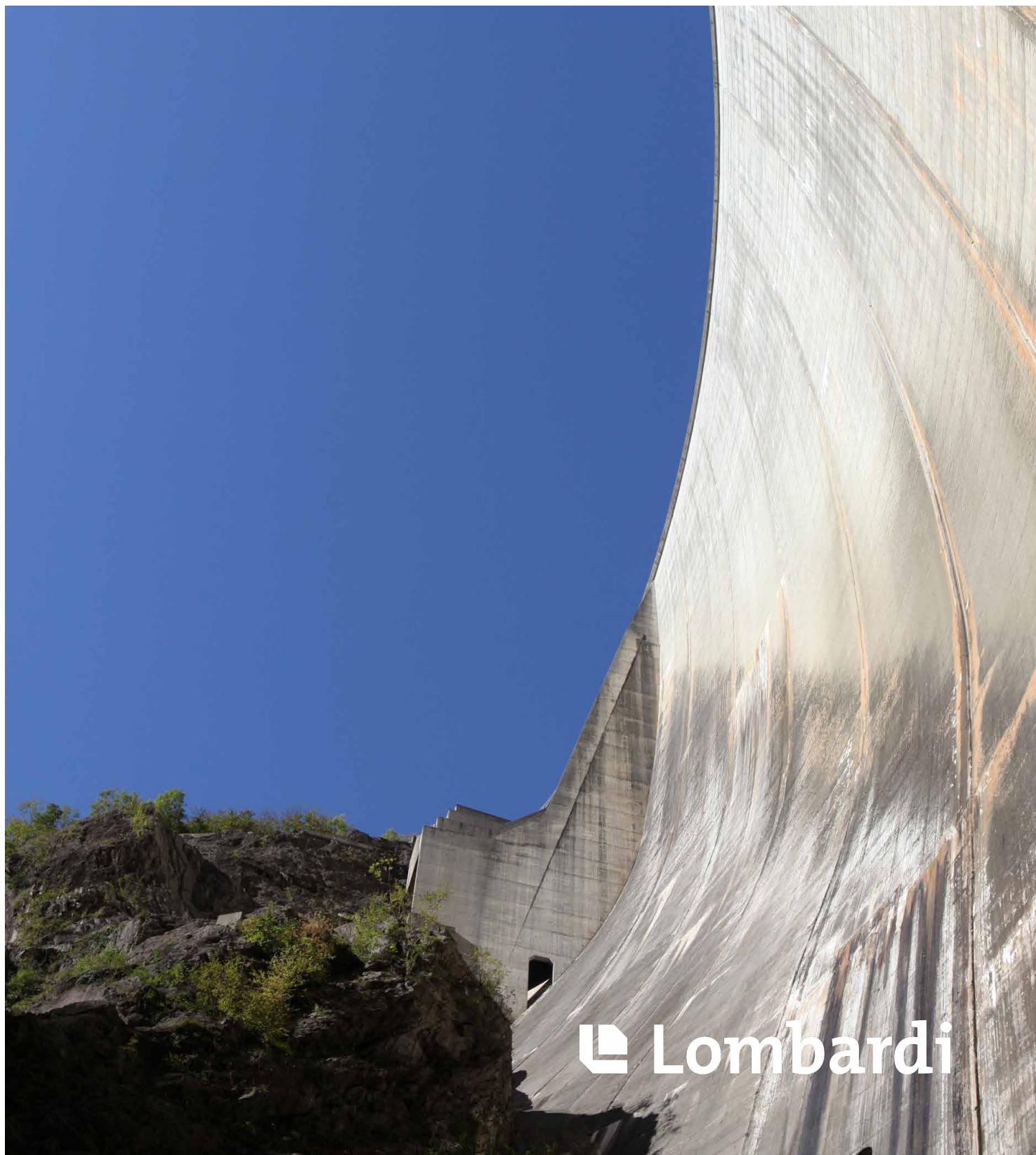




**All-inclusive monitoring software for structural and geotechnical
long-term safety assessment**



 **Lombardi**

Software description

Resulting from more than 4 decades of experience in dam monitoring and monitoring software development, the MIC software is specifically designed for assisting all actors involved in the different phases of the monitoring process for civil and geotechnical structures.

MIC is a SaaS (Software as a Service) platform based on a database on cloud server accessible via internet by any device: computer, tablet, smartphone. No installation or maintenance is needed. Any upgrade of the software, which is constantly improved, is available for all the users. On request, other installation concepts may be arranged

Thanks to its flexibility, MIC can be adapted to any existing monitoring infrastructure or process and it is compatible with any type of instrument, sensor, and manufacturer. Monitoring data can be inserted into the database through a keyboard, data files, spreadsheets, hand-held and automatic dataloggers.

MIC provides an integrated processing, analysis and long term archiving of monitoring data related to in-service structures or geotechnical assets, from the plausibility control of automatic or manual records to the preparation of personalized graphs and reports. The program allows the implementation of advanced prob-abilistic and deterministic models, which offer the necessary support to quickly identify any ir-regular behavior of the structure/geotechnical assets or of the monitoring instrumentation. The software provides some analysis tools specifically developed for dam monitoring, such as thermal analysis or the determination of the creep delay effect.

The software procedures allow to implement user-defined workflows which help the Owner to manage the monitoring process of a structure/geotechnical assets, thanks to a reminder and notification service guiding all the involved figures in the different monitoring phases: data acquisition, data validation and safety assessment.



Features

Safety

MIC implements a phase-and-role based access control system for organizing permissions and specifying who can do what, offering the required flexibility and safety. Reading permissions are available for all users and other permissions are authorized to specific users depending on the validation stage: recent readings, validated data and historic data.



Accessibility

MIC is hosted online, meaning that it is accessible everywhere, at any time and with any device. Data backup, software and hardware maintenance are guaranteed. MIC is also distributed, on request, as a “local installation” application (installation of MIC and database on the Client’s server. Access through a web browser. The Client is responsible for the backup).

Advanced analysis tools

MIC allows the implementation of personalized interpretative models, statistical or deterministic, which helps to quickly identify any irregular behaviour of the structure or of the monitoring instrumentation. MIC offers unlimited possibilities of data combinations, independently from the reading frequencies. A simple equation editor allows the use of any type of formula and user-defined functions.



Warning system

MIC automatically and regularly informs the designated users on the ongoing activity via email with warnings in case of irregular measurements or any discrepancy between measured and expected behaviour, with reminders of the monitoring activities to be carried out and with notifications to inform regarding the completed activities and the main results.

Flexibility and personalization

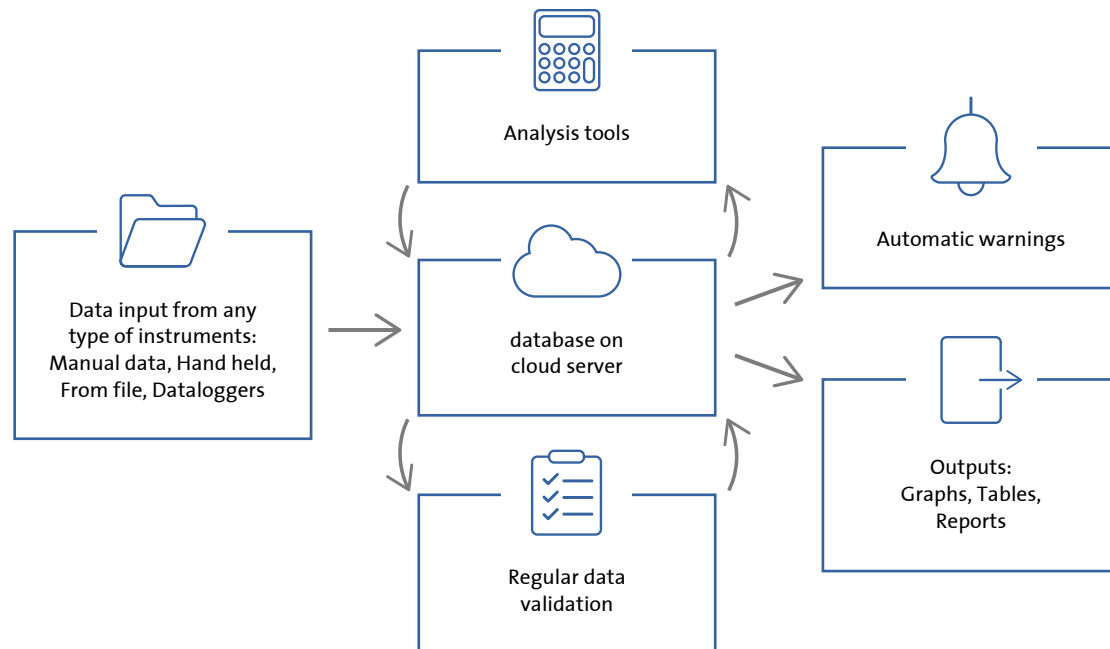
MIC can be completely customized to a specific project, considering the characteristics of its monitoring system and data transmission. The data management process can be customized to suit the needs of the user. MIC is available in 5 languages (Italian, English, German, French, Spanish), while others can be easily implemented on request.



Reporting

Monitoring data can be visualized on screen with interactive plots or can be printed with a wide range of flexible and customizable graphical sheets (time series graphs, seasonal graphs, scatter graphs, profiles, maps) and tables (single or multiple date tables). MIC also provides an automated report generation tool which can be completely user-configured.

Monitoring approach



The scope of structural and geotechnical monitoring is to promptly identify any anomaly in the structure behaviour, in order to implement the appropriate corrective measures in the case the anomaly represents a potential risk for the overall safety. The monitoring process is a key factor for helping the Owner in minimizing the residual risk related to a structure operation and it should not be a mere collection of frequent acquired data. First, the measurements obtained from instruments should be verified by means of plausibility checks to exclude erroneous data. Once the data have been checked and validated, they can be processed, analysed, and finally interpreted. A proper monitoring process, driven by the correct interpretation of the available information, helps preventing two opposing risks: the underestimation of a real problem and the overestimation of any deviation with respect to the expected value. Finally, the measurements should be properly and safely archived to keep under control the long-term behaviour of the structure.

The MIC software, which name is in fact the acronym for Combined Interpretative Model, is conceived on this two-level approach: plausibility checks and validation on the monitoring data; safety assessment based on the interpretative models. The first level ensures that the safety assessment would be based on reliable data and helps identifying possible instruments malfunctions, the second level provides support for the safety assessment, by providing an expected behaviour of the structure based on both statistical and deterministic models.

Although MIC is conceived for an independent use, the Lombardi Group team can assist the client with the definition of the monitoring data's acquisition concept, the measurements analysis and interpretation and special studies in case of abnormal behaviour.

Lombardi Group can also support the client with the first configuration of the software, with the importation of existing historical data and in the daily usage of the software. Specific additional features can be developed on request.

References

Today, many dams or other civil structures are monitored with the MIC software worldwide.



Verzasca dam (Switzerland): 220 m high arch dam



Pian Telesio dam (Italy): 80 m high arch-gravity dam affected by AAR



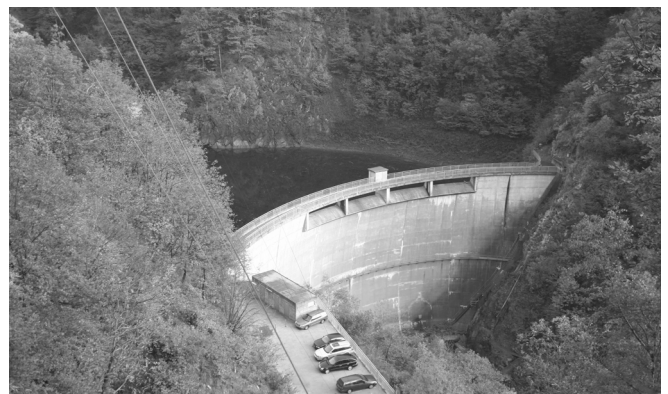
Cerro del Aguila (Peru): 88 m high gravity RCC dam



Melide-Grancia (Switzerland): 1.7 km long tunnel equipped with multicell piezometers



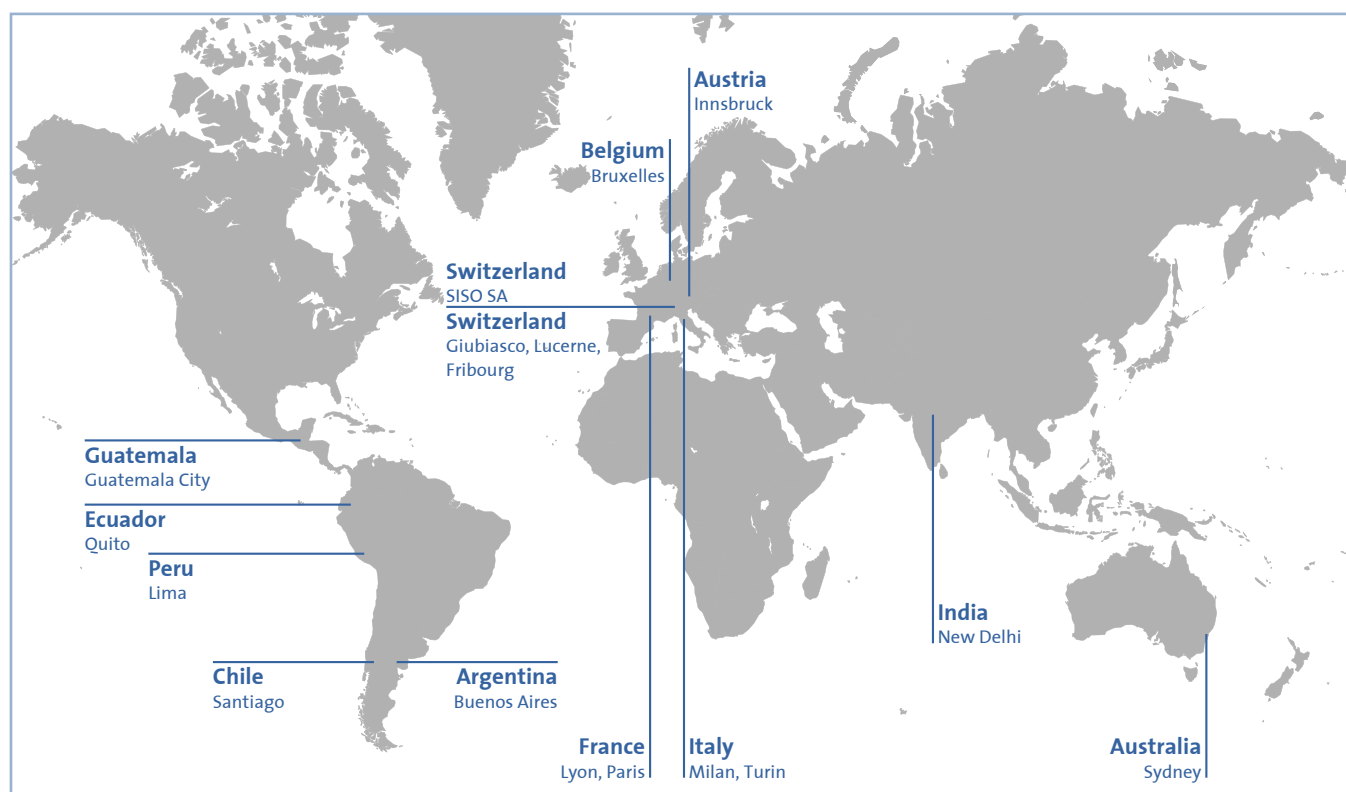
Groupe-E dams (Switzerland): 8 dams (arch, gravity)



Carmena dam (Switzerland): monitoring of the land-slide on the reservoir left bank

About us

Founded in 1955 by Dr Giovanni Lombardi, today the Lombardi Group cares for the life cycle of transport infrastructures and hydraulic works from the initial design phases to their operation. The growth of our activities during the last decades has been achieved by consolidating our presence in our traditional markets and by a continuous search for innovative solutions. Faithful to our commitment to quality and client satisfaction, the Lombardi Group will continue to develop engineering solutions to the world's challenges.



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