MANAGEMENT OF CADASTRAL CO-OWNERSHIP USING 3D GIS TOOLS

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ABSTRACT

The last two decades, the rapid demographic growth, the complexity and increasing densification of the infrastructures in Algerian cities, have created increasingly complex situations between lands properties. On a cadastral plan, which is a technical instrument defining the physical aspects of the property, the horizontal ground limits are known accurately, but this is not always the case for vertical limits. The geometry of these properties cannot be fully represented on cadastral maps.

For this purpose, it then becomes necessary to consider the third geometrical dimension or a volumic representation to represent these situations, because the three-dimensional representation has become a real decision-making tool for town and country planning.

This paper is first step toward an Algerian 3D cadastral model. It aims to:

- Display the plans of the lots.
- Create a volumic representation of buildings using 3D GIS tools.

The general objective of this work is to facilitate management of co-ownership by adding to the urban cadastral documentation additional data (integration of maps of each lot). This work base on analysis of Algerian cadastral data notably co-ownership using the terms of International Federation of Surveyors (FIG).

Keywords— cadastral plan, three-dimensional representation, co-ownership, GIS, FIG

1. Introduction

The Algerian cadastral systems aims to establish the tax and land register which facilitate the land management and optimize land use, that seek to register or protect rights and obligations on properties.

For a long time, we find the multi-level and vertical buildings. However, the establishment of a multi-user cadastral system raises the question of geometric and spatial representation with the third dimension of land ownership.

In the majority of the countries, if a 3D parcel does exist (conceptually), then in most of the cases it is related to a (planned) construction, but exception like Australia, Canada, China, Malaysia, and Portugal [2].

In Quebec, co-ownership is treated according to the concept of the vertical cadastre. The three-dimensional element associated with the lots. These lots are represented by a complementary plan [1]. While Croatia had 2D plans with 3D textual information. Even if 3D survey plans are not created, apartments are registered in jurisdictions like Brazil, while 3D is

not yet supported in jurisdictions like the Czech Republic, Finland, Hungary, India, Israel etc. Macedonia mentioned that infrastructure objects are registered on the map. However, it is not clear whether these infrastructure objects are in 3D. Poland mentioned that although the survey plans did not have 3D parcel representations there were some example or prototype 3D plans available [2].

Based on the description above, we try by this work, to take a first step towards the development of an Algerian 3D cadastral model.
This paper deals two sections: an analyst of Algerian urban cadastral data and a conception of an Algerian 3D cadastral model for co-ownership.

2. Analyst of Algerian urban cadastral data

In order to do a valuable analysis, we need a reference on which we base. The terms of the FIG organization are considered the indispensable element in the analysis.
The International Federation of Surveyors covers the whole range of professional fields within the global surveying community, hereunder surveying, cadastre, valuation, mapping, geodesy, geospatial, and quantity surveyors and provides an international forum for discussion and development aiming to promote professional practice and standards. However, it organizes workshops determining its recommendations for the implementation in place of a 3D cadastral system [3].
This organization identified specific and explained terms in questionnaires. The latter are made every four years, each time they will be modified, and improved.

The questionnaires offer questions on the following: 3D spatial units

Infrastructure/utility networks
Construction/building units
X / Y coordinates
Z Coordinates/height representation
Temporal issues
Rights, Restrictions and Responsibilities
DCDB (The Cadastral Database)
Plans of Survey (including field sketches)
Dissemination of 3D Cadastral information
Statistical information.[3]

In order to assess our data, we consulted the cadastre to retrieve examples that will used in the analysis.

Analysis based on terms of FIG, the results are shown in the following table:

TABLE I

Analysis cadastral data based on terms of FIG

Questions	2D Data	3D Data	Notes
3D spatial unit	✓	X	/
Infrastructure/utility networks	✓	X	- There are data on transport, hydrography - No details to sewerage, electricity or telecommunications networks
Construction/building unit	✓	X	/
X / Y coordinates	/	/	Maps do not guarantee (X, Y); the walls of a building define the plots.
Z Coordinates/height representation	/	/	(Z, height, depth) does not exist on maps and tables of database.
Temporal issues	/	/	There exists in the island table: sup_fo_date, and publication date
Rights, Restrictions and Responsibilities	/	/	- The ANC interest for the registration of cadastral data. -Land conservation for the publication and establishment of the land register. - Titles : does not contain 3D -EDD does not contain 3D
DCDB (The Cadastral Database)	✓	X	-Database exist but incomplete, some information in another DB (GIS software). - No schema based on ISO 19152 LADM -The cadastral information is not fully accessible to the public: only request for extract of the plan and archive documentation. Thus a dedicated area to professionals (Example : Solicitors)
Plans of Survey (including field sketches)	✓	X	/
Dissemination of 3D Cadastral information	X	X	/
Statistical information	/	/	On the Web, the statistics are for the cadastral areas by province.

DCDB (The Cadastral Database)	✓	X	-Database exist but incomplete, some information in another DB (GIS software). - No schema based on ISO 19152 LADM -The cadastral information is not fully accessible to the public: only request for extract of the plan and archive documentation. Thus a dedicated area to professionals (Example : Solicitors)
Plans of Survey (including field sketches)	✓	X	/
Dissemination of 3D Cadastral information	X	X	/
Statistical information	/	/	On the Web, the statistics are for the cadastral areas by province.

Based on the elements of the FIG questionnaires, the Algerian cadastre does not contain three-dimensional information on all types of graphic and literal cadastral documentation. This prompts us to think of another model.

2. To an algerian 3d model cadastral for co-ownership

For the first step, we present the practical method of the approach developed, which consists of:

A. Set up a Geographic Information System that allows:

- Design of a cadastral database, which facilitates the understanding of urban environment, it also allows to identify the problems of representation of the building according to the needs of legal cadastre.
- Integration of informations as possible from additional exogenous data.

B. Integration of the complementary plans of the buildings.

In this paper, a section will be devoted to the volume representation of buildings, using ArcScene tool.

3.1 Cadastral database conception

- Realize the conceptual data model. Data used concerns co-ownership.

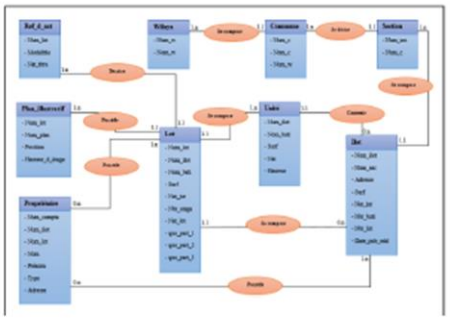
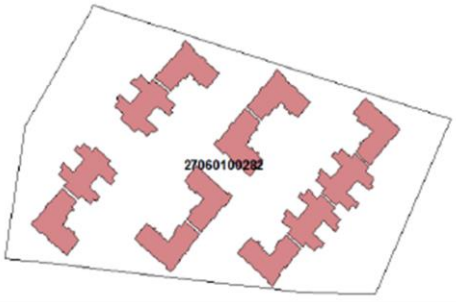


Fig. 1 an extract from the conceptual data model



- Creation of the database under ArcGIS and enter data.

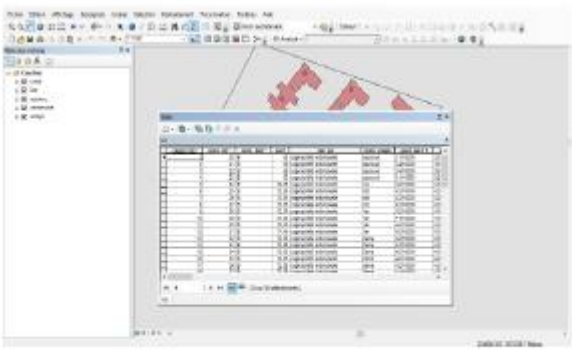


Fig. 3 Data entry

3.2 Architectural drawing integration

- The data is simplified and then converted to the appropriate format

Fig. 4 Architectural plans before treatments

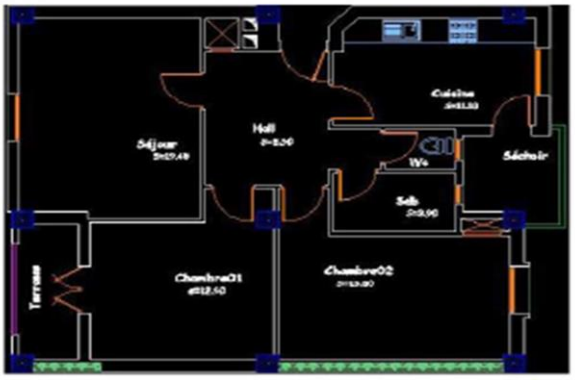


Fig. 5 Architectural plans after treatments

Integration of the illustrative plan

This method consists of creating attachments in an entity class.
Attachments are stored internally in the Geodatabase in a separate attachment table that maintains a link to the target dataset. Attachments are added to the target dataset using a correspondence table that dictates for each input record (or an attribute group of records) the path to a file added as a part attached to this recording.

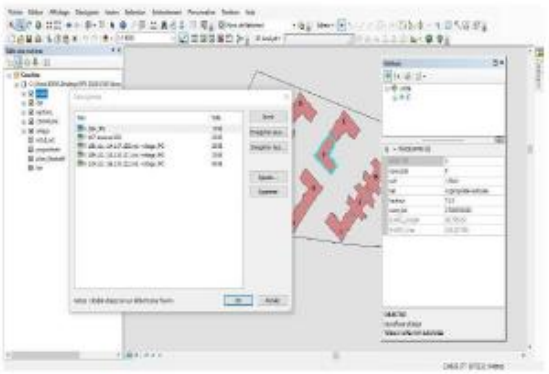


Fig. 6 Import the illustrative plan in JBEG format

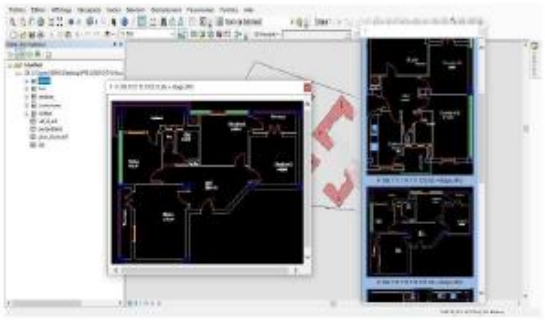


Fig. 7 Display of illustrative plans of each lot.

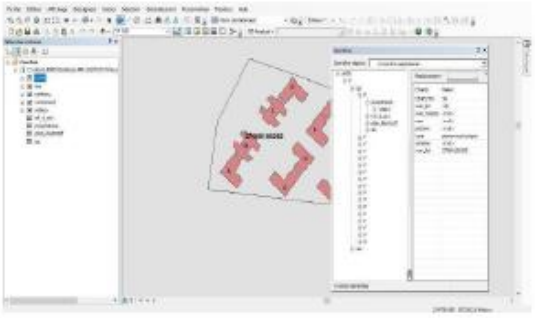


Fig. 8 extracting other information graphically

Attachments are linked to each condominium. For example after a graphic selection on building F, we can have a list of all the attached plans (Fig. 6), as we can also display the plans of each lot either of the ground floor or of the floor (Fig. 7) or even of the basement if it exists. However, any information attached to these plans, will be also displayed on the window "identify" as the names of owners (Fig. 8).

3.3 Volume representation of buildings

The goal is to represent the island with real dimensions (3D) by a 3D GIS software.

The tool used is ArcScene.

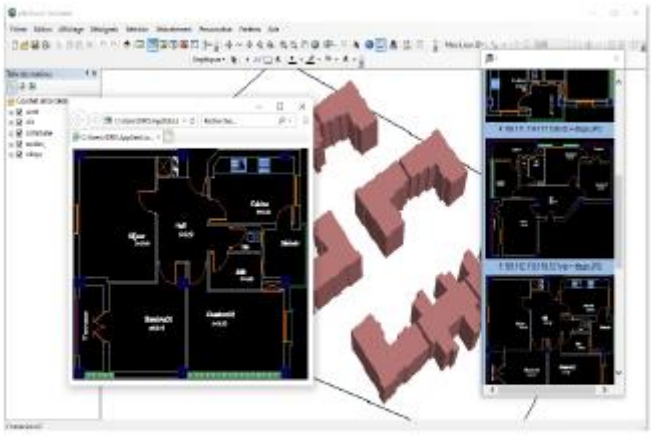


Fig. 9 3D information display

3.4 Discussion

The added attachments will copied internally on the Geodatabase. The original attachment files will not affected in any way. If the original files are modified, these changes will not be made automatically to the Geodatabase attachment. To synchronize the modifications made to Geodatabase, you must delete the attachments concerned using the Remove Attachments tool, and then add the modified files as new attachments. It takes time especially when it comes to a large amount of data.

For this work to be efficient and reliable, it is necessary to think of an automation of the procedures carried out.

3. Conclusion

In this developed methodological approach, we dealt with the case of structural heterogeneity of a condominium block through the design of a cadastral geographic database.

Modeling cadastral data is a difficult task, especially in an urban environment, which requires checking the semantic links and logical coherences.

The integration at the maximum of information and data concerning the condominium, allows enriching the database and understanding of the state of property.

Based on the design of a cadastral data model, that groups together geometric and attribute entities. We were able to perform easily the extraction and analysis of 3D cadastral data, as well as the 3D volume representation of a built entity.

This is the first vision, towards a 3D cadastre it allows us to:

A. Have a deep understanding of the structure of cadastral data.

B. Identify gaps and technical problems encountered.

C. Think about improving the design towards a fully 3D cadastre.

5. REFERENCES

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