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Working Group 2 – Cadastre and land management

Future Spatial Management of the Cadastre

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Outline

1. Cadastre as one of the foundation components of land administration.
2. Australian Digitisation Case Studies - From Fit-For-Purpose to Digital Twin
 - a) South Australia
 - b) Northern Territory
 - c) New South Wales
3. The Disruptive Technologies for Cadastral Surveyors
4. What have we learnt for the Future?

Cadastre As One Of The Foundation Components Of Land Administration

Security and Spatial Definition of tenure in the cadastre is the foundation to:

- The economy
- Political stability
- Etc



Problems from lack of proper land management and administration

- ✓ Tenure Security
- ✓ Land conflicts
- ✓ Lack or shortage of revenue for the government, both national and local
- ✓ Illegal or irregular transaction of real estate
- ✓ Unstable investment in land
- ✓ Unfair distribution of land
- ✓ Ineffective usage of land
- ✓ Environmentally unfriendly behavior, Unplanned urbanization
- ✓ Others



Problems from lack of proper **SPATIAL** land management and administration

- ✓ **Tenure security**

- ✓ **Land conflicts**

- ✓ Lack or shortage of revenue for the government, both national and local

- ✓ **Illegal or irregular transaction of real estate**

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Digitisation of Land Administration and Cadastre - Australia

Digitisation of survey data and automation of processes has been happening in Australia for over 20 years.

In Australia we are in the transition from the manual measurement based title systems of the past to the digital location based title systems of the future.

DIGITISATION CASE STUDIES

Northern Territory

Area - 1.3 mill sq kms

Population - 250,000

Total Parcels - 85,000

**New South Wales is
60% the size of the
Northern Territory
but with 30 times
the population**

South Australia

Area - 1 mill sq kms

Population - 1.75 mill

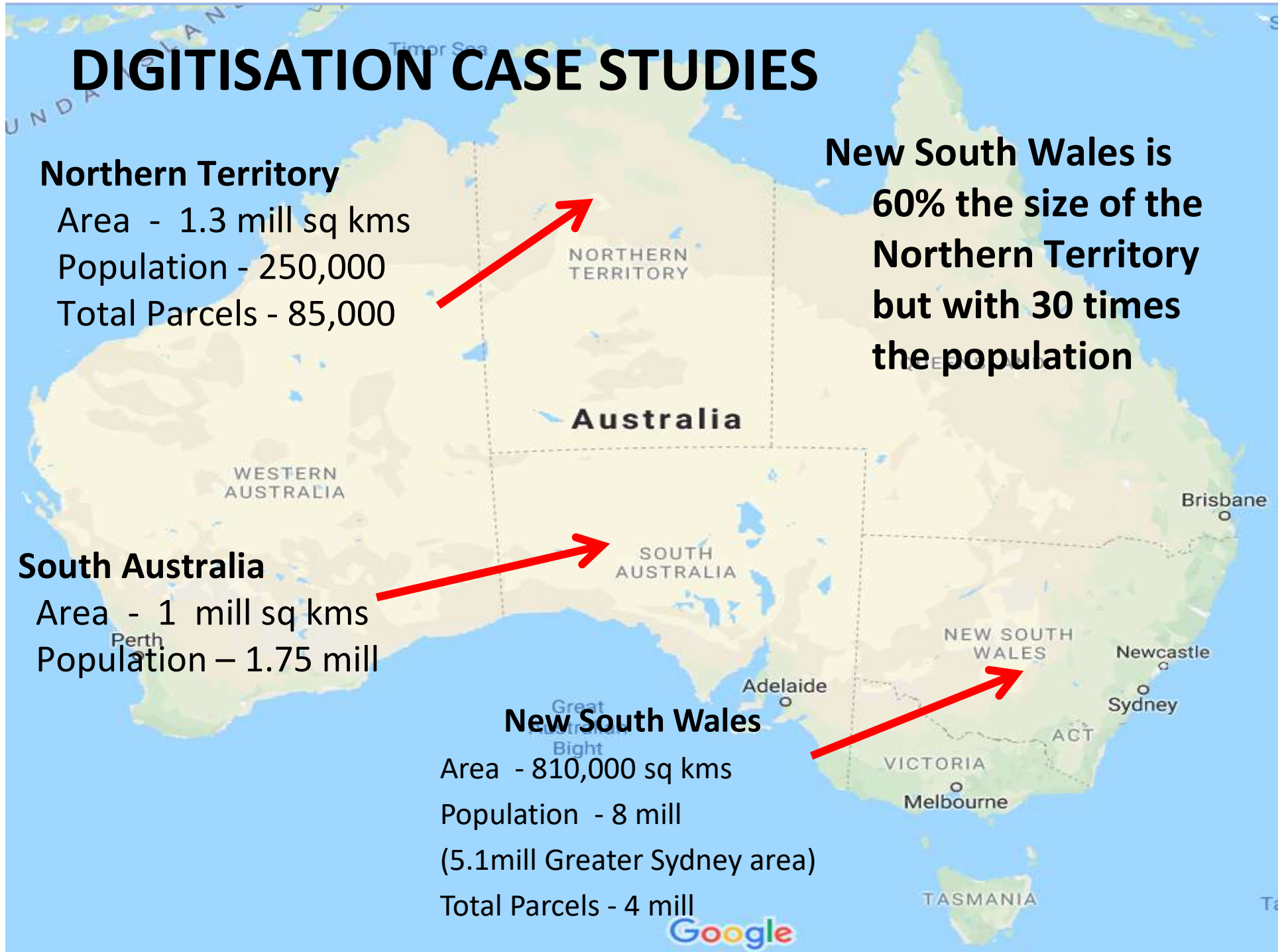
New South Wales

Area - 810,000 sq kms

Population - 8 mill

(5.1mill Greater Sydney area)

Total Parcels - 4 mill



Digitisation of Land Administration and Cadastre - Australia

South Australia

Land Services SA has been the private industry service provider to the South Australian Government for transactions through the Land Titles Office since October 2017.

Land Services SA is introducing efficiencies through the automated examination of the survey content and spatial integrity of new survey plans defining land titles.

Digitisation of Land Administration and Cadastre - Australia

New South Wales

Over the last 15 years NSW Land Titles Office has been investing strongly in the digitisation of survey and cadastral processes and have implemented a high level of rigour and automation.

The complexity of those processes has meant they have had to revue some of those goals.

Digitisation of Land Administration and Cadastre - Australia

New South Wales

On 1 July 2017 the private company **NSW Land Registry Services** began operating the land titles registry on behalf of the NSW Government under a 35-year concession.

“Since the concession took effect, NSW Land Registry Services has improved service outcomes for customers, invested to enhance the security of the register and enabled digital innovation in the conveyancing and surveying sectors.” (LRS Web Page)

Digitisation of Land Administration and Cadastre - Australia

New South Wales – Digital Twin

NSW has developed an interactive platform to capture and display real-time 3D and 4D spatial data in order to model the urban environment.

This upgrade from traditionally held 2D spatial data is the NSW 'Digital Twin'. The [State Infrastructure Strategy 2018](#) recommended an upgrade to NSW's spatial data from 2D to real-time 3D and 4D, the launch of this platform is the first step in making this recommendation a reality.

For more information:

<https://www.digital.nsw.gov.au/article/twinning-spatial-services-has-created-digital-twin-nsw>

The NSW Digital Twin



4D Model showing the internal structure of a building in Penrith as at December 2018

Digitisation of Land Administration and Cadastre - Australia

Northern Territory

In the early 1990s the NT was beginning the creation of the cadastral database for land administration.

Pastoral Leases covered large expanses and existing maps of their extents (boundaries up to 80km) provided a spatial challenge to represent.



Digitisation of Land Administration and Cadastre - Australia

Northern Territory

A Fit-For-Purpose application was developed in the 1990s using the parcel dimensions to create a coordinated survey database.

The coordinates facilitated the use of GNSS to provide position based measurement rather than needing large ground measurement traverses and to overcome survey disruption issues.



Digitisation of Land Administration and Cadastre - Australia

Northern Territory

The original FFP solution using survey measurements to build a dynamic survey database parcel fabric has been expanded to the whole of the NT.

The same process has been adopted by ESRI as the Parcel Fabric cadastral management application worldwide.

Digitisation of Land Administration and Cadastre - Australia

Northern Territory

Over 25 years the NT has been extracting relevant measurement and other data from all NT survey plans and is now all but complete.

The NT the mapping based Cadastral Database is now being replaced by a dynamic survey database (SPICAD) built by compiling the machine readable text files of individual survey plans.

Digitisation of Land Administration and Cadastre - Australia

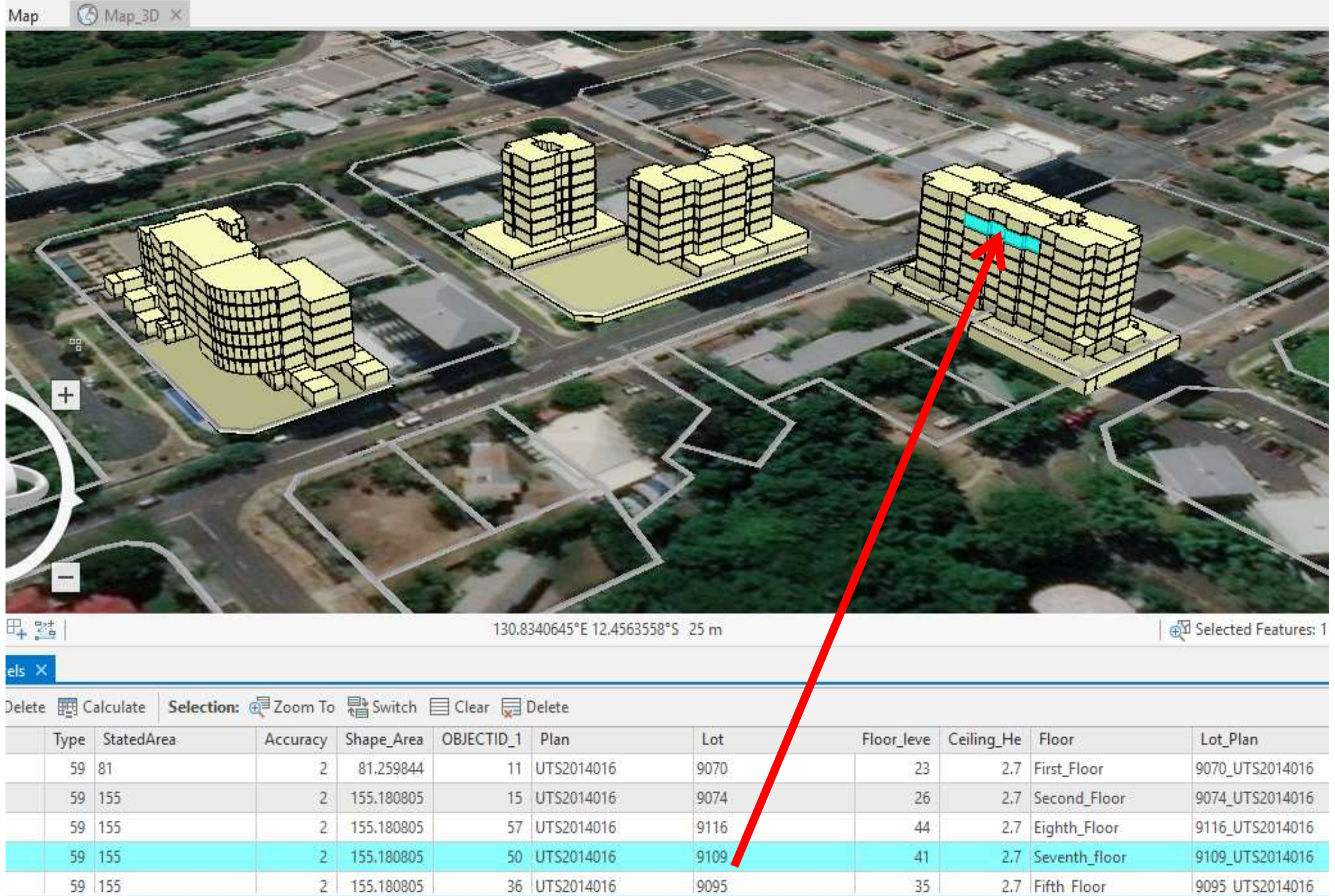
Northern Territory

Total Digital lodgement was made mandatory in 2017.

That lodgement is simplified with a mixture of digital formats:


1. a digital image of the new survey plan
2. A machine readable text file of relevant survey data for automated processes.
3. A spatial analysis report generated by Surveyors prior to lodgement.
4. Surveyor's application now has the capacity to collect 3D & 4D parcel data where available.

The Northern Territory Survey Database



Cadastral Database with 3D Parcel

ion Inquiry Labeling



UTS2014105_parcel - 10135

Accuracy	2
Rotation	0.39624
Scale	1.000048
Unclosed	0
MiscloseRa	33084.590956
MiscloseDi	0.00766
MiscloseBe	66.741069
Constructi	0
ShapeStdEr	0.001
ShapeStd_1	0.002
BacksightB	224.633333
Shape_Leng	253.454509
Shape_Area	3072.912361
OBJECTID_1	2
Plan	UTS2014105
Lot	10135
Floor_lev	20
Ceiling_He	3.7
Floor	Basement
Lot_Plan	10135_UTS2014105

The Disruptive Technologies for Cadastral Surveyors

- Measurement tools - EDM, GNSS, Scanners, high resolution imagery.
- Computing power.
- Software, Applications, AI, etc
 - The database

The Disruptive Technologies for Cadastral Surveyors

The Database

Cadastral Surveyors historical role:

1. Surveying parcel boundaries.
2. Surveying many parcels on a plan/plat with the outcome of survey plan

= Local Solution

The Disruptive Technologies for Surveyors

The Database

The database moves into a regional or state outcome. It requires:

- A change in methods
- A change in processes to get a cost effective solution

This was identified in the FIG Fit-For-Purpose Land Administration document.

What have we learnt for the Future?

The Northern Territory

The successful implementation on a limited budget of the Northern Territory cadastral database have been due to doing what is readily achievable and not trying to pursue complicated outcomes even though technology has the capacity for those outcomes.

What have we learnt for the Future?

The Northern Territory – Dr Michael Elfick

- *I think that the most important issue was in the design of the basic model*
- *Plans have parcels, parcels have lines, lines are linked by points and line points, networks are held by control points.*
- *With each object you need to hold the essential attributes and have provision to add others as needed.*
- *Essential to keep the basics simple and not over complicate it or design it for a specific instance.*
- *The base model should be applicable everywhere.*
- *This model has worked with cadastral systems everywhere and probably reflects the fact that it was designed by people who really understood the data and how it was collected and used.*

What have we learnt for the Future?

Data – Flexibility in Sources

- applications should be able to utilise all current and historical survey and spatial data irrespective of it's integrity:
 - Survey
 - GNSS
 - Position data from imagery
 - Crowd sourcing??
- raw measurement or position data should be retained in an accessible machine readable format to allow future applications to provide greater analysis or use for spatial upgrading

What have we learnt for the Future?

Data – Management

- Data should generate an object based database or contribute to its spatial integrity
- Compiling those objects into a seamless “fabric” that represents the true **relationships between land parcels in the real world.**
- Precision is not critical – that can always be improved if the resources required can be justified. The scalable structure of the database is essential.

What have we learnt for the Future?

Data – Spatial Improvement

- Smarter applications should be used so the spatial integrity (location and shape) of good data is not compromised if data of less spatial integrity is added to the database.

What have we learnt for the Future?

Data - Existing Databases

In developed and developing countries financial and human resources have been utilised in developing existing cadastral databases.

Rather than begin a process from the start existing databases can provide a valuable foundation with:

- Cadastral or parcel intelligence previously populated
- Topology or “fitting together of parcels”
- Identifying spatially good data.

After identifying cadastral database weaknesses, flexibility in modern applications can manage existing databases and save money.

What have we learnt for the Future?

Technology

It has the capacity to solve all problems or automate many processes.

But - Be wary of what it promises!!

In a perfect cadastral world that is represented in a perfect database there will be no problems.

The cadastral world is not a perfect place.

What have we learnt for the Future?

Governance of Future Innovation

We have to be clear in the basic needs.

Input of too many stakeholders can be detrimental to the most efficient and cost effective outcome.

Australia was united in its adoption of Torrens Title for land tenure but every state and territory has significantly different protocols in the way they manage the survey processes.

Creating a standard data model is challenging.

Managing the Cadastre in a Fit-For-Purpose solution or Future Digital Twin

Spatial precision is not critical in FFP but is the foundation for an effective Digital Twin.

Smarter survey databases have the capacity for the higher precision by managing all types of spatial data (survey traverses, GNSS, imagery location, crowd sourcing, etc) where the spatial integrity of the data is taken into consideration in a rigorous adjustment.

A FFP solution should have that capacity (As per the Northern Territory)

Essential Reading for Future Cadastral Management

Fit-For-Purpose Land Administration



JOINT FIG / WORLD BANK PUBLICATION



Stig Enemark
Keith Clifford Bell
Christiaan Lemmen
Robin McLaren

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Fit-For-Purpose Land Administration

The FFP document implied that the capacity of technology was one of the drivers of complexity in implementing land administration systems.

That has been a symptom of aspects of the cadastral digitisation systems being implemented in Australia.

Fit-For-Purpose Land Administration - Forward

“At the annual World Bank Conferences on Land and Poverty concerns were raised by various stakeholders that **the current procedures and requirements for mapping and boundary delineation were often too cumbersome and expensive** and did not comply with the actual needs of most citizens for achieving security of tenure.”

Fit-For-Purpose Land Administration - Forward

“This perspective calls for a **flexible** and **pragmatic** approach rather than requirements imposed through rigid regulations, demands **for spatial accuracy and systems** that may be unsustainable for less developed countries”

The “Take away message”

Thank You

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