CASE STUDY

Above and below Genoa: Innovation, collaboration and transformation

City of Genoa | *Italy*

Industry

- Government & Public Sector

Solution

- Octave Alto Twin

Challenges

- Safeguarding historical charm while modernizing infrastructure
- Pollution, mass tourism, climate change
- Extensive underground assets and rivers

Results

- Balanced preservation with urban efficiency
- Precise 3D models of the city and what lies beneath
- Enhanced water resource management, structural monitoring, cultural heritage protection

"Le Strade Nuove" and the system of the Palazzi dei Rolli were designated a UNESCO World Heritage Site in 2006 and comprise one of Genoa's most renowned districts in northwestern Italy. Contrary to the implication of their name, Italian for "new streets," these structures date back to the late 16th and early 17th centuries. The site features a distinguished ensemble of Renaissance and Baroque mansions built during the Republic of Genoa's period of prominence.

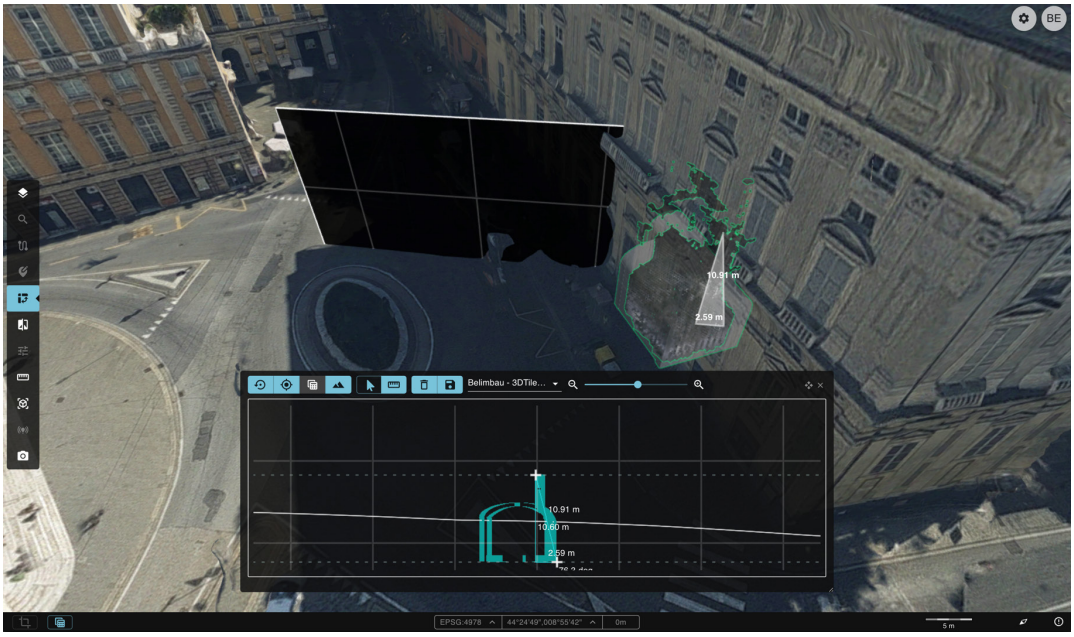
However, issues such as pollution, mass tourism and climate change present ongoing challenges to the conservation of the city's architectural legacy. The administration of Genoa employs advanced technological solutions to safeguard its built heritage and foster long-term sustainability.

In collaboration with Octave, the **City of Genoa** has implemented an ambitious urban digital twin project, encompassing innovative workflows and detailed digital mapping of both underground and surface infrastructure.

The challenges of urban planning

The management and evaluation of urban planning in a modern city is a complex task that necessitates coordinated efforts among various public administration departments. Considering Genoa's significant historical legacy with ancient streets, centuries-old palaces and aristocratic character, addressing these challenges requires more than a standardized approach. It needs a systemic vision in which various technologies and different workflows can coexist and collaborate.

Since 1985, Genoa has made technological advancement a priority by developing a comprehensive, accurate and accessible Digital City initiative. This program facilitates virtual surveys and supports services consistent with digital transition and accessibility objectives. In these efforts, Genoa benefits from strong partnerships, notably with START 4.0 and technology partner Octave.



This image shows an OGC 3D Tiles mesh of an area with streets and buildings, featuring an OGC 3D Tiles point cloud of an underground building and an OGC 3D Tiles mesh of that building in the city's digital twin. City planners can view this cross-section in 3D and perform measurements simultaneously thanks to Octave Alto Twin.

The START 4.0 Competence Centre, supported by the Italian Ministry of Economic Development, now the Ministry of Enterprises and Made in Italy (MIMIT), fosters digital innovation and facilitates Industry 4.0-enabling technologies, with a particular focus on the security and optimization of strategic infrastructure.

Its long-standing technology partner Octave provides reality capture equipment, such as laser scanners and ground-penetrating radar, but above all Octave Alto Twin (formerly HxGN Smart Sites), a platform capable of aggregating existing data and data that will be acquired in the future — whether static, dynamic or real time — in a unified, multiuser interface. A network of users from different organizations and companies linked to the city can access the system, which can be integrated with external applications. This ensures a systemic approach.

The "OverUnderGround" project

With the "OverUnderGround" project, START 4.0 and Octave aimed to create an integrated environment for the City of Genoa to use georadar, BIM and point cloud data. This integration assists in managing interactions between the city's modern infrastructure and historical features, both above and below ground.

Using reality capture data, this initiative enhanced water resource management, structural monitoring and cultural heritage protection and safely mapped key historical areas without disrupting urban flows.

"By working with the port authority, we can manage city operations more efficiently, directing tourists away from areas under maintenance and improving overall traffic."

Stefania Traverso
Head of Geospatial Information Systems
City of Genoa, Italy

The unfolding of Genoa's digital twin

In the heart of Genoa, a bold vision began to take shape. It started not with a single spark, but the shared determination of city administration, engineers and technicians to bridge the city's storied past with its digital future.

The journey truly began when representatives from the City of Genoa, the START 4.0 Competence Centre and Octave gathered in the shadow of the city's ancient palaces. The challenge was clear: how could they preserve Genoa's historic charm while modernizing its infrastructure and raising urban efficiency to meet the demands of a bustling, ever-changing metropolis?

Enter the concept of the urban digital twin — a bold idea that would weave together layers of reality, both above and below ground, into a living, breathing digital model of the city. This vision would require unprecedented teamwork, drawing on the expertise of Octave's technological divisions and the collaborative energy of local organizations.

The first phase was a proof of concept. A select few roads, winding through Genoa's historic quarters, were chosen for detailed scanning. Armed with cutting-edge technology — Leica BLK2GO and RTC360 laser scanners, Leica Cyclone REGISTER 360 PLUS and the advanced IDS GeoRadar Stream DP solution — the teams began to capture the city in ways never imagined, that is, always looking at the systemic or holistic approach. Data was gathered from the city's river channels using point clouds, while georadar swept beneath the streets to uncover a hidden world of pipes, utilities and ancient tunnels. Each scan added "bright new threads to the city's digital tapestry."

Like in other urban digital twins projects, the Alto Twin platform operates as a hub across all data and systems.

By June 2025, the first results shimmered on the screens of city planners and engineers: precise 3D models that allowed them to see Genoa's above and below ground worlds in seamless harmony. Overhead, the city's 3D mesh was integrated, while below the surface, GPR-based mapping revealed the complex web of infrastructure lying unseen beneath centuries of stone.

Beyond infrastructure planning

The digital twin assists beyond planning infrastructure projects — e.g., in tourism management by helping regulate the number of visitors in heritage areas, particularly when air pollution levels or crowding are high. The city can provide real-time impact maps for both residents and tourists to inform them about environmental conditions.

Stefania Traverso, head of geospatial information systems at the City of Genoa, pointed out another benefit from the system: "The port receives many cruise ships, bringing in thousands of tourists daily. Therefore, the city must coordinate road maintenance with the tourist influx. By working with the port authority, we can manage city operations more efficiently, directing tourists away from areas under maintenance and improving overall traffic."

"A key factor in the success of this project is the scalability of the deployed digital twin solution," explained Dirk Wagemans, vice president, geospatial business and product lead of Octave Alto Twin. "Similar approaches can easily be adapted for different sectors and facilities, such as hospitals or chemical plants. Furthermore, the integration of video management systems and additional security equipment significantly expands the platform's potential."

The vision

The city is not content to stand still. The team looks further ahead, envisioning a future where real-time sensors — IoT devices embedded in riverbanks or utility corridors — will stream live data into the digital twin. With these, the city could predict rising water levels, monitor environmental changes and respond to emergencies before they became disasters.

As the data grows richer, the ambition of the project expands. Plans are laid for a citywide event — a gathering of Genoa's community, authorities and stakeholders. Police, port administrators and highway managers are all invited to witness the transformation and imagine new possibilities for collaboration. The digital twin, once a technical experiment, has become a citywide movement, a testament to Genoa's capacity for innovation and unity.

The story of Genoa's digital twin is still being written. Each scan, each partnership, each stakeholder brought into the fold, adds another chapter to a narrative defined by resilience and reinvention. In the end, Genoa stands as a beacon for cities worldwide — a place where the past and future coexist, not in opposition, but in a dynamic, digital embrace.

About Octave

Octave is a leader in enterprise software, turning data into decisive action and intelligence into your edge. Our software solves for and simplifies complexity, from the design and build to operations and protection of people, property and assets – for any scope, at any scale. For decades, we've partnered with customers to sharpen performance, elevate efficiency and amplify results. From factory floors to entire cities, our solutions are tuned to scale up what's possible from day one onward.