Digital Survey Plans Review

NSW GOVERNMENT | Customer Service

Final Report

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Grosvenor Public Sector Advisory
CANBERRA | SYDNEY | MELBOURNE | BRISBANE
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Grosvenor Performance Group welcomes any feedback on the content or methodology of this review as well as any suggestions for future improvement.

Executive Summary

Almost half of the total outlay for a new house and land package in a greenfield estate in Sydney is estimated to be due to regulatory costs and statutory taxes[1]. The process of land development is also extremely complex and with limited transparency for end users. Digitalisation throughout the development process presents many opportunities to address these issues and improve outcomes for customers. Initiatives such as eConveyancing and ePlanning have already shown the potential for increasing speed, efficiency and transparency.

Efforts have been made to digitise the process of survey plan creation through to registration over the past decade, primarily through online lodgement of plans through the ePlan portal and the introduction of the LandXML (LXML) smart digital file format. Uptake for this format has remained low however, with only approximately 5% of plans lodged in LXML.

The NSW Department of Customer Service (DCS) engaged Grosvenor to conduct a review of digital survey plans; the three main objectives of the review were to:

- explore and explain why uptake of digital plans has remained low
- identify what opportunities exist for digitalisation of plans
- provide recommendations on the best way to progress digital plans such that benefits to surveyors, Government and other plan users are maximised.

It is recognised by most stakeholders that the initial attempt to introduce LXML did not sufficiently consider the views of the surveying industry. The Government and NSW Land Registry Services (LRS) are keen to ensure that any future changes have the input and support of the industry and, therefore, a major part of this review was engaging closely with surveyors to understand their sentiments relating to digitalisation. The review was primarily informed by consultations with surveyors, as well as representatives from many other stakeholders involved in the plan registration process, including councils and utilities, LRS, developers, software vendors and NSW Government entities such as DCS Spatial Services, the Office of the Registrar General, Transport for NSW and the Department of Planning, Industry and Environment. Approaches in other jurisdictions and from eConveyancing were also examined to identify applicable lessons for digital survey plans in NSW.

[1] The CIE, *Summary and methodology of the final research report: Taxation of the Housing Sector*, available at: https://hia.com.au/-/media/HIA-Website/Files/IndustryBusiness/Economic/research/cie-taxation-of-the-housing-sector.ashx?la=en (accessed 10/12/2019)

Engagement throughout the review from all stakeholder groups was high and there is a lot of support for digitalisation in various forms. Ultimately however, in the absence of mandating it, uptake of LXML has remained low for the following reasons:

- there are insufficient incentives for surveyors to adopt LXML as inherent benefits (such as improved quality control or efficiency in plan preparation through utilising existing LXML plans) are not readily available or apparent. Many surveyors reported that they do not know how to access existing LXML files or who to request them from
- poor rendering of LXML files results in surveyors having to create both a TIFF image and a LXML file; this requires additional effort in most software packages and clients are typically unwilling to pay for this, except where it may speed up registration (particularly for larger developments with high holding costs)
- there is a perception by some surveyors that LXML may be moving away from the current monument-based approach and favours data over decisions; likewise, there is resistance to the concept of the data being the source of truth instead of the representation on the plan image
- benefits from digitalisation more broadly (such as approvals and associated documents) are disaggregated across a complex array of stakeholders and insufficient for any single group to act on in the absence of state-wide leadership and coordination.

Whilst the opportunities for digitalisation vary somewhat by user group, overall there are three key consistent themes, namely: improving efficiency, accuracy and customer service. The most salient prospects to achieve these include the following:

- **pre-populated documents (with automated validation) and easily ingestible metadata** – this will reduce manual data entry requirements for all stakeholders and improve accuracy through minimising typographic errors
- **digital signatures and a portal for managing associated documents** – this will reduce time currently spent on administering physical 'wet' signatures and enable approvals to occur in parallel, resulting in increased speed of registration and improved transparency of process for customers
- **smart plan data for automated validations and examination** – this will facilitate improved accuracy, more efficient examination and faster registration (through lower requisitions); in turn reducing the risk of professional indemnity and Torrens Assurance Fund claims, as well as improving the accuracy and usefulness of the NSW Spatial Cadastre. Smart plan data may also enhance survey practice by including additional boundary evidence (such as photos) and should be easily accessible for surveyors to assist in plan preparation.

Ultimately these will all contribute to faster land access and reduced costs for homebuyers.

To pursue these prospects barriers need to be overcome, including residual industry resistance from the initial roll out of LXML and a lack of clear ownership for solution design and implementation. A four-step high-level roadmap for change will ensure that these issues are resolved and help progress digitalisation; the four steps are as follows.

1 – Confirm outcomes: the overarching aim of the digital survey plans reform should be agreed upon and articulated to guide design and implementation and inform communications with stakeholders, particularly surveyors who need to be convinced of the benefit of digital plans. This will also prevent the perception of digital for digitals sake and ensure efficiency, accuracy and customer service (or other agreed outcomes) remain central tenets for any change initiatives.

2 – Agree governance: clear roles, responsibilities and accountabilities should be established; this would likely include LRS for solution design and implementation and DCS for governance and policy as well as stakeholder engagement and communications.

3 – Design solutions: technical solutions should be designed for three main areas, deposited plans, strata plans and approvals and associated documents. The designs should address the current issues and opportunities raised by stakeholders and be cognisant of other programs such as 'Re-imagining plans', ePlanning and Cadastre 2034. An assessment framework (which considers impact alignment to user needs and ease of implementation) has been proposed within this report to assist in solution design and evaluation. The final designs should be compared and prioritised prior to implementation. This may include a multi-stream approach where solutions for simpler elements are implemented while more complex design remains ongoing – however it is likely that the interdependencies between elements will require a somewhat unified approach. Consultation and continued engagement with surveyors and other industry stakeholders should be maintained throughout the solution design phase.

4 – Implement solutions: Once the technical solutions have been proposed and the assessment framework has been used to understand their impact and feasibility, changes should be prioritised for implementation. Equity of change should be considered to ensure disadvantages to stakeholder groups (e.g. rural vs metro, big vs small firms, large greenfield development vs two-lot subdivision) are minimised where possible. Likewise, change management elements must be adopted including continued stakeholder engagement, co-design, pilot-testing and staged implementation, as well as support for users with high barriers to uptake. Mandating and legislative changes may be required, depending on the technical solution. In the case of mandating, an appropriate notice period should be given with the timing designed with, and agreed upon, by industry representatives.

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1 Introduction

The New South Wales (NSW) land titling system is undergoing a significant period of digital transformation. Currently, 96%[2] of all possible dealings are lodged electronically with NSW Land Registry Services (LRS).

In contrast, the lodgement of digital survey plans for registration at LRS is lagging. Despite the Government introducing the LandXML (LXML) format for plan lodgement in 2010, only 5% of plans are currently lodged using this intelligent data format.

The benefits of digital survey plans are substantial and may include cost savings for LRS, Government and industry, improved customer services and risk reduction by protecting the integrity of the Cadastre. However, several issues with LXML have largely prevented these from being realised and there is a recognition that the attempt at digitalisation of plans did not adequately consider the views of or impact on the surveying industry.

1.1 Objectives

The NSW Department of Customer Service (DCS) engaged Grosvenor to work with industry stakeholders to undertake a review of digital survey plans. The review has three key objectives, namely to:

- explore and explain why uptake of digital plans has remained low
- identify what opportunities exist for digitalisation of plans
- provide the Government and LRS with recommendations on the best way to progress digital plans such that benefits to surveyors, Government and other plan users are maximised.

Through delivering upon these objectives, the review will support the efforts of the DCS-led Digital Survey Plans Program, which has the following objectives in transitioning to digital survey plans:

- make it easier for industry to subdivide developable land while protecting the integrity of the cadastre
- improve Government services to the property sector
- make new housing more affordable.

Critical to this review was strong engagement with the surveying industry, to avoid repeating the mistakes of the past and ensure the sentiment of surveyors is clearly considered in any future changes.

[2] https://www.registrargeneral.nsw.gov.au/property-and-conveyancing/eConveyancing/eConveyancing-Statistics (accessed 02/12/2019)

1.2 Report structure

This report is structured as follows.

Chapter	Contents
Introduction	Details of the objective of the review, contextual background information relating to the surveying industry and the history of digital plans, and a summary of the methodology and limitations of the review.
Findings	Summaries of findings grouped by the key stakeholders involved in the plan registration process as well as the various benchmark jurisdictions reviewed. Detailed findings are contained within Attachments A to H.
Conclusions	Answers to the key questions aligning with the three objectives: > why has uptake of digital survey plans been low? > what opportunities exist for digital survey plans? > what needs to be overcome to increase uptake of digital survey plans?
Recommendations	A four-step roadmap recommended in order to pursue and progress opportunities for digital survey plans.
Attachments	Detailed findings by stakeholder group and benchmark jurisdiction, as well as sample scenarios to support the recommendations.

1.3 Background

Land Surveying is not an exact science. Establishing title boundaries, or re-establishing them, is at least as much about the law, its interpretation and the gathering of evidence as it is about measurement and position fixing.

Bell and Cleary, 2001[3]

About the surveying industry

Surveyors play an integral role in the construction of roads, infrastructure and buildings, as well as planning and designing land subdivisions; their tasks include:

- measuring distances, directions, and angles between points on, above, and below the earth's surface
- establishing official land and water boundaries
- preparing plots, maps, and reports
- working alongside developers, architects, and construction managers.

Registered surveyors are the only practitioners warranted with direct management of the land boundary system. They interpret legal aspects of land ownership; providing an understanding of land, water and air, as well as the surrounding environment, to protect development from impediments and unlock latent value[4]. They often act as agents for developers and help with, or administer, the plan approval and registration process.

As of 30 June 2019, there were 1,059 registered surveyors in NSW, of which 928 were land surveyors, 116 were mining surveyors and 15 were both land and mining surveyors[5]. Henceforth, throughout this report, the term 'surveyors' is taken to refer to land surveyors.

As of 2017, the average age of surveyors was 52, with the largest proportion aged 61. The surveying industry is male dominated, with men representing approximately 97% of the industry.

The majority of enterprises within the industry are sole proprietors and partners, with 95.7% of enterprises consisting of less than 20 employees. Registered companies consist of 12.8% of the industry, and of those, 59% are private organisations.

[3] Bell, K.C. & Cleary, M., 2001, Protecting the Integrity of Victoria's Cadastre – Managing the Risks, Australian Surveyors Congress, Brisbane

[4] BIS Oxford Economics, 2019, *Determining the Future Demand, Supply and Skills Gap for Surveying and Geospatial Professional,* available at: http://admin.acsnational.com.au/uploads/9/docs/Website%20Full%20report%20Determining%20the%20Future%20Demand,%20Supply%20and%20Skills%20Gap%20for%20Surveying%20and%20Geospatial%20Professionals%20-%202018-2028.pdf (accessed 11/10/2019)

[5] Board of Surveying and Spatial Information (BOSSI), 2019, *BOSSI Statistical Review 2018-2019*, available at: https://www.bossi.nsw.gov.au/__data/assets/pdf_file/0010/222949/BOSSI_Statistical_Review_2019.pdf (accessed 11/10/2019)

A significant proportion of the industry's revenue is derived from cadastral and boundary surveying work within the residential construction market. Of the surveyors engaged with as part of this review, on average 36% of their total workload was preparing plans for registration. The process for preparing plans for registration and the main user group involved at each phase is summarised in the diagram and descriptions below.

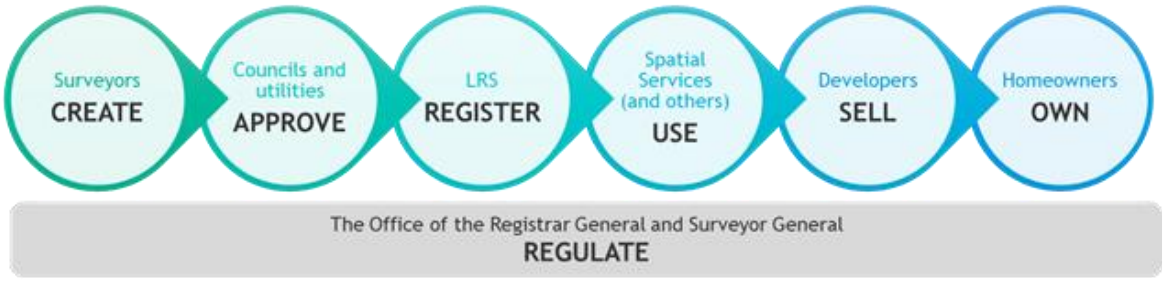


Figure 1 - Survey plan registration journey

- **Surveyors create** – surveyors are responsible for plan preparation and administration, including reviewing historic plans, conducting field work, producing plans and often administering the process of obtaining all necessary approvals before lodgement with LRS.
- **Councils and utilities approve** – as part of a development application (DA) a series of conditions of consent are stipulated by councils and utilities. These entities subsequently review the plans to confirm their conditions have been met, then issue approvals, after which the certifying authority can release the subdivision or strata certificate.
- **LRS register** – LRS conducts an examination of plans lodged to ensure they comply with legislation and guidelines; it then facilitates the updating of the Titles Register. LRS are contractually restricted from providing electronic survey plans to some third-party consumers, including surveyors, councils, utilities and developers; this information is provided exclusively through Information Brokers. Information Brokers have not been considered independently of LRS in this review, however, would need to be when progressing the recommendations outlined in this report.
- **DCS Spatial Services (and others) use** – DCS Spatial Services (DCS Spatial Services) obtain registered plans from LRS and add these to the NSW Spatial Cadastre within ten days for use by surveyors, planners and other stakeholders. Plans are also utilised by multiple other ancillary stakeholders such as other Government agencies, lawyers, valuers and banks; the outcomes sought by these groups are similar in nature to DCS Spatial Services and the groups below.
- **Developers sell** – after the title has been created developers are able to finalise the sale of individual lots to homeowners.
- **Homeowners own** – the title is used by homeowners to provide proof of ownership of the parcel of land.
- **The Office of the Registrar General (ORG) and the Surveyor General (SG) regulate** – ORG is the main regulator of land titling, including oversighting LRS; the SG has responsibility for regulating survey practice; both have a strong focus on improving outcomes for end users.

Each of the main 'customers' that interact with the plan registration process have unique roles and objectives. Nonetheless, among them all is a common overall desire for a secure, intuitive process that ensures a reliable and cost-effective outcome.

Digital change agenda

The NSW Government has been proactive about pursuing a digital change agenda to make Government more agile, responsive and accountable for the services delivered to and on behalf of NSW citizens[6]. This has touched and will continue to touch, many areas of public life, including the process of creating a new home. It has been recognised by the Government that the experience of customers and NSW citizens, who are navigating the process of creating a new home, needs to be significantly improved. For the eventual owners at the end of the process, this means lower costs with greater efficiency and transparency.

A recent study by the Centre of International Economics (commissioned by the Housing Industry Association of Australia) revealed there is a significant financial burden on Sydney house prices associated with delays from regulatory red tape. The report suggested that the average sum of regulatory costs and statutory taxes for a new house and land package in a greenfield estate in Sydney is $400,000, almost half of the average total outlay ($841,000) and the highest ratio in the country. The report noted that one of the most significant cost contributors is interest charges incurred by developers due to unreasonable delays arising from Government policies and decisions (mostly in the development approval stage). Besides directly adding to developer costs, this impacts the GST collected and the stamp duty paid by the purchaser[7]. Whilst quantifying the cost contribution of survey plan registration (or potential savings from digitalisation) was beyond the scope of this engagement, it is undoubtedly a large amount in aggregate.

More broadly, the Government is committed to improving customer experience and delivering greater efficiency and transparency. It has recently introduced the following six customer service commitments which will help communicate and prioritise service design[8] and delivery.

[6] https://www.digital.nsw.gov.au/beyond-digital/ministers-foreword (accessed 11/11/2019)

[7] The CIE, *Summary and methodology of the final research report: Taxation of the Housing Sector*, available at: https://hia.com.au/-/media/HIA-Website/Files/IndustryBusiness/Economic/research/cie-taxation-of-the-housing-sector.ashx?la=en (accessed 10/12/2019)

[8] https://www.dpc.nsw.gov.au/programs-and-services/nsw-customer-service-commissioner/customer-commitments (accessed 1/10/2019)

A major part of the Government's drive towards improving outcomes in the home ownership domain has been through electronic conveyancing (eConveyancing). This is a more efficient, accurate and secure way of conducting the settlement and lodgement stages of the conveyancing process. A study by KPMG revealed significant benefits to industry from eConveyancing, including:

- 75% time saved per transaction
- risks associated with human error almost eliminated
- settlement day can be more confidently set
- funds from sales available sooner.

Adoption of eConveyancing has been positive, with a steady increase since its introduction to almost 100% usage as of July 2019 (as seen in Figure 2 on page 14).

Another related endeavour by the Government has been the creation of the ePlanning portal, which provides an online environment where customers can access planning services and information at any time. The ePlanning portal has improved application determination times, increased transparency of the planning system and improved accountability of all stakeholders. Linking these two digital initiatives is the Digital Survey Plans Program, which will help deliver an end-to-end digital service for customers.

History of digital survey plans

The limitations of a paper or PDF based approach for plan lodgement and registration have long been recognised as causing issues in the land development process – particularly stemming from delays created by a linear process of review and approval[9]. For almost two decades, various jurisdictions across Australia have pursued a shift towards digital cadastral data that can be shareable, discoverable, retrievable and downloadable. This has largely been through the Inter-Governmental Committee on Surveying and Mapping's (ICSM) ePlan working group, who were responsible for the introduction of LXML in states across the country, including NSW. A timeline of the design and delivery of LXML in NSW is shown below and discussed in more detail overleaf.

2003	ICSM ePlan working group convened
2004-05	ePlan model designed
Jul 2006	LXML 1.1 released which supported ePlan model
Mar 2009	Preliminary LXML scheme given to software vendors
Jun 2009	LXML used by LPI to register land title plans internally
Sep 2009	National ePlan model finalised following software vendor feedback
Nov 2009	Final national LXML scheme formally published
Dec 2009	Pilot testing by LPI using select surveyors lodging LXML files
Apr 2010	LXML opened to the public

[9] Falzon, K., & Williamson, I. P. (2001). *Digital lodgement of cadastral survey data in Australia - user needs*. Trans-Tasman Surveyor

ICSM is responsible for leadership, coordination and standards for surveying in Australia and New Zealand[10]. ICSM has long been a strong advocate for digital plans. In 2003, after initial investigations by Queensland, ICSM sponsored a working group to develop a digital cadastral survey information transfer protocol to allow for consistent transfer of data between surveying entities and the jurisdictions. Through 2004 and 2005 the working group developed a generic logical model for a cadastral survey, then investigated suitable international standards to implement the model. Finding that no existing standard fully supported the model and, with New Zealand having adopted LXML 1.0, the working group partnered with the producers of LXML. In 2006 LXML 1.1 was released, fully supporting the ePlan model.

The ePlan LXML file is an intelligent digital file that contains cadastral plan and survey information including:

- survey measurements
- dimensions of the parcels
- interests in land (e.g., easements and restrictions)
- land parcel descriptions
- administrative information (e.g., locality)
- owners' corporation schedules
- survey marks
- traverses
- radiations
- connections to title
- annotations
- plan approval status
- stakeholders' signatures[10].

In March 2009 the ePlan working group[11] provided a draft copy of the LXML schema to software vendors to enable them to develop packages capable of producing LXML files suitable for lodgement in each jurisdiction. The NSW Land and Property Information (LPI) started using ePlan for the electronic lodgement and processing of land title plans in June 2009. On 29 September 2009 the National ePlan model for LXML was finalised following feedback from the software vendors. The final version of the LXML schema was ratified by the ICSM on 19 November 2009 and then formally published. Through December 2009 and January 2010, LPI ran a pilot program of ePlan by inviting a number of selected surveyors to lodge both a LXML file and a TIFF image of the land tile plan, using the TIFF image as a backup in case of problems. In April 2010, the LXML ePlan lodgement facility was made available to the public for use online through the LPI SIX portal.

[10] Olfat H., et al, (2018) *Strategic Actions for Increasing the Submission of Digital Cadastral Data by the Surveying Industry Based on Lessons Learned from Victoria, Australia*, International Journal of Geo-Information

[11] Which represents all Australian states and territories involved in the implementation of ePlan (including NSW).

Current state

Surveyors are currently able to lodge plans through three different channels:

- manual lodgement of a printed plan (which is then scanned by LRS); these represent approximately 20% of total plans lodged
- digital lodgement of a TIFF file (known as ‘ePlan’); these represent approximately 75% of total plans lodged
- digital lodgement of a LXML file and a TIFF file (known as ‘Digital Plans’ or ‘EPlan’); these represent approximately 5% of plans lodged.

Since its introduction the adoption rate of LXML has remained low. This varies significantly to the adoption of eConveyancing (mandated for all mainstream documents from July 2019), which, as visible below, has risen sharply since 2016.

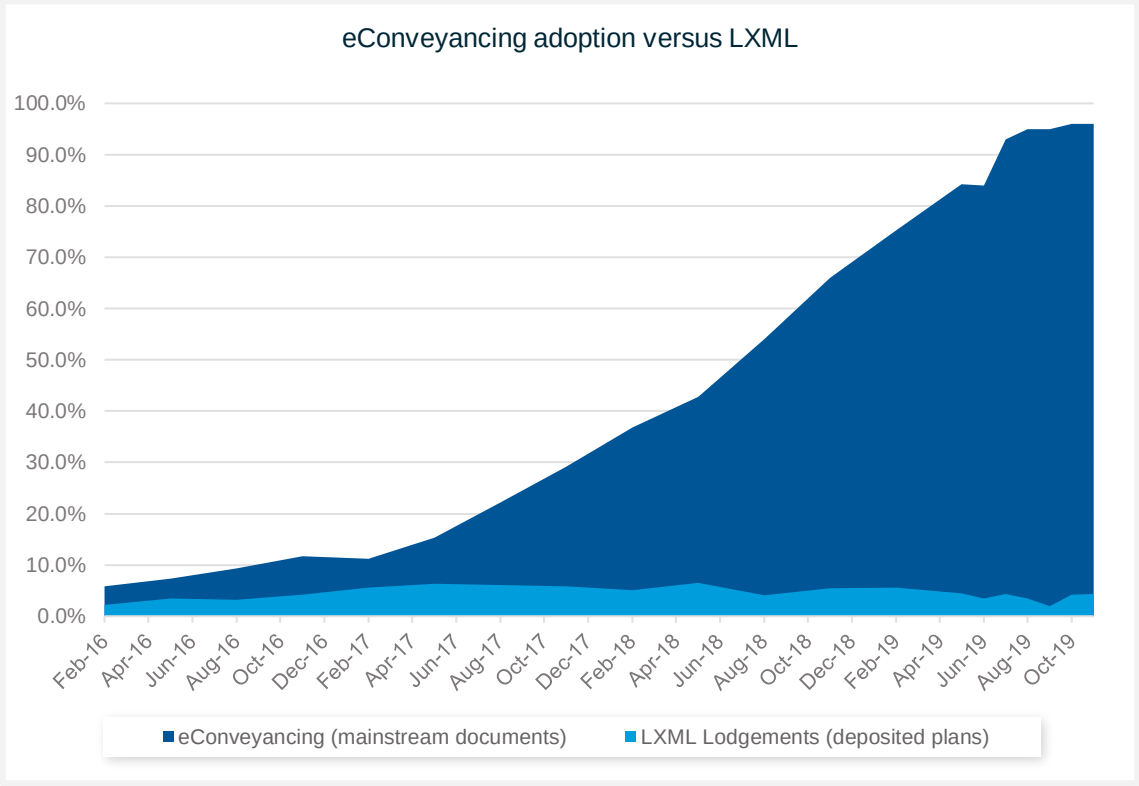


Figure 2 - eConveyancing adoption versus LXML

Despite the low lodgement rate, LXML plans account for a large portion (34% in 2018) of all new lots created from deposited plans; over 50% of LXML plans lodged are for 1-10 lots, but the average number of lots per LXML plan is 19 (compared to an average of 2.5 lots per TIFF plan). As shown in Figure 3 overleaf, the vast majority of LXML plans lodged are for subdivision (79%); only one strata plan has been lodged with LXML to date (as a proof of concept).

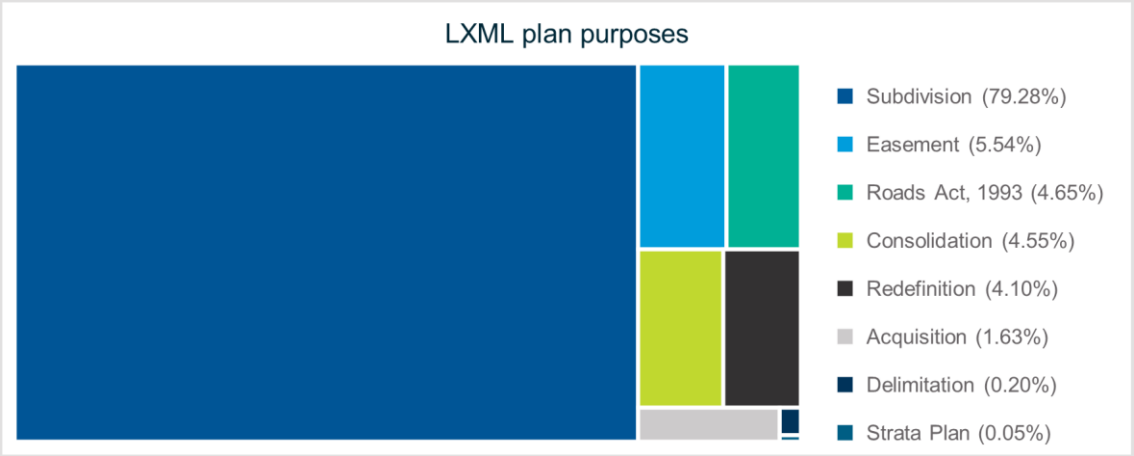


Figure 3 - LXML plan purposes

It was estimated through consultations that the creation of a typical TIFF survey plan for a subdivision involves the following breakdown of effort:

- **pre-calculations** – approximately 10% of total effort; this involves obtaining existing DPs and then conducting pre-calculations and preparations in a calculation software package
- **field work** – approximately 30% of total effort; this involves taking measurements and records on site (typically utilising a total station with comprehensive digital capabilities including gathering distance and angular information as well as photos)
- **calculations, finalisation and drafting** – approximately 60% of total effort; this involves calculations and manual adjustments in a calculation software package, then exporting to drafting package (e.g. AutoCAD or BricsCAD) for plan creation – draftspeople are often used for drafting (they may or may not be trained in LXML, nor understand the surveying process enough to use it).

How surveyors create LXML varies significantly based on the software package used. Landmark dominates the software for LXML plans lodged, accounting for 42% of all LXML plans lodged (the next closest is Magnet Office with 27%). One software package is purpose built for surveying and the raw data is used to generate the TIFF and LXML, which are identical. Other packages may not have the same level of LXML integration and after calculations are done in the calculation packages one of two routes may occur:

- a DXF/DWG can be exported into a drafting package, which then creates the TIFF and the LXML file (it has geometry and the data attached); or
- a LXML file is created from scratch based on the TIFF.

The current process is not what was envisaged at the time LXML was introduced. The initial concept was to create a LXML file only, which could be rendered automatically to generate a plan image suitable for lodgement. However, the quality of rendering has prevented this and forced the surveyor to create a TIFF in addition to the LXML.

1.4 Approach

Methodology

Grosvenor was engaged by DCS to conduct the Review of Digital Survey Plans in September 2019. To ensure the perspectives of relevant stakeholders were appropriately considered, the review involved significant engagement with stakeholders across the end-to-end process to develop, lodge and use survey plans. Insights gathered from stakeholders were supplemented with a review of relevant existing documentation and data.

A comprehensive stakeholder engagement plan was developed, which detailed the objectives, approach and key lines of questioning for each stakeholder group. This was reviewed and approved by the Digital Survey Plans Steering Committee prior to Grosvenor contacting stakeholders.

Stakeholder engagement involved the exploration of the following elements:

- lessons learnt; why adoption of digital survey plans has not been greater
- analysis of stakeholders' perspectives and perceptions
- how previous/current initiatives align with the existing plan creation process within private sector
- analysis of successful implementations of digital survey plans or other relevant digital transformation initiatives (e.g. eConveyancing) interstate and overseas.

Consultations included:

- surveyors in Sydney and Newcastle (two focus groups with approximately 10 firms in attendance at each, varying in size and scope)
- regional surveyors (phone consultations with 11 firms of varying size and location)
- utilities and councils (phone and face-to-face consultations with three councils and four utilities, both regional and metropolitan)
- LRS (face-to-face consultations and demonstrations with various team members and executives)
- developer representative (phone consultations)
- software vendors (phone consultations or face-to-face consultations with Position Partners, 12d, LISCAD)
- benchmark jurisdictions (phone consultations with representatives from relevant entities in New Zealand, Western Australia, South Australia, Queensland and Victoria)
- Government entities (phone and face-to-face consultations and workshops with DCS Spatial Services (including the SG), ORG, Department of Planning, Industry and Environment (DPIE) ePlanning team, Transport for NSW (including Roads and Maritime)).

Details of the consultees can be found in *Attachment A – Consultee details*. Most surveyors responded to a small written survey and a number of consultees also provided additional information via email. It was observed throughout the consultations that the industry is highly engaged and keen to remain involved in designing any future changes. A 2018 survey of the surveying industry conducted by LRS (distributed to 840 surveyors with 141 responses received) supplemented the consultations to inform surveyor sentiment. Other documentation and data was also reviewed, including implementation of similar initiatives in other jurisdictions and details of LXML usage in NSW provided by LRS.

The ultimate outcome of the review has been to provide the Government with a way to progress towards increased adoption of digital survey plans in NSW. This has been delivered through the high-level roadmap (supported by detailed examples and an assessment framework) in the recommendations.

Limitations

No significant limitations were encountered as part of this review. However, it should be noted that the review deals with complex technical matters which have a number of interdependencies. The findings, recommendations and conclusions are based primarily on anecdotal feedback from stakeholders. We have not validated the technical feasibility of the current state nor the set of sample scenarios. As such, it is recommended that continued engagement with experts in surveying and software is maintained through solution design. In absence of a detailed solution no cost-benefit analysis has been undertaken for the possible scenarios. This should be conducted as part of the development of a business case for any material changes.

2 Findings

A critical element of the review was exploring the sentiment of the stakeholders involved in the creation, review, registration, use and regulation of survey plans; including:

- surveyors
- councils and utilities
- NSW Land Registry Services (LRS)
- DCS Spatial Services (DCS Spatial Services); including the Surveyor General (SG)
- NSW Office of the Registrar General (ORG)
- developers
- software vendors.

For each stakeholder group this typically included understanding:

- the fundamental outcomes sought from the lodgement of survey plans
- perceived opportunities from digitalisation
- potential barriers to achieving these.

Other state entities including the Department of Planning, Industry and Environment (DPIE) and Transport for NSW (TfNSW) were consulted and the input of the representatives from these organisations has been considered in the conclusions and recommendations that follow.

Additionally, other jurisdictions in Australia and New Zealand were examined, to ensure lessons learned from their efforts to digitise survey plans are considered for future changes in NSW.

2.1 Surveyors

Surveyors are pivotal stakeholders, not only do they produce plans themselves, they also often act as the lodging party and coordinate the gathering of approvals and endorsements. Understanding the sentiment of surveyors, particularly why the uptake of digital plans has been low, is therefore vital to the design of any future solution.

The key findings from engagement with surveyors have been categorised into 12 themes and summarised below. Expanded details of these can be found in *Attachment B – Surveyor sentiment*.

An important observation underpinning all of these themes is the general willingness of the industry to be involved, demonstrated by the high level of engagement from surveyors in this review, regardless of location or size of their firm.

Theme	Summary of findings for surveyors
Outcomes sought	Surveyors' primary objectives from the process of plan creation to registration are client satisfaction and professional integrity.
Attitude to digitalisation	Digital change is seen as important to remaining contemporary and it is recognised that there are opportunities for improvements, particularly in the approvals and associated documents space. However, it is felt that previous efforts have focused on benefits to Government and LRS only and there is some ambiguity over the problem that LXML is supposed to solve.
Issues with LXML	LXML has frustrated surveyors principally due to the additional effort (estimated to be 30% on average) required to produce both a TIFF and a LXML (a result of the low quality of rendering from LXML). It currently provides little intrinsic benefit to surveyors and, except where it enables faster registration for developments with large holding costs, has limited demand from clients. Additionally, there is a fear that the format favours data over decisions, which are seen to be vital to maintaining the integrity of the monument-based cadastre.
Benefits of LXML	Some surveyors utilise LXML to assist with quality assurance (QA), enabled both through the inherent requirements of the file and automated validation. LXML can also enable faster plan creation for staged division of greenfield sites.
Incentivising LXML	Prioritised lodgement was seen to be a compelling incentive for developers to pay additional costs to surveyors to create a LXML. Additionally, if the LXML was simpler and easier to create, as well as the only file required, then surveyors would be more likely to utilise it.
Attitude to mandating LXML	Surveyors consulted were pragmatic and believe that the industry will adapt to LXML if mandated, but that any additional costs will be passed on to clients.
Plan contents	The concept of a 'lite' LXML was raised by some surveyors who suggested that, whilst almost all currently depicted survey information is relevant to

Theme	Summary of findings for surveyors
	other surveyors, there is an opportunity to simplify digital requirements. Digitised information on a lite LXML should, at a minimum include parcel information (boundaries, lot numbers, dimensions and area) and easements.
Alternative file types	The design and construction industries are dominated by CAD formats (DWG and DXF); most surveyors are highly familiar with these and create them to generate the lodged image. Some councils and utilities also request plans in CAD formats for review and ingesting into their databases.
Strata plans	The relative simplicity of strata plans means that some surveyors believe they are an ideal candidate for digitalisation. There are, however, some concerns over data misuse given that linework in strata plans is often generalised.
Approvals and associated documents	Adopting digital signatures is seen to be the biggest opportunity to improve efficiency of the currently time-consuming approvals process (such as endorsements by councils and utilities). There are also opportunities for smart associated documents (such as Section 88B instruments and strata by-laws) to minimise manual data entry and errors.
Other opportunities	Other opportunities for improvements to the current processes were identified, including: > automated notification upon registration by other surveyors of pre-allocated plan numbers (PPN) over parcels adjacent to their client's > separation of spatial cadastre (including the NSW Spatial Cadastre) updates (as a proposed layer) to the registration process > improved boundary decision evidence (e.g. photos) in the metadata.
Other findings	There are currently mixed feelings about the quality of requisitions and some frustration about the multiplicity of spatial cadastral datasets across the state.

2.2 Councils and utilities

Councils and utilities provide approvals for plans and are the primary stakeholders that surveyors engage with prior to lodgement with LRS. Councils are typically the certifying authority and sign the subdivision certificate, confirming all conditions of consent for the development have been met. The conditions of consent usually incorporate sign-off of requirements from other relevant agencies (utilities in many cases). Within both councils and utilities, the main teams which interact with plans are Property and Planning (known as Development Services within some utilities). Understanding the sentiment of councils and utilities is vital in two regards; firstly plans are with them for a significant duration of the survey registration process and secondly, they are important consumers of plans.

The key findings from engagement with councils and utilities have been categorised into the following themes and summarised. Expanded details of these can be found in *Attachment C – Councils and utilities sentiment*.

Theme	Summary of findings for councils and utilities
Property	Property teams use information from plans to: > update property records to deliver services and determine rates > spatially assess planning conditions that apply to land parcels > record the location of assets (for maintenance and repair). Many maintain their own spatial cadastral databases and update these with DXF/DWG files (though only minimal information is required compared to a full survey plan).
Planning	Planning teams typically review and certify or endorse plans and associated documents. The administration and management of this is currently quite labour intensive and highly manual.
Opportunities for digitalisation	Both Property and Planning teams from councils and utilities strongly support enhanced digitalisation. The perceived opportunities related primarily to: > minimise manual data handling through ingestible metadata > provide faster turnaround of documents through electronic or digital signatures > provide transparency of status (for customer and approvers) > reduce errors through validation of smart documents. Additionally, it was noted that there is a strong focus on improving customer experience within these organisations and an appetite for digital change.

2.3 Land Registry Services (LRS)

LRS performs an important function in maintaining the integrity of the Titles Register. It acts as a quality gatekeeper for plans, responsible for examining lodged plans to ensure only those which meet legislative and regulatory requirements are registered. Understanding the sentiment of LRS is vital given the significance of the examination and registration process.

The key findings from engagement with LRS have been categorised into the following themes and summarised. These are expanded upon in *Attachment D – LRS sentiment*.

Theme	Summary of findings for LRS
Outcomes sought	LRS exists to maintain the integrity of the Titles Register and desires to improve plan lodgement, examination and registration outcomes for customers and citizens of NSW. As a commercial entity it must also ensure short term costs deliver long term benefits to LRS and their customers.
Opportunities for digitalisation	LRS is very keen to see an increase in uptake of digital plans as they have the potential to enable more efficient examination, as well as an increase in the quality of plans, and therefore, the Titles Register
Barriers to change	LRS is mindful of the previous attempts to introduce LXML without due consideration being given to the views of surveyors and is reluctant to introduce any solution without close and ongoing consultation and co-design with all stakeholders.

2.4 DCS Spatial Services

DCS Spatial Services is responsible for the provision of spatial and land information services for NSW. Its primary objective is to utilise spatial products and services in support of the NSW Government Digital Strategy to improve services to the community, Government and industry. Understanding the sentiment of DCS Spatial Services helps to identify the necessary functionality any digital solution must have to meet the needs of Government.

Additionally, the Surveyor General (SG) is a part of the DCS Spatial Services division and has responsibility for regulating surveying practice within NSW. Whilst the SG is co-located with the ORG in Figure 1 on page 10 to highlight its regulatory focus, the findings for the SG are included below as part of DCS Spatial Services, in alignment with its organisational structure.

The key findings from engagement with DCS Spatial Services staff have been categorised into the following themes and summarised. These are expanded upon in *Attachment E – DCS Spatial Services sentiment*.

Theme	Summary of findings for DCS Spatial Services
Outcomes sought	DCS Spatial Services seeks to maintain the currency, completeness and accuracy of the NSW Spatial Cadastre. The SG in its regulatory role seeks to deliver improvements to surveying practice and ensure standards are maintained.
Opportunities for digitalisation	Multiple opportunities for digitalisation are perceived by DCS Spatial Services; these include: > improved quality of information in the spatial cadastre > faster ingestion into the spatial cadastre and related datasets by reducing manual entry requirements > improved interoperability with other datasets (e.g. Survey Control Information Management System, transport network, imagery) > the ability to propagate and improve the survey control network > the potential to increase use of the NSW Spatial Cadastre through better meeting the needs of users > progression towards the future visions of Cadastre 2034 and support for development of a digital twin (including 3D and 4D spatial cadastre). With the SG's regulatory focus, it is also felt that digitalisation can improve efficiency and accuracy of surveying practices; including through facilitating enhanced evidence for defensibility of decisions of boundaries.
Barriers to change	It is recognised by DCS Spatial Services that the previous approach to digitalisation of the plan registration process did not sufficiently consider the views of the industry and that this must be overcome.

2.5 Developers

As the main client in the process of plan registration, developers have a clear set of interests and objectives. Their role and engagement in the process varies depending on the scale of the organisation, from high frequency users such as multi-billion-dollar developers with inhouse surveying teams, to one-off 'mum and dad' developers. Regardless of the scale, the developers' sentiment is critical to appreciate in order to ensure strong outcomes for the ultimate end user - homeowners.

The key findings from engagement with developers have been categorised into the following themes and summarised below; these are expanded upon in *Attachment F – Developer sentiment*.

Theme	Summary of findings for developers
Outcomes sought	Developers noted a desire to have plans registered as quickly as possible with the least complexity, in a cost-effective manner.
Opportunities for digitalisation	Two significant opportunities for improved customer service through digitalisation were raised by developers: > speed of registration – through automated examination and registration as well as digital approvals and associated documents > transparency of the process – through a portal where the status of plans can be easily viewed.
Barriers to change	It is felt that there are some historic issues with LXML which need to be overcome to affect change in the market. This can be addressed through a high level of engagement including educating surveyors and developers of the benefits of any changes.

2.6 Office of the Registrar General (ORG)

ORG is responsible for ensuring the integrity of the NSW land title system. It acts as a policy and legal advisor, regulator, review body, litigator and driver of reforms in land titling. In all these areas, particularly in its capacity as the regulator and driver of reforms, the sentiment of ORG must be considered for any possible changes. ORG also has insights from the introduction of eConveyancing that are highly relevant for digital plans.

The key findings from engagement with ORG have been categorised into the following themes and summarised; these are expanded upon in *Attachment G – ORG sentiment*.

Theme	Summary of findings for ORG
Outcomes sought	ORG is ultimately responsible for the integrity of the NSW land titles system and for overseeing LRS's performance in maintaining the security, performance and availability of the system. It sees its customers, in the context of survey plans, as landowners, surveyors, conveyancers and developers. The ORG desires to increase efficiency, accessibility and availability to ensure better outcomes for these customers.
Opportunities for digitalisation	ORG is keen to progress digitalisation and sees the potential benefits that digital plans can bring to all customers involved, with the end result being: > faster registration of plans > enhanced accuracy of plans from automated examination and data control (minimising boundary errors and mistakes in documents) in turn reducing conflicts between surveys and the cost of resolving disputes and improving the integrity of titles > reduced Torrens Assurance Fund (TAF) claims from errors on registered plans > assistance in its regulatory role through rapid data insight extraction.
Lessons from eConveyancing	Through the introduction of eConveyancing ORG learnt some valuable lessons that can be applied to the digitalisation of plans, particularly relating to the change management required. These include the importance of: > clear benefits for industry from the change > clarity of roles and responsibilities (for governance and policy versus solution and business rules) > communication and engagement with stakeholders to encourage uptake before mandate > training for users to encourage uptake and provide confidence in the reform prior to the mandate > mandating with a suitable fixed notice period (through close consultation with stakeholders and strong partnerships with peak industry bodies) > staged implementation, which prioritises low difficulty high volume aspects first, so industry becomes familiar with changes before the final mandate > under a mandate regime, test and prevent launch day surge issues.

2.7 Software vendors

As a result of the relatively small surveying industry in NSW, there are relatively few software vendors that provide tailored survey calculation packages. The vendors interviewed as part of the review were Position Partners/Topcon, Landmark, LISTECH and 12d. The software solution is integral to the feasibility of digital plans and, as noted by surveyors, has had a major impact on the low uptake of LXML by many surveyors.

The key findings from engagement with software vendors have been categorised into the following themes and summarised, then expanded in *Attachment H – Software vendor sentiment*.

Theme	Summary of findings for software vendors
Business drivers	The importance of the surveying software package (and the NSW market) as a revenue stream varies between software vendors; but is not insignificant for any. As such, all software vendors interviewed have invested in LXML to varying degrees.
Opportunities for digitalisation	Software vendors were big advocates for digitalisation and believed that digital plans can be faster and more accurate if implemented correctly.
Issues with LXML	While all software vendors were generally supportive of LXML they expressed a degree of frustration at the limitations of the format. This was mostly around the lack of suitability of the format for visual representation of a plan image and 3D capabilities. Issues with visualisation largely stem from the poor-quality rendering (external to their packages) which leads to additional work by surveyors to prepare the plan image and LXML file. However, one software vendor demonstrated an integrated approach where the plan image and LXML are prepared simultaneously.
Alternative formats	There was no consensus for a particular existing file format being ideal as an alternative to LXML; however, a few options were suggested for further examination, particularly IFC files. Another popular option was the creation of a new XML based format which could cater for the specifics of NSW and resolve some of the current issues of LXML. A strong warning against using DWG was indicated by one vendor based on its proprietary nature.

2.8 Benchmarking

Across Australia and New Zealand, approaches to survey plan creation, approval, examination and registration differ. This is a result of historic differences in the legislation and governance in each jurisdiction. Despite this, there is a consistent appreciation of the benefits of digitalisation and efforts have been undertaken in all jurisdictions to progress this. There are therefore valuable insights gained through examining the current approaches and future intentions of the various jurisdictions. A summary table is of these insights is presented below, while details for each jurisdiction can be found in *Attachment I – Benchmark finding details by jurisdiction*.

Jurisdiction	Summary of survey plan lodgement processes
New Zealand	> 100% digital survey lodgement in LXML since 2007, when mandated. > Surveys lodge in LXML format; pictures, text and PDF documents that support the data set are uploaded as a Cadastral Survey Dataset package. > The system provides an electronic workspace for surveyors. Automated business rules for pre-validation are provided and automated warnings are flagged to surveyors. The system facilitates supporting documentation with drop down menus and pre-populated templates. Approvals are processed digitally online in the system. > LXML was chosen as the format as no better alternatives were identified at the time. Standardisation of file format was important. The NZ cadastre is effectively one single LXML dataset, which surveyors can use to easily select existing survey data to use for their pre-calculations.
Western Australia	> Surveyors lodge plans in a proprietary Cadastral Survey Data (CSD) file along with a plan graphic and field notes in PDF. > All files lodged electronically since 2013, now via the New Land Registry system. > Survey plans are relatively simple compared with NSW, with correspondingly light examination, resulting in a very low requisition rate (2%). > The WA *Planning and Development Act 2005* allows most easements to be created just by spatial definition on a plan, especially in greenfield subdivisions. > All approvals are done as electronic signatures on PDF by authorities such as the WA Planning Commission.
Victoria	> Digital signatures are used for approvals within the Subdivision and Planning through Electronic Applications and Referrals (SPEAR) system. > SPEAR applications account for 98% of all plans lodged. From 01 January 2020, SPEAR will be compulsory for the creation and processing of all supported application types. > The majority of information uploaded in SPEAR is either in PDF or direct data input; it does allow surveyors to submit all 2D land subdivision plans in ePlan format (LXML) but only 1% are supplied as such. > By the end of 2020 the aim is to have a structured CAD file (co-designed with industry) and a CAD to LXML conversion tool to support the process.

Jurisdiction	Summary of survey plan lodgement processes
South Australia	> Surveyors lodge TIFF image of the plan via online portal, and generate a textual sheet in the system that includes easements in short form and parcel details. > Approvals involve electronic signatures on the textual sheet. > Lodged survey plans are digitally captured in CEXML format using PCPlans software. PCPlans is also made available to surveyors to check closures before lodging. Connecting parcels to coordinated survey marks enables spatially accurate representation. > LXML has not been adopted. Currently piloting alternative formats.
Queensland	> All lodgement is with titles office, done at lodgement centres for paper plans with a bundled approach to registration and creation of title. Have recently begun accepting PDF from approved lodgers. Wet signatures are used for approvals. > While progressing with back-capture of registered plans in LXML, further investment in systems to support LXML lodgement have been paused due to cost and technology uncertainties and limitations, while awaiting a national consensus on a digital solution.

3 Conclusions

3.1 Why has uptake of digital survey plans been low in NSW?

Ultimately, uptake of digital survey plans in NSW has remained low as there have been insufficient incentives for surveyors to adopt LXML and it has not been mandated.

Surveyors are appreciative of the potential benefits of digitalisation and keen not to be seen as averse to technology and change. However, in most cases, the benefits to surveyors and their clients have not overcome the challenges of producing a LXML file. The challenges primarily stem from the fact that, compared to the 'traditional' approach of producing a TIFF image, producing a LXML often requires significant additional effort[12]. This can be largely explained by the rendering inadequacies and the LXML creation process not fitting into the normal plan preparation workflow (requiring duplication of effort). In addition, error reporting from the validation service is difficult to understand and surveyors reported in some cases increased frequency of requisitions when lodging a LXML, a result of minor inconsistencies between the LXML and the TIFF.

The corollary of these issues is usually additional costs for surveyors to create a LXML. Not wanting to reduce their profit margin, the additional costs to create a LXML are typically forwarded to clients. Where the use of a LXML results in faster registration (such as previously when LXML lodgements were prioritised) this can be a sufficient incentive for clients (particularly those with high holding-costs) to pay the additional costs. However, with a large proportion of plans being for small developments with relatively low holding costs, this demand does not exist for most plans.

The perception of surveyors is that most of the benefits of LXML accrue to Government (and LRS) and only firms who primarily work with greenfield subdivisions can realise efficiencies. This is compounded by the fact that it is difficult for surveyors to access registered LXML files to assist with their pre-calculations. Even when these are available, there is a lack of trust in the data reflecting the plan (as it is not the legal source of truth) by some surveyors, as well as resistance to moving from working with a plan image to a dataset. Surveyors are therefore unwilling to invest in software and training for their staff where there is low demand and no intrinsic benefits to themselves or their clients.

Lastly, the benefits from LXML are disaggregated across stakeholders and have not been sufficient for any one group to act on. Likewise, broader digitalisation of other elements of plan registration, such as associated documents and approvals, has lagged as there has not been sufficient state-wide coordination or leadership.

[12] It was reported that, if rendering was better, and an image suitable for registration could be generated straight from the LXML file, then the total time difference compared to the 'traditional' method would be negligible in many cases.

3.2 What opportunities exist for digital survey plans?

Whilst not without its challenges, digitising plans present opportunities to multiple stakeholders. Table 1 - *Opportunities for digitalisation through the survey plan registration journey (page 33)* summarises the findings from each of the main stakeholder or 'customer' groups in the process from plan creation to registration and the use of plans. Opportunities for other users, such as lawyers, valuers and banks are not called out specifically as they are similar in nature to other customer groups, particularly DCS Spatial Services, developers and homeowners. The table includes:

- the *Objective* of each stakeholder group through their participation in the process
- *Success factors* that, if met, will contribute substantially to the achievement of objectives
- *Enablers* which digitalisation can help provide to support the success factors
- *Outcomes* that will result from meeting the success factors
- *Opportunities* that may be secondary to the main success factors but are possible through digitalisation.

As apparent in the table, there are many benefits through digitalisation for customers. These can be generally summarised into two main areas, faster registration and improved data for land administration. These are driven by increased accuracy (enabled by enhanced validations and minimised human error) which also contributes to increased speed (through fewer requisitions) and is beneficial in and of itself for the integrity of the Titles Register. Digitalisation can also achieve greater efficiency through increased automation, with subsequent reduction in costs for surveyors, LRS and Government. The benefits also align tightly to four of the six NSW Customer Commitments[13] as shown in the table below.

Opportunities	NSW Customer Commitments
Improved access to existing plans Transparency of process	Easy to engage Make it easy to access what I need Make it simple for me to understand
Faster registration Reduced manual effort	Respect my time Tell me what I need to know beforehand Minimise the need for me to repeat myself Make what I need to do straightforward
Improved data for land administration	Resolve the situation Be accountable for your actions Be clear in decision-making Reach an outcome
Continual engagement with industry	Engage the community Listen to the community to understand our needs Ask us how we want services delivered

[13] https://www.dpc.nsw.gov.au/programs-and-services/nsw-customer-service-commissioner/customer-commitments/ (accessed 25/11/19)

Faster registration

Reducing the time from plan preparation to registration will provide some benefits to almost all parties. Developers and purchasers will benefit the most, as it will reduce holding costs and therefore potentially also reduce purchase costs. Additionally, utility service providers would benefit from a reduced delay between providing services (water, electricity, etc.) and formally taking legal ownership of the infrastructure required to deliver those services.

Faster registration is achieved by shortening the duration of the 'critical path', particularly obtaining approvals and then successful examination and registration by LRS. This can be facilitated through the following means:

- **simplified and pre-populated data in associated documents** will save time for surveyors in document creation, as well as reduce errors from incorrect details, leading to faster approvals, fewer requisitions and faster examination.
- **digital signatures** which will save significant time as the current requirement for documents to be physically mailed and signed by hand was seen to be one of the biggest sources of delay.
- **parallel approvals** which can be enabled by digital signatures and will allow for concurrent endorsements to be obtained, shortening the critical path. Digitising the approvals process may also enable transparency for stakeholders to monitor the status of the plan throughout.
- **structured data enabling enhanced workflow management** (rather than physically looking at a plan to transfer details into systems) which will enable automation and efficiencies for administration and management of documents during approval and examination.
- **automated pre-validation of digital plan data** by surveyors which should lead to reduced requisitions as more errors are identified prior to lodgement, and some automated examination checks by LRS may lead to faster registration.

Improved data for land administration

Capturing more detailed and accurate data will support land administration, primarily through helping to enhance the quality and utility of the NSW Spatial Cadastre. The main beneficiaries from this are planners, both Government and private. Additionally, surveyors will benefit from being able to access more information earlier than they currently do. Improving data for land administration is primarily facilitated by:

- **smart plan data** which allows for automatic ingestion into a variety of systems, particularly the NSW Spatial Cadastre, allowing more information to be included and with lower risk of data integrity degradation (as it is easier to import information from a LXML file and does not introduce risk of human error). This may include automated quality checks which improve the standard of plans that are registered and then incorporated into the NSW Spatial Cadastre. It may also include additional evidence for boundary decisions made by surveyors, such as photos, to assist in future boundary surveys.

- **lodgement of plans separated from registration** which, whilst not purely a digital aspect, can be enabled by digital plans. By incorporating plans into the NSW Spatial Cadastre as close to the time of the actual survey, the currency of the information is enhanced, as other surveyors can access and use the most relevant and recent information. This may include a digital system flagging when a PPN is registered for any relevant adjacent parcels.

These opportunities will also promote interoperability, and ideally consolidation, of the disparate cadastral databases being maintained by various entities, which is a source of minor frustration for many stakeholders.

Lastly, there is a contemporary opportunity at an industry level for change, as other initiatives like ePlanning and the shift to GDA2020 are encouraging stakeholders to think differently and modify their processes.

Table 1 - Opportunities for digitalisation through the survey plan registration journey

	CREATE	APPROVE	REGISTER	USE	REGULATE	SELL	OWN
Customer	**Surveyors**	**Councils & utilities**	**LRS**	**DCS Spatial Services**	**ORG & Surveyor General**	**Developers**	**Homeowners**
Objective	*Ensure client satisfaction and professional integrity*	*Ensure appropriate compliance and billing*	*Maintain integrity of Titles Register and improve customer service*	*Maintain high-quality NSW Spatial Cadastre (SC)*	*Maintain integrity of Titles register, improve survey practice and enhance user experience*	*Lower costs of development*	*Certainty of title and positive customer experience*
Success factors	> **speed of creation** > **accuracy of plans** > **completeness of information**	> **efficiency of review** > **ease of approval** > **speed and accuracy of addition to records**	> **speed of examination** > **accuracy of examination**	> **currency of SC** > **completeness of SC** > **accuracy of SC**	> **accuracy of titles** > **appropriateness of the plans for homeowners** > **enhanced surveying practice**	> **reduced time to market** > **cost effective plan registration**	> **readable and reliable plans** > **simplicity of interactions** > **faster and reduced costs of purchase**
Enablers	> more efficient pre-calculations (easily obtain trusted, ingestible information) > less time spent drafting > minimised duplication of effort > automated validation pre-lodgement	> automated workflows from ingestible data > reduced errors in plans and associated documents submitted > easier sign off method for approvals > ingestible, accurate information	> integration of business rules into lodgement process to reduce errors of form > automated parts of examination > simplified examination > reduced requisitions and amendments	> data from LRS quickly checked and uploaded to spatial cadastre	> reduced errors in plans being registered > fit for purpose plans > improved boundary decision evidence in plans > ease of checking for compliance with fit for purpose regulation	> faster registration > simplified process	> reduced errors in plans being registered > faster registration > readable title image
Outcomes	> fewer requisitions > lower risk of professional indemnity claims > boundary determination evidence clear and usable for examination and future surveys	> confidence in compliance with development conditions > reduced internal manual effort > ability to accurately bill land owners > accurate asset information capture and maintenance provisions	> lower costs to examine > higher detection of errors pre-registration > enhanced satisfaction from ORG and surveying industry	> increased confidence in spatial cadastre > enhanced use across NSW (by other authorities) > increased utility for developers and planners	> reduced TAF claims > reduced amendments > high quality survey practice outcomes	> reduced development costs (holding costs)	> faster purchase and occupation of property
Opportunities	> ability to include additional boundary determination evidence (e.g. photos, videos)	> greater transparency for status of concurrences and referrals > increased standardisation and consistency (presentation of information and formats)	> demonstrate innovation in development of new products and services	> opportunity to display proposed lots, strata/stratum, easements, acquisition lots > enhanced interoperability with other datasets	> greater capability to adapt regulation to improving customer outcomes from access to digital data > reduced red tape for regulation	> transparency of process (tracking status)	> transparency of process (tracking status)

3.3 What needs to be overcome to increase uptake of digital survey plans?

With the benefits disaggregated, to achieve increased uptake of digital plans, a convincing solution needs to be designed that provides tangible benefits back to industry without unfair impost on any one group. The solution needs to overcome the majority of issues identified by surveyors, most considerably so that digital plans do not take additional effort compared to the current state, or that benefits to themselves or their clients are significant enough to warrant the extra effort or cost.

To overcome current challenges and achieve increased uptake of digital plans, the technical solution must be well designed and implemented. There are several interdependent factors that must be considered to achieve the ideal design for file formats and processes. As shown below, surveyors in their responses to the 2018 survey revealed the importance of effective software solution(s) to overcome the barriers to utilisation of LXML. The relative difficulty of implementing this depends on the file formats chosen (explored below in *Recommendations – Step 3: Design Solutions*).

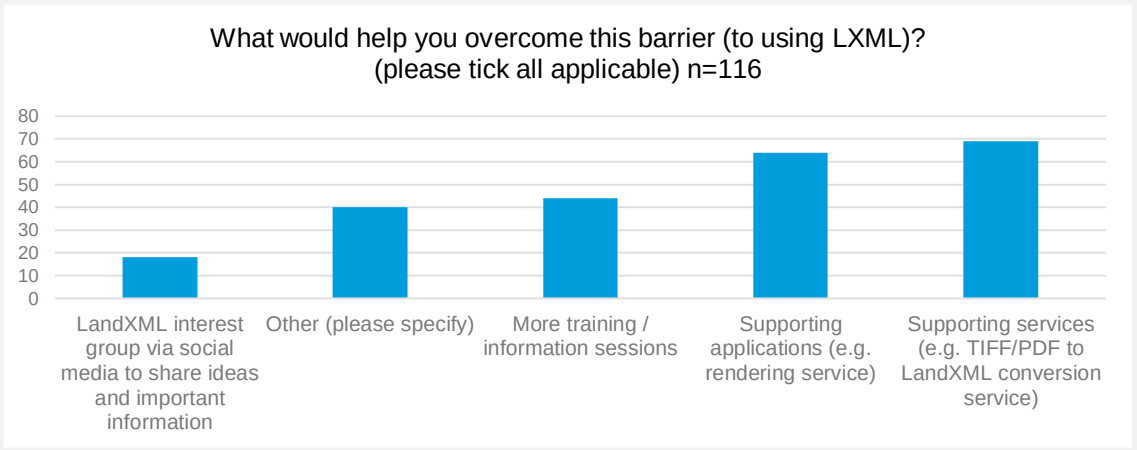


Figure 4 - Overcoming barriers to using LXML

Training will also be required for any changes, particularly software based. Other change management processes, including continued stakeholder engagement (particularly to overcome historic perceptions of under-valuing surveyor's input), pilot testing and staged implementation, will also help to overcome typical barriers to change such as inequity. These are discussed in *Recommendations – Step 4: Implement Solutions*.

The multitude of stakeholders has also led to a lack of ownership for improvements, with no one group the clear leader with oversight over the whole process that tie together other related projects such as 'Re-imagining Plans', ePlanning, 3D Cadastre and 'digital twin'. To drive improvements across the whole customer journey clear accountability and direction is required. As learned from implementing eConveyancing, whilst DCS and the ORG should retain a key role in communications, policy setting and governance, LRS should be leading the technical design and implementation of the solution.

Implementation of any changes are further complicated by the lack of consistency across jurisdictions. Whilst various jurisdictions have been successful in certain areas, even NZ and WA – considered by many to be leaders in this space – are looking to improve their approach to digitalisation. That no jurisdiction believes their current position is ideal highlights the complexity in designing a suitable solution. While pursuit of national consistency remains a common aspiration, legacy differences in legislation and approach make this difficult.

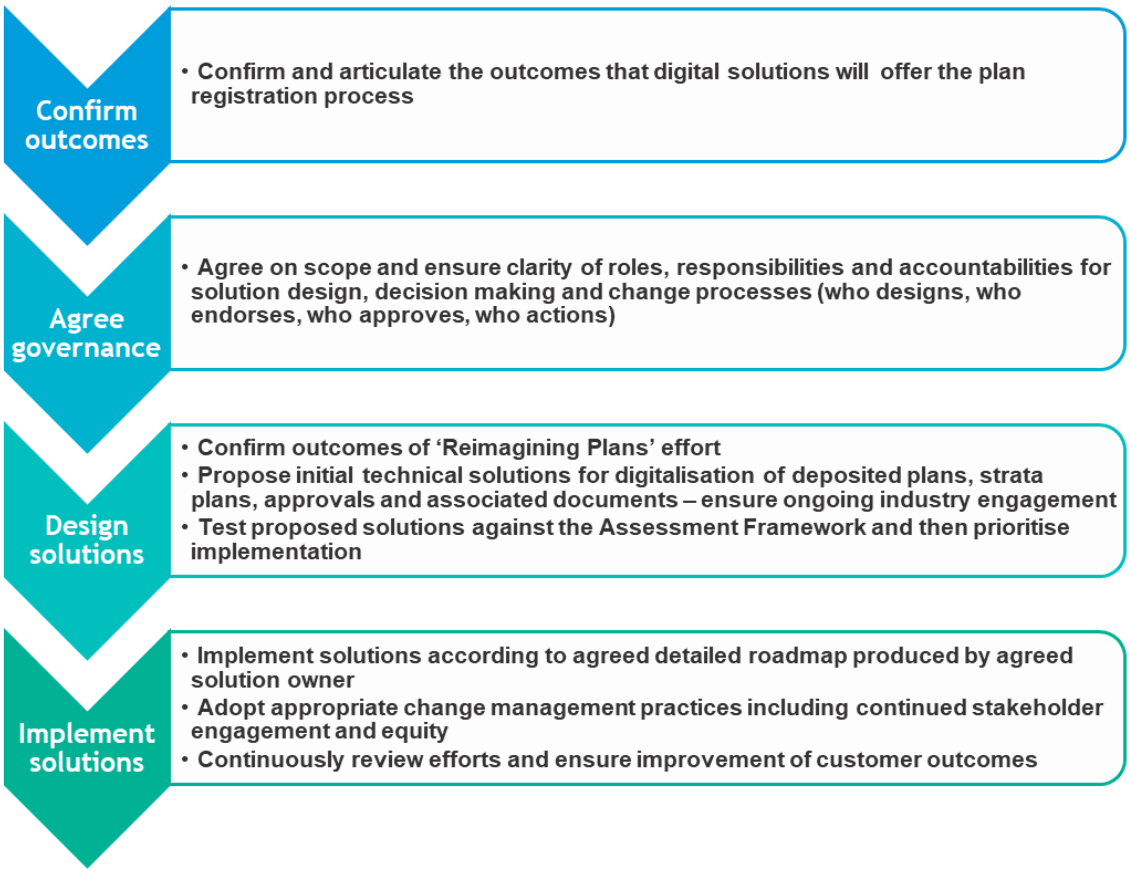
Lastly, it was reported by other jurisdictions that the only way to achieve a high level of digital adoption was through mandating use of LXML. Surveyors in NSW believe that, if digital plan lodgement was mandated, the industry would adapt within 12-24 months but that costs would be passed to clients. This must be done carefully, with suitable change management processes and only after an effective solution has been designed.

4 Recommendations

A number of recommendations have been prepared to assist DCS and LRS in increasing digital survey plan uptake. These are based on an appreciation of the reasons for low uptake of digital plans, the opportunities digitalisation presents and the barriers that must be overcome to realise the benefits.

The recommendations are structured as a high-level roadmap with four steps designed to efficiently progress digitalisation efforts from the current state. It should be noted that there may be multiple solution streams which exist in parallel and some solutions, by virtue of their complexity, will take longer than others to design and implement.

The four steps are outlined below then expanded upon in the following pages.



4.1 Step 1: Confirm outcomes

There is seemingly tacit agreement on the purpose of the drive to digitise plans amongst members of the Digital Survey Plan Steering Committee (henceforth 'Steering Committee'). These are based on the views of their organisations as well as the input of industry and other related stakeholders. However, the specific outcomes sought should be defined, articulated and agreed upon by the Steering Committee. These outcomes will then underpin all planning and communication activities. The outcomes may be 'faster, smarter surveying' – which encompasses speed for all parties along the customer journey, as well as improved survey integrity.

Labelling the push "towards 100% digitalisation" (or similar) risks conveying that the main outcome is digitisation for the sake of it. Communications should focus on benefits to the stakeholder groups and the problems that digitalisation solves. For surveyors, for example, amongst other things, digital solutions will:

- enable effective automated validation of plans; reducing requisitions
- reduce time waiting for approvals through digital signatures and electronic associated documents
- reduce professional indemnity claims by enhancing survey quality
- facilitate simplified sourcing of existing plans, giving surveyors access to search for registered plans available in digital format, and linking to a downloadable source of plans
- support more efficient plan preparation by utilising existing registered digital plans
- allow integration of lodged/proposed plans into a layer in NSW Spatial Cadastre prior to registration, again accessible to surveyors.

Surveyors should also be provided assurance that monument-based surveying will remain. Surveyors have voiced concerns that digital processing of collected survey information will ultimately lead to a coordinate-based cadastre. As part of any change and communication plan, it will be important to address this concern and neutralise the presumption that a monumented cadastre will be at risk as digitalisation of survey information is implemented.

For the wider users of plans, an aspirational goal could be to ultimately reduce number of unique cadastral datasets being operated by Government, councils and utilities. Developing a more accurate spatial cadastre in a format that can be shared with end users to manage their assets, operations and obligations would remove extensive duplication of systems and effort across NSW.

4.2 Step 2: Agree governance

An absence of clearly articulated roles and responsibilities has led to inertia on progressing digital solutions, as no individual party has a sense of ownership of the change process. All stakeholders consulted acknowledged there are benefits to digitalisation of the survey registration process. But while significant in the aggregate, the benefits are widely dispersed across multiple varied stakeholders, with no single entity being strongly motivated enough to make the change, nor holding a strong enough mandate to lead others in a collective change.

The current Steering Committee approach has created a platform where necessary actions for a path forwards can be agreed between parties. Nonetheless, there is a need to have one organisation ultimately responsible for each agreed action. Whilst the organisation responsible for each action will drive the change, they will still need to coordinate with many stakeholders, including Consultative Committee members, DPIE, surveyors, developers, software vendors, councils and utilities. Key areas for defined accountabilities should include governance and policy, solution design, and communications and engagement.

Governance and policy

DCS' remit is to work across the NSW Government to provide a better customer experience for citizens. It holds responsibility for policy and regulations, as well as driving reforms in land titling through the ORG. Through the Surveyor General, DCS is also responsible for supporting the quality of the surveying profession. As such, DCS should retain ownership of the overall governance and policy setting for all changes related to surveying, including digitalisation. In this capacity DCS would be responsible for setting timelines, approving proposed technical solutions and implementing policy and legislative changes.

Technical solution design

As the concession holder responsible for the administration of the NSW Titles Register, LRS has a strong incentive to increase digitalisation. It is therefore the most suitable organisation to lead the design of future technical solutions for smart plans and associated documents, as well as any new portal to support these (including possible integration with ePlanning). LRS is somewhat agnostic to the file formats ultimately adopted, as long as they provide users with the capabilities to achieve the stated outcomes and benefits of digitalisation.

The digital approvals processes for survey plan registration involves surveyors and LRS, as well as many different council and utility entities across NSW. No individual entity is in a position to take the lead on improving every aspect of approvals, but the majority of stakeholders would benefit. The Consultative Committee needs to identify stakeholders across the varied parties to champion digitalisation and work with LRS in designing a solution which will meet all parties' needs.

Communications and stakeholder engagement

Whilst engagement should involve all stakeholders from the Consultative Committee, a single party should own responsibility for managing engagements and communications. DCS has a strong profile and engagement capacity, and it was reported that its leadership for the engagement for eConveyancing was highly effective. As such it should be considered by the Steering Committee to lead the communications and stakeholder engagement efforts.

4.3 Step 3: Design solutions

Once the desired outcomes and governance models have been decided, the next step is to design the solutions for digital plans. Solutions should initially focus on the three main areas:

- deposited plans
- strata plans
- approvals and associated documents.

The solutions may be heavily influenced by the 'Re-imagining Plans' project and the outcomes of this should inform any designs. Likewise, the impacts of related NSW and national endeavours, such as ePlanning and Cadastre 2034, should continue to be considered as they evolve.

Solution design should be the responsibility of the party designated as part of Step 2 – Agree Governance (likely LRS), but with the continued input of the surveying industry and other stakeholders.

Considerations for each of the three main elements have been set out below. An Assessment Framework (the Framework) to assist in solution design and evaluation has also been designed and is explained after the considerations. Finally, sample scenarios for the deposited plans are included to demonstrate the application of the Framework.

The final designs should be compared and reviewed to understand impact and ease of implementation and then approved by DCS prior to implementation.

Considerations for deposited plans (DPs)

Defining and establishing boundaries is fundamental to the role of registered surveyors and any change to the format or nature of DPs must ensure legally sound methodologies for this are retained. Evidence for how the surveyor defined a boundary is currently contained on the plan image, in a fashion that typically only registered surveyors can accurately interpret. If DPs become lodged in a digital format, it will be important to consider how the evidence gathered in the field will be captured, particularly if less information is required on a future legal source of truth as part of the 're-imagining plans' program. Options for providing this evidence include:

- embedded in smart data
- a digital survey report as part of lodgement
- annotations on the plan image.

Additionally, surveyor instrumentation typically has the functionality to collect digital photos in the field, which could be included within the plan data where relevant as a method of documenting evidence used to define the boundary, such as occupations.

The transition to digital survey plans may create an opportunity to enact a reduced content or 'lite' plan as part of the registration process; potentially simplifying rendering and improving legibility while ensuring the data is the same as the 'full' plan. If any changes result in

simplification of plans, or a reduction of information on a separate title plan (compared to the full survey plan), the minimum content for what needs to be digitised may include:

- subject boundaries, lot number and areas
- easements
- reference and control marks
- bearings and distances for subject parcels and connections.

Lastly, consideration should be given to minimising changes to the current plan preparation workflows used by surveyors, as this will mitigate resistance to adopting digital change.

Ideally, prior to lodgement, surveyors should be able to pre-validate their digital plans against similar checks that will be run by LRS. The current validation service provided is not considered effective by most surveyors and a future solution should be more comprehensive, up to date and user friendly[14]. Automated validation tests could be run either in provided calculation software packages or on an online portal. This would allow lodgement business rule violations to be flagged, or potentially enforced, prior to lodgement, which would likely reduce requisitions and increase the speed of plan registration.

A digital system could enable automated creation and collation of metadata, and provide pre-population of key information, which could be tethered to associated documents, for example, automating the same plan number on all documentation.

Ideally for examination, only a single version of the plan is needed (e.g. not a TIFF and LXML) and a comparison of alignment between two files is not required. If two files are created then workflows should ensure alignment between a full drafted plan and a lite digital boundary plan. Several such processes are outlined in the scenarios below.

Any digital solution should facilitate access to registered digital plans. Plans should able to be quickly searched for and available to surveyors and other entities, such as utilities, via a portal. This will be a key benefit to surveyors (who mostly reported that finding LXML files is currently difficult or impossible) by reducing effort in pre-field calculations through ingesting survey data available as LXML files or other formats. It will also support the examination procedure by LRS, where examiners currently have to locate plans via a manual process. Lastly it should also assist utilities to easily obtain digital information, such as what is currently provided in the Authority Registered Plan Report (the content of which could be enhanced through digital data).

Other users, such as utilities, would also benefit from having relevant information that can easily be viewed, with metadata contained in a format that can be automatically read and ingested into their systems.

Opportunities for enhanced presentation and functionality such as 3D plans and/or BIM integration should be considered. LXML has received generally poor reviews from stakeholders

[14] LRS representatives reported that this is currently being overhauled and an improvement to the current service will be released in early-2020

consulted regarding its ability as a file format to capture 3D spatial information. Other formats used in the engineering and design industries are better able to produce 3D representations. Such formats include spatial data file (SDF), LandInfra and IFC, which are used to model building and facilities designs. These formats have not been included in the lodged format scenarios below as there was limited understanding or awareness of these across industry and no consensus on what a suitable format would be. Nonetheless, it should be considered in future. Likewise, a custom XML based format (essentially a modified LXML) should be explored. Regardless of the format chosen the parameters should be clearly defined and, if it is a shift from an image to a data-based plan, then the change management effort will likely be more significant.

Considerations for strata plans

Strata plans are a good candidate for digitalisation as they are expected to be more easily rendered from digital data to plan graphic, and are a large proportion of all plans lodged, particularly in metro areas. The ability to represent components of strata lots (such as the main apartment, carpark and storage cage) in 3D space on the NSW Spatial Cadastre would be highly valued by strata owners to easily determine ownership (including of the body corporate) within the building. In doing so, associated documents, particularly by-laws, could be uploaded and clauses linked to spatial objects, in turn improving access to and comprehension of obligations under the by-laws.

However, the benefits of digitally lodging strata plans is likely lower for surveyors than Government and end users, as the current TIFF plans are already relatively simple in presentation. As strata plans are primarily for metro locations, any change to the requirements for strata lodgement would not impact regional surveyors as much as digitising DPs.

Surveyors did raise concerns about liabilities and reputational damage from misuse of digital information, as strata plans generalise the location of boundaries and are not ‘survey accurate’. This would need to be addressed with suitable protections in order to gain the support of surveyors.

LXML may not be the ideal file format for digitising strata plans. An alternative file format that better enables visual representation of 3D strata lots could be more suited.

Considerations for approvals and associated documents

Sequential wet signatures are seen to be a major delay to the approvals process by all stakeholder groups. In many instances even if documents can be digitally uploaded, prepopulated, and edited, they must still be printed in hard copy to be signed with ink, and then either posted as hard copies (occasionally lost in the post) or scanned to a new PDF.

Implementing a digital signature approval system is highly recommended. Such a system would:

- shorten the end to end process for customers, reducing developer holding costs and allowing plan approvals to be managed across all authorities, monitored in real-time with push notifications for actions

- enhance interoperability and consistency across stakeholders, with roles and responsibilities for approvals controlled
- not unreasonably disadvantage any stakeholder group, and costs can be shared fairly and transparently.

A digital approval system would provide greater transparency and enable approval processes to occur in parallel. Approving stakeholders would require notification if a consenting authority requires a change on a plan they have already approved, and they may need to reassess and endorse the changed plan depending on the nature of the required change. An arbitration process, and associated governance, would be needed to determine if a change impacts an approver's area of control.

In conjunction with a digital approval process, associated documents lodged with the plan should be digitised. These should be implemented as a consistent state-wide set of documents, which have embedded functionality to auto-populate with the correct information following enforced business rules that can be readily kept up to date. These could be either downloadable smart documents or completed in an online workspace. Whilst ePlanning is still being developed, consideration should be given to potential integration and links to this platform.

The lodging party would select the document type, location and only the relevant consenting authorities for that location would be able to be selected. Councils and utilities would be able to more easily make available their standard text requirements, such as for the creation of easements, to the lodging party via the portal. The document suite or system would enable document content to be managed by the appropriate authorities. The lodging party would then select the relevant standard text from a list or similar means.

NSW may also consider reducing duplication or simplification of information across a plan and associated documents. As an example, in WA, simple easements can be automatically created by spatial representation on the plan (without a Section 88B). These sort of adjustments will likely require legislative changes which will take time to implement.

Assessment Framework

The Framework has been developed to understand which changes should be pursued to improve uptake of digital plans. The Framework is based on the findings and conclusions of the review. It also incorporates the pain points and success measures that arose from engagement workshops with the Digital Survey Plans Consultative Committee in mid-2019[15].

The Framework assesses the likely contribution of changes towards achieving the key outcomes for each customer and stage of the surveying lodgement process (as detailed in the table in *Conclusions – What opportunities exist for digital survey plans* above). Contribution towards each outcome is understood by considering the likelihood of achieving the relevant success factors.

[15] DCS, Digital Survey Plans Program Consultative Committee Workshop Outcomes, 9 August 2019

Whilst the contribution for all stages of the survey plan journey are shown equally, it should be noted that success factors for the final two stages (developers and ORG) effectively amount to the net impact for the key outcome criteria (time from creation to registration, and quality, respectively).

The impact of achieving the key outcomes is balanced by reviewing the ease of implementation, to understand the practicality of each change across the following categories:

- technical feasibility – including the amount of disruption to current surveying practices, as well as the likely complexity of any software solution required to support the change.
- cost of change – to each of the stakeholder groups to implement the change.
- legislative change – both the quantity and difficulty of any legislative change required to support the change.

The Framework is presented overleaf, showing the criteria by which, each element is assessed.

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OUTCOMES ASSESSMENT

Stakeholder	Surveyors	Councils & utilities	LRS	ORG & Surveyor General	DCS Spatial Services	Developers	Homeowners
Outcome	*Ensure client satisfaction and professional integrity*	*Ensure appropriate compliance and billing*	*Maintain integrity of Titles Register and enhance user experience*	*Maintain integrity of Titles Register, improve survey practice and enhance user experience*	*Maintain high-quality NSW Spatial Cadastre (SC)*	*Lower costs of development*	*Certainty of Title and positive customer experience*
Criteria	▪ speed of creation ▪ accuracy of plans ▪ completeness of information	▪ efficiency of review ▪ ease of approval ▪ speed and accuracy of addition to records	▪ speed of examination ▪ accuracy of examination	▪ accuracy of titles ▪ appropriateness of the plans for homeowners ▪ enhanced surveying practice	▪ currency of SC ▪ completeness of SC ▪ accuracy of SC	▪ reduced time to market ▪ cost effective plan registration	▪ readable and reliable plans ▪ simplicity of interactions ▪ faster and reduced costs of purchase

IMPLEMENTATION ASSESSMENT

Element	Technical feasibility	Cost of change	Legislative change
Criteria	▪ amount of change to surveying practices ▪ feasibility of technical solutions	▪ to surveyors ▪ to councils & utilities ▪ to LRS ▪ to DCS Spatial Services and other plan users	▪ amount and ease of legislative change required

Figure 5 - Assessment Framework

There are multiple decisions that need to be made on the path to improving and digitalising plans, each with interdependencies to other decisions. Even when reducing the scope of a single decision to a binary choice, there still remains a significant number of permutations of all the decisions and the order in which each can be made is complex. Example decisions to consider include:

- *mandate 100% vs mandate <100%*
- *metro or regional vs metro and regional*
- *mandate sooner vs mandate later*
- *lite LXML vs full LXML*
- *bearings and distances boundary only vs all surveyor information*
- *multi-lot greenfield development vs 'mum and dad' two lot*
- *online portal vs distributed software*
- *in-house software development vs market software development*
- *training for all for free vs training for some/none*
- *digital for DP only vs digital for DP and strata.*

Using the Framework will help focus decision making on achievement of outcomes. It has been developed to facilitate agreement on a technical solution that will achieve outcomes such as increased speed of registration, improved data quality and greater efficiencies for stakeholders.

Sample scenarios

A series of five sample scenarios for deposited plans, as well as one for strata plans and one for approvals and associated documents, have been devised. The five scenarios for deposited plans revolve around the file created and lodged by surveyors; an overview of these scenarios is presented in the summary table overleaf. The scenarios have all been conceived through initial engagements with stakeholders as part of this review; however, these are not intended to represent final design solutions.

Details of each of the seven sample scenarios (five sample scenarios for deposited plans, one sample scenario for strata plans, one sample scenario for approvals and associated documents) is provided at *Attachment J – Sample scenarios for solution design*.

The outcomes and implementation of the seven sample scenarios have been assessed against the Framework, with findings summarised in two separate tables in *Attachment K – Sample application of Assessment Framework*. Again, these sample scenarios have been assessed without consultation and input from all stakeholder groups and serve to illustrate the use of the Framework as well as prompt discussion on possible design solutions. Further, these sample scenarios do not consider Information Brokers, who exclusively deliver some survey plan products and information to third-party consumers including surveyors, councils and utilities, on behalf of LRS. Where LRS intend to include any delivery mechanism of digital plan information through Information Brokers, the impacts must be considered.

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Summary of sample scenarios for deposited plans						
Scenario	**Lodged by surveyor**	**LRS Processing**	**Examined by LRS**	**Legal source of truth**	**Digital capture**	**Technical solution requirements**
Roll back digital	TIFF	TIFF back-captured to LXML	TIFF	TIFF	Back-captured LXML	LRS sources a back-capture service provider
Structured CAD	Structured DXF	DXF conversion to lite LXML Boundary image for title rendered from lite LXML	LXML (with DXF to support examination)	Rendered boundary image from converted lite LXML	Boundary LXML	Tool for conversion from DXF to LXML needs to be developed for bearings and distances-based boundary information digitisation
Lite LXML	TIFF + Lite LXML	None	Examination of TIFF and lite LXML	TIFF	Boundary LXML	Rendering tool for boundary information possibly required
Full LXML	TIFF + LXML	None	Examination of TIFF and full LXML	TIFF	Full LXML	Rendering tool possibly required
Full LXML only	LXML	Render boundary image for title from LXML	Full LXML file	Rendered boundary from full LXML	Full LXML	Rendering tool for boundary image for title required

4.4 Step 4: Implement solutions

Once the technical solutions have been proposed and the Framework has been used to understand their impact and feasibility, changes should be prioritised based on the benefits versus the ease of implementation. A detailed roadmap describing the steps of change should be presented by the responsible party and agreed upon by the endorsing party or parties, then adhered to.

Key implementation principles of equity and change management must be considered regardless of the technical solution agreed in order to achieve the aims and benefits that digitalisation of survey information seeks to realise. Likewise, mandating and legislative changes may be required, depending on the technical solution.

Equity

Decisions made regarding potential changes to the format and content of plans will impact all surveyors. Depending on the nature or extent of some of these decisions, different surveyors will be impacted to varying extents. An important consideration for any decision making as part of the pathway to digital plan lodgement is mitigating issues of fairness, perceived or real, across surveyors.

In particular, the size of impacted surveying firms, and by proportion, the number of plans lodged by the surveying firm, will likely dictate considerations for how digital changes are implemented.

Training may be required and as a result, pose an imposition, for all firms, however it is likely that smaller firms will feel this burden most. Unlike smaller firms, larger firms are more likely to be in a position to have select staff undertake formalised training and specialise in digital plans initially. These staff can then subsequently pass on the skills to others in the firm over time, thereby easing the cost burden and opportunity loss.

Software is a cost consideration to firms. Small firms, or those lodging relatively very few plans, will be disproportionately affected if new software is required to produce plans in a new digital format.

As such, if specific software solutions are necessary, consideration should be made as to whether these should be provided to the surveying industry, particularly to smaller firms. This requirement would be mitigated if the software to produce digital plans is hosted in an online workspace. This would, however, require changes to the current workflow for how surveyors and their drafting colleagues produce plan graphics.

Mandating digital plans

Mandating was a common characteristic across jurisdictions which have high digital adoption – they all noted that without mandating it would never have been achieved. Most surveyors consulted were open to the idea of mandating, with many noting that there would be ‘grumbling’

but the industry would just adapt and 'get on with it'. Equally, software vendors and LRS indicated that mandating would provide clarity on the likely return on investment from creation of associated tools or processes to support digitalisation.

If changes are to be mandated, it should be well understood who will make such a decision, the extent to which changes will be mandated, and how the changes will be mandated, for example using a staged approach similar to eConveyancing.

There needs to be a viable, preferably co-designed, solution agreed to, tested and established prior to mandating, with considered and agreed timelines that are clearly communicated to all impacted stakeholders. It is likely that a minimum of 12 to 24 months (depending on the change) will be necessary to give time for the industry to prepare and transition.

Legislative changes

Depending on the technical solution agreed upon, the legal source of truth for survey plan information may need to change. Any legislative changes are likely to take time to be passed and readied for enactment. Other changes to regulations may require less time or fewer decision makers to implement, but regardless, it should be clearly established who will be accountable for ensuring decisions are endorsed in a timely fashion.

Change Management

Surveyors have demonstrated a strong desire to be actively engaged in any digitalisation process. Clear communication must be provided to all surveyors (and other impacted stakeholders) along each stage of the design and implementation process. From LRS' 2018 survey it was reported that the most effective mechanism for increasing industry awareness is through seminars or conferences (reported by 59.5% of all respondents - all other channels were selected by less than 6%).

Close and active industry involvement was also common to the digitalisation efforts of all jurisdictions. This has been considered by all benchmark consultees to be vitally important and was achieved via working groups, partnership with representative bodies and/or employing independent surveyor(s) to be part of the project team. Continual engagement should also be maintained with other jurisdictions, as any practical solution that works for NSW is likely to be beneficial across Australia.

The industry will require time to adopt change and should be appropriately supported. A measured approach, with an initial pilot test phase followed by gradual roll out of changes (potentially such as initially greenfield subdivision plans for DPs or Section 88B instruments for associated documents) will help minimise impost and encourage uptake. To assist with this, consideration should be given to the technical support, such as training, that may be required to assist industry members to begin to transition. This will also prevent a large initial adoption immediately after the mandate coming into effect and avoid the resource strain that this may pose. Once new solutions have been pilot tested then case studies with partaking firms should be developed to identify possible issues and capture and communicate benefits to industry.

An indicative implementation schedule has been shown overleaf. The timing of each element is subject to the solutions chosen. The process may also include phased and parallel elements, such as key digital associated documents being implemented while the technical solution for digital deposited plans is designed.

The amount of change should also be considered and balanced, where synergies exist (e.g. a transition to digital signatures and smart associated documents) then changes may be implemented concurrently. Conversely, where changes are likely to cause significant disruption (e.g. requiring the learning of a new software solution) these should be done independently to avoid putting adverse stress on the industry. Finally, incentives to support early adoption should also be considered. It was suggested by surveyors that reduced examination time and lower lodgement fees would motivate them to lodge digital plans. However, it was reported by other jurisdictions that little behavioural change was achieved through reduced fees and reduced examination time is likely to be more effective. The Steering Committee should refer to the experiences of other jurisdictions, notably NZ and WA, when determining how it can best support early adoption.

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Indicative process for phased solution design and implementation

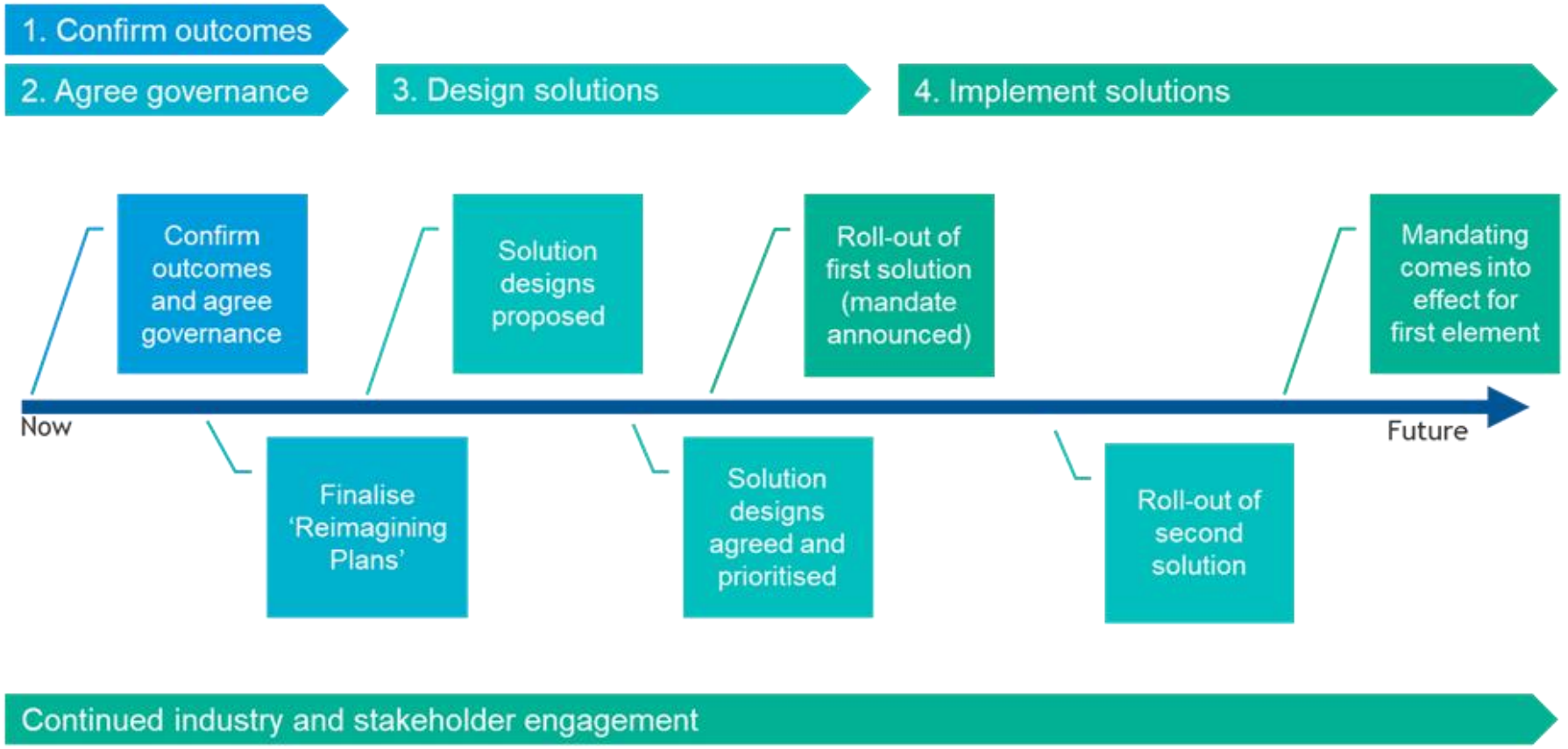

Figure 6 - Indicative process for phased solution design and implementation

5 Attachments

Table of attachments	
A	Surveyor sentiment
B	Surveyor sentiment
C	Council and utilities sentiment
D	LRS sentiment
E	DCS Spatial Services sentiment
F	ORG sentiment
G	Developer sentiment
H	Software vendor sentiment
I	Benchmark finding details by jurisdiction
J	Sample scenarios for solution design
K	Sample application of assessment framework

Attachment A – Consultee details

Surveyors - Sydney focus group

- North Western Surveys
- Veris Australia
- RPS Group
- YSCO Geomatics
- D J Hore
- Craig & Rhodes
- RPS Group
- CMS Surveys
- Paul Lawson

Surveyors - Newcastle focus group

- Palmer Bruyn
- Le Mottee Group
- Tattersal Lander
- Bannister and Hunter
- Daly Smith
- Monteath & Powys
- Parker Scalon
- ADW Johnson

Regional surveyors

- PHL Griffith
- SMK Consultants
- Bradley Surveying
- Rygate & West
- King & Campbell
- Resource Design & Management
- Casey Surveying & Design
- Baxter Geo Consulting
- Hanlons Consulting

- Hopkins Consultants
- Conway Burrows and Handcock

Utilities and councils

- Sydney Water
- Hunter Water
- Essential Energy
- Endeavor Energy
- Transport for NSW
- Tamworth Regional Council
- Penrith City Council
- Sutherland Shire Council

Software vendors

- Position Partners (distributor of Magnet)
- Landmark
- 12d
- LISCAD

Service provider

- LRS

NSW Government entities

- Spatial services - including the Surveyor General
- ORG - including legal and those involved in eConveyancing
- Department of Planning, Industry & Environment (DPIE) - ePlanning team members
- Transport for NSW (TfNSW) – including Roads and Maritime Services and Maritime

Benchmark jurisdictions

- Land Information New Zealand
- Landgate (Western Australia)
- Department of Planning, Transport and Infrastructure (South Australia)
- Department of Natural Resources, Mines and Energy (Queensland)
- Department of Environment, Land, Water and Planning (Victoria)

Attachment B – Surveyor sentiment

Outcomes sought

Surveyors indicated that, regarding the lodgement of plans, they are motivated primarily by two key elements:

- a desire to please clients – to achieve this they need to deliver a high-quality survey, at a competitive cost, which will be lodged and registered quickly without contestation now or in the future.
- passion and pride in their profession – there is a strong sense of professional integrity with respect to the establishment of accurate boundaries; this minimises boundary disputes (and possible indemnity issues), but also, in a tight-knit industry, maintains the reputation of the surveyor.

Surveyors see not only their client, but also the next surveyor as the end user of their plans. Surveyors rely on (after verification) the historic efforts of other surveyors to establish boundaries; indeed, almost all surveyors consulted estimated that a large majority of what is contained on a plan is only useful to other surveyors.

Surveyors see the next surveyor as the end user of their plans

Surveyor (Regional)

Attitude to digitalisation

Surveyors consulted feel it is important for the industry to adopt digital solutions relating to plans, associated documents and approvals, to remain current.

If surveyors keep producing paper plans, we are going to be left behind as a profession; we need to get better at sharing data

Surveyor (Sydney focus group)

As a highly technical field, it was reported that, despite the average age of registered land surveyors being 52[16], most surveyors are comfortable with digital technology. Whilst recognising that the workflow sees 'smart' data being converted into a 'dumb' image, surveyors believe that the current TIFF based survey arrangements work well. Consequently, there is some confusion about what specific problem LXML is supposed to be the solution for – especially since a TIFF image is still required by LRS. Surveyors feel the beneficiaries of LXML are largely LRS (easier examination) and DCS Spatial Services (easier ingestion into the NSW Spatial Cadastre); yet the costs are borne by surveyor's clients.

The main benefits are for Government, we are just data collectors for them…if someone in Government wants to play with it then fine, but why put the cost back onto our clients?

Surveyor (Regional)

[16] https://www.bossi.nsw.gov.au/__data/assets/pdf_file/0010/222949/BOSSI_Statistical_Review_2019.pdf (accessed 20/11/19)

Equally most surveyors consulted feel that it is critical that a monument-based approach is adhered to and catered for within any solution. With this paradigm, the digital solution needs to accommodate the non-mathematical, decision making aspects of the surveying process. There is a perception that LXML focuses too much on coordinate data rather than decisions and may be moving away from the monument-based system.

Monuments must rule, and measurements need to allow for variation

Surveyor (Newcastle Focus Group)

It's not easy to digitise – it's not a mathematical thing, it's more a legal thing

Surveyor (Regional)

Issues with LXML

Short of mandating, the uptake of LXML depends on surveyors being motivated, either internally or by their clients, to use it. Whilst some surveyors consulted saw benefits in LXML, almost all voiced a number of issues that prevented them from utilising it regularly.

In LRS' 2018 survey of surveyors, '*time'* was the single largest inhibitor of adoption with 70% of respondents selecting this when asked '*What do you see as the barriers to adopting LandXML*?'[17].

The (extra) time varies depending on the plan, two hours to two days, the plan is basically redrawn to be able to export the LandXML format

Surveyor (response to 2018 LRS survey)

Surveyors consulted estimated that the average additional time to create a LXML is 30% extra. This extra effort is due to the fact that in most software packages the LXML file must be created separately. Whilst one software platform was praised for its handling of LXML, the majority were seen to be difficult to use for LXML. Though creating just the boundary information in an LXML file is not a significant addition of time, the inclusion of occupations, SCIMS and attributes was stated to take a long time. It was also reported that manually editing the data (through Notepad or similar) is difficult due to poor navigability of the file. Small existing lots in older areas with complicated boundary definitions were seen to be particularly challenging to create in LXML.

Most of the time it is difficult to do things (in LXML) which are otherwise simple and quick

Surveyor (Newcastle Focus Group)

It's time consuming including all the things in LandXML required for verification by LRS

Surveyor (Sydney Focus Group)

[17] '*Time'* was followed by '*software vendor support*' (39%) which causes the additional time and '*cost*' (34%), a result of the extra time.

That the TIFF file has to be created in addition to the LXML is due to the poor quality of the images rendered from LXML plans, such that they are not considered suitable for lodgement. This is particularly problematic for bigger plans - it was reported that plans with over 90 lots often struggled to render – and easements also complicate it.

The rendering is hopeless – just pages and pages of tables

Surveyor (Sydney Focus Group)

LandXML plan rendering is next to useless, thus requires an additional plan to be prepared manually. The manually drafted plan needs to precisely reflect the LandXML coding, which requires an additional check listing procedure. Also, the coding itself is extremely buggy and can sometimes amount to several hours of debugging. LandXML coding as it currently exists, requires surveyors to essentially double up on all plan preparation procedures

Surveyor (response to 2018 LRS Survey)

There is also a perception (particularly in regional areas) that LXML requires 'unreasonable' accuracies and that it focuses too much on coordinates instead of the bearings and distances.

LandXML is encouraging people to show distances down to the nearest mm and bearings to the second, which is ridiculous

Surveyor (Regional)

Haven't seen a package which ingests LXML and uses the reduced observations, not the coordinates, to make the TIFF - but when LRS check the closure of the lots they use the reduced observations

Surveyor (Regional)

The training required to effectively create LXML files was reported to be a considerable cost to surveying firms. This includes both the costs of the courses themselves and, more significantly, the lost productivity with staff attending training then becoming familiar with the format (most surveyors estimated this took approximately two to four weeks). Training was also difficult to access for some regional surveyors.

The training to get it (LXML) set up was significant

Surveyor (Sydney Focus Group)

Surveyors are frustrated by the fact that lodging a TIFF and LXML can, in some instances, increase the chances of requisitions due to differences (many perceived to be inconsequential - a few seconds or millimetres) between the two files[18]. Some surveyors, who create the LXML file for QA only, do not lodge the file for this reason. Error reporting is also considered not-user friendly, with the output hard to analyse to identify the major issues.

[18] Though this is not an issue when using a software package that generates the TIFF and LXML from the same base data.

Benefits of LXML

It is recognised that being able to retain smart data throughout the workflow would be useful, both to minimise manual handling errors and for the reuse of data in future plan creation. In this regard many surveyors who use LXML noted that they would highly value being able to access LXML registered plans for their pre-calculations and plan preparation (as it would allow easy plotting of adjoining information to a sufficient level of accuracy for a rendered plan). One surveying firm consulted reported obtaining these plans from LRS, however all others were either unaware of their availability or reported that accessing them is challenging.

Would be very handy to download a crown plan as an LXML file (as it is mathematically closed and will save me a lot of time, maybe half a day building up a map of the surrounds)

Surveyor (Regional)

There were mixed views on whether LXML would improve survey quality and, in turn reduce requisitions[19]. Most surveyors consulted believe that the nature of LXML is useful for QA as it identifies issues such as mis-closes and other mathematical errors.

I pick up problems, missed lines or wrong connections, and use it even for plans I don't lodge with LXML

Surveyor (Regional)

Equally, most surveyors recognised that LXML would support automatic validation whereby the file could be checked against LRS' business rules prior to lodgement, allowing amendment of any errors (and reducing subsequent requisitions). This service is already available; however the validation is not in line with the current regulations and, due to the format of the error reporting, is seen to be only marginally useful. Surveyors also recognised that the same capabilities, if implemented well, would assist LRS in examination, in turn speeding up registration of plans.

The realisation of benefits is largely seen as contingent on more effective software solutions. Some surveyors noted that if the rendering of LXML improved they would then prepare the file end-to-end themselves, rather than using a draftsperson who may inadvertently introduce errors.

Despite the general consensus being that LXML would improve survey quality, there were a small number of stakeholders consulted who did not support this view.

Electronic plans have the opportunities to have a lot of mistakes, might even increase, but don't think will significantly improve the accuracy

Surveyor (Regional)

[19] However, surveyors noted that many clients do not expect requisitions and are therefore not appreciative of this as a benefit.

Incentivising use of LXML

In absence of any intrinsic net benefits to surveyors, the incentives that were desired to use LXML typically focused on their clients. As shown below, the 2018 LRS survey of surveyors revealed the importance of turn-around time as a driver for uptake[20]. Being able to register a plan faster was particularly compelling for developers with significant holding costs.

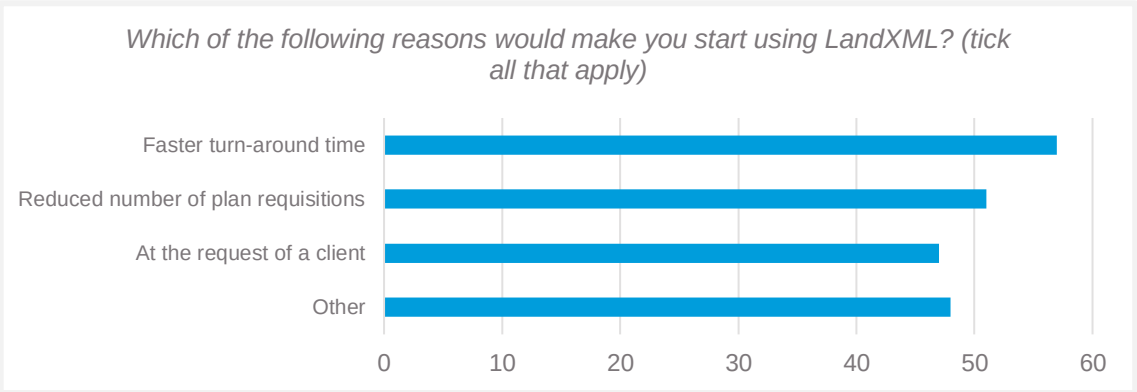

Figure 7 - Drivers to increase LXML usage

The survey findings were supported through consultations, where it was commonly reported that when LXML plans were prioritised for examination that this was an effective selling point to encourage clients to pay for the creation of the LXML – particularly for larger subdivisions with significant holding costs. That there is only minimal time difference between electronic examination of LXML compared to manual examination of TIFF plan images now[21] has made it harder to sell LXML, but there was variable appreciation this is largely due to the fact that TIFF lodgement speed has increased[22]. Some surveyors suggested that if LRS were to reimplement prioritisation of LXML then a written statement of this would assist in communicating the benefit to their clients.

Akin to faster registration, making the plan creation process faster by only having to create one plan was reported as highly likely to assist uptake. This again stems from the aforementioned issues with the rendering quality.

The biggest issue for me is preparing two documents, so just doing one, be it LXML or TIFF, would be best. There is a lot of time in drafting, the rendering service doesn't currently work but if you could just do LXML it could be faster than doing it as a TIFF; then just render the key info for a title diagram

Surveyor (Regional)

[20] Not only was '*Faster turnaround time'* the most popular response, '*Reduced number of plan requisitions'* will lead to reduced time and '*At the request of a client'* is typically due to faster registration. Those who selected *'Other'* almost unanimously specified the reasons as being easier and faster to make than presently (particularly if rendering worked so that a separate TIFF file was not required) or if it were mandated.

[21] As of 19 November 2019, LXML plans were being examined one day earlier (7 November) than non-LXML DPs (6 November) according to the LRS website.

[22] This is partly due to a reduction in plans submitted and, if submission rates increase the ePlan (normal TIFF lodgements) lodgement time may revert to being more significantly slower than EPlan (LXML lodgements).

The following other incentives for increasing use of LXML were suggested by surveyors:

- reduced costs of submission - this is seen to be justified if only LXML is used (rather than TIFF and LXML), as it is perceived that this would reduce the effort for examination required by LRS
- free training and software – particularly relevant for surveyors who do not have a strong incentive to invest in LXML due to a low volume of plans being created for lodgement. It is also felt that if free training and software were provided by LRS or Government it would improve consistency across the state.
- reduced requirements – simplifying what is included on the LXML plan to just the essential geometry (see 'What's on a plan' below) would significantly decrease the effort to create a LXML file (it was estimated that this may only require one hour of extra work for a 'normal' plan)
- acceptance across stakeholders – it was noted that all stakeholders (councils and utilities) should be required to accept LXML plans to maximise benefits and avoid duplication.

They (councils and other authorities) must accept LandXML files, can't just make the surveyors go digital and no one else does

Surveyor (Newcastle Focus Group)

Attitude to mandating LXML

Almost all surveyors consulted reported that if 100% digital plan lodgement in LXML is mandated then the industry would adapt within 12-24 months. It is likely that there would be minor disruption with some firms being better placed to respond (i.e. those already using LXML). Surveyors felt strongly that disruption would be minimised if the software improved and a reasonable time for transition is established to manage the change. Surveyors also noted that the legal source of truth would have to be clarified between the TIFF and LXML if mandated.

Smaller firms and those preparing plans for lodgement less frequently (such as small regional surveyors) will be more disadvantaged and less likely to want to change and invest in the software and training. Some consultees believe that across the state there would be a small number of older sole practitioners who may rather retire. It was also reported that there may be an increase in the use of third parties to produce the LXML files for those who cannot do it in-house.

The training and software's not worth it for the amount of work we do; clients don't even know about it. We would possibly do the field work only and farm out creation of the LandXML file

Surveyor (Sydney Focus Group)

The expectation to learn LXML is not feasible, only doing one lot a year and would take two weeks to come up with something to satisfy LXML, I haven't got time to learn

Surveyor (Regional)

It was suggested by some surveyors that an equitable approach may be to establish a threshold number of plans which can still be lodged in TIFF, above which they have to be in LXML[23].

Overall, surveyors feel that if LXML is mandated then it is a 'level playing field' and surveyors as an industry would not be disadvantaged. However, costs would be passed on to their clients (noting that it's a Government requirement), in which case it is likely that any additional costs would be ultimately passed on to the purchaser who buys the land.

What's on a plan

The contents of survey plans were discussed with surveyors, both to gather data for the related 'Re-imagining Plans' project and to understand what a minimal viable product (MVP) may look like if digitisation of a simpler plan is pursued. Surveyors are keen to produce user friendly plans, both for surveyors and other parties, but, as mentioned previously, believe that a large majority of the information on survey plans is useful only to other surveyors. Most surveyors feel almost all information currently on the plan should remain, but that only a small amount needs to be digitised. There is some sentiment that information already held by LRS should not be included on survey plans, such as parish and county data, addresses, as well as the permanent mark table. In this regard some surveyors feel they are unnecessarily moving data from one part of Government to another.

We're just shuffling around Government data from one entity to another

Surveyor (Regional)

The concept of separating the 'survey' plan (for surveyors) and 'title' plan (for banks, clients and solicitors) was regularly mentioned. This previously occurred in NSW (pre-1983) and occurs in other jurisdictions, including South Africa where there are two different documents, a full survey and the legal document, which is a subset of just basic information (boundaries and easements) that is registered to create the title.

Basic parcel information is universally agreed as essential for inclusion on any digital plan, other elements were variably supported (as essential) by different surveyors as per the table overleaf.

[23] Or a similarly scaled incentive process with no-lodgement fees and high prioritisation for first 10 LXML files, 25% lodgement fees and medium prioritisation for next 10 LXML files and so on.

Element	Support
Boundaries (including dimensions and area)	Agreed by all
Lot number	
Easements	
Bearings	Agreed by some
Reference marks	
Relevant occupations and structures	
SCIMS control marks	
Adjoining information	

Lastly, a constant source of frustration for surveyors is the inclusion of street addresses on plans due to the challenges and delays obtaining these from council.

Real addresses are an administrative thing (between LRS and local council) that don't need to be there; putting them on is no problem, but getting the addresses from council can take six weeks

Surveyor (Regional)

Alternative plan file types

It was reported that LXML as a file format is not commonly used by other stakeholders and that CAD files (DWG/DXF) are the most common format in the design and construction industry. It was noted that some councils and utilities also request these (sometimes with specific layer structures), whilst others may request a PDF or TIFF (or even printed A2 plans).

Almost all surveyors utilise CAD files to exchange information from their calculation packages to their drafting packages in which the TIFF is created, and many advocated the idea of utilising a structured CAD file as a digital format.

The best way would be a simplified DWG/DXF that just contains the boundaries and easements - it would only be an extra hour to create – so still lodge the TIFF image and accompany with DWG/DXF (will be a one for one with the plan and readable) – a title search would then be connected to that, would print an A4 diagram of that lot for attaching to title docs – rather than having to look at a whole DP, with 30 to 40 lots. The typical landowner doesn't want to see that

Surveyor (Regional)

Some surveyors proposed a solution where the raw data from the calculation packages (which can export in a variety of formats) could be uploaded directly into a portal that generates the information required by LRS and DCS Spatial Services.

Lastly, a small number of users suggested smart PDF (with layers) and CEXML (as used by the NT) could also be explored for suitability.

Approvals and associated documents

Surveyors consistently noted that digitising approvals and associated documents hold the most potential for improved efficiency. The current process of obtaining 'wet' signatures for documents is seen to be both time consuming and frustrating (with risks of forms being lost or held up in the post). It is felt that digital signatures and parallel endorsements would result in significantly faster registration.

> *The biggest opportunity for efficiencies is approvals, it's all being done in a straight line bouncing back and down the chain, needs to be done in parallel*
>
> Surveyor (Regional)

> *Spend a lot of admin time posting plans or 88Bs around to get signatures*
>
> Surveyor (Regional)

> *Can take 4 to 6 weeks for the mortgagee to sign and another four to six weeks for council and they can't have it together at the same time*
>
> Surveyor (Regional)

Digitalisation additionally presents the opportunity to have the status of approvals tracked and required endorsements can be automatically and appropriately applied then revisited as needed. Equally, it can help speed the creation and accuracy of associated documents by pre-populating key information.

> *If creating easements for example, then it should automatically populate the admin sheet for creation of the 88B*
>
> Regional Surveyor

There was also a suggestion to lodge plans (including associated documents) while waiting for approvals. Similar to the current pre-examination process, at additional cost, a preliminary examination would be conducted without signoff, but a guarantee would be provided that, when all signatures come in it can be registered almost instantly (assuming no changes are flagged).

Strata plans

There were mixed views on opportunities for digitisation of strata plans. Some surveyors believe that as they are simple plans compared to normal DPs, they are a good candidate for digitisation. However, surveyors were not convinced that LXML is a suitable file format for strata plans, again preferencing a CAD file.

Some surveyors however, expressed concerns with possible liability issues arising from the inherent generalisations in the strata plans (i.e. if someone used them to make a digital model and then realised it did not perfectly line up with the space). There were also broader questions about the appropriateness of surveyors' strata plans, compared to those of the architects, being used for the data records.

A lot more opportunity to do this with strata plans but LandXML is probably not the right format. Need lot number and area determined by the surveyor. Strata plans are the most rubbery of the lot, the way the legislation is written, have to replicate a complex building with two thicknesses of lines - it's impossible. We need a good picture but not something you can get an area off of. More bang for your buck to make strata simpler, leave DPs out of it for now

Surveyor (Regional)

Other opportunities

Surveyors identified a number of other opportunities for improvements that digitalisation could help enable. These included the following:

- automated notifications when other PPNs in close proximity to the surveyor's are registered
- a more customer friendly plan search functionality for registered plans from LRS (this would also benefit LRS by enabling self-service)
- enhanced boundary determination evidence such as photos and/or videos of where survey marks were found, and information tagged to lines and points in the smart data.

Though unrelated to digitalisation directly, it was requested on multiple occasions that the registration of plans be separated from the issuing of titles. The inclusion of these non-current plans on a separate layer is seen as an opportunity to enhance currency of the NSW Spatial Cadastre and would help avoid a survey being completed but not lodged for a period of time in which another survey has been conducted that impacts the boundary definition.

Other findings

Through consultations surveyors also commonly expressed two other concerns; variable satisfaction with the performance LRS, particularly the quality of requisitions, and frustrations with the state of the NSW Spatial Cadastre.

Some surveyors reported that the performance of LRS had been variable in recent years. Issues consistently related to the quality of requisitions and there is a perception that examiners do not focus on the right elements due to a lack of surveying knowledge. Some surveyors however, noted that in the last six months this has improved and LRS has been more inclined to avoid minor requisitions where possible.

LRS used to be very much oriented to checking the position of the boundaries and the trail of the title, any encumbrances etc. but now we have a tick a box mentality where we are getting requisitions on every plan

Surveyor (Regional)

LRS is getting better now, there will be a phone call with a minor error saying fix this up and send it back and we won't requisition you

Surveyor (Regional)

Many surveyors stated that they now assume they will be requisitioned for every plan. The resolution of requisitions is also a pain point for surveyors who reported that call backs to discuss issues with the examiner are too slow, and that it is faster and easier to just accept the requisitions and make the modifications, even if it reduces the quality of the survey.

Can either change plan to get it accepted quickly or can dig your heels in and stick to what is right

Surveyor (Regional)

Another minor issue noted was the lack of value in pursuing pre-examination as it conferred no assurances to surveyors that their plans would be more likely to be registered faster. It is felt that LRS should offer semi-automatic registration if the lodged plan does not differ from an approved pre-examined plan.

Additionally, there is some confusion over the lack of ownership of the digitalisation of plans by LRS, with some surveyors expressing surprise that LRS had not driven digital plans harder.

I honestly expected when LRS was privatised they would come up with a different stream for LXML which would be faster and cheaper – but they don't seem that interested, and we are doing their work for them

Surveyor (Regional)

Lastly, some surveyors expressed frustration with the state of spatial cadastres across the state. There is confusion by some surveyors as to why new plans are being made to fit with old plans rather than the other way around in the NSW Spatial Cadastre. Additionally, some surveyors reported being concerned that some of their survey work does not result in accuracy improvements to the NSW Spatial Cadastre (e.g. where redefining boundaries for rail infrastructure) and that so many entities have their own spatial cadastres that do not interface with each other.

Sharing the spatial cadastre with more individual councils would be good, the more people that are contributing to it and have access to it the better

Surveyor (Regional)

Attachment C – Councils and utilities sentiment

Property - uses

Representatives from Property teams within councils and utilities reported that their primary use of plans is to:

- update property records to deliver services
- produce planning certificates (e.g. spatial relationship to planning restrictions, roads or environmental corridors)
- determine applicable rates
- record the location of assets (for maintenance and repair).

Property - spatial cadastres

Property teams typically maintain their own spatial cadastre, with some regularly drawing base data from the NSW Spatial Cadastre. While most of the representatives engaged with indicated a willingness to move towards only utilising the NSW Spatial Cadastre they reported that their concerns with its accuracy prevent them from doing so. It also does not contain all types of registered plans in all instances (e.g. registered leases, acquisition plans, easements). These currently require manual effort by the property teams to digitise against their internal cadastres wherever not captured in the NSW Spatial Cadastre. It was also noted by some representatives that their own spatial cadastres are updated more rapidly than the NSW Spatial Cadastre (three days compared to ten days).

Councils and utilities add data to their spatial cadastres at various stages, but all are eager to incorporate data as soon as it is available to assist with other planning activities. Data is typically received as a CAD file or PDF/TIFF file. Whilst some organisations, such as Sydney Water[24], have a specific layer structure for CAD files (for those prepared by a water servicing coordinator at the proposed stage only)[25], there is no standard structure used across the industry. As such, entering data from CAD or image files into spatial cadastres was reported to be currently labour intensive. The GIS systems were believed to support LXML for easy ingestion, however the files are still required to be fit to the fabric of the organisation's spatial cadastre which requires manual effort. One council reported obtaining LXML from DCS Spatial Services through the 'capture on demand' service and 40 councils have either production or pre-production accounts[26], however the format is not currently widely utilised. Representatives from multiple other organisations noted that while they are not using LXML from DCS Spatial Services, they are exploring LXML's use for the future.

[24] Sydney Water also developed an AutoCAD plugin which then assigns standard line weights and colours to specific layers.

[25] Smaller subdivisions (2 lots) submitted to Sydney Water through its inhouse 'Developer Direct' service are submitted as PDF files.

[26] A further lift in adoption is expected once the service is expanded to support strata plans.

Property – plan contents

Representatives from Property teams had differing views regarding the information they required from plans; however, the following elements were reasonably consistent:

- parcel information (boundaries, dimensions and area)
- easement lines and restriction references (indicative of asset locations)
- unit entitlements for strata plans
- roads and references.

Property representatives noted that it is desirable to confirm addresses at the DA stage, as it enables them to tell developers the addresses for sales documentation and drive surveyors to correctly sequence the lot numbers (street direction) It would also be beneficial to utilities (to ensure meters are consistently assigned) and emergency services (to locate sites) during the construction stage. However, managing this is problematic and complex, resulting in different management processes utilised by councils across the state One of the councils consulted has a process to provide address numbers for free within a day of receiving a request via email, while others charge for the service and have longer service delivery timeframes.

> *The address is important when using it as sales document; it also helps force surveyors to sequence the lot numbers in alignment with the direction of numbering of the street. At this point in time it's creating work, but important to have on there*
>
> Council GIS manager

It was also reported by Property team representatives that some private certifiers are approving strata plans even when the directions of council (e.g. addresses allocated) have not been adhered to. Unaware that this has occurred, surveyors are only discovering the strata plan is wrong when registering it. Local surveyors who regularly work in the area were seen to be more conversant with councils' rules and requirements, more likely to correctly apply these and therefore have plans processed more rapidly.

Planning

The other main user group within councils and utilities are the Planning teams who utilise plans to confirm alignment with the conditions of consent stipulated at the Development Application (DA) stage. For this purpose, an image was seen to be adequate for reviewing.

Some of the organisations consulted reported using the ePlanning portal for managing DAs. These organisations asserted the ePlanning portal is a good tool for the end user, as it has streamlined the front-end, ultimately increasing the speed of the process. Nonetheless, front-end efficiencies have not been matched at the back-end, which still requires a significant amount of effort and resources to manually create applications and endorse DA plans. These DA plans must be physically printed and signed, then scanned back into the system. Systems integration with enterprise software systems, such as Technology One, is being pursued and should help automate workflows.

ePlanning is great as the Government is now accountable for meeting the times for the referrals (which can be tracked) rather than relying on council chasing, also great for customers as it saves time driving between councils

Council Planning Administrator

Opportunities for digitalisation

Representatives from both Property and Planning teams across all the councils and utilities consulted consistently articulated a number of opportunities for digitalisation. If implemented, these would improve the efficiency, speed and quality of service relating to plans for registration.

A compelling benefit to both internal staff, as well as surveyors and their customers, is faster, more accurate processing of plans enabled through digitising plans, particularly approvals and associated documents. Digital signatures are seen to be an obvious improvement that would support faster approvals. The current requirement to have wet signatures delays councils signing off the subdivision or strata plan. Use of digital signatures would reduce internal administrative effort and minimise holding costs for developers.

Some of the developers' holding costs are $50,000 a day

Utility Approvals Manager

A digitised signature would give team members two to three hours a week back; broader digitisation would save a few hours per application – huge benefits

Council Planning Administrator

Consultees expressed a degree of agnosticism for the specific format but believe, critical to reducing internal effort, is the ability to automatically obtain smart data from plans (DP numbers, lot numbers) to avoid manual entry. It was estimated by representatives from one organisation that doing so would save significant time (half an hour per plan) from that process alone. This metadata would also be useful for workflow automation, where it would be automatically ingested into council and utilities work management systems.

Once the applicant has submitted the document it should be straight into LRS; a subdivision certificate with a two to three week turn around could be reduced to one week

Council Planning Administrator

At the moment we are coding from one format to another, digitising off PDFs, none of that would exist if we had smart digital plans as the standard for proposed land and registered, it would be so much faster - LXML isn't necessarily the requirement, the key thing is getting the data electronically including the metadata

Utility Spatial Manager

It was also suggested that a digital workflow system should connect automatically to a portal for automatic notification of approvals by other parties. This portal system would enable visibility of the status of an application for all parties, including when documents are changed by a surveyor (at the request of other authorities) and may require subsequent re-review of approvals already given. Presently these changes may occur without the approvers (particularly utilities) knowledge.

A bit more communication between the council and utilities rather than having the applicant as the middleman would be much better

Council Planning Administrator

It should be coming back for signing after changes have been made – there is a need to sign it every time its requisitioned with currently manual signing back and forth between LRS and Council which could be digital

Council Planning Administrator

Almost all of the representatives consulted from councils and utilities desire to utilise smart documents (pre-populated forms with inbuilt data validation) wherever possible to enhance accuracy and save time. Having standardised templates that can be easily populated, (e.g. Section 88Bs with standard clauses), and with mandatory fields, (e.g. plan purpose, underlying DP, lot numbers), that can be automatically validated is seen to be a major opportunity for digitalisation. This would also assist to drive consistency across the state. It was reported that LRS have made changes to land title dealing forms - the idea of interactive forms has been well received, but it was noted that they have missed administrative information, which requires handwritten amendments.

88Bs can be problematic (e.g. used the wrong memorandum). Ideally digital data comes through and is colour coded depending on the type of interest being created (still want to check the title plan); it would save a fair bit of time, look at tonnes of these every year – probably half-a-day's work per plan and look at over 60 a year. There are less than twelve different memorandums which could be templated and would cover 90% of cases.

Utility Asset Manager

The concept of a dataset was suggested whereby a single source of truth for the application has the key information entered once. This information would then be automatically included in the relevant plan documents. This would also enhance consistency of naming files and labelling elements, which is currently an issue.

Another opportunity raised by councils and utilities representatives, primarily those from the Property teams, is the potential for operational staff to access digital information in the field if there is an increase in digitalisation. This is in line with the broader ambition to go paperless within almost every organisation consulted; many reported that digital signatures and fillable PDFs are becoming common practice. Likewise, there is a current push for renewed focus on customer service across organisations[27].

We are trying to keep stuff digital, once it is created digitally it stays digital

Council DCS Spatial Services Manager

[27] Relevant initiatives in this space include one council reporting that the Planning team is now customer oriented as a 'one stop shop' for development approvals (planners, engineers etc. all in one division now to assess) as well as online mapping capabilities being shared with public and a self-help portal showing developers their current database to aid their planning efforts.

We are required to have hard copy documents with wet signatures, it's the biggest thing that needs to change and the only process left that is still hard copy

Council Development Assessment Coordinator

Lastly, it was noted that digitalisation presents opportunities for enhanced strata data being captured and carried over for building information management (BIM) applications. Similarly, having additional clarity through easy identification of lots and maximum extent information is increasingly useful when assessing planning permits for strata / stratum developments.

Barriers to change

Whilst a definite willingness for digital change was observed, some councils suggested that the smaller scale of regional councils, that typically have small teams and a low volume of DAs, would be limited their ability to invest in digitalisation. There is also a diversity in terms of internal software (Technology One, Civica Authority, SAP and others) that somewhat complicates solution interoperability.

Attachment D – LRS sentiment

Outcomes sought

LRS acts as the middle party between Government and the industry, it therefore sees its customers as both the general public and surveyors. The function of LRS is to facilitate the necessary transactions to create and maintain land title records on behalf of the NSW Government. In this regard a primary outcome sought from its operations is maintaining the satisfaction of the ORG – this is contingent upon the integrity of the Titles Register being preserved and enhanced. LRS also reported a desire to 'improve plan lodgement, examination and registration outcomes for customers and citizens of NSW'.

Additionally, as a commercial entity, LRS must adhere to the conditions of its contract and operate in a commercial manner. It is therefore driven to provide services efficiently as possible without compromising service quality.

Opportunities for digitalisation

LRS perceives robust opportunities for digitalisation to help achieve the outcomes sought. This includes faster assessment of plans and increased quality, leading to reduced plan requisitions and amendments.

Currently LRS examiners have to check both the TIFF and the LXML if submitted. This is a manual and burdensome process that requires more effort to examine than if only a TIFF is lodged. Smart digital surveys have the potential to allow for increased accuracy and automation of examination. Human assessment of decisions will still be necessary in all cases, but digital plans were seen to offer the ability to include enhanced information about where the survey was started from and what methodology was applied in boundary decisions. LRS stakeholders did not indicate a preference for any particular file format for lodgement, noting that they were somewhat agnostic as long as it could be easily converted into another suitable format (if required to be).

Minimising requisitions is seen to be a significant benefit for LRS and surveyors and a strong opportunity for digitalisation. LRS stakeholders cited a number of minor typographical errors they encounter that could easily be mitigated through smart associated document forms with data controls (e.g. compulsory fields and data validation). They have started with some automated templates, which have reportedly been well received.

The current manual entry (hard copy) channel, which accounts for approximately 20% of plans lodged, requires additional effort to manage and process paper documents. LRS would support mandating digital lodgement.

More broadly, LRS is keen to simplify and automate the lodgement process and plans as much as possible, making it easier to create and examine plans.

Barriers to change

LRS accepts its responsibility for supporting and driving digital change. However, it is mindful of the history of the introduction of LXML and is keen to not replicate the previous approach, where there was insufficient engagement with surveyors and benefits were not balanced. As such there is a strong preference for industry co-design and involvement in the process.

Attachment E – DCS Spatial Services sentiment

Outcomes sought

As the provider of spatial and land information services, DCS Spatial Services' stated primary objective is to 'fully leverage spatial products and services in support of the NSW Government Digital Strategy which, in turn, has improving service to the community, Government, industry and the environment as its purpose'[28]. A key success factor, critical to achieving its objective, is ensuring the NSW Spatial Cadastre is current, complete and accurate. The NSW Spatial Cadastre graphically shows legal and other approved boundaries applying to land and supports a range of community, business and Government activity – from tourism and land management, to electoral boundaries.

DCS Spatial Services is also responsible for the surveying profession's standards through the Surveying and Spatial Information Act and Regulation and the Surveyor General's (SG) directions.

Opportunities for digitalisation

DCS Spatial Services has developed a tool to automatically validate then convert LXML files into the ArcGIS format required for importing into the NSW Spatial Cadastre. This process has already been seen to provide benefits to DCS Spatial Services by enabling faster, more efficient upload of accurate information to the NSW Spatial Cadastre.

It was reported that the utilisation of the validation tool has identified geometry errors in registered plans prior to upload into the NSW Spatial Cadastre. It is felt that these errors could be picked up by LRS prior to plan registration if the same validation tool was utilised, enhancing the accuracy of information received. Validation tools also provide the ability to identify incomplete data sets. More generally, by improving the accuracy and usefulness of the NSW Spatial Cadastre it is probable that more organisations will cease operating their own disparate spatial cadastres and there will be convergence towards a single source of truth.

Automated checking and ingestion into the NSW Spatial Cadastre is also seen to offer significant efficiency gains by minimising double handling through multiple manual entries.

Capture once, use many times

DCS Spatial Services representative

[28] https://www.spatial.nsw.gov.au/about_us (accessed 20/11/19)

More broadly, representatives from DCS Spatial Services also cited a number of other opportunities for digitalisation, including:

- faster, more user-friendly plan discovery for surveyors
- inclusion of a more detailed and complete proposed layer[29] in the NSW Spatial Cadastre integrated into the broader property development life cycle and supporting other Government initiatives like the ePlanning portal
- enhanced workflows and integration with other related datasets such as Survey Control Information Management System (SCIMS), transport network and imagery
- propagation and support of the survey control network, by incorporating newly placed permanent survey marks while also updating the status of permanent survey marks and upgrading the accuracy of their recorded location
- the potential to enhance the evidence and defensibility of boundary decisions; in turn supporting the SG to improve the quality of survey practice in NSW
- improved integrity of the cadastre through more comprehensive regulatory compliance measures enacted in a more customer friendly way
- supporting progression towards the national Cadastre 2034 vision[30] and NSW digital twin[31].

Strata plans are seen to be another opportunity for digitalisation, especially to provide more information on where the relevant space is within the parent lot (i.e. which building an apartment is in within a multi-building estate). It is felt that this would have significant benefits for the general public relating to mapping (e.g. emergency service access) but that, before this can progress, there should be agreement on what digital data for strata plans is required (e.g. dimensions and height information).

A lot of information on a full LXML plan is not required for the current scope of the NSW Spatial Cadastre (and is not ingested). It is felt that a LXML 'lite' or similar format may be feasible and that this would not need to include elements such as occupations or adjoining information. It was reported that the file would, at a minimum, require complete geometry for every parcel (including boundaries, bearings and distances) as well as survey control and that, whilst currently RMs and easements aren't ingested, in future these may be a useful addition to the NSW Spatial Cadastre.

DCS Spatial Services has developed its current system to ingest LXML files into the ArcGIS format required for the NSW Spatial Cadastre. It would require adjustment to accept other file types, however this is possible. Whilst it is recognised that CAD files do not contain intelligent digital data it was noted that the system could be modified to ingest these and that DXF may be a viable option worth exploring.

[29] Currently this information is only obtained from councils at subdivision certificate sign-off; digital plans may support automatic addition of this information at the DA stage.

[30] This envisages a fully automated process with a federated (based on common standards) 3D cadastral system which is survey accurate. In the short to medium term this is likely to include a 2D map base with 3D information in an adjacent dataset.

[31] A 3D or 4D cadastre is essential data underpinning the digital twin which has a broad range of use cases across land use planning, the built environment, infrastructure development, natural resource management, emergency services planning, and Government services.

Barriers to change

Whilst LXML is utilised currently, it was noted by DCS Spatial Services' representatives that it is not an ideal format. LXML is seen to be 'inefficient and cumbersome' to use and the poor rendering quality prevents easy visual interrogation of the data. There is also not a suitable place to include all data contained within the administration sheet attached to a plan in a machine-readable form. Ultimately however, the biggest barrier preventing DCS Spatial Services from benefiting from digital plans has been the low take up of LXML by industry.

A number of entities across the state (particularly councils and utilities) maintain their own spatial cadastres. This was initially prompted by previous business model to charge users to access the NSW Spatial Cadastre. Though this is now a free service, over time, other entities have improved their spatial cadastres to the point where they are more accurate or aligned with the other entities' datasets than the NSW Spatial Cadastre. This multiplicity of datasets contributes to a disaggregation of benefits and lack of ownership for improvements. DCS Spatial Services have been working with councils to demonstrate and improve the quality of the NSW Spatial Cadastre; the benefits of digitalisation should augment these efforts.

Attachment F - Developer sentiment

Outcomes sought

Developer representatives reported a simple objective from the process of plan registration; being to have plans registered as quickly as possible with the least complexity, in a cost-effective manner.

It was noted that when plans are being processed by LRS is often at the height of debt and investment for the developer, where a delayed registration can have material financial consequences. Developers are therefore highly motivated to ensure the plan registration process is as quick as possible. They are also keen for it to be efficiently priced, recognising that increases in cost in some cases may be overall worthwhile if there is a resultant decrease in time to registration.

Opportunities for digitalisation

Developers engaged with are strongly supportive of digitalisation. They perceive significant opportunities relating to the speed and transparency of the plan registration process.

It is believed that digital plans will enable quicker examination and registration by LRS. One developer noted that when LXML was first introduced they had a very positive experience where a plan was lodged and registered within 48 hours.

We thought as an industry it was a great idea – the gap between finishing the subdivision and house construction commencing can be 6 to 9 months and there are costs with loans.

Developer

Developers also have high expectations for the ability of digital plans, particularly associated documents and approvals, to speed up the end to end process by facilitating automated workflows between the various reviewers and approvers.

Can't see why there isn't a situation where, once a utility issues their certification, it is electronically transferred to council, then automatically released to LRS who automatically assess and register it - then the loans are settled, and house construction starts

Developer

Developers noted that they have only a 'casual engagement' with the plan registration process and rely on whatever information is provided by their surveyors. It is seen to be a very complex process with a multitude of elements, where increased transparency would be highly valued to enhance their customer experience and potentially also assist in the speed.

It would be great being able to see where referrals and maters arising are siting or why additional information has been requested. We always have to do it through consultants who blame each other and the approvers

Developer

Delays can lead to clients saying that their builders now want to put up house prices and then we find out that a missed $450 fee has held up a 2,000 lot subdivision being registered

Developer

Related to transparency is the ability to integrate data streams into other digital elements. Developers suggested that linking digital plans with other aspects of the whole development cycle, such as ePlanning and eConveyancing, should be explored.

We have digital information and spatial information and planning regulation and other regulations; if we could integrate to be able to use and measure performance in real time that would make a big difference

Developer

Integrating the digital plan data into the design and construction side of developments is also seen to be an opportunity. Developers reported not being too concerned with the contents of a plan (provided there is a clear boundary with dimensions and easements). However, being able to obtain final plans in a CAD format that builders could use as a base plan to sight houses on would add to the value chain.

Barriers to change

It was noted by developers that the low uptake of LXML from the surveying industry had surprised them. Speculations were made as to the reasons for this, but developers reported feeling as though many surveyors did not value LXML. This has had some reputational consequences and shifting industry (both developers and surveyors) sentiment was seen as critical to achieving digital change.

LXML was supposed to be the great saviour and that fell over, not sure what happened but as developers we are a bit sceptical

Developer

Educating the market of any changes and benefits was seen to be very important to supporting adoption. Training, providing content for seminars and establishing partnerships with industry associations are all viable options to achieve this education. Through the process, consideration must be given to the diverse scale of entities and recognition that the major companies are likely well informed but that smaller ones will not be.

Attachment G – ORG sentiment

Outcomes sought

The ORG sees its customers as landowners, surveyors, conveyancers and developers (including big developers and 'mum and dad' developers), among others. It needs to ensure integrity of titles and the cadastral system. In practice this means overlapping boundaries and mistakes in documentation are minimised and easements and restrictions are always on the title. Preventing errors after registration helps to reduce Torrens Assurance Fund (TAF) claims, as well as professional indemnity claims. More broadly the ORG desires to increase efficiency, accessibility and availability to ensure better outcomes for customers.

Opportunities for digitalisation

The ORG is very keen to progress digitalisation as it is a Government priority ('Government made easy') and there is significant support for this within Government to increase efficiency, accessibility and availability to ensure better outcomes for customers.

ORG believes that digitising plans will present opportunities for automated validation, which will help eliminate plans being registered with errors (in turn minimising subsequent amendment actions). It is also felt that digital plans, particularly digital approvals and associated documents, will help increase the speed of registration and in turn, reduce holding costs for developers.

Whilst most of the opportunities for digitalisation do not directly apply to the ORG, there is potential for digital information to assist the ORG in its regulatory role if it can quickly consume data and extract relevant insights.

Lessons from eConveyancing

Through the introduction of eConveyancing a number of observations were made, and lessons learned. Representatives from the ORG reported the most salient of these were realising the importance of:

- **commercial benefit** – the most obvious benefit was the substantial decline in time required by lawyers and conveyancers - from minimising data entry, time spent on the phone with financial institutions (obtaining relevant information for the transaction) and remedying mistakes and errors - freeing their time up for other work.
- **governance** – the ORG retained responsibility for the governance and policy, LRS was responsible for the IT solution and business rules.
- **industry engagement** – the ORG lead engagement with stakeholders via constant digital communications and multiple roadshows across NSW to promote benefits and obtain input from regional and metropolitan stakeholders.
- **mandating** – this assisted with driving industry uptake and without this the uptake would have taken much longer. It was also noted that adhering to the stipulated timelines conveys the right message to industry that Government is committed to the initiative. The mandate

notice period should be reasonable and decided upon after close consultation with stakeholders, including strong partnership with peak industry bodies.

- **staged roll-out** – eConveyancing was introduced through a three-stage mandate which focused on the easier, high volume documents first in the transition towards complete adoption. In 2017 it was stipulated that all standalone mortgages and refinances go digital, in 2018 standalone transfers, caveats and all refinance documents had to be lodged digitally, and finally in July 2019 all mainstream property transactions had to be lodged digitally. These timeframes were believed to be the shortest possible to achieve a practical and sustainable outcome for eConveyancing.
- **support for industry** – it was reported that PEXA provided valuable one-on-one systems training for an initial number of transactions. Additionally, peak bodies (such as Australian Institute of Conveyancers and the Law Society of NSW) provided group training on the reform in general (including new regulatory and legal requirements). This support to industry assisted with promoting the platform and bringing users onboard incrementally, preventing a rush of users signing up at the last moment and causing unnecessary strain on the system.

The ORG representatives noted that, as a result of the changes to eConveyancing, namely the removal of middle parties, it is now closer to the customer and its customer base has expanded.

Attachment H – Software vendor sentiment

Business drivers

Most of the software vendors engaged provide civil engineering software in addition to surveying software. While the latter typically represents a smaller revenue stream than the former, all maintained that providing surveying software packages is core to their business. The importance of the NSW survey market also varied between software vendors; again though, it was consistently noted that it was an important one[32].

All software vendors reported valuing a close working relationship with their clients and, in response to their anticipation of the industry moving towards mandated LXML, have added LXML capabilities to their software. It was observed, however, that despite an initial surge (seen to correlate with prioritised examination), surveyors' interest in LXML has subsequently decreased.

Benefits of digitalisation

Software vendors are naturally very supportive of digitalisation of survey plans. There is a general consensus that, whilst LXML is not perfect, it should remain unless a better alternative is developed, and that the NSW recipe is appropriate.

Software vendors all reported that digital plans should lead to time savings in the production of surveys, (particularly when working within digitally established boundaries), and cited that it could reduce the need for a draftsperson if rendering is better capable of producing a plan image. It was also noted that digital plans would enable automated pre-validation and examination, reducing human error. This would be further supported by the ability to include additional survey evidence as metadata, such as photos (though it was reported that the format may have to change slightly).

Issues with LXML

Despite overall support of LXML, software vendors raised a number of concerns. These were primarily related to the ability of the format to render plans, its suitability for 3D and inconsistency across jurisdictions.

Whilst the approaches to implementing LXML within the software packages varied, there is consistent acknowledgement that the format is data based and not well suited to rendering plan images. Whilst all software vendors reported that their software packages could produce a LXML, the amount of additional effort to do so (compared to producing a CAD file or TIFF) varied between packages. The frustrations of surveyors around having to duplicate effort to create a LXML is appreciated by vendors (who likely anticipated an effective rendering solution

[32] And one for which they would respond to changes, particularly mandates.

being provided). As noted above, it is felt that if the LXML could be lodged without a TIFF then the total time of creation would be similar to just creating a TIFF.

LXML doesn't have a presentation layer, it's purely data – we are trying to get a format which is not designed for a plan into a plan - things like font size and direction are just not in LXML

Software vendor

Whilst some software vendors reported that strata plans could be produced in LXML, the general consensus is that it is not an ideal format. This stems from the belief that LXML strata plans are too complicated and that a 3D native format should be adopted with the potential to support a 3D cadastre and align with building information modelling (BIM).

Software vendors were frustrated that the LXML recipe is not consistent across the country, making it harder to invest in a single solution. The challenges that prevent this were largely understood but some software vendors believed these could be at least partially overcome with national coordination. As a result, most of the software vendors focus their products on only one or two jurisdictions, with the differences across states requiring subtle but significant effort to customise the software.

They say it's ePlan for Australia but it's not, very different inclusions in LXML between each of the states – until they have one cadastral system for the country it won't happen

Software vendor

There was also sentiment expressed from some software vendors that, whilst the content is good, the NSW LXML is not well defined and there are elements and attributes that can be interpreted differently. As a result, the implementation of LXML across different software packages is believed to differ slightly. It was noted that whilst they can still import/export LXML files into any of the software packages, there is a need for clear definitions of all the attributes.

Alternative formats

Most software vendors have not explored other formats in detail and there is no strong consensus on an ideal solution. Suggested formats included CityXML (used in Singapore), Land and Infrastructure Conceptual Model Standard (LandInfra) or Industry Foundation Classes (IFC) but these would require further investigation.

Two software vendors suggested that the best way forward would be for NSW to develop its own XML based file format. If NSW led the creation of a new format it would ensure it has the exact information required by all stakeholders within NSW (and could potentially then be modified for other jurisdictions). This could be similar to the current LXML format but with some improvements (effectively a superset of the current LXML elements) and clear definitions. XML is seen to be ideal due to its Unicode implementation (able to handle many languages). It is also believed to be a secure 'archivable' format which will be readable in the far foreseeable future.

It is believed that developing a tool to convert from LXML to a new XML format would not be technically challenging, and that most software packages could be modified to work with the new format within a short period of time (three to twelve months depending on the extent of

change). This would require an acceptance that a visual plan (other than potentially a simple rendered boundary plan) is no longer required. In turn it will enable digital interrogation of the file to fit the users' purposes (e.g. turning on relevant layers and being able to zoom in digitally). The file format could also support additional metadata such as photos, videos or textual comments to provide evidence of boundary decisions.

Whilst it is recognised by software vendors that CAD files fit within the current standard industry workflow, it was also believed by some software vendors that allowing these diminishes the benefits of genuine 'smart' formats such as those which are XML-based. It was also noted that the proprietary nature of DWG should exclude it from consideration as a format (as this will go against the Government's view on open and accessible data).

> *DWG is not an industry friendly format; it's so locked down. It should not be anything proprietary as this is against Government's view on accessible and open data. DXF doesn't have those issues, but it's still a CAD format and is not designed for smart data - then you are still locked into drafting, the same thing that has held industry back for years when we should be focusing on data.*
>
> Software vendor

Attachment I – Benchmark finding details by jurisdiction

New Zealand

Digital survey lodgement in New Zealand (NZ) has been 100% since 2007, when it became mandatory. Surveys are lodged in LXML format, and pictures, text and PDF documents that support the data set are uploaded as a Cadastral Survey Dataset package.

Land Information New Zealand (LINZ) developed an electronic system called Landonline for the lodgement and processing of cadastral surveys and land title dealings, which became fully operational in 2003. The initial uptake of digital lodgement from 2003 was low. In 2006 it was announced that digital lodgement would become mandatory from 2007. At this time private brokerage firms established services to help smaller surveying firms transition to digital lodgement. These have since disappeared as the surveying industry has become accustomed to the digital operating environment.

There was a significant backlog of plans being lodged as NZ approached mandatory digital lodgement. Discounts of approximately 50% were offered for digital lodgement, but it has been reported that this did not influence the market significantly.

For survey and titles, existing legislation was based around paper filing, as such, the existing *Castral Survey Act* was updated, with supporting regulations, and Surveyor General rules. It took two years to make legislative changes, and this was done prior to the launch of Landonline. The new *Cadastral Survey Act 2002* introduced the concept of a Cadastral Survey Dataset rather than plans of subdivision. Titles refer back to plan numbers, which links back to the dataset. Plans contain boundary definitions, easements, and adjoining allotments.

A private practice surveyor, representing the surveying industry was part of a team established during the design and roll out of digital surveys in NZ, and extensive stakeholder management with the surveying institute was undertaken, including testing the design with surveyors and seeking feedback and input. Sharing the strategy with stakeholders was well received. LINZ contracted an early adopter survey firm, to train other firms, and an education training group visited surveying firms that were lodging with mistakes.

Landonline is an electronic workspace for surveyors. LXML was chosen as the format as no better alternatives were identified at the time. Standardisation of file format was important for the development of Landonline.

12D is the major survey software provider in NZ with 80-90% market share and facilitates conversion of survey data to LXML format. Surveyors download data from Landonline, combine it with data collected in the field in their survey software. They then load the package into a Landonline workspace, where some (approximately 10%) massaging of the data is generally required for compliance, completion of data capture, and plan generation. Once uploaded into the workspace the file cannot be exported back out into survey software such as 12D. Automated business rules for pre-validation are provided and automated warnings are flagged to surveyors, although these can be ignored. There is an approximately 50% requisition rate.

Landonline allows the supporting documentation to be completed with drop down menus, using pre-populated templates.

The result is the NZ cadastre is effectively one giant LXML dataset, which surveyors can use to easily select existing survey data to use for their pre-calculations. Surveyors pay an annual licence fee of $1200 to access the dataset.

Lodgement fees are adjusted for how much it costs to approve, and there is a drive to automate approval processes to reduce the cost of LINZ overheads, and reduce lodgement fees.

Surveyors have reportedly found digital plans more seamless to use and accept digital data as more important than the plan. Title plans can be rendered directly from the Landonline system. LINZ had to commission its own system to render plans.

The future of digital surveys in NZ is moving to the cloud, where digital data is what the surveyor produces, and can be visualised with common tools. Putting business rules in the cloud will make it easy for surveyors to lodge fully compliant and validated plans by empowering validation within the software packages. A Surveyor Working Group with 10 surveyors from across NZ has been established to provide guidance to this project. LINZ is also developing a 3D cadastre.

Western Australia

Digitisation of survey information in Western Australia (WA) began in 1995, driven by reforms to reduce salary costs in the examination of plans. For all subdivision plans, surveyors must lodge a Cadastral Survey Data (CSD) file, a proprietary digital data format, in addition to a plan graphic and survey field notes. The agency responsible for land titles, Landgate, has allowed electronic lodgement of the plan graphic and field notes in PDF format since 2003.

The CSD file captures digital data on polygons, addresses, boundary corners, roads, cadastral boundaries, lot and plan number. This provides an efficient mechanism for bringing in spatial data with points, and point to lines, and lines geometrically aligned. Dimensions are retained as provided by the surveyor, but the system fits new polygons with existing records, by identifying common points. It then contains calculated length and the surveyor's length, and all data is available to surveyors. It is the surveyor's responsibility to ensure the parcel fits within the existing cadastral fabric, and checks are made to ensure it fits within reasonable tolerances. Surveyors can obtain a spatial cadastre export in several formats, with DXF the most common. Landgate provides a Land Transactions Toolkit, including a CSD user guide.

Survey field notes are provided with the plan, and the regulations around this specifies information that is not required on the plan. Surveyors can upload a scan of the notes, or a drafted version. Some surveyors collect everything in their total station, download into drafting package, join dots and make notations, then lodge as a PDF.

The plan graphics in WA is only of the subject parcel, and adjoining information is not required, as surveyors are only required to sign-off on what they have surveyed, not the surrounds. Plans

label the abuttals, but Landgate does not check these (as they are not material to the integrity of the Land Titles Register).

The WA *Planning and Development Act 2005* allows most easements to be created just by spatial definition on a plan, especially in greenfield subdivisions. Easements that cannot be automatically created require a deed to be lodged and the surveyor hands over to a settlement agent to complete the title dealings (the plans status is known as 'awaiting dealings' before a dealing has activated them).

Plan examination has been simplified in WA and includes checks that all land in the original title is accounted for, dealings are for the right land, spatial miscloses are within tolerances, and legal annotations are correct. This results in a significantly lower requisition rate compared with other jurisdictions (approximately 2% for freehold deposited plans lodged). A requisition penalty regime was introduced, with penalties relating to the severity of the breach. Severe breaches lead to the Land Surveyors Licensing Board disciplining a surveyor, potentially, but rarely, with loss of practising certificate/licence.

The central state Planning Commission (WAPC) endorses surveyor certified plans that have been checked by Landgate, with electronic signatures on PDF.

The term 'registered' has a different meaning in WA, referring to documents that are part of the Land Titles Register, but the register does not include plans. Survey plans are 'lodged' and 'approved', but their status can also be 'with WAPC' and then 'in order for dealings', but not registered.

The change to simpler plan examination processes with fewer checks meant surveyors ultimately became more responsible for their work. Regulations have become less prescriptive in methodology, with a focus on principles and outcomes. Surveyors essentially became 'approved examiners'. A licensed surveyor can only undertake cadastral surveying if they maintain a practising certificate, which mandates continuing professional development, including keeping up to date with all plan lodging requirements.

The future for digital lodgement in WA is the Portal Plan Project (NLR-Plan Surveyor Portal). It is part of the New Land Registry suite (an Advara/Landgate product), and is a bespoke survey portal, the preliminary development of which has been underway for three and a half years. Portal Plans will provide the capability for surveyors to lodge a completely digital plan, with the surveyor drafted PDF plan no longer needed, as it will instead be able to be rendered from digital data.

The surveyor will create new interests (such as easements) within the portal, allowing the CSD file and PDF plan image to be in alignment.

All through production of the plan, the portal will enforce compliance with relevant business rules and drafting rules, and ensure full compliance with the existing cadastre, and existing easements.

Surveyors have several paths to the portal depending on their choice of software, allowing them to go from the field to CSD efficiently. Surveyors can import either a CSD (which can be directly exported from calculation packages such as Magnet), DWG or ASCII points file into the portal. Many surveyors import survey observations into CSD Editor, coordinate geometry software that has been developed by Landgate in conjunction with ESRI, from which a compliant CSD file can be exported.

When the CSD/DWG/ASCII file is imported, the portal then renders a graphic that can be edited by the surveyor. The portal creates a PDF to be electronically certified by a surveyor within the portal, and then creates a matching CSD file at lodgement of the PDF file. The NLR-Plan Workflow module receives the PDF file, CSD file and any other required forms from the portal for manual and automatic plan examination.

Victoria

Victoria uses an online portal-based approval system called SPEAR (Surveying and Planning through Electronic Applications and Referrals) for processing all plan based approvals under various legislation including the *Subdivision Act 1988, Transfer of Land Act 1958, Local Government Act 1989, Planning and Environment Act 1987* and others.

SPEAR is voluntarily used by all key parties involved in the planning and subdivision processes, but in differing capacities:

- Applicant contact: surveyors or planners submit, manage and track application progress. Licenced Surveyors use digital certificates to digitally sign their plans and surveys, thus replacing all ‘wet signatures’.
- Responsible authorities: all 79 Victorian councils receive, manage, refer and approve applications. Delegated council officers use digital certificates to digitally sign key council decisions, such as planning permits, certification and statement of compliance. This has replaced all ‘wet signatures’.
- Referral authorities: all 54 Statutory Referral Authorities (service authorities/utilities) receive and respond to referrals made under the provisions of various legislation. SPEAR allows them to request further information, or request plan amendments if required.
- Lodging parties: solicitors and conveyancers prepare the application lodgement, including all forms, consents and other supporting documentation, and lodge electronically to Land Use Victoria (LUV). Lodging parties use digital certificates to digitally sign all their forms. This has replaced all ‘wet signatures’.
- Land Use Victoria: receive applications from SPEAR and utilise information in SPEAR to prepopulate other Government databases. SPEAR also allows LUV staff to request amendments to application documents, including plan changes and/or survey amendments, in some cases these changes require council to re-assess the application. All these workflows are enabled in SPEAR.

SPEAR applications account for 98% of all plans lodged at LUV. From 01 January 2020, SPEAR will be compulsory for the creation and processing of all supported application types.

Whilst the majority of information supplied in SPEAR is either in PDF format or direct data input, SPEAR does allow surveyors to submit 2D plans in ePlan format (LandXML). This is currently available for all land subdivision plan types under the Subdivision Act.

Industry uptake of ePlan has been very low with less than 1% of total plans lodged in SPEAR being supplied in ePlan format. LUV is exploring options to streamline the creation of ePlan, which currently relies heavily on third-party software vendors to provide ePlan capability to surveyors.

LUV's initial focus on streamlining the ePlan creation process for 2D plans is to collaboratively develop a structured CAD file format with industry. It is envisaged that the structured CAD file will include all layers used in the creation of a cadastral plan and survey, including subject parcel boundary, traverse, connections, survey marks, new lot boundaries, easement information, annotations, owners corporations schedules and any other administrative data required on the plan. Procurement for a facilitator of the co-design project is about to commence.

The next step will be to develop and host a web service (API) converter that will allow the structured CAD file to be converted to ePlan (LandXML) and vice-versa. This initiative is proposed to be rolled out by end of 2020.

Increasing ePlan take up will directly benefit another significant Victorian Government project: The Digital Cadastre Modernisation Program. Currently the project is in the process of back-capturing existing plans into LandXML format (to date, over 360,000 of approximately 3.3 million parcels have been captured from 50,000 cadastral plan and survey records). The aim is to complete the back-capture program by the end of 2022. To ensure that back-capturing of plan and survey information is not an ongoing maintenance requirement of the digital cadastre, it is imperative that surveyors embrace ePlan as a means of providing current plan and survey information to the cadastre.

The aim of these initiatives is to ultimately allow surveyors to easily convert their CAD files to ePlan format, and therefore radically increase ePlan submissions in SPEAR to support Victoria's digital cadastre journey into the future.

South Australia

South Australia (SA) introduced a system for online portal Electronic Plan Lodgement (EPL) in 2009. Surveyors lodge a TIFF image of the plan and a textual sheet which is generated in the system, and includes easements. Lodgement of plans in TIFF format has been mandated, although strata amendments are excluded.

Plan numbers are issued on lodgement, but the conveyancing processes (via PEXA or manual lodgement) activates the plan for issuing title, not lodgement. Plans are approved for data and deposited once documents to enact the process have been lodged as a separate process. The titling system is known as the SA Integrated Land Information System (SAILIS) and facilitates pre-population of title data. The EPL links to the Electronic Development Application Lodgement

and Assessment System (EDALA), which is done manually prior to planning approval via the EDALA system.

The concession holder, Land Services SA (LSSA), capture all lodged survey plans using a software program called PCplans and provide the Surveyor General's Office with a CXML output to maintain the spatial cadastre. PCplans checks parcel closures and connects the parcels to coordinated survey marks to enable spatial accurate representation of the parcels. PCplans is also available to surveyors to pre-check closures and coordinate joins before lodging. A pre-lodgement checklist is provided by LSSA.

The TIFF remains the source of truth, and no legislative changes have been needed to date.

SA has not adopted ePlan or LXML. LXML is perceived to be a cumbersome format which would limit the use of 3D in survey land information.

LSSA would like a 'data-in-data-out' format and see the benefit of digital surveys to move towards automation and reduce examination effort. LSSA are driving digital data lodgement and Government is supportive of these initiatives. A small industry group will be piloting new software for digital data lodgement with LSSA over the next 6-12 months.

Queensland

In Queensland all lodgement is with the Titles Office, and is undertaken at lodgement centres for paper plans, with a bundled approach to registration and creation of title. From September 2019 plans scanned to PDF are accepted in the document-based system via approved lodgers. Easements are shown on plan, and easement documents are lodged either with the plan or later.

Queensland had been working towards EPlan and a model for LXML digital survey; however, a major overhaul of the cadastral system in 2017 led to pausing this process. The need to replace 30-year-old IT systems and refresh business processes was a contributing factor.

A 10-year strategic roadmap was developed with high level outcomes including digital lodgement, 3D cadastre, pre-registration layers in the spatial cadastre, and automation of plan examination. A surveying reference group of a cross section of different types of firms was established specifically to address digital lodgement and was engaged more generally on issues relevant to the transformation of the cadastral system.

The high cost of implementing this roadmap has impeded progress, and the current strategy is to take a step back and align the work with activities in other jurisdictions, including numeric cadastre and digital twins. While the land registration differences between jurisdictions have made it difficult for a single LXML system to be defined, Queensland favours collaborative cadastral development by a National Committee, and is open to alternative or multiple formats, as long as the data requirements are well understood.

Attachment J – Sample scenarios for solution design

The following scenarios do not consider Information Brokers independently of LRS. Given the critical role Information Brokers play in exclusively delivering some survey plan products and information to third-party consumers, including surveyors, councils, utilities and developers, it is imperative that they are considered in any further assessment of future models.

Scenario DP 1: Roll back digital – surveyors lodge TIFF only

Under this scenario surveyors do not lodge survey plans in LXML or any other digital format, and only lodge the TIFF of their plan drawings. Surveyors can continue to use LXML for their own requirements, such as an internal quality assurance of their surveys to validate bearings and distances on their plans prior to lodgement of the TIFF. The TIFF is the only file examined. This may potentially result in a lower requisition rate, as inconsistencies between TIFF and LXML will no longer be an issue and less elements are checked – however it will prevent validations which may instead lead to increased requisitions. The registered plan is the TIFF.

The TIFF format plans can be subsequently digitised by LRS into LXML format for use by DCS Spatial Services, surveyors, utilities, councils and other users. The solution from LRS to produce digital plans would be the same or similar conversion process that occurs for back-capture of existing plans. The timing between examination of the lodged TIFF and conversion to LXML format would need to be agreed.

The feasibility of this scenario option would depend on the cost per plan to back-capture negotiated with a provider by LRS, and should this be the digital solution proposed by LRS, these costs should not be passed through to lodging parties as an addition to the fixed lodgement fees agreed in the concession.

The approvals process and associated documents should still be digitised even if plans remain in TIFF format.

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
Surveyors	> Speed of creation > Accuracy of plans > Completeness of information	> No change to the current completeness, accuracy or speed of creation of plans lodged as TIFF only.
Councils & utilities	> Efficiency of review > Ease of approval > Speed and accuracy of addition to records	> No change to current for approvals, potential for faster incorporation into GIS from converted LXML after registration.
LRS	> Speed of examination > Accuracy of examination	> No change to examination time and accuracy of TIFF plans only. Slower examination of large TIFF and LXML plans (where LXML speeds up examination).
ORG & Surveyor General	> Accuracy of titles > Appropriateness of the plans for homeowners > Enhanced surveying practice	> No change to current (TIFF files only).

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
DCS Spatial Services	> Currency of NSW Spatial Cadastre > Completeness of NSW Spatial Cadastre > Accuracy of NSW Spatial Cadastre	> Survey plans back-captured in LXML format by LRS at registration will be uploaded to the NSW Spatial Cadastre (with same completeness and currency as Capture on Demand program). The service levels (speed and accuracy) would be determined during LRS' procurement of a conversion provider and according to the specifications prescribed by the SG and RG.
Developers	> Reduced time to market > Cost effective plan registration	> No change to current (TIFF files only).
Homeowners	> Readable and reliable plans > Faster and reduced costs of purchase	> No change to current (TIFF files only).

Implementation assessment		
Element	**Criteria**	**Scenario outcome**
Technical feasibility	> Amount of change to surveying practices > Feasibility of technical solutions	> No disruption to surveyor's current methods of surveying. > Technical solution to back-capture LXML plans from lodged TIFF plans currently demonstrated.
Cost of change	> To surveyors > To consenting authorities > To LRS > To DCS Spatial Services	> No cost of training for surveyors – however, surveying companies that have previously invested in LXML capability would be unlikely to recover the associated costs, although can continue to use for internal QA. > Cost to LRS of ongoing back-capture. > No cost to councils and utilities, nor to DCS Spatial Services.
Legislative change	> Amount and ease of legislative change required	> No change required.

Scenario DP 2: Structured CAD file – surveyors lodge DXF only

Similar to the developing strategy for digital survey plans in Victoria, this scenario requires surveyors to submit a DXF file that is structured according to defined business rules and layers that contain a specified information, e.g. a 'boundary' layer. The specific requirements for the layers would need to be agreed and approved by DCS Spatial Services and ORG, but would include a minimum set of information prepared by surveyors, such as subject boundaries, lot numbers and areas, reference marks and easements.

The full DXF plan will include all the information surveyors currently include on survey plans. The key layers will be extracted from the DXF file, and converted by surveyors to a LXML through a portal which may require slight adjustments or manual addition of metadata. The resulting LXML file will:

- contain boundary information – ideally a solution will allow for override of the line measurements to the surveyors adjusted distance and bearings (and ideally capture these decisions)
- be able to be rendered to produce a usable boundary diagram suitable for registration
- be able to be ingested into the NSW Spatial Cadastre
- be able to be examined automatically by LRS
- be searchable and available to surveyors to use for their pre-calculations.

The DXF and converted LXML file would then be provided by LRS to surveyors when obtaining precedent plans for plan preparation. A TIFF image would no longer be required for submission.

This scenario would require:

- a DXF to LXML conversion tool to be developed and operated by LRS
- a simplified LXML rendering tool to be developed and operated by LRS
- business rules for terminology and other layer requirements of the structured DXF file to be clearly articulated and communicated to the surveying industry.

This review has identified some market capability to both convert and render LXML plans from DXF files, however a more advanced capability would be required to be developed by LRS.

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
Surveyors	> Speed of creation > Accuracy of plans > Completeness of information	> Speed of creation may be similar to TIFF only, depending on amount of automation in conversion of DXF to LXML. > Plans will be created with all boundary definition evidence captured however potential for this evidence to be captured digitally and manual handling reduced, increasing accuracy.

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
Councils & utilities	> Efficiency of review > Ease of approval > Speed and accuracy of addition to records	> Utilities and some councils typically have GIS functions which are used to consume DWG/DXF formats, and surveyors are used to engaging with these utility companies. This may aid in efficiency of review and speed of addition to records.
LRS	> Speed of examination > Accuracy of examination	> LRS examine the LXML plans which will help with speed and accuracy.
ORG & Surveyor-General	> Accuracy of titles > Appropriateness of the plans for homeowners > Enhanced surveying practice	> A more digital workflow (than TIFF only) should minimise human error. > If enhanced evidence can be captured digitally there is a potential for improvements to surveying practice.
DCS Spatial Services	> Currency of NSW Spatial Cadastre > Completeness of NSW Spatial Cadastre > Accuracy of NSW Spatial Cadastre	> Ingestion into NSW Spatial Cadastre enhanced as boundary data is provided by LRS as LXML. > Registered plan and boundary details in the NSW Spatial Cadastre are generated from the same source and therefore aligned.
Developers	> Reduced time to market > Cost effective plan registration	> Depending on the efficiency of the DXF to LXML conversion process there may be an increase or decrease in the overall efficiency and in the time to market.
Homeowners	> Readable and reliable plans > Faster and reduced costs of purchase	> Should be little change to readability (assuming render from LXML is adequate). > Cost of purchase may change slightly depending on efficiency of conversion from DXF to LXML.

Implementation assessment		
Element	**Criteria**	**Scenario outcome**
Technical feasibility	> Amount of change to surveying practices > Feasibility of technical solutions	> Surveyors are typically familiar with CAD software and DXF file formats. > TIFF format no longer used, surveyors will have to utilise DXF for reviewing other survey details. > Conversion from DXF to LXML will likely require a portal solution – this is complex and

Implementation assessment		
Element	**Criteria**	**Scenario outcome**
		will need to allow for surveyors to override measurements from the linework to align to adjusted bearings and distances. > Implementing business rules for DXF 'boundary' layer, and communicate updates as required is relatively simple.
Cost of change	> To surveyors > To consenting authorities > To LRS > To DCS Spatial Services	> Costs to train surveyors on new requirements likely low. > Likely significant cost to LRS to develop tool to convert structured 'boundary' DXF layer to LXML and then adequately render 'boundary' LXML into image for title.
Legislative change	> Amount and ease of legislative change required	> Change required as TIFF will be replaced by reduced boundary image.

Scenario DP 3: Lite LXML – surveyors lodge TIFF and lite LXML

This scenario would ideally form a transition pathway to eventual 100% lodgement of LXML plans. Under this scenario it would be mandated for surveyors to lodge a Lite LXML plan in addition to the TIFF plan currently required.

The Lite LXML would require sufficient detail to examine the boundary. All other information (as required by other surveyors) would continue to be captured on the TIFF plan, which would remain the legal source of truth, and legislative changes would not be required at this stage.

While this would require surveyors to produce two plans, the lite LXML should require less effort for surveyors to produce compared to the current full LXML, while still providing them with a pre-lodgement quality check on their measurements. This would allow surveyors to become accustomed to using LXML enabled software, and may provide incentive to the software vendors to develop their products to be more accessible and useful to surveyors.

Both the TIFF and the Lite LXML would be examined by LRS, and the Lite LXML would be able to be ingested into the NSW Spatial Cadastre without requiring conversion.

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
Surveyors	> Speed of creation > Accuracy of plans > Completeness of information	> Additional work for some surveyors who have a workflow requiring them to produce two separate plans; Lite LXML would not require as much effort as a full plan in LXML. > Survey accurate digital data could be made available to surveyors for use in their pre-calculations. However, this would not include chain of evidence for how boundaries were previously determined, and surveyors would likely continue to use TIFF plans.
Councils / Utilities	> Efficiency of review > Ease of approval > Speed and accuracy of addition to records	> Limited metadata from plans could be made available to councils and utilities in a smart fashion.
LRS	> Speed of examination > Accuracy of examination	> Examination of both TIFF and lite LXML may be slower than TIFF only (though faster than examining TIFF and full LXML) and would be slower than LXML only. > Potential for enhanced automated examination of lite LXML may provide speed and accuracy benefits.
ORG & Surveyor-General	> Accuracy of titles	> A more digital workflow (than TIFF only) should minimise human error.

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
	> Appropriateness of the plans for homeowners > Enhanced surveying practice	> Likely no change to current; potential for increase in quality of plan information as surveyors would be using LXML to check their work.
DCS Spatial Services	> Currency of NSW Spatial Cadastre > Completeness of NSW Spatial Cadastre > Accuracy of NSW Spatial Cadastre	> DCS Spatial Services acquires a simple plan in LXML format that can be directly ingested into the NSW Spatial Cadastre.
Developers	> Reduced time to market > Cost effective plan registration	> Potential minor increase in time to market if dual plan examination is slower and results in an increase in plan requisitions (however likely faster than TIFF and full LXML).
Homeowners	> Readable and reliable plans > Faster and reduced costs of purchase	> No change to current (TIFF files only) readability unless suitable rendering of LXML lite is developed which may be easier to read. > Possibly increase in costs of purchase compared to TIFF and full LXML due to increased effort for surveyors and dual examination by LRS.

Implementation assessment		
Element	**Criteria**	**Scenario outcome**
Technical feasibility	> Amount of change to surveying practices > Feasibility of technical solutions	> Change favours larger surveying firms; impact of change greater to small firms with limited resources.
Cost of change	> To surveyors > To consenting authorities > To LRS > To DCS Spatial Services	> Potential costs to surveyors to learn the new requirements and to purchase software to produce the LXML. > Cost of tool to adequately render 'boundary' LXML (optional if the TIFF is what appears on registered plans).
Legislative change	> Amount and ease of legislative change required	> No changes required.

Scenario DP 4: Full LXML – surveyors lodge TIFF and full LXML

This scenario is a mandated version of the current state where surveyors lodge a TIFF and full LXML.

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
Surveyors	> Speed of creation > Accuracy of plans > Completeness of information	> Slower to create plans for many surveyors; minimal additional effort for others depending on choice of surveying software. > Overall increase in plan accuracy, with LXML forcing surveyors to check measurements. However, if each plan is created from a separate workflow there is an increased chance for requisitions due to misalignment between the two plans.
Councils / Utilities	> Efficiency of review > Ease of approval > Speed and accuracy of addition to records	> Metadata from plans could be made available to councils and utilities in a smart fashion.
LRS	> Speed of examination > Accuracy of examination	> Surveyors are required to lodge both TIFF and LXML plan until LXML plans can be adequately rendered, while the plan graphic remains the source of truth. > LRS will examine both the TIFF and the LXML plan to ensure alignment, which requires more effort and resources, and is more likely to result in requisitions.
ORG & Surveyor-General	> Accuracy of titles > Appropriateness of the plans for homeowners > Enhanced surveying practice	> A more digital workflow (than TIFF only) should minimise human error and full LXML should allow robust automated validation leading to improved accuracy of titles. > No change to appropriateness of plans from TIFF only. > Surveying quality may improve however efficiency may decrease.
DCS Spatial Services	> Currency of NSW Spatial Cadastre > Completeness of NSW Spatial Cadastre > Accuracy of NSW Spatial Cadastre	> DCS Spatial Services acquires a full survey plan in LXML format containing all survey information that can be directly ingested into the NSW Spatial Cadastre.

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
Developers	> Reduced time to market > Cost effective plan registration	> Potentially increased time due to plans taking longer to create, and increased chance of requisitions.
Homeowners	> Readable and reliable plans > Faster and reduced costs of purchase	> No change to current (TIFF files only) readability unless suitable rendering of LXML is developed which may be easier to read. > May increase costs of purchase (compared to TIFF only) as there will be increased effort for surveyors and potential delays from more requisitions.

Implementation assessment		
Element	**Criteria**	**Scenario outcome**
Technical feasibility	> Amount of change to surveying practices > Feasibility of technical solutions	> Severely burdens survey firms that don't lodge many plans. > Not all current software packages used by surveyors provide a LXML capability. This would advantage some surveyors already using software that easily enables LXML without additional effort.
Cost of change	> To surveyors > To consenting authorities > To LRS > To DCS Spatial Services	> Additional effort required of surveyors would mean increased costs passed onto customers. > Surveyors may need to change or upgrade software. > Surveyors would require training to learn LXML, which can be significant time away from revenue generating tasks. > LXML plans may not be able to be produced by lower cost drafters, instead more expensive resources may have to produce digital plan. > Additional effort for LRS to examine two plans. > LRS may need to invest in software and training to reliably examine LXML plans.
Legislative change	> Amount and ease of legislative change required	> No changes required.

Scenario DP 5: Full LXML only – surveyors lodge full LXML only

Under this scenario a LXML plan is the primary file that surveyors produce, similar to the New Zealand approach. The LXML file, either the data captured, massaged and recorded by surveyors, or a suitably rendered image of the file plan becomes the legal source of truth, and a TIFF is no longer lodged or used.

This will require three major changes:

- significant investment in a tool to adequately render plans from LXML files that contain all information surveyors document to demonstrate how they defined a boundary. The current standard/quality of rendering of LXML by LRS tools has been the most common complaint from surveyors when asked for feedback on digital lodgement
- complete disruption/change to the way most surveyors produce plans
- legislative changes that allow data collected by surveyors to become the legal source of truth.

Adoption of this scenario would be a major change impacting the surveying industry and would likely have significant costs that need to be determined. Some of the impacts of such a change could be mitigated by first adopting the lite LXML scenario, in a staged approach to 100% digital survey plans in NSW.

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
Surveyors	> Speed of creation > Accuracy of plans > Completeness of information	> Surveyors only required to produce their plan in a single digital format.
Councils / Utilities	> Efficiency of review > Ease of approval > Speed and accuracy of addition to records	> Potentially significant impact on how authorities would assess plans for approval; if the LXML plan can be suitably visualised then changes would be minimal. However, if the data in the LXML file can only be interpreted using specialised viewing software, changes would be significant. Likewise, the ability to easily ingest the data (in this and all scenarios) is critical.
LRS	> Speed of examination > Accuracy of examination	> Only examine a single LXML plan, which is much faster than examining the TIFF and LXML. > Potential for increased automation of plan examination. > Potential for pre lodgement validation of LXML plans by surveyors to enforce business rules.
ORG & Surveyor-General	> Accuracy of titles	> A more digital workflow (than TIFF only) should minimise human error and full LXML should

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
	> Appropriateness of the plans for homeowners > Enhanced surveying practice	allow robust automated validation leading to increased accuracy of titles. > If suitable rendering of plans can be developed than plans should be appropriate for homeowners. > Surveying quality may improve if software packages enable robust creation of LXML files with enhanced evidence.
DCS Spatial Services	> Currency of NSW Spatial Cadastre > Completeness of NSW Spatial Cadastre > Accuracy of NSW Spatial Cadastre	> DCS Spatial Services acquires a full survey plan in LXML format containing all survey information that can be directly ingested into the NSW Spatial Cadastre.
Developers	> Reduced time to market > Cost effective plan registration	> Faster end to end process from plan production to plan examination and registration.
Homeowners	> Readable and reliable plans > Faster and reduced costs of purchase	> Plans should be readable (if rendering can be developed) and reliable (as they will be based on the source data). > May decrease or increase costs of purchase (compared to TIFF only) as there will be increased effort for some surveyors to create the file but faster examination by LRS.

Implementation assessment		
Element	**Criteria**	**Scenario outcome**
Technical feasibility	> Amount of change to surveying practices > Feasibility of technical solutions	> Not all current software packages used by surveyors provide a LXML capability. This would advantage some surveyors already using LXML. > Severely burdens survey firms that don't lodge many plans. > Option to create a portal or cloud based LXML workspace for surveyors to generate their plans in, similar to NZ. > Current ability for system to adequately render LXML data into meaningful plan images is poor and unsatisfactory. > Depending on the extent of change to the legal source of truth: either a significant improvement in software to render the full plan, or software that can render a simpler 'Lite boundary image' for printing to paper purposes would be required.

Cost of change	> To surveyors > To consenting authorities > To LRS > To DCS Spatial Services	> Many surveyors will have to adapt to a new way of working using new systems. > Surveyors will complete their own plans instead of drafters doing part of the work; this may be offset if plans can be produced faster once surveyors are competent with LXML. > Consenting authorities will need to be able to easily ingest and interpret LXML plans; data transformation processes should be minimised. > Likely significant cost to LRS to procure and implement a suitable system that supports surveyors to lodge digital plans, including automated validations, and that can adequately render plan graphics to the requirements of the RG and SG. > LRS overheads would be lower once a technical solution for digital plans is established, as the ability to examine plans in LXML is considerably faster and can utilise automation.
Legislative change	> Amount and ease of legislative change required	> Significant change to the definition of what a plan is; will depend on the effectiveness of a technology solution to rendering. > Data potentially becoming what surveyors produce. > No change to principle of monuments over measurements.

Scenario: Digital strata plans

In this scenario strata plans are digitally lodged in a smart format.

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
Surveyors	> Speed of creation > Accuracy of plans > Completeness of information	> Potentially faster to create strata plans if the required content is simplified. > Accuracy to be determined; strata plans currently not produced to be survey accurate. > Plans could be more user-friendly, particularly if 3D information can be captured digitally.
Councils / Utilities	> Efficiency of review > Ease of approval > Speed and accuracy of addition to records	> Faster to approve if the digital strata plan can be readily viewed by consenting authorities. > Metadata can be made available in a smart fashion.
LRS	> Speed of examination > Accuracy of examination	> Opportunity to automate some checks undertaken by LRS during examination.
ORG & Surveyor-General	> Accuracy of titles > Appropriateness of the plans for homeowners > Enhanced surveying practice	> Potentially more customer friendly process, depending on requirements for digital boundary definition capture for strata.
DCS Spatial Services	> Currency of NSW Spatial Cadastre > Completeness of NSW Spatial Cadastre > Accuracy of NSW Spatial Cadastre	> NSW Spatial Cadastre completeness improved. Currently representation of strata subdivisions in NSW Spatial Cadastre is limited to the parent parcel only; more granular detail such as separate buildings within a strata scheme is not currently captured.
Developers	> Reduced time to market > Cost effective plan registration	> Shorter end to end process depending on approvals.
Homeowners	> Readable and reliable plans > Faster and reduced costs of purchase	> Likely limited to no change.

Implementation assessment		
Element	**Criteria**	**Scenario outcome**
Technical feasibility	> Amount of change to surveying practices > Feasibility of technical solutions	> New surveying practice for strata which is not currently digital. > Technical solutions already evident in 3D rendering of buildings by architects and designers.
Cost of change	> To surveyors > To consenting authorities > To LRS > To DCS Spatial Services	> Increased cost to surveyors if they have to spend more time capturing accurate boundary information; potentially offset if existing digital building plans are accessible. > Cost to authorities if they require specialised software to view strata plans for approval. > Additional cost to LRS if digital strata plans are to be in LXML format. > Increased cost to developer/purchasers if surveyors have to spend more time developing digital plans.
Legislative change	> Amount and ease of legislative change required	> Potentially significant change, in line with DPs, depending on the extent of digital data captured, and how the plan is required to be presented on a page, or accessible via a viewing system.

Scenario: Digital approvals & smart associated documents

In this scenario digital signatures are introduced through a portal for managing approvals. The portal allows approval processes to occur in parallel, progress to be tracked, and stakeholders notified automatically.

Smart associated documents are also designed which can be automatically pre-populated and have inbuilt data validations.

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
Surveyors	> Speed of creation > Accuracy of plans > Completeness of information	> Enhanced accuracy of information between plan and associated documents. > Improved accuracy of easements on plan. > Faster process from field to lodgement.
Councils / Utilities	> Efficiency of review > Ease of approval > Speed and accuracy of addition to records	> Faster and simpler approvals process. > Reduction of manual tasks.
LRS	> Speed of examination > Accuracy of examination	> Potential impacts on examination speed and accuracy of associated documents and approvals by enabling automated checking of data fields and workflow management.
ORG & Surveyor-General	> Accuracy of Titles > Appropriateness of the plans for homeowners > Enhanced surveying practice	> Improved certainty that all registered plans have been verified and approved by the relevant authorities. > Will support greater efficiency of the surveying industry.
DCS Spatial Services	> Currency of NSW Spatial Cadastre > Completeness of NSW Spatial Cadastre > Accuracy of NSW Spatial Cadastre	> Potentially easier to include additional information in the NSW Spatial Cadastre earlier in the development process.
Developers	> Reduced time to market > Cost effective plan registration	> Potential to significantly reduce time to market (weeks).

Outcomes assessment		
Customer	**Criteria**	**Scenario outcome**
Homeowners	> Readable and reliable plans > Faster and reduced costs of purchase	> Should improve reliability by reducing typographical errors. > Should contribute to reduced purchase costs by decreased administrative effort and potential reduction in holding costs for larger developments.

Implementation assessment		
Element	**Criteria**	**Scenario outcome**
Technical feasibility	> Amount of change to surveying practices > Feasibility of technical solutions	> Technical solutions for digital approvals are available in the market; are used.
Cost of change	> To surveyors > To consenting authorities > To LRS > To DCS Spatial Services	> A single entity would need to take the lead on establishing a system that enables digital approvals; how this is funded would need to be agreed across all impacted parties; ongoing costs could be passed through to users.
Legislative change	> Amount and ease of legislative change required	> Change would be required to move to digital signatures (this has already been enacted in Victoria). > Wider changes would be required to allow surveyors to create automatic easements on the plan.

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Attachment K - Sample application of Assessment Framework

The following tables show a simplified overview of the application of the Assessment Framework against seven digitalisation scenarios (five for deposited plans and one each for strata plans and approvals and associated documents).

The scenarios have been designed and assessed without extensive input from stakeholders and serve to illustrate the use of the Framework and to prompt discussions on possible solutions.

Summary of Scenarios against the Outcomes Assessment Framework Criteria								
Customer	Criteria	Potential Scenarios						
		Digital Deposited Plans					Digital strata plans	Digital approvals & associated docs
		TIFF only	DXF	TIFF + Lite LXML	TIFF + LXML	LXML only		
Surveyors	speed of creation	✓ current workflow	✓ minor change	× additional workflow	××× double effort	✓ new workflow	✓ new workflow	✓✓✓ time savings
	accuracy of plans	— no change	✓ slight improvement	✓✓ slight improvement	✓✓ slight improvement	✓✓ slight improvement	✓ potentially more accurate	✓✓✓ improved document management
	completeness of information	✓ no change	✓ no change	✓ no change	✓ no change	TBD	✓ potentially more complete	N/A

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Summary of Scenarios against the Outcomes Assessment Framework Criteria								
Customer	Criteria	Potential Scenarios						
		Digital Deposited Plans					Digital strata plans	Digital approvals & associated docs
		TIFF only	DXF	TIFF + Lite LXML	TIFF + LXML	LXML only		
Councils & utilities	efficiency of review	– no change	✓ minor improvement	✓ minor improvement	✓ minor improvement	TBD	TBD	✓✓✓ online access to review and smart notifications
	ease of approval	– no change	– no change	– no change	– no change	TBD	TBD	✓✓✓ digital approvals
	speed and accuracy of addition to records	– no change	✓ streamlined ingestion into GIS and other records	✓ streamlined ingestion into GIS and other records	✓✓ streamlined ingestion into GIS and other records	TBD	TBD	✓✓✓ digital records workflow
LRS	speed of examination	✓ single plan manual examination	✓ single plan manual examination	TBC dual plan examination but allows streamlining	TBC dual plan examination but allows streamlining	✓✓✓ single plan electronic examination	TBD	✓ reduced typographical errors
	accuracy of examination	– no improvement	✓ single plan manual examination	✓ some improvement and consistency	✓ improvement and consistency	✓✓ consistent high accuracy	TBD	✓ smart documents enhance accuracy

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Summary of Scenarios against the Outcomes Assessment Framework Criteria								
Customer	Criteria	Potential Scenarios						
		Digital Deposited Plans					Digital strata plans	Digital approvals & associated docs
		TIFF only	DXF	TIFF + Lite LXML	TIFF + LXML	LXML only		
ORG & Surveyor-General	accuracy of Titles	– no change	✓ possibly reduced human error	✓ automated validation and error checking	✓ automated validation and error checking	✓✓ automated validation and error checking on source of truth	TBD	✓ smart documents enhance accuracy
	enhanced surveying practice	– no change	✓ potential for improvements	✓ potential for improvements	✓ potential for improvements	✓ potential for improvements	TBD	✓
	appropriateness of the plans for homeowners	– no change	✓ subject to rendering tool	✓ subject to rendering tool	✓ subject to rendering tool	✓ subject to rendering tool	TBD	✓
DCS Spatial Services	currency of NSW Spatial Cadastre	– no change	✓ digital boundary information acquired sooner	✓ digital boundary information acquired sooner	✓ digital boundary information acquired sooner	✓ digital boundary information acquired sooner	TBD	✓ earlier inclusion in spatial cadastre
	completeness of NSW Spatial Cadastre	– no change	✓ could include easements	✓ could include easements	✓ could include easements	TBD	✓ strata details in NSW Spatial Cadastre	N/A

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Summary of Scenarios against the Outcomes Assessment Framework Criteria								
Customer	Criteria	Potential Scenarios						
		Digital Deposited Plans					Digital strata plans	Digital approvals & associated docs
		TIFF only	DXF	TIFF + Lite LXML	TIFF + LXML	LXML only		
	accuracy of NSW Spatial Cadastre	– no change	✓ small improvement	✓ small improvement	✓ small improvement	TBD	N/A	N/A
Developer	reduced time to market	– no change	– no change	× additional surveyor time	×× additional surveyor time	TBD	TBD	✓✓✓ faster approvals
	cost effective plan registration	– no change	– no change	× additional surveyor time	×× additional surveyor time	TBD	TBD	✓✓✓ less manual effort
Homeowners	readable and reliable plans	– no change	– no change	✓ subject to rendering tool	✓ subject to rendering tool	✓ subject to rendering tool	TBD	✓ reduced typographical errors
	faster and reduced costs of purchase	– no change	TBD	TBD	TBD	TBD	TBD	✓✓ faster registration and reduced manual administrative effort

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Summary of Scenarios against the Implementation Assessment Framework Criteria									
Customer	Criteria	Potential Scenarios							
		Digital Deposited Plans					Digital strata plans	Digital approvals & associated docs
		TIFF only	DXF	TIFF + Lite LXML	TIFF + LXML	LXML only		
Technical feasibility	amount of change to surveying practices	✓✓✓ no change	✓✓ some change	× significant change	×× major change	××× complete change	××× complete change	✓✓ beneficial workflow change
	feasibility of technical solutions	✓✓✓ current requirement	✓✓✓? CAD tools widely in current use by industry Conversion to LXML capability unknown	× no current solution for guaranteeing TIFF and LXML match	× no current solution for guaranteeing TIFF and LXML match	××× no current rendering solution	× no current rendering solution	✓✓ proven market capability
Cost	to surveyors	✓✓✓ no change	✓✓ some change	× software change and training	× software change and training	× software change and training	× software change and training	✓✓ none
	to consenting authorities	✓ no change	✓ no change	✓ no change	✓ no change	× change to systems and processes	TBD	TBD

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Summary of Scenarios against the Implementation Assessment Framework Criteria								
Customer	Criteria	Potential Scenarios						
		Digital Deposited Plans					Digital strata plans	Digital approvals & associated docs
		TIFF only	DXF	TIFF + Lite LXML	TIFF + LXML	LXML only		
	to LRS	✗ cost of back-capture	✗✗ cost of conversion and rendering tool	✓ no change	✓ no change	✗ cost of rendering tool	TBD	TBD
	to DCS Spatial Services	✓ no change	✓ no change	✓ no change	✓ no change	✓ no change	TBD	TBD
Legislative change	amount and ease of legislative change required	✓ no changes required	✗ changes required	✓ no changes required	✓ no changes required	✗ changes required	TBD	TBD

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