Author/s:
Olfat, H;Shojaei, D;Briffa, M

Title:
The Victorian digital Cadastre: Challenges and investigations

Date:
2016-01-01

Citation:
Olfat, H., Shojaei, D. & Briffa, M. (2016). The Victorian digital Cadastre: Challenges and investigations. CEUR Workshop Proceedings, 1570, pp.47-52. CEUR.

Persistent Link:
https://hdl.handle.net/11343/245482

The Victorian Digital Cadastre: Challenges and Investigations

Hamed Olfat, Davood Shojaei, and Mark Briffa

Electronic Subdivisions Unit, Land Victoria, Department of Environment, Land, Water and Planning (DELWP), VIC, Australia, Emails: hamed.olfat@delwp.vic.gov.au (H.O.); davood.shojaei@delwp.vic.gov.au (D.S.); mark.briffa@delwp.vic.gov.au (M.B.)

SUMMARY

In 2011 the Digital Cadastre Protocol (ePlan) was introduced in Victoria. ePlan is a collaborative program between the Australian land authorities and the surveying industry, in conjunction with the Intergovernmental Committee on Surveying and Mapping (ICSM). ePlan is to replace paper and PDF plans with digital files based on a national standard. ePlan has been operational in Victoria for 2D (non-building) plans since 2013 and several services such as validation, visualisation and digital data download have been built within the Victorian land authority - Land Victoria - systems.
The Victorian ePlan project is faced with some challenges that will impact the uptake of this initiative among the cadastral surveyors, e.g. surveyors acceptance of adopting a new method of producing plans, quality of the visualisation service which converts the ePlan LandXML file into PDF as the legal title diagram and support for 3D building subdivision plans.
In order to overcome the identified challenges, Land Victoria has defined several research programs. An 'ePlan Engagement Program' has commenced and aims to gain a greater understanding of surveying firms' subdivision processes and how ePlan can fit into them and also means surveyors are participating in ePlan's development. The design and development of a new online tool is also under investigation which aims to enable surveyors to improve the quality of the visualised PDF and define sheets, exaggerations and enlargements when required. Another ongoing research program is related to the technical aspect of a 3D digital cadastre for Victoria including 3D data modelling, validation and visualisation components.
This paper aims to explore the current status of the Victorian ePlan implementation and discuss the identified challenges and ongoing investigations.

Keywords: ePlan, Visualisation, 3D Cadastre, LandXML, Victoria

INTRODUCTION

The paper/PDF-based method of cadastral survey and plan lodgements and registration has highlighted a number of challenges to the Australian jurisdictions [3]. This method is not efficient as it does not record ownership boundaries in a digital format and as a result, spatial queries (e.g. finding the parking and storage associated to an apartment) are not supported and the DCDB[1]s cannot get updated in an automated fashion. Also, the digital data produced by the surveyors is not available to other stakeholders of land development processes for re-use. In order to address the issues of paper/PDF-based plans, an ePlan Working Group (eWG) was formed by the ICSM to develop a national model to transfer digital cadastral survey data between the Australian surveying industry and government agencies.
In 2009, ICSM endorsed ePlan as an agreed conceptual national data model of a cadastral survey that meets the needs of all Australian jurisdictions [1]. In 2011, an ePlan Protocol was developed to map the components of the ePlan data model to LandXML, a specialised XML[2] data file format containing civil engineering and survey measurement data commonly used in the land development and transportation industries. 2D ePlan is currently operational in Queensland, New South Wales and

[1] Digital Cadastre Data Base
[2] eXtensible Mark-up Language

Victoria. Other jurisdictions have also participated in the eWG and are investigating their options. The Singapore Land Authority also joined the eWG in 2013 and have adopted the ePlan Protocol for their cadastral surveying modelling and electronic lodgements [6].
Similar to other states, the Victorian ePlan project has faced a number of challenges, e.g. the quality of the visualisation service (for visualising legal PDF plans from ePlan LandXML files), surveyors acceptance of adopting a new business process, supporting building subdivisions, etc. These challenges have directly impacted on the uptake of ePlan by the surveying industry. Accordingly, Land Victoria has defined several research programs to address the identified challenges and increase the uptake of ePlan.
This paper explores the current status of ePlan implementation in Victoria, and discusses the ePlan project challenges, the ongoing research programs and their recent results. Finally, the paper proposes the future directions for the Victorian ePlan project.

CURRENT STATUS OF THE VICTORIAN EPLAN IMPLEMENTATION

ePlan was introduced in Victoria in 2011. During 2011 to 2013, Land Victoria conducted two pilot programs with ten surveying firms and two surveying software developers including LISTECH and Geocomp Consulting. The main aims of the pilot programs were to test the ePlan-enabled software packages and to identify the business requirements for integrating ePlan with the 'Surveying and Planning through Electronic Applications and Referrals (SPEAR[3])' system. SPEAR is an Australian-first, allowing subdivision planning permit and certification applications to be compiled, lodged, managed, referred, approved and tracked online. Most of the application types supported by SPEAR are currently supported by ePlan. This includes Plans of Subdivision/Consolidation and Staged Plans.
ePlan provides the surveying profession and those involved in the land development industry with numerous benefits, in particular it:

- improves the quality of plan data and associated documents
- improves access to/delivery of survey information
- assists with improved digital plan examination/checking processes
- reduces errors, anomalies and requisitions
- eliminates the 'drafting' step from the plan of subdivision creation process
- speeds up the application creation process in SPEAR through pre-populating most of the required information in the application screen
- enhances the accuracy of the State's DCDB (VicMap Property)
- provides a standard data exchange format for sharing and collaboration, which is also nationally and internationally recognised.

For Land Victoria, ePlan data can be utilised in future enhancements to automate creation of newly created folios and Owners Corporation reports.

ePlan Services within SPEAR

SPEAR has been fully ePlan-enabled since early 2013 and provides the following services to cadastral surveyors in Victoria:

ePlan Digital Data Download Service

The ePlan digital data download service is available through a web mapping application - LASSI-SPEAR[4]. Using this service, LASSI-SPEAR users are able to define a polygon on the map base and download a digital file in ePlan LandXML format that contains parcel line works, administrative areas (e.g. LGA, Parish, Township), datum, location addresses, road abuttals, survey marks and monuments from DCDB (Vicmap Property) and SMES[5] data base. The downloaded ePlan file can be imported into surveying software packages (e.g. LISCAD) to pre-populate the known data for ePlan preparation, which saves the surveyors' time.

[3] www.spear.land.vic.gov.au
[4] www.spear.land.vic.gov.au/lassi/SpearUI.jsp
[5] Survey Marks Enquiry Service

ePlan Validation Service

One of the benefits of an ePlan compared to a traditional drafted PDF plan is that a large number of automated validation tests can be applied to the plan at the time the plan is submitted in SPEAR. This service identifies some of the errors and potential problems in plans at an early stage, which allows the surveyor to correct them prior to the examination process. This will result in a reduction in the number of refusals and requisitions. SPEAR currently has 130 ePlan validation rules which cover three main areas of 'survey accuracy (e.g. parcel area, parcel observations closure)', 'survey examination rules (e.g. appropriate title connections)' and 'metadata completeness (e.g. easement purpose)'. Once an ePlan file is uploaded to SPEAR, a validation report is generated including the status of the report (pass, pass with warning and fail) and the result for individual validation rules (pass, warning, for information, error, system error and not applicable). Before signing the plan in SPEAR, any validation errors and warnings must be corrected or justified.

ePlan Visualisation Service

The ePlan visualisation service has been developed to convert the ePlan LandXML file into PDF, as PDF plan is the legal title document in Victoria. Automatic visualisation of an ePlan file is fundamental to streamline processing and dissemination of digital cadastral data. It is used for the following purposes for:

- Surveyors to review the visualisation to confirm the ePlan file contains correct and complete survey information
- Land Victoria to examine the visualisation and be confident that it is an accurate representation of the plan.

Surveying Software Developers' Progress

Currently there are two fully functional ePlan-enabled surveying software packages in Victoria; LISCAD and GeoCivil/ePSALON from LISTECH and Geocomp Consulting respectively. In addition, AutoCAD Civil 3D Stringer ePlan developed by Civil Survey Solutions and 12d Model developed by 12D Solutions are currently under test by Land Victoria and a few surveyors. Topcon Positioning Systems are in the process of developing Victorian ePlan options in Magnet Office (previously known as CivilCad).

The next section discusses the identified challenges that have affected the uptake of ePlan and the research programs developed to overcome them.

EPLAN IDENTIFIED CHALLENGES AND ONGOING INVESTIGATIONS

Land Victoria has identified the following challenges that need to be addressed to increase ePlan uptake:

- Surveyors acceptance of adopting a new method of producing plans i.e. business change
- Quality of the visualisation service and the need for supporting diagram exaggeration, enlargement and sheet definition – the visualisation service currently supports simple to medium type cadastral plans, however it cannot properly handle complex plans including a large number of lots and easements
- Support for building subdivisions – currently, the building footprints (return walls) are supported in ePlan, however the building subdivision plans including cross sections are not supported yet
- Need for surveyors accessing the most recent version of ePlan enabled software and the associated license costs – ePlan enhancements in the next few years will support the remaining types of cadastral plans, therefore surveyors need to use the most recent version of software packages until the implementation phase is completed
- Not all surveying software vendors currently support ePlan (e.g. Bentley)

In order to address the most critical challenges listed above, Land Victoria has commenced the following research programs:

ePlan Engagement Program

This program aims to investigate the subdivisional processes of the surveying firms and better understand how ePlan can fit into those processes. This program also enables surveyors to participate in the future development of ePlan. Land Victoria has conducted workshops with seven surveying firms to explore their business requirements. As part of this program, a case study is also underway with the data provided by the surveying firms. This case study aims to compare both PDF and ePlan application creation processes and realise the time/cost savings from ePlan services. The results of this case study will be distributed to the surveying industry in 2016.

ePlan Visualisation Enhancement Tool Design and Development

This research program aims to investigate the business and technological requirements for designing and developing a new tool for surveyors to control the visualisation of their ePlans. This tool is planned to be implemented in 2016.

Figure 2 illustrates the main components of the proposed ePlan Visualisation Enhancement Tool.

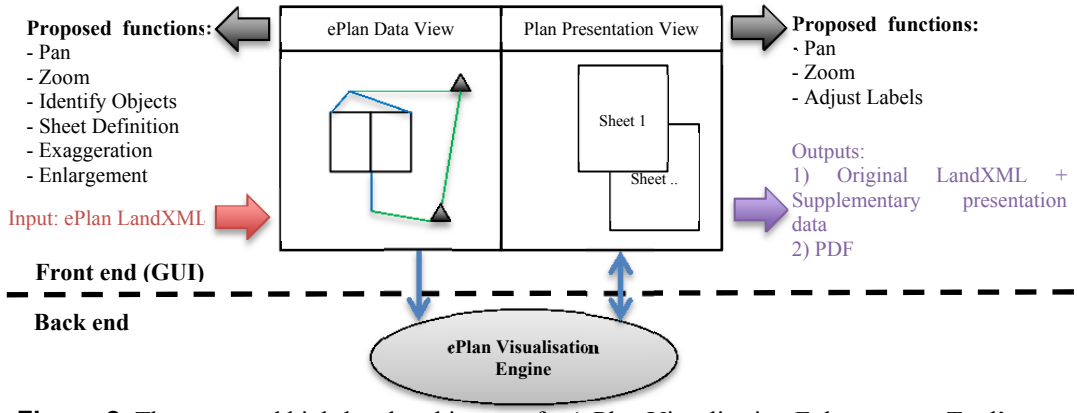

Figure 2. The proposed high-level architecture for 'ePlan Visualisation Enhancement Tool'.

The proposed Graphical User Interface (GUI) of this tool includes two main windows, as following:

i. Window 1) ePlan Data VIEW

The input of this window will be the surveyor's supplied ePlan LandXML file. Once the ePlan file is uploaded, the diagram including line works and labels will be displayed in this window. In addition to basic tools, the following three functions will be available in the toolbar:

- Sheet Definition – to draw rectangles to define the expected sheets
- Exaggeration – to distort the points particularly for narrow features and not-to-scale diagrams
- Enlargement – to draw rectangles for the enlargement areas, define the sheet where the enlargement is to be shown on, and define what is shown in the enlargement as opposed to what is shown on the original diagram.

When required, the user can refresh the second window (Plan Presentation View) to see the changes reflected in the PDF. To refresh the second window, two files need to be transferred to the ePlan visualisation engine in the backend – the surveyor's supplied ePlan LandXML and a supplementary file including the LandXML elements resulting from user's visualisation changes.

ii. Window 2) Plan Presentation VIEW

Once an ePlan file is uploaded to the first window, the second window represents exactly what the corresponding PDF looks like. The toolbar above this window will enable the user to pan, zoom in/out the screen and adjust the labels. Once a label is adjusted the new coordinates of its centroid needs to be transferred to the 'ePlan Visualisation Engine' for creating PDF. In this window, a value-added LandXML file should be able to be exported for submission to SPEAR. This file should include the surveyor's supplied ePlan LandXML and the supplementary elements added by the surveyor for presentation purposes.

3D Digital Cadastre Investigation

Land Victoria has been investigating the technical requirements for a 3D digital cadastre since 2014. Among the technical requirements, 3D cadastral data modelling and visualisation have been studied in detail. The main results of these studies are discussed below.

3D Data Modelling

In this investigation, the national ePlan LandXML Protocol was studied to see how it can handle modelling of different types of building subdivision plans. 3D modelling in ePlan has been previously investigated to some extent by researchers [2, 4, 5, 7]. However, in these studies, 3D modelling approaches in ePlan were not completely discussed and evaluated and various building scenarios were not tested. To investigate the potential of 3D object definition in the ePlan Protocol, a study in three phases was undertaken, as follows:

- Phase 1: modelling a simple building subdivision plan

In this phase, a simple building subdivision was modelled in ePlan using two possible approaches. In both approaches, the 3D objects were created using flat faces. The difference between them was the way those flat faces could join together. In the first approach, the faces common between two parcels (medium faces) had to be captured twice, however in the second approach all the faces were captured once and could be used multiple times for capturing different parcels. The results of this phase confirmed that the second approach is the most efficient approach for capturing 3D objects in ePlan due to its capability of supporting topology and reducing data redundancy.

- Phase 2: modelling a complex building subdivision plan

In this phase, a complex building subdivision including 12 lots and 2 common properties was modelled in ePlan based on the second modelling approach discussed earlier. Similar to the previous phase, this phase confirmed that the ePlan Protocol can support complex building subdivision plans with flat faces.

- Phase 3: modelling curved shaped building subdivision plans

In this phase, modelling of buildings with curved surfaces in the ePlan Protocol was investigated. This phase confirmed that the curved surfaces should be approximated in ePlan by flat faces (triangles/rectangles). As a result, the 3D objects with curved surfaces in ePlan might be an approximation of the real objects which would have different area and volume.

As an alternative to the ePlan Protocol, the potential of Building Information Modelling (BIM) for modelling building subdivision plans is also under investigation by Land Victoria.

3D Data Visualisation

As part of this investigation, Land Victoria has developed an interactive and web-based 3D visualisation prototype[6] based on WebGL technology to illustrate how the legal and physical objects of a building subdivision plan can be visualised and queried in a 3D digital system. This prototype system is being used for communicating with other stakeholders of a 3D digital cadastre for Victoria, e.g. planners, developers, surveyors, Owners Corporation managers, utilities, etc. Figure 3 shows a snapshot of this prototype.

(a) (b)

Figure 3. The Land Victoria 3D ePlan Prototype. (a) an overview of the prototype. (b) the result of a sample search for apartment 102.

[6] www.spear.land.vic.gov.au/spear/pages/eplan/3d-digital-cadastre/3dprototype/prototype.html

According to feedback the prototype can significantly help the understanding of 3D digital cadastre and its benefits to the wider community.

CONCLUSION AND FUTURE DIRECTIONS

This paper explored the current status of digital cadastre (known as ePlan project) in Victoria, Australia. It also discussed the main challenges that have impacted the uptake of ePlan in this jurisdiction. The most critical challenges include the surveyors acceptance of adopting a new method of producing plans, quality of the visualisation service which converts the ePlan LandXML file into PDF as the legal title diagram and support for 3D building subdivision plans. The paper also introduced the research programs defined by Land Victoria in order to address the ePlan challenges and increase its uptake among the surveying industry in the near future. The research programs discussed in the paper include the 'ePlan Engagement Program' which aims to gain a greater understanding of surveying firms' subdivision processes and how ePlan can fit into them, the development of a new tool to enable surveyors to improve the quality of the visualised PDF and define sheets, exaggerations and enlargements, and the investigation of the technical aspect of a 3D digital cadastre for Victoria comprising 3D data modelling, validation and visualisation components.
In addition to the above research programs, Land Victoria will continue to enhance the quality of its current ePlan visualisation service. Further investigations will be undertaken to identify the business requirements for supporting all plan-based dealings (e.g. Transfer of Land Act plans) in ePlan format. A pilot program is also being developed by Land Victoria that aims to utilise ePlans for upgrading the spatial accuracy of the Victorian map base.

ACKNOWLEDGMENTS

The authors would like to thank the ICSM ePlan Working Group and Land Victoria staff for sharing their thoughts and contributing to this paper.

REFERENCES

[1] AIEN, A., KALANTARI, M., RAJABIFARD, A., WILLIAMSON, I. AND SHOJAEI, D. Developing and Testing a 3D Cadastral Data Model: A Case Study in Australia. in *proceedings of XXII ISPRS Congress*, (Melbourne, Australia, 2012).

[2] CUMERFORD, N. The ICSM ePlan Protocol, Its Development, Evolution and Implementation. in *proceedings of FIG Congress*, (Sydney, Australia, 2010).

[3] FALZON, K. AND WILLIAMSON, I. Digital Lodgement of Cadastral Survey Data in Australia - User Needs. *Trans Tasman Surveyor Journal* (2001), jointly published by Australian Institution of Surveyors Australia and Institution of Surveyors New Zealand, 8-17.

[4] KARKI, S., THOMPSON, R. AND MCDOUGALL, K. Data validation in 3D cadastre. in Neutens, T., Maeyer, P. eds. *Developments in 3D Geo-Information Sciences,* Lecture Notes in Geoinformation and Cartography*,* Springer Berlin Heidelberg, 2010, 92-122.

[5] SHOJAEI, D., RAJABIFARD, A., KALANTARI, M., BISHOP, I.D. AND AIEN, A. Development of a 3D ePlan/LandXML Visualisation System in Australia. in *proceedings of the 3rd International Workshop on 3D Cadastres: Developments and Practices*, (Shenzhen, China, 2012).

[6] SOON, K.H. A Conceptual Framework of Representing Semantics for 3D Cadastre in Singapore. in *proceedings of the 3rd International Workshop on 3D Cadastres: Developments and Practices*, (Shenzhen, China, 2012).

[7] SOON, K.H. A Proposed Framework for Achieving High Level Automation in Cadastral Processing. in *proceedings of the FIG Congress*, (Kuala Lumpur, Malaysia, 2014).