Things (IoT) sensors, real-time data acquisition and advanced analytics.

## Project Activities

- » Designed and built custom IoT sensors installed on the bridge to continuously monitor and collect vibrational data.
- » Developed an integrated digital platform for real-time data acquisition and advanced bridge health analytics.
- » Developed web-based application to view and analyze bridge response trends and relevant structure KPIs.
- » Enabled automatic alerts for maintenance if dynamic bridge responses move outside of the safety threshold.
- » Supporting future plans for AI and video image analysis integration to expand capabilities of system delivered.

## Business Drivers

- » Fast and flexible platform development
- » Enhance reliability and performance of infrastructure
- » Optimize bridge maintenance planning and interventions
- » Reduce naval infrastructure maintenance costs
- » Enable real-time data collection and monitoring of bridge
- » Provide accurate analytics about bridge health to drive continuous improvement and more informed decisions
- » Facilitate the monitoring of critical structures not easily reachable (bridges, trellises, railways, wind turbines, etc.)

## More About the Infrastructure

Built in 1887 and renewed in 1958, the San Francesco di Paola swing bridge of Taranto is 295 feet long and 30 feet wide. The bridge allows for the passage of big military ships into the naval dockyard when opened. The importance of this bridge to naval operations has led to the enforcement of a rigorous schedule of physical checks and maintenance interventions which ensure that it continues to function as expected.

Due to the unique structure and physics of the swing bridge, these frequent interventions are carried out by highly specialized operators and using very expensive equipment. In addition to being costly, the checks drastically interrupt the normal flow of urban traffic on the bridge. As a result, the Italian Navy's engineering headquarters in Taranto decided to invest in new technologies to facilitate and improve the monitoring, management and maintenance activities for the San Francesco di Paola bridge. Thanks to our company's expertise designing, implementing and integrating digital solutions for a long list of leading Aerospace, Space, Naval & Defense customers in both the U.S. and Europe, the customer partnered with Engineering for this initiative.

## More About the Project

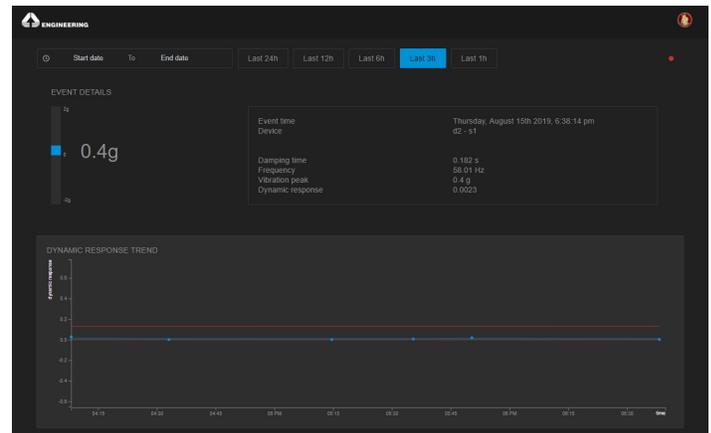
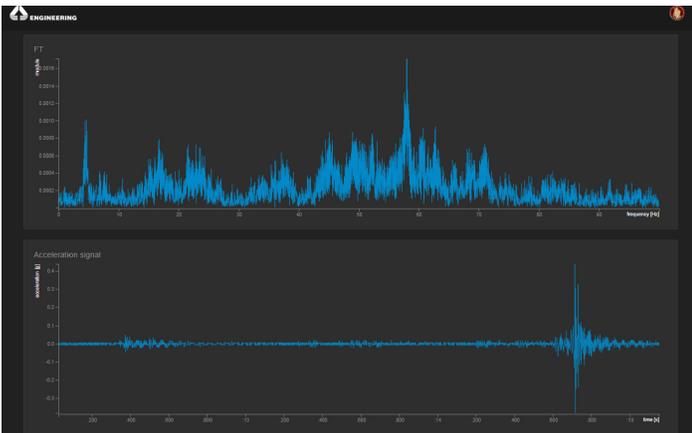
» **Powerful IoT sensors to monitor the naval bridge.** Our team first designed and built powerful sensors that were installed on the bridge in order to continuously monitor the structure and collect vibrational data in real time. The sensors are able to process an amount of data that is far too great

and high volume than could ever be collected manually. The IoT system samples bridge vibrations at 200 Hz, meaning that the sensors collect 4,000 vibration instances every 5 seconds.

» **Real-time data collection in central platform.** As the sensors measure bridge vibrations, they automatically collect and send this information to an integrated platform for real-time data management and analytics. Designed and deployed by our software development team, the system is a secure and central repository for all the vibrational data collected, creating a continuously-growing data lake related to the performance of the swing bridge that can be accessed, studied and utilized by the customer now and in the future.

» **Intelligent bridge performance and health evaluation for maintenance optimization.** The platform is also able to analyze the vibrational data and use it to deduct information about the stability of the bridge. The vibrational events are consumed as an input by a sophisticated algorithm developed by Lieutenant Fabio Campeggio, Naval and Civil Engineer of the Italian Navy. The algorithm was based on the results from a 6-month pilot using the FEM, or Finite Element Method, a powerful method for computing the displacements, stresses and strains in a structure under a set of loads. If the dynamic response of the bridge changes too greatly over time or moves outside of a specific threshold, the system sends automatic notifications to alert relevant personnel. This information will be used by the Navy to optimize maintenance planning and interventions for the swing bridge, saving costs and resources.





It will also enable them to identify issues early and close the bridge in order to avoid possible unexpected failures.

» **Monitoring dashboards for Key Performance Indicators (KPIs) and advanced data analytics.** The solution uses the data being collected to calculate and provide bridge performance analytics that can be accessed by naval personnel via a web-based application. There, authorized users can see and understand the dynamic responses of the bridge over different time periods. They can run drill-down analyses for KPIs that the sensors have been configured to extract from vibration signals, including Damping Time, Fourier Transformation, Peak Frequency, Peak Vibration, Velocity, Displacement and Dynamic Response.

## Engineering's Advantage

Our team is very proud of the successful completion of this project, which was truly the result of a close collaboration between the Italian Navy, Engineering USA and Engineering Italy teams. The dynamic monitoring system is now successfully running on the Taranto bridge, and the customer is analyzing the results of the data being collected by the system. We look forward to continuing to partner with the customer on future

initiatives that will further expand the capabilities of their new monitoring system, including the integration of Artificial Intelligence and video image analysis with to enable advanced pattern recognition and predictive analytics.

We believe the solution delivered is a powerful showcase of the value that digitalization can bring to infrastructure performance, stability, improvement and disaster prevention. The project was even mentioned in Parliament by the Italian Minister of Defense as an exemplary initiative for the modernization of electric control systems and bridge automation in the country. We also strongly believe that this initiative will be a critical use case for the future of smart infrastructure, showcasing how and why projects like this must be expanded in order to ensure the stability of bridges, buildings and critical structures not only across Italy, but in the U.S. and around the world.

**Would you like to learn more about this customer case study? Contact us at [info@engusa.com](mailto:info@engusa.com).**

# ENGINEERING

## Industries eXcellence Global

Industries eXcellence is a division of the Engineering Group, a global software maker, system integrator and provider of innovative technology solutions and services. Our division specializes in the digital transformation of the manufacturing and transportation sectors. We design, build and implement solutions that drive process automation, operational efficiency, supply chain optimization and intelligent data analytics for leading industrial enterprises worldwide.

## CONTACT

 Engineering USA  
55 W Monroe Street  
Suite 2575  
Chicago, IL 60603

 +1 630.625.0045

 [info@engusa.com](mailto:info@engusa.com)

[www.engusa.com](http://www.engusa.com)