NSW GOVERNMENT

Capture on Demand (COD) Analysis

Version 1.0
May 2019

Title: Capture on Demand (COD) Analysis

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Acknowledgements

This report documents the results from the Capture-on-Demand trial project, jointly undertaken by NSW Land Registry Services, Spatial Services (DFSI) and the Office of the Registrar General (DFSI).

Head Office

346 Panorama Avenue
Bathurst, NSW 2795

Office Hours: 8:30am to 4:30pm Business Days

Contact Details

Spatial Services
Department of Finance, Services & Innovation
T: 02 6332 8200
W: http://spatialservices.finance.nsw.gov.au

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1. Report Purpose

This report provides a detailed project analysis of the Capture on Demand (CoD) digital plan processing initiative and documents the post-implementation review of the trial. This document will allow the Digital Survey Plan Steering Committee to make a recommendation of viability for implementing the CoD processing stream to the production channel on a more permanent basis.

2. Project Summary

The CoD Project is a joint initiative between NSW Land Registry Services (LRS) and Spatial Services (SS) to prove the efficiencies of digital plan examination and the capture of intelligent data for successful DCDB ingestion. A Memorandum of Understanding (MOU) was entered into between LRS, SS and the Office of the Registrar General (ORG) for the administration of the project.

As part of the CoD Project, LRS provides TIFF images of deposited plans lodged for registration, as well as all necessary reference plans (registered plans), to SS. SS, using their existing service provider (DSM) to convert these TIFF images into intelligent LXML data and return to LRS. LRS then completes the digital data set; conducts the assembly process and inputs the intelligent data through the digital plan examination process (refer to Figure 1 below).

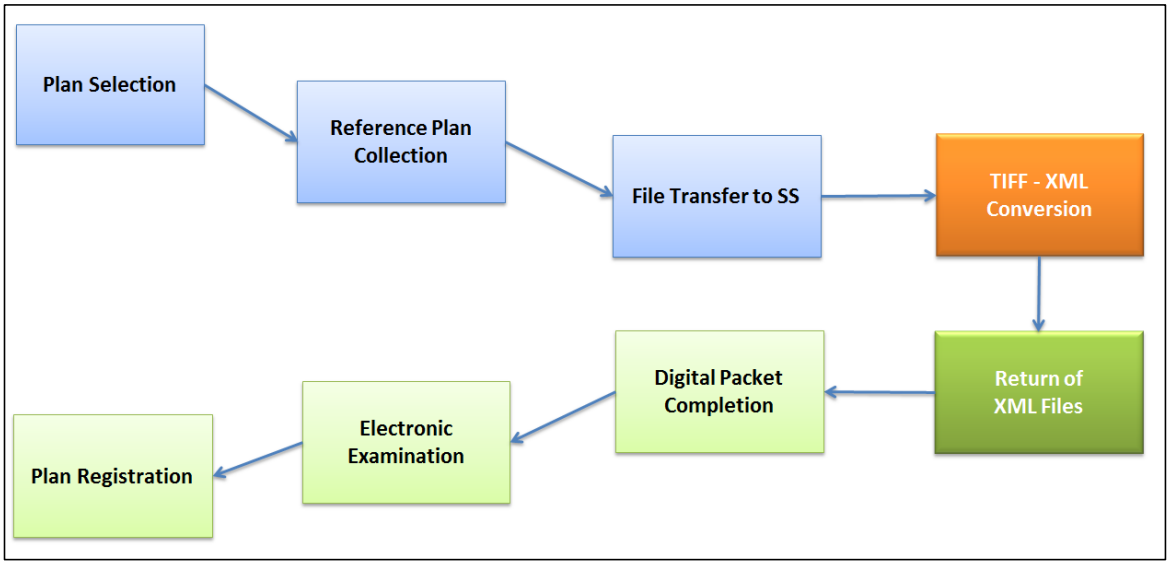


Figure 1: Simplified CoD Processing Stream

The CoD processes were tested and improved during two testing periods from November 2017 – February 2018, with the trial period beginning on the 5th June 2018. This included a staged progression of plan input levels with each stage running for a minimum of 4 weeks:

- **Stage 1 – 10 weeks (05.06.2018 – 31.08.2018)** - Maximum of 5 lodged plans per day
- **Stage 2 – 9 weeks (03.09.2018 – 12.10.2018)** - Maximum of 10 lodged plans per day
- **Stage 3 (Not initiated)** - Maximum of 20 lodged plans per day

During the trial, DSM were able to implement changes to their capture process to align with a new version of the LXML recipe. Progression to Stage 2 occurred once these changes had been put in place.

The trial was completed on 12/10, as a result of an extension to the original MOU. It was agreed that the post-implementation review should be completed to allow informed decisions to be made rather than further extending the trial and progressing to Stage 3.

The table below (Table 1) provides an overview of key statistics collected from each reporting period of this trial (05.06.18 – 12.09.18).

	Period #1 (05.06.18 - 13.07.18) 6 Weeks	Period #2 (16.07.18 - 10.08.18) 4 Weeks	Period #3 (13.08.18 - 14.09.18) 5 Weeks	Period #4 (17.09.18 - 12.10.18) 4 Weeks	Total
Total Plans	171	163	222	166	722
• Subject Plans	106	86	159	126	477
• Reference Plans	65	77	63	40	245
Plan Types (Subject Plans)					
• Subdivision	91	81	141	115	428
• Redefinition	7	0	3	4	14
• Consolidation	8	5	15	7	35

Table 1: Key Statistics

Throughout the project monthly reports were distributed to all members of the Steering Committee and Working Groups in order to share progress to date, key statistics and an assessment of demonstrated benefits, risks & recommendations.

3. Governance

The Digital Survey Plan Steering Committee, comprising of representatives of the ORG, SS and LRS, supervised the project and communicated on a monthly basis to discuss progress and resolve issues. Project performance was reviewed at the end of each stage to determine whether progression should occur and was only agreed if a unanimous decision was reached by all members of the Steering Committee.
A Digital Plan Working Group was established with representatives from the same parties (LRS, SS & the ORG). These weekly/fortnightly working group meetings were utilised to discuss technical issues and process improvements.
At LRS, weekly stand up meetings with involved staff were held to discuss relevant issues, challenges or changes made to any of the processes. Further, project progression and insights were discussed and documented at the LRS Business Performance Improvement (BPI) Steer Co. meetings.

4. Processing Structure

4.1 Human Resources

The CoD process was comprised of the following staff resources within the LRS & Spatial Services Teams

LRS Resource (FTE)	Responsibility
Operational Lead x 1 (DPC Team Leader)	• Operationalising the project; ensuring adequate resources available. • Reporting on project progression • Training outline & materials • Analyse project data & initiate internal process improvements • Involvement in the Digital Survey Plan Working Group
LXML Officer x 1	• File selection & distribution • Correction of structural issues in LandXML file • Determination of criticality of issues • Critical error investigation. • Maintaining issues/error database • Involvement in the Digital Survey Plan Working Group
CoD Officer x 3	• Manual assembly • Data completion - Reporting on any issues of captured LXML files through the QA & join process - Correction of minor issues in CEXML format • Update of XML file after re-lodgment
Digital Examiner x 3	• Plan examination using PlanTest & trialling end to end examination.
SS Resource (FTE)	**Responsibility**
Operational Lead x 1 (LXML QA Team Leader)	• Coordinate LXML QA Officer allocation. • Reporting on project progression • Identify and escalate issues • Involvement in the Digital Survey Plan Working Group
LXML QA Officer x 5 (rotation basis)	• FTP file collection • FTP file upload • Email monitoring and notifications
Project Officer x 1	• Analyse project data & document outcomes

4.2 Process Overview

Plans were selected by LRS based on an agreed selection criteria which best enabled electronic examination. The lodged plan and all necessary registered plans (not already held in the internal XML repository) were collected and sent via email to SS.

These plans were converted from TIFF to LXML format by the existing service provider (DSM). Where issues were encountered by SS Service Provider during the conversion and QA process, they were populated in an error exception report (CSV) and provided back to LRS with the LXML file within the agreed 48 hour timeframe. Once received by LRS, these files were run through the Online LXML Validation Service to identify any structural issues within the LXML files. If critical issues were identified these would be investigated by the LXML team and a decision made if these plans would proceed to electronic examination or be rerouted to manual examination.

The LXML team then distributed these plans to DPC staff for internal QA of data capture, completion of data set & manual assembly procedures. Once DPC was finalised, the complete digital plan packets were then sent on for electronic examination.

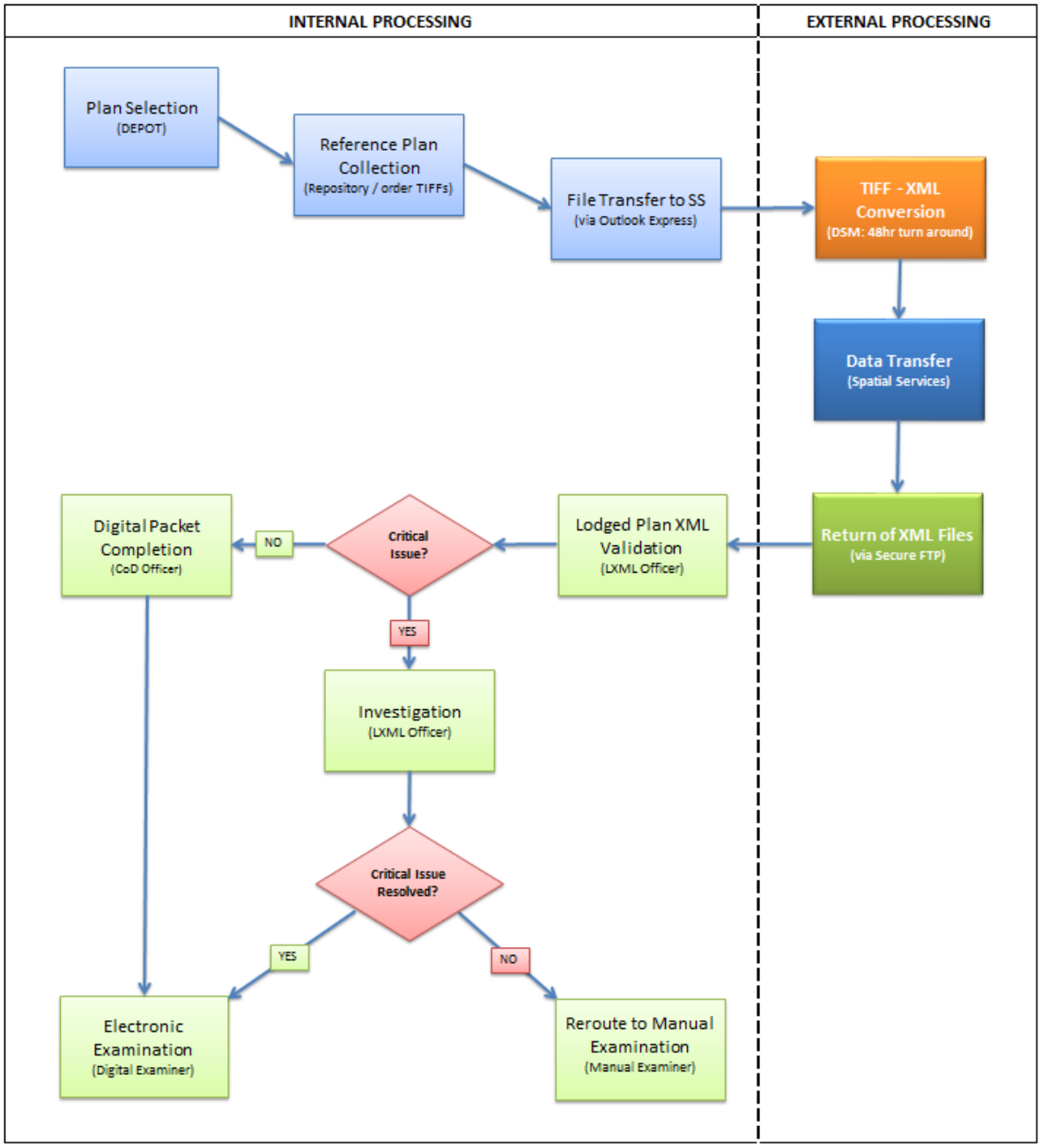


Figure 2: CoD Internal & External Workflow

4.3 Digital Plan Processing Channels

The difference between the digital plan processing channels & the manual processing channel outlined in this report are summarised below.

4.3.1 DPC LXML (Internal Capture) Processing Channel

The DPC LXML plan processing channel has a similar workflow as shown for the CoD Project in Figure 3; with the 'QA' step being replaced by a 'Data Capture' step.

Plans fit for electronic capture are converted internally from TIFF to XML format. All reference plans not already held in the internal LXML repository are also captured internally. The DPC officer then conducts the assembly process, completes the digital data set and notes any issues before sending the plan on for electronic examination.

4.3.2 CoD LXML (Capture on Demand) Processing Channel

Plans fit for electronic capture are converted by an external party through SS. The DPC Officer then conducts the assembly process, quality assures (QA) the data, completes the digital data set and notes any significant issues before sending the plan on for electronic examination.

All sections outlined green in Figure 3 shown on page 8 display additional processes required for electronic processing.

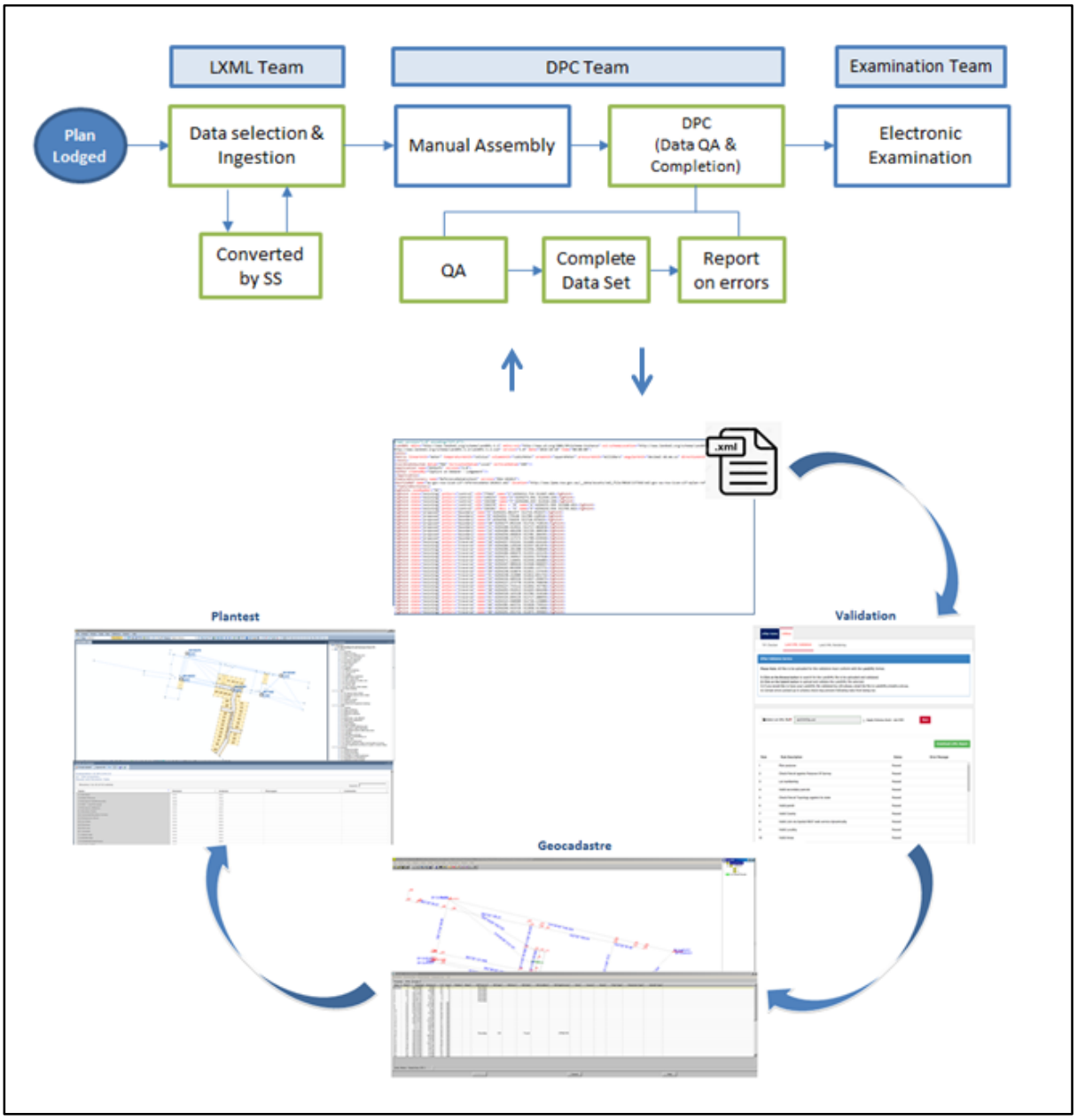


Figure 3: CoD Processing Workflow & Software Visualisation

5. Project Objectives and Results

The CoD Project ultimately aims to prove 3 key objectives. The ability to increase digital data usage, the capture quality of digital plans and the potential for efficiency improvements with the use of this intelligent data.

5.1 Increase of Digital Data Usage

With existing digital plan capture channels, there were many limitations in the availability of resources which led to low volumes of digital data generated. The project has facilitated an increase in the availability of digital data via use of external resources and the implementation of the CoD processing channel (refer to section 4.2).

This has led to a significant increase in the overall number of electronic plans being registered each week. A comparison over the same period for 2016, 2017 and 2018 shows numbers have gone from an average of 15 to 31.

5.2 Increase in Digital Plan Quality

Digital Plan Quality is directly related to the accuracy of surveyed data and therefore the integrity of the register. Accurate data is a vital component within the digital processing streams, hence the quality of lodged plan data was closely monitored throughout the project for correctness, completeness and capability. Increases in returned data quality and a decline in re-work have led to significant efficiency benefits. See section 5.3.

The issues were broken down into Surveyor related issues, DSM capture/ interpretation issues, a combination of Surveyor and DSM issues and plans that reported no other issues than schema updates which required upgrades to DSM systems. Figure 4 below shows a breakdown of all reported issues and respective time spent to address these issues. Please see Annexure 3 for a further breakdown of all reported issues of lodged plans.

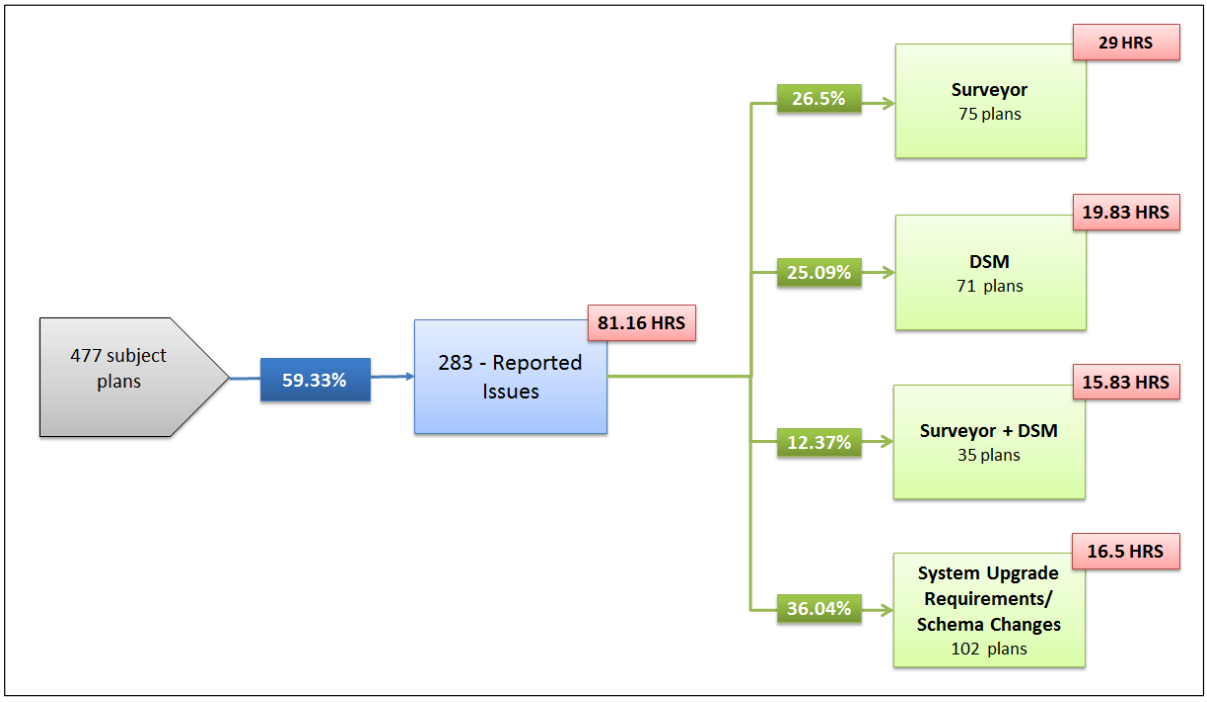


Figure 4: Breakdown in Reported Issues of Lodged Plans

192 plans came through the CoD channel with validation failures related to schema updates that were addressed early on in the trial. Once the changes were implemented, this saved a total of 47.5 hours for the additional 285 plans sent through the project as shown in Figure 5 below.

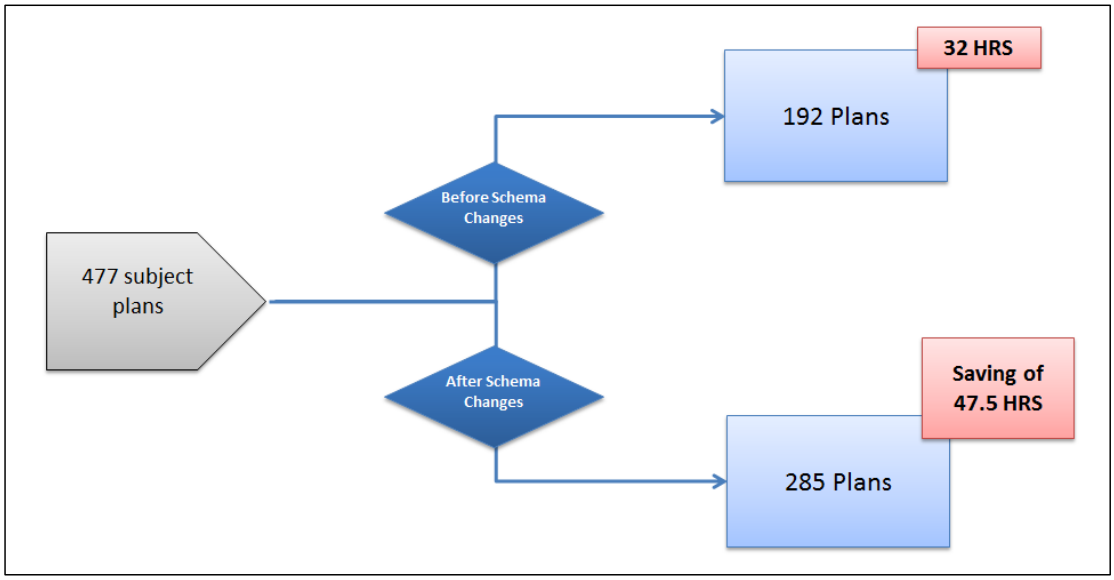


Figure 5: Technology Savings on Schema Changes

Further analysis was also undertaken on post-registration amendments to plans, which occurs when critical errors on registered plans are found. Approximately 15% of lodged plans went through CoD over the course of the trial. To date, only one CoD plan has been identified as requiring post-registration amendment, due to an internal LRS issue. This compares to approximately 25 plans registered in the same time period which were not part of the trial, being identified by Spatial Services as requiring post-registration amendments. Data was found by reviewing log maintained by SS of newly registered plans where significant errors were identified post-registration and amendment action was requested.
As an indication of data quality, DCDB ingestion success rates for each source of LXML files were compared (See Table 3). Surveyor lodged LXML files were the most likely to be ingested successfully. LXML files that originated through CoD were more likely to be successfully ingested than both LRS internal capture and DSM capture after registration. DSM capture after registration is required where LRS utilise their Manual Processing Channel for plan examination.

While the CoD Trial did not increase the utilisation of LXML data for DCDB ingestion by Spatial Services, it improved data being available for DCDB ingestion (intelligent digital data provided by LRS along with registered plans, rather than post-registration capture by DSM)

Likelihood of successful ingestion (Jul-Sept 2018)				
Source	Surveyor sourced LandXML available	LRS sourced landXML available (not CoD)	LRS sourced LandXML available (CoD)	DSM sourced LandXML available (post registration capture)
Success rate	96.2%	92.1%	94.6%	89.7%

Table 3: DCDB Ingestion Success Rates

5.3 Efficiency Improvements

Throughout the project efficiencies continued to be realised as a result of internal streamlining of processes and constant development and collaboration with the Working Groups. Please refer to Figures 6 and 7 on page 12 for an overview of channel efficiencies. These statistics were derived from collated count sheet data shown in Table 4.

Key insights:

- The CoD project has proven to be the most efficient plan examination electronic processing channel with an overall efficiency of 23.5% compared to cases that are captured internally at LRS. This percentage was calculated from the difference in total average time taken for internal capture (DPC LXML) compared to COD LXML. See Table 4 below.

- Within the CoD Project, time savings of up to 42.5% in the data completion component were realised when compared to cases that are captured internally at LRS.

- With the recent implementation of a revised & standardised checklist/report manual assembly processing times should now be consistent across any processing channel (DPC LXML, CoD LXML or Manual).

DEPOT	DPC LXML				COD LXML			
Plain Type	Manual	DPC	Exam	Total	Manual	DPC	Exam	Total
Category 1	0.97	2.47	1.73	5.16	0.62	1.55	1.73	3.91
Category 2	1.09	3.87	2.30	7.26	0.69	1.82	2.30	4.81
Category 3	1.16	4.04	3.03	8.22	0.62	2.03	3.03	5.67
Category 11	0.75	2.67	3.20	6.62	0.82	2.19	3.20	6.21

Table 4: Collated count sheet data
***The manual & DPC breakdown are both duties performed by the DPC Team**
****Troubleshooting of LandXML files shown in Figure 4 is not included in these statistics.**

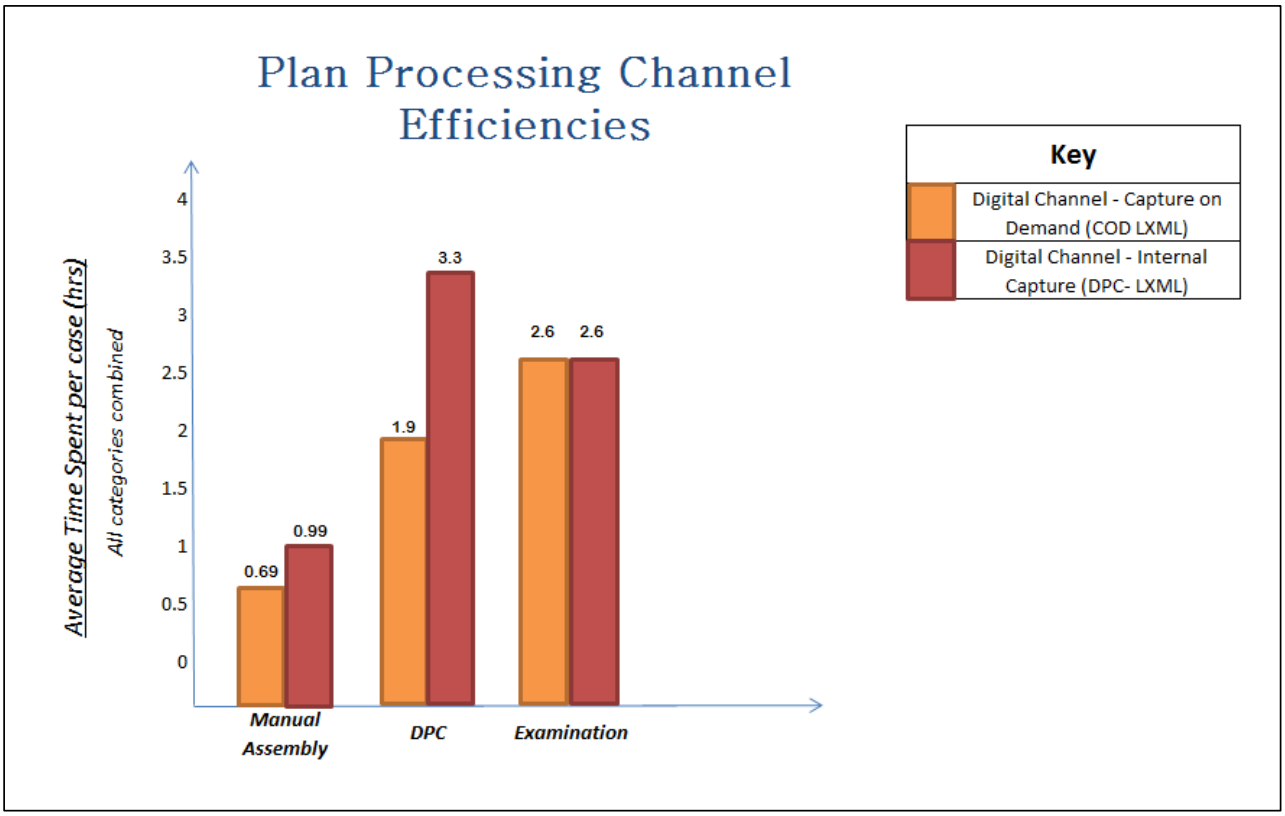


Figure 6: Breakdown of Processing Channel Efficiencies

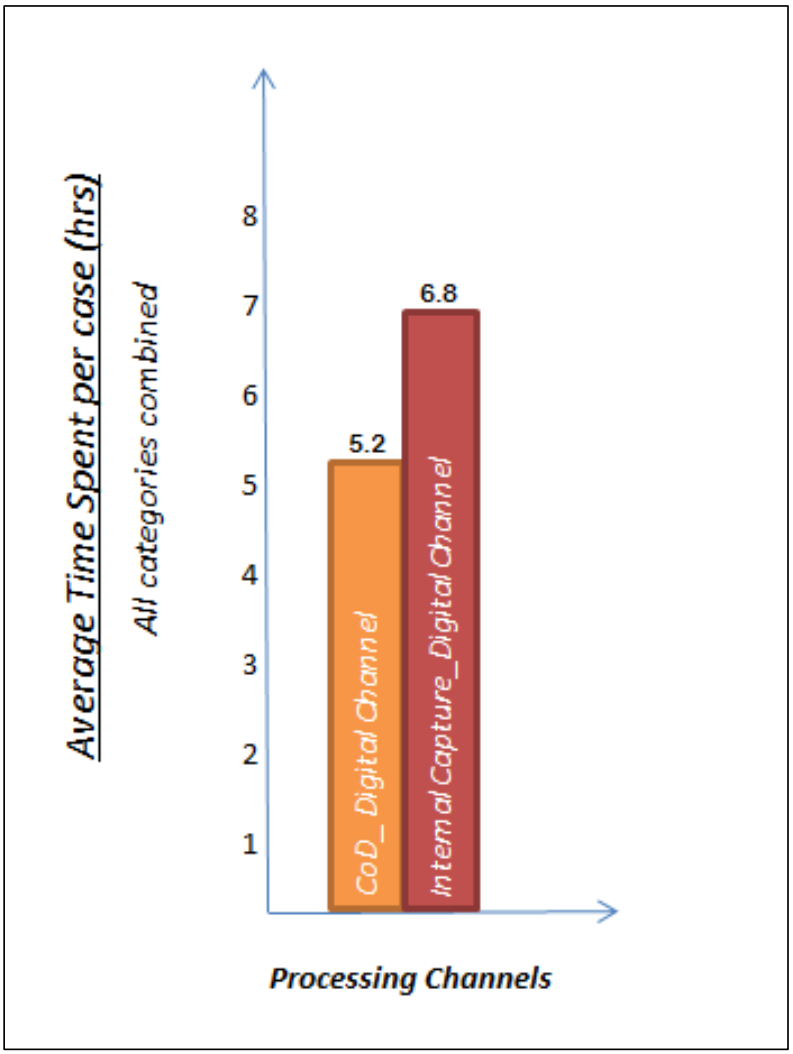


Figure 7: Overall Plan Processing Channel Efficiencies

6. Lessons Learned – Successes & Potential Improvements

Lessons Learned – Successes	Description, Impacts & Solutions
Volume of electronic plans	The CoD Project produced the highest volume of electronically examined plans completed per week.
Evidence of Fatal survey errors	Throughout the CoD Project, a significant numbers of critical errors were identified in lodged plans. This was driven by the increased use of digital intelligent data. For the purposes of the project the term "Fatal Error" was used for substantial data distortion and required significant time to locate and/or amend the issue. Generally, these errors correspond to incorrect drafting of the lodged TIFF images, where bearings and/or distances are shown incorrectly. This identifies a benefit in the use of digital data and for an increase in digital examination processes. With the traditional Manual Examination processing stream these "Fatal Errors" are much likely to be missed and registered. See Annexure 1 for further explanation & examples.
Successful DCDB ingestion rate	SS reported 94.65% success DCDB ingestion rate for plans registered through the CoD channel compared to 92% of plans captured internally at LRS.
Reduced post-registration amendments	As a by-product of 'Evidence of Fatal survey errors' above, the number of critical plan errors identified by Spatial Services after registration was substantially reduced. Of the 25 plans with critical errors identified over the same time period as the trial, only one was part of the CoD Trial. Note that on average the trial processed approximately 15% of plans lodged with LRS.
Efficiency improvements	As noted in section 5.3, the CoD project has proven to be the most efficient plan examination electronic processing channel with an overall efficiency of 23.5% compared to cases that were internally captured at LRS. Within the CoD Project, time savings of up to 42.5% in the data completion component were also realised when compared to cases that are captured internally at LRS.
Internal processing efficiencies	As the project progressed adjustments to workflow and best practices were continuingly being made which resulted in internal processing efficiencies. For example; an analysis of data completion (i.e. from plan received to DPC complete) for CoD plans demonstrated an efficiency gain of 24% when comparing weeks 1-3 to weeks 11-14. Responsibilities were also shifted from CoD Officer to Examiner throughout the trial to establish the most robust workflow method. A change that was implemented throughout the project saw CoD officers supplying Examiners with access to the digital files so they could perform their own join process & residual analysis. This process was implemented for all digital processing methods as it proved most efficient.
Effective communication working group	An effective working group with SS & the ORG was established which has allowed for an open line of communication for the progression of digital plans.
Future processing enhancements realised.	Future processing enhancements were realised throughout the trial. 1. Throughout the project, end to end examination was trialled with Digital Plan Examiners experienced in LXML processing. This proved to be a more efficient process. Due to limited plans trialled and the manual process of collecting this data, we are unable to predict or quantify the results of these cases however this has shaped our proposed digital workflow model as shown in item 7.3 of the analysis. 2. A CoD Checklist was implemented during the project which allowed transparency for Digital Plan Examiners in the checks being performed by the CoD Officer. This led to the introduction of a revised checklist/ report for all plans processed through DPC.
Utilisation of secure file transfer protocol	NSWLRS and SS did not utilise SFTP for all data exchanges throughout the trial as initially agreed in the MOU. However, it was agreed that the alternative of sending information via email was an acceptable risk for the purposes of the trial and there were no identified data breaches,

Lessons Learned – Potential Improvements		Description, Impacts & Solutions
	Consistency in data collation & analysis	From the analysis of this project, it has been proven that there is a definite efficiency improvement compared to the existing digital channel but it still shows lack in overall efficiency when compared to manual channel. This has been looked into during the analysis and has been realised that the DPC component was not segmented as per the examination component. This has led to a subjective comparison between the manual and digital processing channels. Solution: Ensure data is consistently and accurately collated.
	Internal workflow/ responsibilities	DPC Staff are trained in digital software and systems to complete the data set for the examiners. However this has many road blocks due to comprehension and it has been realised that the data set should be solely selected and dealt with by the Examiner. With a dedicated digital training course for Examiners it is predicted this will form the most robust digital processing method going forward Solution – All digital components of the plan are dealt with by the examiner. Examiners are up-skilled to use & edit digital data using digital software. A 10 week training program has been recommended.
	DSM Capture knowledge	DSM has difficulty interpreting plan information if a surveyor drafts the plan differently to the examples they have on hand. This leads to DSM entering incorrect data or omitting data which results in LRS manually editing the data. This will always be an ongoing issue but can be maintained through consistent communication with SS. For the files that already exist in our database, manual QA & manipulation of this data will always be required. Solution - Ongoing communication with SS and provide them with more examples to send to DSM. Monitor through regular staff meetings, record issues in a running log and report issues to SS. Raise any ongoing issues for discussion at DSPWG meetings.
	Automation of upfront selection process	An estimated 93.75 HRS was spent throughout the COD project on selecting suitable plans. Solution - It is proposed that this task is automated.
	Response Times for DSM practice changes	Changes to DSM practice can take a significant amount of time which leads to efficiency losses for LRS. Solution- Continue to Liaise with SS so we can better understand how changes impact DSM practices.
	Automation of data transfer	The manual and batched exchange of data between NSWLRS, SS and DSM resulted in a slower turnaround time for data capture. Solution: Utilisation of Spatial Services Capture on Demand API would allow for data exchange to be automated.

7. Conclusion & Recommendations

7.1 Conclusion

In many ways the Capture on Demand project has been very successful. It has met all project objectives and achieved many useful insights to digital plan processing and overall end-to-end plan processing. Through the CoD project, many efficiency improvements were achieved and other initiatives for end-to-end digital plan processing have been realised. These include:

1. Highest volume of electronically examined plans per week.
2. Ability to discover fatal errors.
3. An increase in DCDB ingestion rate.
4. The CoD proved to be a more efficient digital plan processing method than the existing digital plan processing method by 23.5%.

5. Internal process improvements throughout the project resulted in a 24% efficiency gain from week 1-3 when compared with weeks 11-14 of the project.

As the CoD Project was only trialled for three months, full potential and internal efficiencies may not be fully realised. It is confidently envisaged that the digital plan processing will see its full efficiency potential with training and investment in digital processes and its respective software. This will lead LRS to shape the digital future and forefront digital plan processing.

7.2 Recommendations

For the CoD to be operationalised within LRS the following need to be considered:

1. The contract timeframe & budget for SS to continue to offer the free service of TIFF to LXML conversion to LRS.
2. Opportunities for further improvements to data quality.
3. Ongoing collaboration through the DSPWG.
4. Automate the subject plan selection process in DEPOT.
5. TPS internal restructure to assist with end to end electronic plan examination.
6. Reinitiate the CoD and move into stage 3 before fully Operationalising the CoD.
7. LRS to investigate the benefits of integration with SS CoD API.

7.3 Proposed Digital Workflow Model

Derived from insights out of the CoD Project, a proposed digital workflow model has been designed. The proposed restructure of duties will see the DPC Team only performing the manual assembly checks & the Examiners starting examination from their first contact with the intelligent data.

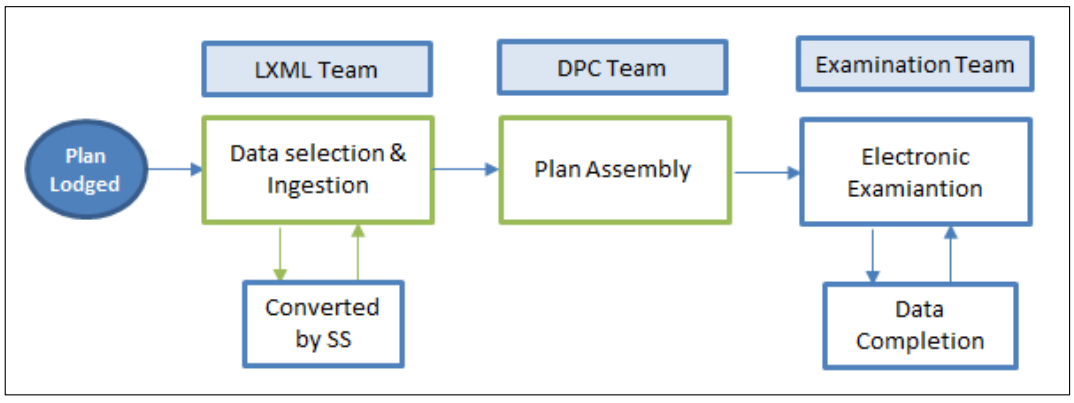


Figure 8: Proposed Digital Workflow Model
* The process step highlighted green is proposed to be automated or semi-automated.

Figure 9: How to achieve the Proposed Model in Figure 8

Annexure 1: Fatal Errors

As noted in the lessons learned table, a significant number of critical errors were identified in lodged plans throughout the CoD Project. This was driven by the increased use of digital intelligent data. For the purposes of the project the term "Fatal Error" was used for substantial data distortion and required significant time to locate and/or amend the issue.

Generally, these errors correspond to incorrect drafting of the lodged TIFF images, where bearings and/or distances are shown incorrectly (refer to Figure 10). Following investigation, a certain number of these errors were found to correspond with their base plan, suggesting the error has been carried forward from a previously registered plan of survey that was examined manually (refer to Figure 11).

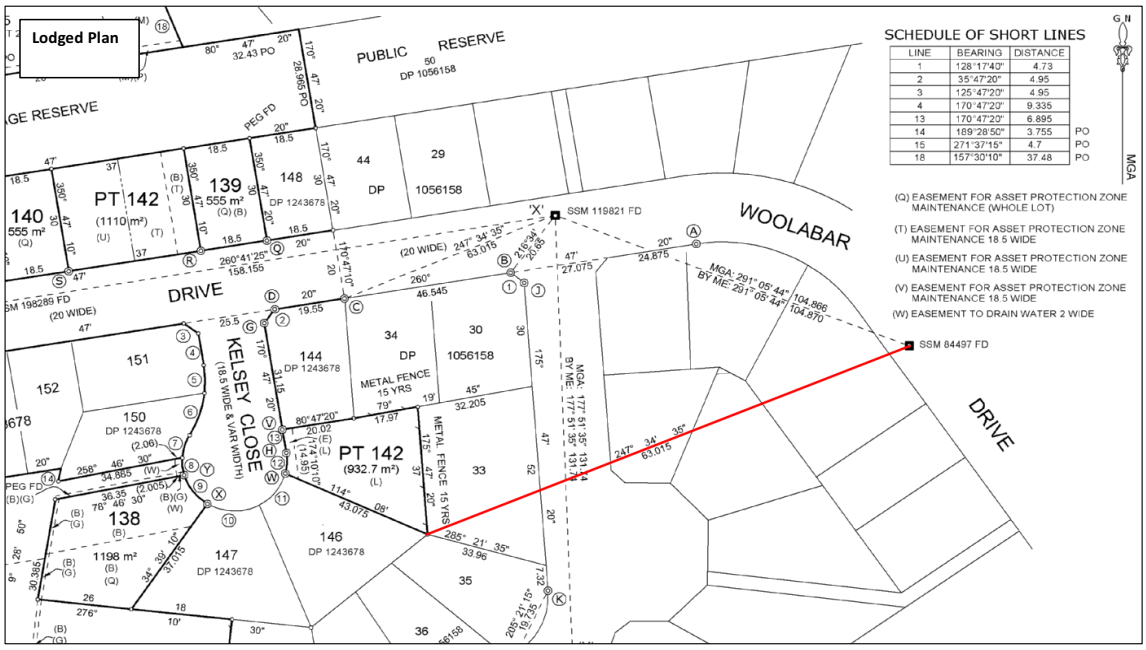


Figure 10: Lodged TIFF displaying incorrect bearing/distance.

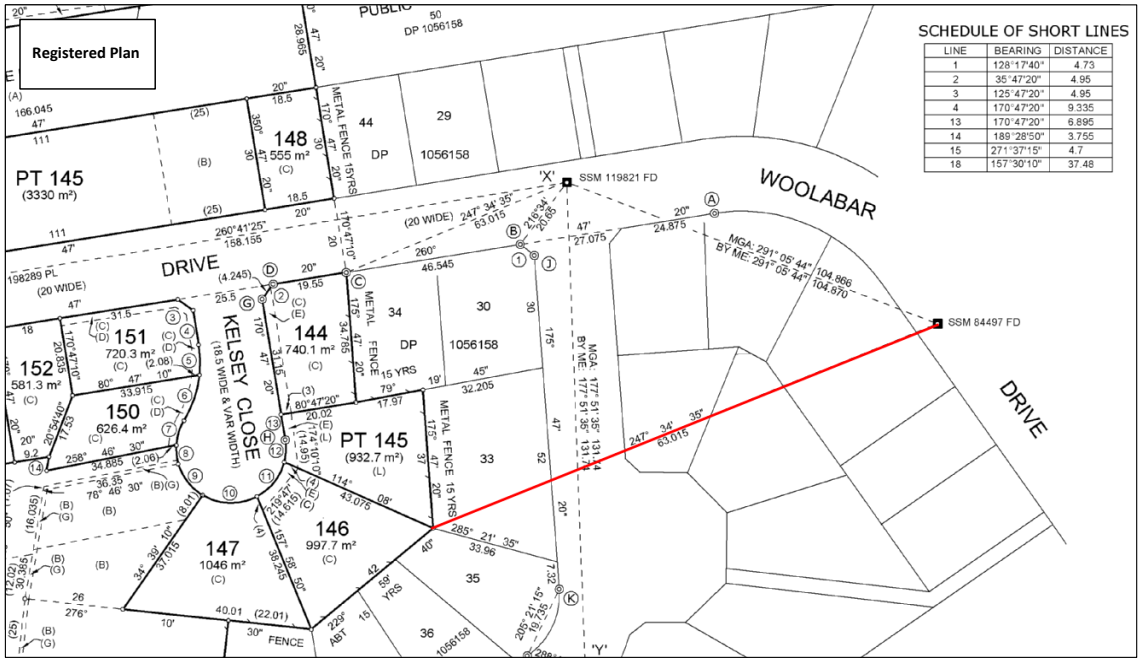
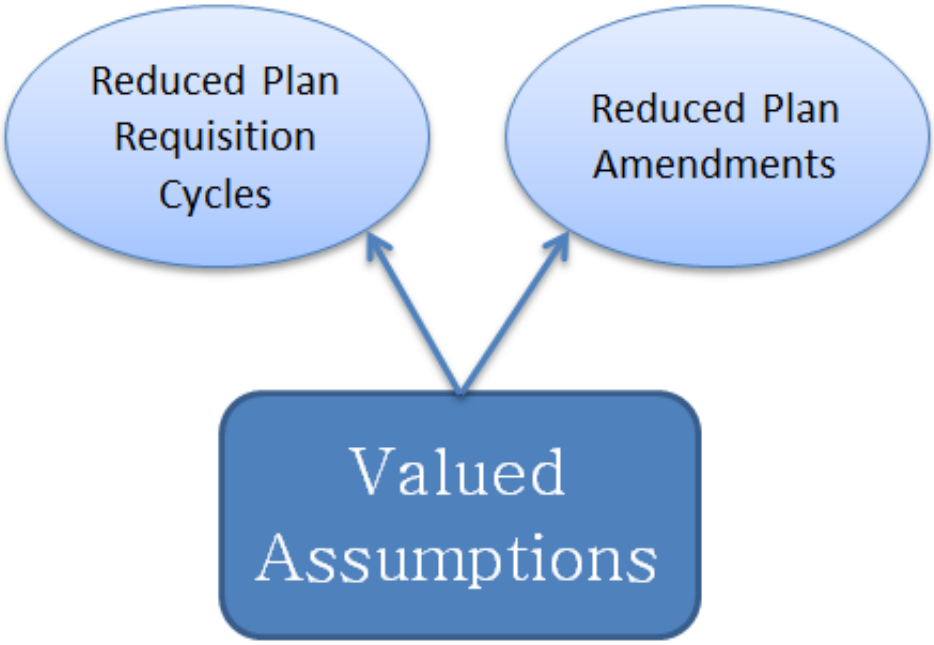


Figure 11: Previously registered plan displaying identical error.

Annexure 2: Valued Assumptions



- **Reduced requisition cycles:**

A preliminary requisition analysis of 217 registered CoD Project plans has been conducted with results as follows:

- Only 24% of plans were requisitioned more than once.
- The average resubmission cycle was calculated to be 1.17. This is favourably comparable to the average re-submission cycle calculated for manual plans of 2.5*

*Sample size for manual plans>17,000 plans. This sample size also included all plan types & categories where the CoD sample only included limited plan types & categories.

- **Reduced plan amendments:**

Incorporating digital examination leads to detection of errors within the cadastral register which ultimately improves integrity of the register. A preliminary analysis was performed on one months' worth of amendment data from 14th August – 14th September 2018 with results as follows:

Of the 158 amendment cases, 60 were due to survey related issues of which 86% could have been avoided if examined through the digital channel. Examples of issues that could have been avoided were: Parcel miscloses, incorrect connection lines, incorrect reference mark dimensions, incorrect parcel area, incorrect connection lines, incorrect MGA coordinates.