



BRIDGING SCALES IN DIGITAL URBANISM: POLICAD'S ROLE IN ENHANCING BIM-GIS INTEROPERABILITY FOR SMART URBAN MANAGEMENT

Lavinia Chiara Tagliabue¹, Paolo Mistrangelo², Paola Gasbarri¹, and Hira Ovais¹

¹University of Turin, Turin, Italy

²Magellano Projects, Milan, Italy

Abstract

In Italy defining common and standardized procedures to enable a structured Digital Building Permit adoption are consistent issues. However, the Decree to promote digitization of public tenders (Decree n.50/2016) had been confirmed and renovated in 2023 (Decree n.36/2023). At the national level, barriers and burdens completely block construction activities and urban renovation due to uncertainty in approval procedures and legislative doubts. These deficiencies are unsolved by the public bodies, and practitioners and companies are struggling to operate. The paper drafts possible methods and tools to overcome the issue, supporting procedures digitalization through a trans-scalable City Information Modeling based on municipality digital documents.

Introduction

The compelling slogan "From the spoon to the city", coined by E.N. Rogers (1952), effectively reinterprets the Vitruvian, all-encompassing approach to architecture. It underscores the unique ability of designers to operate across diverse scales, affording equal importance and attention to detail at both the micro and macro levels of urban design. These varying scales necessitate highly differentiated analytical skills, coupled with a broad spectrum of digital tools for developing design proposals.

Design professionals require a multitude of software applications: these range from CAD (Computer-Aided Design) programs, to BIM (Building Information Modeling) software used to define buildings as interconnected assemblies; from GIS (Geographic Information Systems) for representing territorial scales and defining urban regulations, to modeling and rendering software for realistic visualizations; from tools for updating land registries to those for construction cost estimation, surveying instruments, and software for assessing a building's energy performance. This vast array of competencies inevitably necessitates increasing specialization. However, the compartmentalization of these "environments," particularly concerning the interoperability of different software, is less inevitable but increasingly necessary, hindering the ability to seamlessly navigate between scales (Souza & Bueno, 2022). This

compartmentalization generates several paradoxes. For instance, aircraft and drones survey territories, measuring terrain elevations and building forms to create realistic 3D models. Yet, these models often lack informative content useful for urban planning, such as the number of real estate units, building density, or urban load. Conversely, at the building level, the wealth of plans, elevations, and sections submitted to public administrations in digital format for decades has yet to coalesce into a digital urban model capable of precisely defining the forms that aerial surveys can only capture as outer shells.

A functional urban digital twin would require agreement on a few simple rules and a shared ontology (Shi et al., 2023). This goal could be within reach for a truly digital cadaster; nevertheless, currently, it remains unable to georeference the plans of real estate units, settling for archiving them, even in vector format, as A4 sheets with a symbolic indication of North. This stems from an initial flaw: considering "computer-aided design" as a mere transposition of the functions of a technical drawing board, enabling the creation of drawings as "sets of lines and curves" on a screen. These lines and curves only acquire meaning in their spatial aggregation, a meaning that the viewer can interpret and attribute, but that not even the most advanced inference engine can assign to a precise use unless explicitly stated in the drawing itself with text. This intrinsic limitation of CAD is overcome due to technological advances. BIM allows designers to work with "building objects" characterized by specific parameters, such as floors, walls and building components (Architectural, Structural, Mechanical, Electrical and Plumbing). Moreover, in a more territorial context, in GIS environment it is possible to define georeferenced geometries (points, lines, and polygons), to which several attributes can be associated (Gil, 2020). Indeed, the strength of GIS lies in providing geometries and attributes precise localization on the Earth's surface. A paradigm shift is thus both inevitable and necessary, recognizing that every urban transformation project, by interacting at various scales, cannot be fragmented into unrelated representations that depend solely on the design software used for each scale. The conventional practice of zooming in on a map to detail its external shape must extend beyond the outer envelope to encompass the internal

configuration of those buildings. A platform designed in this manner should effectively inherit the capabilities of leveraging the powerful articulation specified by IFC classes in BIM software, thereby creating a bridge between these standards. This approach gives meaning and substance to City Information Modeling (CIM), which should not merely become another standard but must find its *raison d'être* in facilitating dialogue among diverse standards and formats. In the paper, PoliCAD is presented: it is an open-source drawing platform project, easy to use and open to co-design and widespread development, which aims to wedge itself into the market of license-based software solutions characterized by an undoubted technological maturity that is, however, hindering widespread use, creating communities of users who are highly specialized but poorly interconnected in their work. And this is even more evident in the inexplicable paradigm difference between the modeling of GIS systems versus the specific modeling of CAD/BIM-based systems. PoliCAD wants to build a bridge between “classical” two-dimensional drawing, rationalizing the immediacy of design intentions that flow from a paper sketch, and the urban model, the digital twin toward which every design configuration appropriately screened by a digitized regulatory verification process converges.

State of the Art

While several European countries are actively piloting or implementing digital building permit systems with BIM and GIS integration, most remain limited by fragmented data structures, siloed workflows, and inconsistent semantic standards (Noardo et al., 2020). Projects like CHEK and national efforts in Finland, the Netherlands, and Germany have advanced rule formalization and spatial integration but often rely on complex or proprietary platforms, posing scalability challenges for smaller municipalities (Noardo & Fauth, 2024).

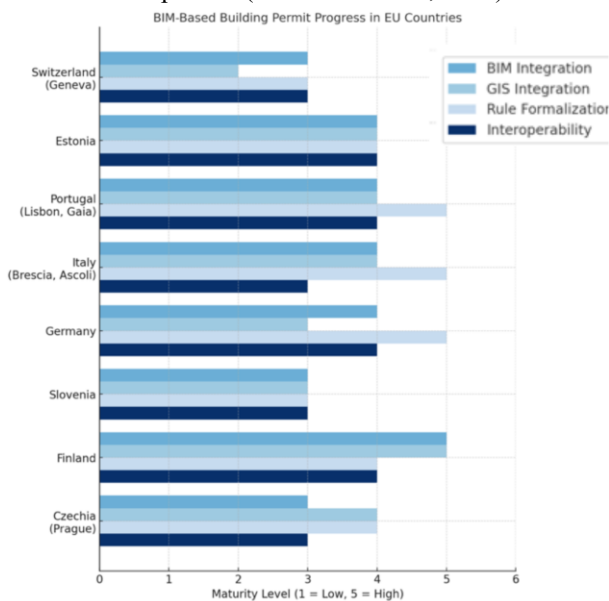


Figure 1: Maturity of BIM-based building permit initiatives

Figure 1 illustrates the relative maturity of BIM-based building permit initiatives across selected European countries, based on findings from the CHEK project and the 2024 Digital Building Permit Conference. The comparison considers four key dimensions: BIM integration, GIS integration, rule formalization, and interoperability. Finland and Portugal stand out for their advanced implementation, with strong semantic rule modeling and institutional support. Italy and Estonia demonstrate high maturity in rule formalization and GeoBIM linkage, particularly through municipal collaborations and CHEK methodology. Germany shows leadership in standard development yet faces challenges from federal fragmentation. Switzerland and Slovenia are progressing steadily, with promising pilots underway. Prague exemplifies common issues such as semantic ambiguity and regulation interpretation hurdles. Across the board, a consistent bottleneck is the translation of local regulations into structured, machine-readable formats. The figure underscores the need for harmonized methodologies to scale digital permitting across diverse administrative contexts. In contrast, PoliCAD offers a lightweight, highly interoperable solution by grounding design models directly in cadastral and zoning data, ensuring geospatial accuracy from the outset. Unlike other systems that treat BIM and GIS as post-design validation layers, PoliCAD embeds regulatory constraints into the early design phase through a parametric, surface-based modeling approach. Its ability to export in both IFC and GeoJSON formats bridges CAD, BIM, and GIS environments, simplifying integration with WebGIS and municipal systems. By enabling real-time urban contextualization, daylight and zoning checks, and digital permit verification, PoliCAD streamlines workflows without requiring advanced BIM authoring tools. Furthermore, its intuitive, georeferenced interface reduces reliance on specialists, making it accessible to smaller practices and municipalities. This democratizes access to digital permitting, aligning with EU-wide goals for transparency, automation, and smart urban planning.

Bridging the gap between GIS, BIM, and IoT for unified data-driven decision making

BIM, GIS and the Internet of Things (IoT) play crucial roles in modern urban planning, infrastructure management (Shi et al., 2023), and digital building permit processes, however, bridging the gap for unified data-driven decision making is a big challenge. Nonetheless, despite their significance, these systems operate with distinct data structures, leading to data silos that hinder seamless integration, data-driven analysis and real-time decision-making. In this context, the paper explores the challenges associated with different data formats interoperability and proposes strategies for establishing a unified data structure that fosters comprehensive, data-driven urban management.

Disparity of Data Formats

GIS primarily deals with spatial and topographic data, offering macroscopic insights into urban development (Al-Saggaf & Jrade, 2015). BIM, on the other hand, focuses on the micro-scale, providing detailed information about buildings and their components (Botin-Sanabria et al., 2022). IoT brings real-time dynamic data into the equation, capturing environmental conditions, building occupancy, and operational efficiency (Eastman, 2018). However, the fundamental difference in data structures, such as GeoJSON, raster, vector formats in GIS, parametric object-based models in BIM, and time series data in IoT, results in incompatibilities that make holistic analysis challenging. To enable real-time, data-driven urban management, a common data schema must be developed. In Table 1 the formats and specific uses are resumed.

Table 1: Data formats for GIS, BIM and IoT

Method	Data structure
GIS	GIS utilizes geospatial data formats such as Shapefiles, GeoJSON, and raster datasets. These formats prioritize location-based information but lack the capability to represent detailed building attributes or real-time sensor data effectively.
BIM	BIM employs Industry Foundation Classes (IFC) and proprietary formats such as Revit (RVT) and ArchiCAD. These models emphasize precise geometric and semantic representations of building components but are not inherently designed for spatial analysis beyond the project site.
IoT	IoT devices generate vast amounts of real-time data, often stored in relational databases, NoSQL structures, or cloud-based platforms. This data is crucial for performance monitoring but lacks direct integration with either GIS or BIM without specialized middleware.

A unified data structure would facilitate interoperability between GIS, BIM, and IoT, allowing seamless data exchange and decision-making across disciplines. This requires the development of:

- **Standardized Data Ontologies:** Aligning GIS, BIM, and IoT data models under a shared ontology would allow meaningful cross-domain data interpretation.
- **Interoperability Frameworks:** Open-source initiatives such as CityGML, IFC extensions, and the use of Linked Data can provide bridges between disparate systems.
- **Common Data Environment (CDE):** A centralized digital ecosystem where data from GIS, BIM, and IoT can be stored, processed, and analyzed collectively.
- **Semantic Data Integration:** Leveraging AI and machine learning to harmonize heterogeneous data formats and automate transformations between GIS, BIM, and IoT structures.

Several initiatives are underway to establish integration frameworks, including:

- **City Information Models (CIM):** Extending BIM principles to city-scale modeling through GIS and IoT integration.
- **Digital Twins:** Creating real-time digital replicas of physical assets by merging GIS spatial context, BIM detail, and IoT real-time updates.
- **Ontological Mapping Approaches:** Utilizing semantic web technologies and graph-based databases to ensure compatibility between GIS, BIM, and IoT data.
- **Application of Blockchain Technology:** Enhancing data traceability, security, and sharing among different urban planning stakeholders.

The lack of a unified data structure across GIS, BIM, and IoT remains a critical barrier to real-time, data-driven decision-making in urban planning and digital building permits. However, through standardization efforts, interoperability frameworks, and emerging technologies such as Digital Twins and AI-driven data harmonization, this gap can be bridged. Indeed, Digital Twin could provide a digital replica of the urban and building context, which, thanks to its connection in a bidirectional flow with the real world, could be exploited for monitoring, analyzing, and simulating real or possible scenarios. In addition, AI-based algorithms can effectively support data extraction, processing, and analysis. A common data schema will not only improve data integration but also unlock the full potential of smart urban management, leading to more efficient, sustainable, and resilient cities (Xia et al., 2022). The construction of a digital twin city is a City Information Model (CIM) that involves spatial information of different scales. CIM integrates GIS, BIM, and IoT data into a comprehensive virtual representation of a city, enabling real-time monitoring, simulation, and predictive analytics. By incorporating data at various levels, from city-wide geospatial data to detailed building models and real-time sensor inputs, CIM facilitates improved urban planning, sustainable development, and smarter decision-making. This digital twin approach allows urban administrators to test scenarios, optimize resource management, and enhance resilience against environmental and infrastructural challenges. As CIM becomes increasingly detailed, many BIM and GIS integration software tools still primarily fuse BIM models and 3D GIS environment only at the visualization level, exploiting location coordinates. However, their foundational data structures remain separate, lacking a unified framework for data representation. This limitation hampers seamless data interoperability and prevents true information integration for advanced analytics and decision-making. Information integration in BIM, GIS, and IoT terminals faces significant challenges due to disparities in users and application fields, varying spatial scales, differing levels of detail, and distinct semantic and geometric representations. The lack of a common data structure exacerbates these challenges, making it difficult

to create fully integrated digital twins for urban management. Current research efforts largely focus on transforming and extending existing data standards such as the Industry Foundation Classes (IFC) and City Geography Markup Language (CityGML). These standards, while crucial, have inherent limitations in addressing cross-domain integration comprehensively. Further advancements in data harmonization techniques, semantic mapping, and ontology-based approaches are needed to achieve a truly unified CIM framework. Trying to bridge the scales and interoperability barriers a new method and tool, namely PoliCAD, have been developed. PoliCAD platform, presented and described in this paper, starts from the digitization of the PGT (Territorial Government Plan), integrates geometries and relates information to them, aiming to support building design operations, respect the urban indexes and law restrictions. To validate the PoliCAD effectiveness, the city of Milan, Italy, has been exploited as a case study (Figure 2).

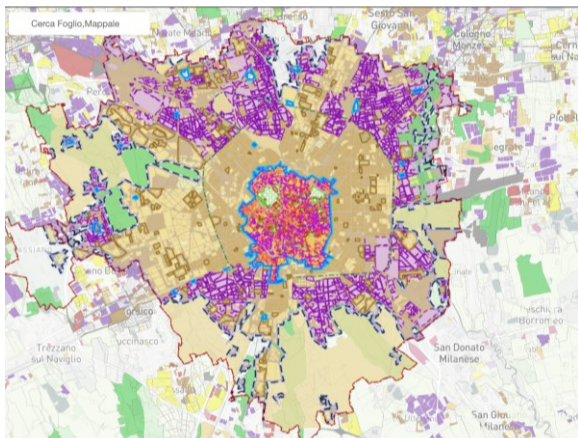


Figure 2: Digital Territorial Government Plan (PGT), city of Milan, Italy. Source: PGTonline

The PGTonline is a Lombardy Region service that provides access to information for construction planning in specific areas of the city, with indicators requirements such as density indexes, allowed volumes, heights, and distances, as well as defined uses. These indices are relevant for the city's development and in accordance with the restrictions delimited by the regulations on the territories (e.g. acoustic limits, groundwater location, etc.). In addition to the information of the PGTonline, the cadaster digital documentation is available for download and consultation and has been exploited (Figure 3).

A digital cadaster is a computerized system that records, manages, and visualizes land ownership, property boundaries, and related spatial data. It integrates geospatial information with legal and administrative records, allowing for precise mapping, efficient land management, and streamlined urban planning. Digital cadasters enhance transparency, support decision making, and facilitate integration with GIS and BIM for comprehensive urban development. For this reason, this digital information has been considered crucial for the development of a system that can disrupt the methods that

are traditionally adopted in the approval of construction works, considering renovation or new construction.

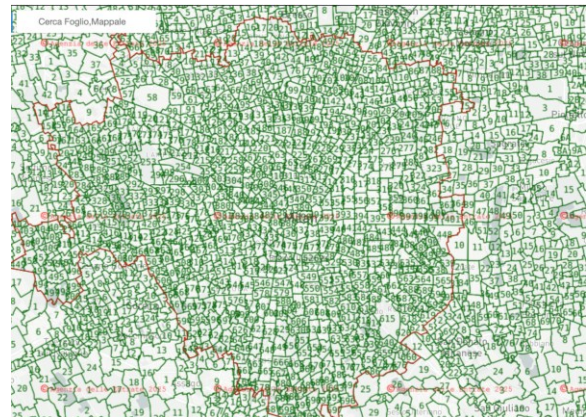


Figure 3: Cadaster, City of Milan, Italy. Source: PGT online

PoliCAD - A Digital Tool for Integrated BIM, GIS, and Urban Planning

PoliCAD is an innovative digital tool designed to facilitate the integration of BIM and GIS towards digital building permit processes. PoliCAD software is currently under development and offers a novel approach to architectural and urban design. It begins with the premise that every designed form possesses a physical extension, and the volume it occupies has a specific spatial location. The grounding of an architectural object is critical, as it dictates maximum volumetric allowances according to urban planning regulations and adherence to specific alignments. Moreover, this grounding establishes a relationship with existing structures, a factor that traditional design and modeling software often overlooks by defaulting to a blank, isotropic drawing space. Another foundational assumption is that architecture delineates and shapes spaces even before constructing the enclosing structures. These spaces not only have their own planimetric extent but predominantly share parallelism and orthogonality in their geometries. Importantly, the geometries defining these spaces are invariably polygonal. In PoliCAD, lines are not merely drawn; surfaces are defined from the step to the perimeter of the intervention area. Each surface, akin to BIM objects, has its own definition and classification, and it is created considering the Cadaster and PGT maps and features previously imported and georeferenced into PoliCAD. So, geometries possess an absolute and georeferenced position relative to the existing space (both planimetrically and vertically) and a volumetric footprint in extrusion. This capability allows PoliCAD to define even complex volumes without being a solid modeler. The software can import land registry data generated in vector format, seamlessly integrating all elements necessary for accurate georeferencing of designs. It also supports the importation of raster images (and soon DXF format) to populate a reference layer for redrawing existing architectures. In the following section the methodology of PoliCAD organization is explained, and

a case study in Milan is used as demonstrator in the section related to the achieved results. The work is in its alpha-testing stage, and being an open platform will enable the ability to integrate differentiated and self-defined verification rules, with an onboarding process still in the experimental phase.

Methodology

Integration with GIS and BIM

While PoliCAD does not possess the functionalities or tools to be categorized strictly as GIS or BIM software, it offers highly effective import and export functions. Indeed, as a result, the software can provide a 3D digital featured model, which can be integrated into 3D GIS environments. As suggested by Figure 4, any information derivable from a GIS dataset, such as points, lines, or polygons with associated properties, can be integrated into PoliCAD by calibrating scripts. The initial focus has been on integrating parcel maps recently made available as open data by the Revenue Agency. These maps facilitate easy georeferencing of the drawn model through simple and controllable transformations without the need for complex geographic reference systems, angular coordinates, or reprojections, topics well-known to cartographers but often challenging for architects and urban planners. Subsequently, PoliCAD allows the definition of georeferenced surfaces, characterized by specific parameters. The resulting model can be measured, queried, exported and integrated into the WebGIS environment, overcoming BIM-GIS interoperability issues. Indeed, PoliCAD creations can be visualized within a GIS platform, sharing not only georeferencing but also geometry extrusion, thereby contextualizing projects within urban space. Furthermore, due to its capability to generate three-dimensional forms from planimetric definitions of typical building-scale objects (such as rooms, windows, doors, walls), exporting models in BIM format is feasible and currently under

implementation. However, this will naturally come with a reduced level of detail (LOD) due to the limitations of the 2D space in which PoliCAD operates.

The software provides the capability to export in IFC BIM and GeoJSON formats, making it compatible with any WebGIS platform. This ensures seamless data exchange and interoperability between different digital environments. Rather than restricting data within the PoliCAD system, it acts as a bridge that enables smooth integration with external platforms, facilitating better collaboration, enhanced spatial analysis, and improved accessibility of urban planning and building information across multiple stakeholders. The compatibility with GIS and BIM also enables the implementation of local regulatory systems within the platform, both urban planning regulations (such as maximum buildable indices, restrictions on certain types of constructions, alignments) and building regulations (minimum surfaces and heights, calculations for daylight ratios). These rules can operate on the surface/volume of each traced object by applying the full set of topological operators typical of GIS systems, positioning PoliCAD as a platform capable of effectively initiating a digital construction permitting process. A key component of PoliCAD is its prototype for visualizing urban three-dimensional models within which projects developed using PoliCAD can be loaded and viewed in three dimensions. Developed using MapBox APIs, this visualization tool can represent both urban planning information (raster and vector data) sourced from the PGTonline platform for consulting urban planning maps and land registry maps (raster and vector) from which parcels can be selected for export to PoliCAD to integrate context during project development. The primary objective of PoliCAD is to enhance urban planning by enabling architects, planners, and municipal authorities to work with geographically accurate, regulation-compliant, and enriched digital building models. This tool streamlines the design phase, validation processes, and municipal approval workflows by

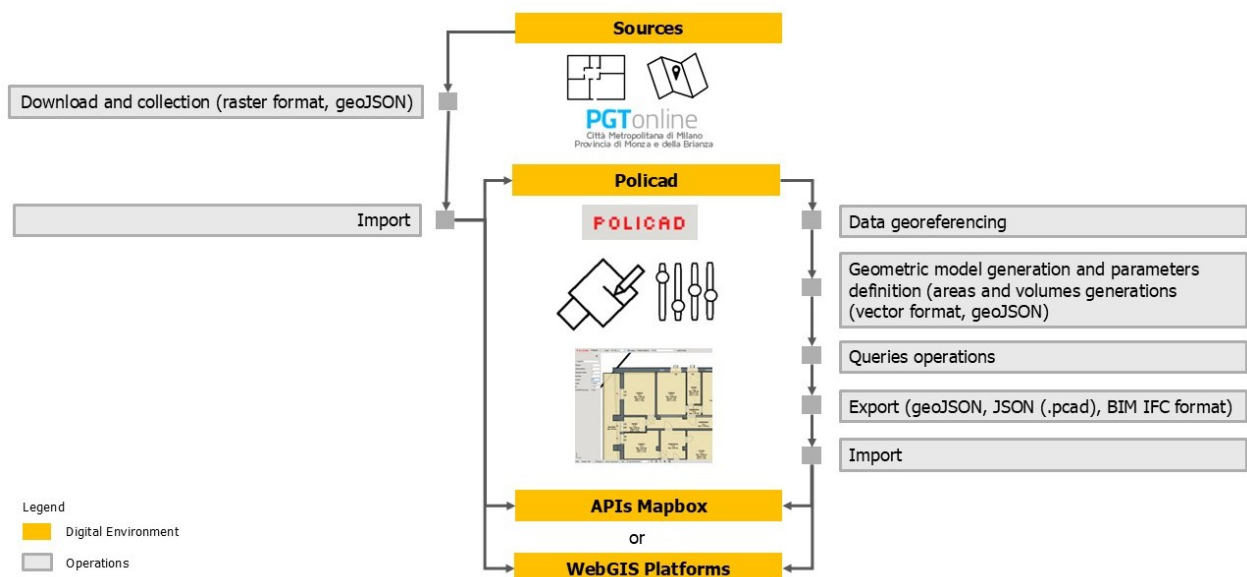


Figure 4: PoliCAD implementation and exploitation methodology

embedding geospatial intelligence into CAD and BIM workflows.

Core Functionalities of Policad

Cadastral Plot Acquisition and Georeferencing

PoliCAD allows users to download a cadastral plot, providing an accurate digital representation of the site where a new building will be designed and constructed. The tool ensures that all projects are georeferenced correctly, aligning with real-world coordinates and urban planning regulations. In Figure 5, a building project is inserted in the correct cadastral plot georeferenced in PoliCAD.

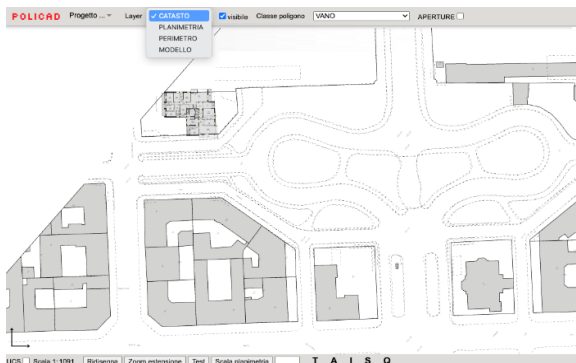


Figure 5: Building plan georeferenced into PoliCAD

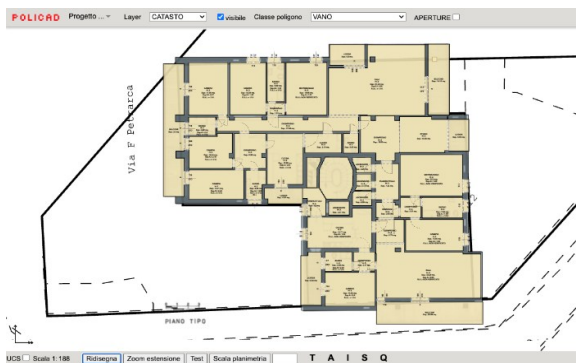


Figure 6: Building model

CAD to BIM Conversion with Rich Metadata

PoliCAD transforms traditional CAD drawings into BIM objects by enriching them with essential attributes (Figure 7), including:

- Ceiling height details
- Door and window placements
- Compliance verification for illuminance and ventilation regulations

This transformation ensures that projects are not just static 2D representations but intelligent models that contribute to a smart, integrated urban planning ecosystem.

3D Urban Model Integration

Once the CAD design is converted into a BIM object, PoliCAD enables users to upload it into a 3D urban model (Figure 8). This functionality provides multiple advantages:

- *Contextual visualization* of the proposed building within its real-world surroundings.

- *Solar access analysis* to determine daylight exposure and shading effects.
- *Zoning regulation checks* to ensure compliance with municipal planning laws.
- *Distance validation* from property borders and neighboring structures.

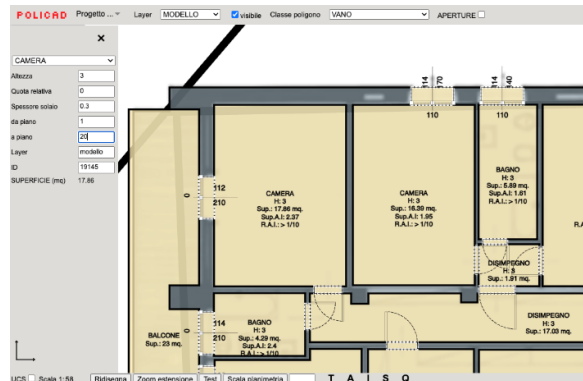


Figure 7: Building model and parameters definition

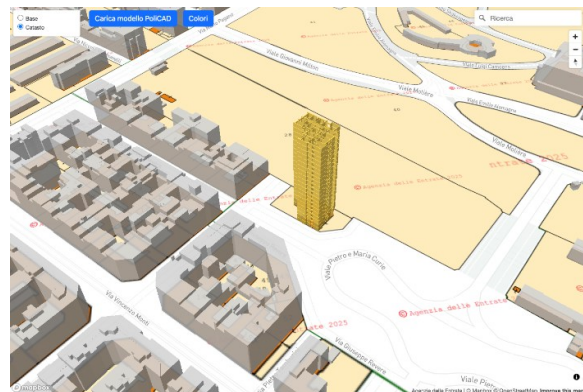


Figure 8: 3D PoliCAD model in a map-based urban environment

By integrating these features, PoliCAD enhances decision-making and reduces planning conflicts before construction begins. The advantages for architects and urban planners are multiple and relevant:

- *Efficiency in Design & Compliance:* PoliCAD accelerates the design process by embedding compliance verification tools that assess projects against municipal standards.
- *Improved Collaboration:* The tool fosters collaboration between architects, engineers, and regulatory bodies by offering a shared, real-time urban model.
- *Enhanced Accuracy:* The integration of GIS and BIM eliminates discrepancies in geospatial positioning, ensuring that all projects are correctly aligned with cadastral maps.
- *Digital Permit Management:* PoliCAD supports municipalities by facilitating a digital workflow for building permits, reducing administrative delays, and improving transparency in urban development approvals.

Case study in the city of Milan

As a case study, the city of Milan has been considered as the digital documents are complete and available at the level of PGT (Figure 2) and Cadaster (Figure 3). Based on these maps, the city model has been deployed, combining the cadaster information of the whole city and creating a database of the 3D volumes of the buildings, including information about floor height (Figure 9).



Figure 9: Urbanplan3D, Milan, Italy.

In this way, a 3D model of the city with included cadastral information has been generated (<http://www.urbanplan.it/urbanplan/3dplatform.html>). In this environment a first test about how to generate information to support the design and the definition of the indexes to meet the local building permission regulations has been conducted (Figure 10). The model allows to select a façade of the building for the automatic creation of the transparent openings (Figure 11) to provide a preliminary analysis of the building requirements. Additional functionalities are under definition and generation of PoliCAD.

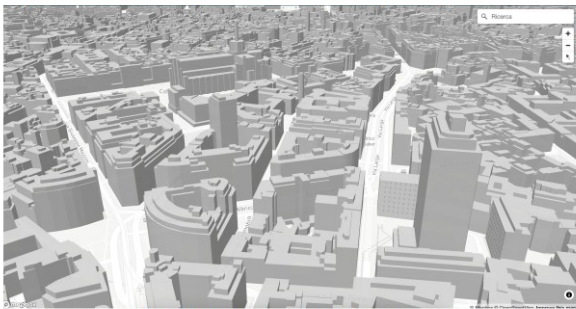


Figure 10: Urbanplan3D, visualization of the 3D buildings in the city, Milan, Italy.



Figure 11: Urbanplan3D, visualization of windows on a building façade, Milan, Italy.

Results

PoliCAD has been tested on a case study in Milan, where it demonstrated significant improvements in interoperability between GIS, BIM, and CAD workflows. The main advantages are that it integrates zoning regulations and building codes for real-time compliance verification, enhancing project feasibility checks; it also creates geospatially accurate 3D models by linking cadastral maps with BIM objects, improving planning accuracy. Traditional CAD drawings are transformed into BIM-compatible designs with added metadata, facilitating smoother integration. Architects can overlay proposals onto 3D urban models for real-time contextualization. Preliminary testing shows PoliCAD can significantly reduce building permit processing times by automating rule checks. This automation minimizes manual errors in zoning adherence and spatial verifications. PoliCAD supports seamless CAD-to-BIM transitions, fostering collaboration and maintaining regulatory compliance. Its scalable design adapts to diverse urban projects, from small developments to citywide plans. By streamlining workflows, PoliCAD optimizes building permit processes, advancing efficient urban development. Overall, PoliCAD enhances urban planning efficiency while ensuring regulatory compliance. The “core” of PoliCAD is the definition of a planovolumetric object appropriately georeferenced and classified with respect to the taxonomy of spatial classes on which urban planning and building regulations intervene. Defined in this way, regulatory verification will act on geometrically defined spatial forms (BIM-based and GIS-compliant). In Table 2, a comparison with traditional manual methods is resumed.

Table 2: Manual process vs PoliCAD workflow.

Metric	Manual Process	PoliCAD Workflow
Average Time for Preliminary Checks	~3–5 days	~1–2 hours
Accuracy of Geospatial Positioning	Subjective (visual/manual check)	Georeferenced via cadaster & PGT
Compliance Error Rate	Medium to high (subjective reviews)	Low (rule embedded modeling)
Permit Approval Time	~30–90 days (varies)	Expected reduction by 30–50%
Data Format Interoperability	Low (PDF, DWG)	High (IFC, GeoJSON, WebGIS compatible)
User Accessibility	Experts required	Usable by architects without BIM tools

Discussion and impacts

PoliCAD can revolutionize urban planning by automating compliance checks, integrating GIS, BIM, and CAD data into a unified digital framework, and enabling real-time design contextualization. It streamlines workflows by embedding zoning laws, height restrictions, and environmental regulations directly into the design process, reducing errors and accelerating approvals. By bridging data silos, the software enhances transparency, improves decision-making, and supports CAD-to-BIM transitions, democratizing digital tools for smaller firms. Economically, PoliCAD cuts costs by minimizing revisions and delays, while socially, it fosters public engagement through accessible 3D models. Its integration of geospatial accuracy and procedural automation positions it as a cornerstone for smart cities, with future potential in IoT, AI-driven compliance, and blockchain validation. PoliCAD represents a paradigm shift, transforming fragmented urban data systems into collaborative, sustainable frameworks for resilient development.

Conclusions

PoliCAD represents a paradigm shift in digitizing urban planning and building permit processes by unifying CAD, BIM, and GIS into a cohesive framework, enhancing efficiency, compliance, and geospatial precision. The software embeds municipal zoning laws directly into design workflows, ensuring adherence to regulations from inception and minimizing costly redesigns or approval delays. By streamlining compliance verification and automating data integration, PoliCAD fosters collaboration among architects, planners, and municipalities, enabling agile, transparent urban development. Its demonstrated capacity to improve interoperability and geospatial accuracy positions it as a critical tool for managing urban growth, bridging gaps between fragmented design and regulatory systems.

Future developments will expand PoliCAD's integration with AI-driven compliance automation, blockchain-secured permits, and IoT connectivity, advancing its role in smart city ecosystems. These innovations will support predictive analytics and real-time monitoring, reinforcing sustainable urban development. As cities transition toward digital twins, PoliCAD provides a foundational platform for creating resilient, adaptive urban environments. By harmonizing stakeholder collaboration and simplifying regulatory workflows, the tool drives intelligent urban planning frameworks. Its adoption empowers municipal authorities to navigate complex urban transformations with precision, foresight, and data-driven governance, ultimately fostering equitable and sustainable cities.

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