MODERN METHODS FOR SPATIAL URBAN PLANNING

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Abstract: *Urban planning involves functions, scales, sectors, and stages and the main functions of urban planning can generally be classified into general administration, development control, plan making, and strategic planning. Currently, the focus is on creating smart cities with increased functionality and on sustainable regional urban systems, with a positive economic impact. Both decision makers involved in urban planning, as well as local and municipal councils, can use the application of modern 3D planning methods to obtain the overall image of urban development. Traditionally, the information management process for local urban projects has been unidirectional and manual. GIS provides planners, surveyors, and engineers with the tools they need to design and map the area of interest. We highlight the workflow applied in an urban area through using, defining or creating of 3D Basemap, Zoning Types, Overlay Types, Building Types, Space Use Types, Project Status Types, according with the general urban plan, focused on the GIS instruments.*

Keywords: *3D GIS; 3D urban; spatial; 3D planning;*

1. Introduction

Currently, cities are the engines of the regional economy and can be considered as catalysts for creativity and innovation. However, a number of problems such as unemployment and poverty are also present here. [7] The various aspects of urban, economic, social, cultural and environmental life are closely linked and a successful policy in the field of sustainable urban development requires an integrated approach. This approach is becoming more important in the current period, given the seriousness of the problems that cities face (demographic changes, the consequences of economic stagnation, the impact of climate change). [5]

From a spatial perspective, inclusive growth should be based on urban and regional competitiveness but, at the same time, it is considered not only economic and social cohesion, but also territorial cohesion. Spatial planning is gaining a fundamental importance in order to attract investors and to support the improvement of development results at urban level. The existence of sustainable and prosperous cities is vital for Romania's sustainable growth. The public authorities must support these areas to prosper, possibly on the basis of a medium and long-term integrated metropolitan strategy (SMI).

2. Spatial Planning Importance Today

Urban, community and regional planning means dealing with constant changes. Planning professionals should have the technical experience, the political experience and

knowledge on the economic problems to translate a vision into a strategic action plan valid today. In a developing country such as Romania, there are more and more requests sent to state institutions, county and local councils, in conjunction with an increasingly active public, composed of citizens. One possibility to meet these requirements is the adoption of GIS instruments. GIS planning solutions [13] can be used for community-based design and planning, economic development, smart growth, improving the quality of life, creating better communities for future generations, creating livable communities, planning services, urban and regional planning, brownfields redevelopment. According with Law 350/2001, the state, through the public authorities, has the right and the duty to insure, through the activity of urban and spatial planning, conditions for sustainable development and respect for the general interest. A smart city plan means that regulatory and policy reforms are used to find new ways for the planning and zoning rules to be subjected to public interest tests to ensure that the benefits of restrictions to the community outweigh the costs. [1]

3. Spatial Planning and GIS

GIS is important in spatial planning [3] because of the possibility to better understand current needs for a city, and then design to fulfill those needs, helping planners understand the needs of densely populated areas and enhancing visibility into data, but they also adapt to examining smaller towns and even informal settlements. Now it can be possible to monitor fluctuations over time, evaluate the feasibility of proposed projects and predict their effects on the environment. [4]

The increasing GIS use in spatial planning and design enabled a higher quality of quantitative and qualitative data analysis, improving the evidence base of decision-making process as well as the knowledge base of the decision-making process itself – all factors upon which delivering such an aspirational, but highly complex, policy goal as Sustainable Development Goal 11 [12] ultimately depends. According with [13], current progress in GIS technology has created the proper conditions for the development of solution- supporting systems at all stages in the planning and design process. On a daily basis, urban planners face a number of demands and challenges that require access to spatial information.

City Information Model represents a model of the urban environment that involves creating the existing urban form and structure, a system of record, established on existing best available data. [5] In figure 1 are emphasized the main elements of a 3D system of record for City Information Model.

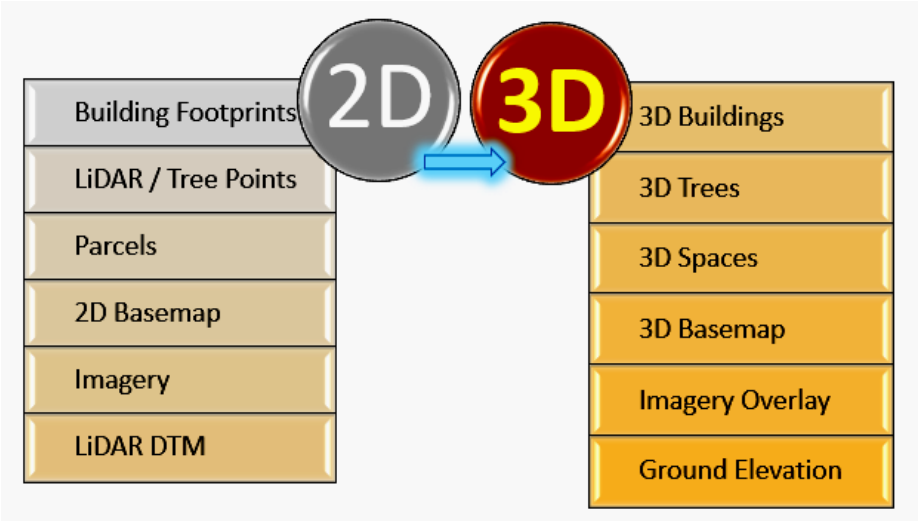

Figure 1. 3D System of Record for City Information Model (adapted from [5])

4. Case Study

Excessive agglomeration of buildings in some areas of Bucharest is a direct consequence of the actions of the local administration. Currently the urban environment in many areas looks as though the General Urbanism Plan (PUG) or the building permit have become over the years documents whose compliance is optional, both by some real estate investors, as well as by the representatives of the municipalities issuing them the documents required to build a construction. Buildings appear that, besides the fact that the architecture of the area is damaged, does not comply with the most elementary rules of urbanism regarding the maximum height of the area, the minimum distance between buildings, there are many blocks built on green spaces or near the gas station fence. The main cause is the permissive and omissive legislation in the field, but there is also the lack of implementation of the methods and technologies of endorsement using integrated GIS systems, in which the restrictions can be set according to the area. Subsequently, when proposing a construction, the violation of certain values is automatically highlighted.

The real estate developers build as they wish because the non-compliance of the building permits does not automatically lead to the demolition of the non-compliant works, and sooner or later they manage to obtain the documents attesting the legality of the construction. A well known example in this regard is the one from 2012, when Millennium Building Development asked the General City Hall of the Capital to take the necessary steps to complete the procedure for entering the legality of the Cathedral Plaza. [14]

In the case study we want to show the workflow that can be applied when planning is required to comply with the specific restrictions of the area in which a new building is being built. Our example exemplifies a way of spatial planning based on clear criteria, in accordance with the Local Urban Regulation [8] of the Municipality of Bucharest. For this purpose we have chosen the software solution ArcGIS Urban from Esri. ArcGIS Urban is gaining significant attention in the GIS and City Planning & Development industries, because the platform is a complete solution allowing municipal planning departments and development-focused NGOs to improve urban planning practices and decision-making on a city-wide scale.

ArcGIS Urban is used to create 3D renderings of city landscapes, proposed buildings, and compare proposed site projects across key stakeholders, being a web-based system for managing urban development, through a fully interactive 3D environment and offering high quality and flexible planning tools. The components of ArcGIS Urban [11] are highlighted in figure 2.

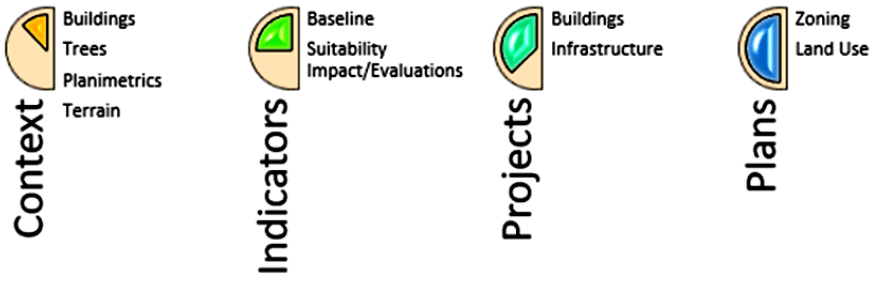

Figure 2. Main Components of ArcGIS Urban

Study area is in Bucharest, in the 3rd district. The situation was analyzed in GoogleEarthPro and Imobile E-Terra (figure 3).

Defining Zoning and Land Use Plans are useful for visual and analytical representation that allows planners to ‘do the math’while at the same time ‘show their work’to stakeholders (Citizens, Real Estate Agencies, Government, Architects, Developers, etc.) [6]

We defined zones according with local code [9], to align unique zoning regulations [10] to generate 3D forms and explore the effects of development constraints.

Figure 3. Study Area (Imobile E-Terra, GoogleEarthPro)

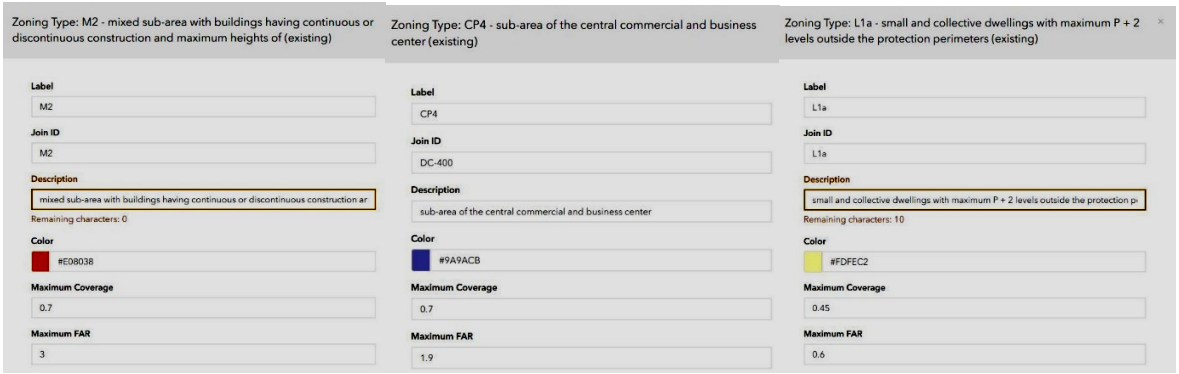

Figure 4. Examples of Defined Zones, according with local regulation [9]

Scenario management advantage is based on create planning scenarios and collaborate on the overall economic attractiveness of a study area. It as been created two scenarios for the study area. (figure 5, 6)

Figure 5. First Scenario: Associated Indicators (Population, Household, Jobs) and Building Space Use

Figure 6. Second Scenario: Associated Indicators (Population, Household, Jobs) and Building Space Use

Visual representation was used for visualize and test regulatory scenarios to achieve policy and growth objectives. The defined indicators can be included in downstream reporting, highlighting key performance indicators and baseline conditions.

It was necessary to define project status, for example our case study was set up as in figure 7.

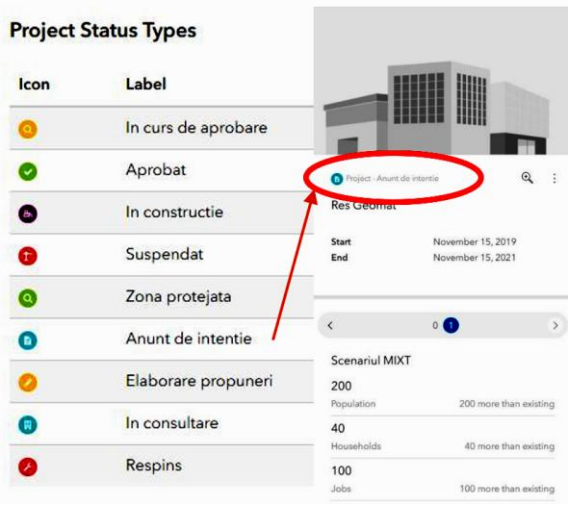

Figure 7. Setting Project Status Types

These scenarios were synchronized and modelled in CityEngine. (figure 8) In ArcGIS Urban were imported these models designed in CityEngine. It is also possible to import from SketchUp or other 3D formats.

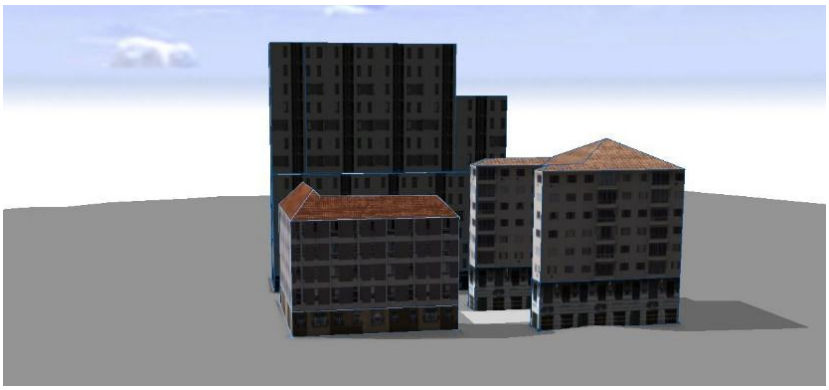

Figure 8. Examples of Models Designed in CityEngine

As an associated benefit, this approach is also useful for studying spatial planning of the location of the surveillance cameras in the projected area in CityEngine. (figure 9)

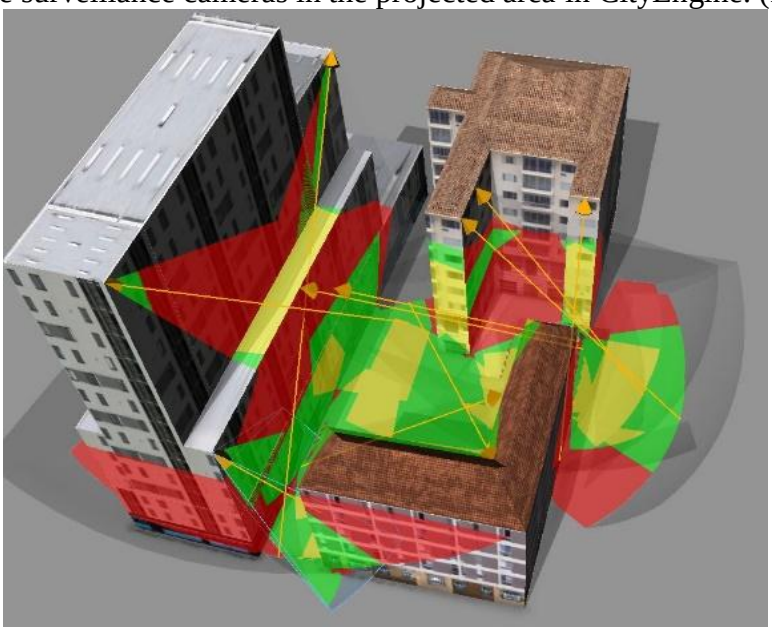

Figure 9. Spatial Planning of the Surveillance Cameras Location in the Projected Area - visibility tools in CityEngine

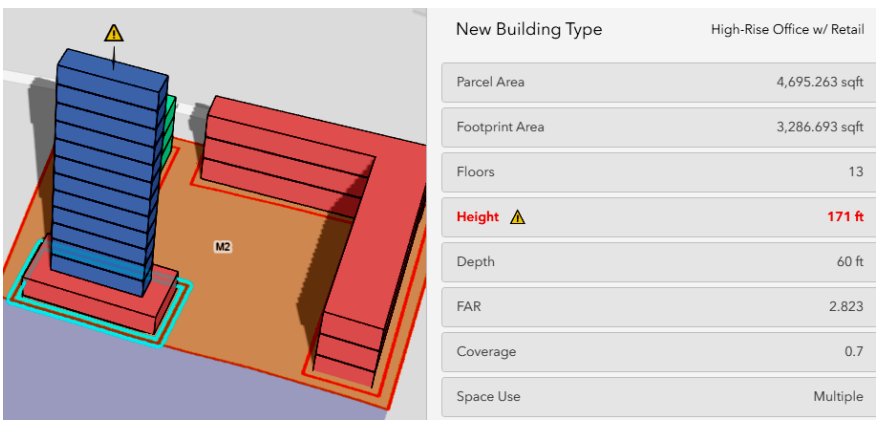

Figure 10. Contradiction between the Zoning Restrictions and the Proposed Building

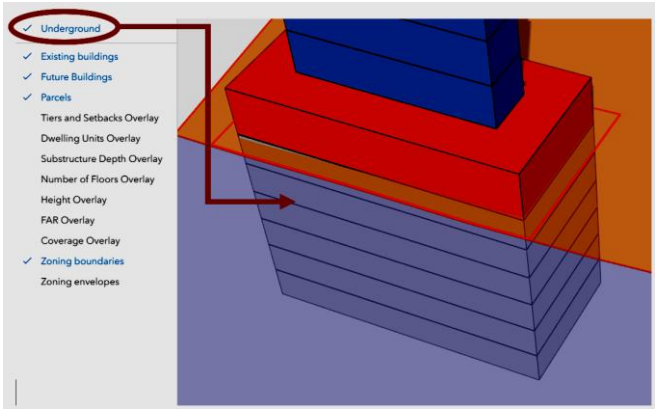

Figure 11. Advantage of Viewing Underground Building

5. Conclusion

The main advantages of using this workflow for urban decisions are the following: communicating trends, improved planning productivity, increasing community engagement, make planner's daily workflow more efficient, 3D context assessment, enhanced decision making, 3D representation of zoning regulations, create future land use planning scenarios.
3D has seen semnificative growth across the ArcGIS Platform in last years. For this reason, the main challenges [5] need to be taken into account:

- BIM & AEC: Revit files, Autodesk InfraWorks'new Autodesk Connector for ArcGIS, integration of BIM 360 and ArcGIS Online
- Interactive tools [2]: visibility tools in ArcGIS Pro, ArcGIS Earth, and Esri CityEngine (figure 10), 3D measurement tools in the ArcGIS API for JavaScript
- Mobile: Scene Viewer and the ArcGIS API for JavaScript 3D, ArcGIS Earth for Android
- Underground capabilities: manipulating surfaces in ArcGIS Pro, underground navigation in the Scene Viewer, ArcGIS Urban (figure 11) and Utility Network
- Urban Planning: ArcGIS Urban and enhancements to Esri CityEngine's drawing tools and possibility to use feature services from ArcGIS Online.
- AR, VR, and MR: VR templates for Unreal engine, for real-time visualizations and intuitive table-top experience in addition to partners delivering products for AR to our users, such as Argis Solutions and Meemim Inc.
- I3S and 3D Content: Content provider partners including Vricon, Nearmap, Orbit, and many others., new AIRBUS 3D ground elevation (best in class), LAZ and zLAS to I3S.

From local administration viewpoint, the digital submission possibility needs to be implemented as best-practice for private developers to submit 3D models and plans over the web for review. Following this workflow, assessing how a proposed project will affect or be affected by the surrounding environment (as shadowing for example) is also an important point.All the results can be shared through interactive web scenes, reducing the need for resubmissions.

Through this case study we wanted to highlight a series of facilities provided by the current software solutions that can be used in spatial planning. Romania needs to cope with the accelerated urbanization process using these software solutions. The main challenge is the reluctance of the employees of the local public administrations to agree with this way of working. However, gradually, taking into account the examples of existing good practices, urban spatial planning will surely be modernized in Romania as well.

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