Land and Property Information in 3D

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Complex structures
Complex structures

UTS Sydney - Dr Chau Chak Wing Building
The Dr Chau Chak Wing Building is the first building in Australia designed by Frank Gehry, one of the world's most influential architects. http://www.uts.edu.au/partners-and-community/initiatives/city-campus-master-plan/projects-progress/dr-chau-chak-wing

ARC-Linkage Project Partners

I C S M
ANZLIC COMMITTEE ON SURVEYING & MAPPING

Australian Government
Australian Research Council

Department of Transport, Planning and Local Infrastructure

Land & Property Information

strata community australia®

A M

Alexander Symonds Consulting

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NSW

Victorian Government

The University of Melbourne
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Scope

[Diagram showing relationships between community members like architect, developer, builder, engineer, agent, surveyor, and local government, with annotations for physical and legal information.]
Limitations of 2D information

Planning

development

management

community knowledge

Objectives of the Project

1. An improved understanding of the problems and issues associated with incorporating 3D property information into land administration systems;

2. A specification of the technical, policy, legal and institutional aspects of a 3D property information and representation system;

3. Prototype 3D property information and building visualisation systems, visualisation and modelling
Project focus

INSTITUTIONAL CHALLENGES
• Regulatory
• Social
• Cultural

TECHNICAL CHALLENGES
• Data source
• Data model
• Data visualisation
• BIM

Project outcomes

STRATEGY DEVELOPMENT
• Cultural change
• Collaboration
• Adoption
• Implementation

TECHNICAL TOOLS
• Data model
• Web-based visualisation platform
• Specifications
Project outcomes

Evaluation of range-based and image-based data sourcing methods for building 3D models

The 3DCDM model has 11 sub-models (modules).

3D Cadastral Data Model (3DCDM)

4 sub-models (modules)

6 sub-models (modules)

1 sub-model (module)

✓ The 3DCDM model has 11 sub-models (modules).
Project outcomes

**Development of a BIM model of a building to show potential for managing 3D land and property information (cadastral info)**

- Physical Information
  - interior walls
  - exterior walls
  - sliding doors
  - single-flush doors
  - awning windows
  - fixed windows
  - stairs
  - slabs

- Ownership Information
  - ownership of property units
  - common properties

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**Project outcomes**

**3D approach to flood modelling for planning purposes in urban areas**
Some elements of the research in more detail

Visualisation challenges and prototype
Institutional challenges

Visualisation challenges and prototype

Cadastre: Current Practice in Victoria

Digital Cadastre Database
Visualisation challenges and prototype

Cadastre: Current Practice in Victoria

- 56 Sheets to Represent Ownership Boundaries, Entitlements and Liabilities

Current Challenges in Understanding Property Rights

- Difficult to understand subdivision plans
- Numerous plans and sections are required for interpretation
- Queries and analyses are not possible; and searching and measurements are not efficient
- This method of representation lacks interactivity
Visualisation challenges and prototype

3D Cadastral Visualisation Requirements

- Required Data Elements
  - Physical Data
  - Legal Data
  - Administrative Information

- User Interface and System Requirements
  - Accessibility
  - Availability
  - Performance
  - Concurrency
  - Suitability and Flexibility
  - Quality of Visualisation
  - Reliability & Consistency
  - Handling Massive Data
  - Support Databases
  - Support Data Services
  - Support Various Formats
  - Support for Technical Diversity
  - Support Semantic System Interoperability and Integration
  - Usability
  - Platform Independence
  - Mobile Capability
  - Web-realised
  - Dissemination
  - Security
  - Open Source

60 Cadastral Visualisation Requirements

- Technical Requirements
  - Support for Open Standards

- Analytical Requirements
  - Examine Spatial Validity
  - Various Search Methods
  - Spatial Measurement Tools
  - Non-Spoke Query
  - Edit Volumes
  - 3D Buffer
  - Cross-section View
  - Shadow Analysis
  - Animation Creation
  - Line of Sight Analysis
  - Visibility Analysis
  - Skyline Creation
  - Sliding
  - Vertical Exaggeration

- Visualisation Requirements
  - Various Views
  - Labels
  - Visual Representation
  - Special Effects
  - Street View
  - Mark a location from annotation
  - Visualisation of Result of Functions
  - Self Evaluation
  - Underground View
  - Light and Illumination Modeling
  - Augmented Reality

- Various Search Methods
  - Spatial Measurement Tools
  - Non-Spoke Query
  - Edit Volumes
  - 3D Buffer
  - Cross-section View
  - Shadow Analysis
  - Animation Creation
  - Line of Sight Analysis
  - Visibility Analysis
  - Skyline Creation

Visualisation challenges and prototype

Validation of Requirements

- Questionnaire No. 1 – 3D Visualisation Specification (161 responses from 37 countries)
- Aim: Validation of identified requirements

Aim: Validation of identified requirements

- Argentina
- Brazil
- Costa Rica
- Denmark
- Germany
- Indonesia
- Iran, Islamic Republic of
- Iraq, Islamic Republic of
- Korea, Republic of
- Latvia
- Lebanon
- Netherlands
- New Zealand
- Norway
- Pakistan
- Poland
- Portugal
- Russia
- Saudi Arabia
- Singapore
- South Africa
- Spain
- Sweden
- Ukraine
- United States

Support Open Standards
Visualisation challenges and prototype

Three defining properties

1. social structures composed of cultural-cognitive, normative, and regulative elements
2. these structures attain a high degree of resilience and become authoritative guidelines for behaviour
3. become “taken-for-granted”

Scott, 2001; 2004; 2008:

Legislation, professional standards, operating procedures, expectations, etc.

Establish “legitimacy”

Behaviour is driven unconsciously – “invisible constraints”
Institutional challenges

What does the Plan mean?

• Inconsistent representation of RRRs
• Not the right scale for city management purposes

Developers

Subdivision Plans

Local Councils

Surveyors

Land Registry

Community

Strata Managers

• Frustrating, inconsistent, ambiguous and limited
• Daunting, yet is the “bible”
• Limited reflection of OC Act

• Problematic, inconsistent quality of plans
• Administering new ownership situations
• 2D good for examination

• Lengthy, resource-intensive, rigid and frustrating
• Ongoing role in clarification

What does the Plan mean?

“core information for development”, “interaction with stakeholders”

“expediency”, “due diligence”

“managing people”, “property”

“registry”, “guarantee”, “authoritative”

“measurement”, “accuracy”, “licensed”

“What do I own?”, “what can I use?”
Institutional challenges

Legitimacy has been built on...

- Longstanding Subdivision Act and registration process
- Rigorous information standards due to licensed surveyors
- Dominance of surveying profession
- Vertical subdivision less common
- Tradition of 2D cognitive/conceptual framing for abstracting building info

2D plan is the source of information

Process works well...mostly

Institutional challenges

Invisible constraints on change

Perception that law MUST change first

Who owns the problem?

Longstanding Subdivision Act and registration process

Rigorous information standards due to licensed surveyors

Entrenched use of ‘parcel’ as basic unit

Dominance of surveying profession

Vertical subdivision less common

Tradition of 2D cognitive/conceptual framing for abstracting building info

Development process highly routinised

2D plan is the source of information

Process works well...mostly

Perceived difficulty of building an argument for change

Taken-for-granted practices
Early Thoughts for Consideration as input to Roadmap

**Cadastre 2034 is ALL about institutions!**

Cadastre 2034
Powering Land and Real Property

What is the cadastral system?
The cadastral system defines and records the location and extent of property rights, restrictions, and responsibilities. It includes a geometric description of land parcels and the identification of property boundaries.

system, and opportunities for growth; with the disruption that comes with the phasing out of one technology and the start of another, as well as industry reaction arising from doing things differently.

The final version of Cadastre 2034 will guide the evolution of jurisdictional systems and ensure a coordinated and consistent approach to future policies, legislation, standards, models and research; and provide clear direction for the sector as a whole.

The value of Cadastre 2034 is that it establishes a single point philosophy on what the community can expect and what the government has to deliver in the future.
Issues for consideration

Concepts developed for ‘land’ not necessarily appropriate for buildings

- More static entity – not much changes after registration
- Typically only development, not necessarily management
- Discrete, separate institutional arrangements
- Concept of ownership

- Continually changing e.g. continuous resubdivision/amalgamation, swapping lots, etc.
- Requires a collaborative approach to both development and management
- Requires integrated institutional arrangements
- Larger number of stakeholders per development process

**Suggestion:**
Segment the market: land and buildings as separate processes

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Issues for consideration

By segmenting market:

- Parcel as unit of analysis
- Continue to pursue ePlan/LandXML

- Property (lot) as unit of analysis
- Invest in 3D technology appropriate for representing building information e.g. Industry Foundation Classes (data model behind BIM), gbXML (Green Building XML schema)
- Leverage other visualisation/web technologies

**Suggestion:**
Facilitates parallel pursuit of technological opportunities without losing current investment in ePlan
Issues for consideration

Current institutional arrangements are silo-based

- Development and management of buildings are supported by different legislation, organisations, processes, etc
- Move towards a building lifecycle approach: productivity and sustainability arguments for change

Suggestion:
Institutional structure and organisational culture needs to change to support greater collaboration
*e.g. governments legislating the use of BIM to force cultural shift*

Concluding Remarks

- Increasing urban complexity
- Needs and opportunities in the context of future cities and future institutional sustainability
- 3D info to support management of urban environment (e.g. leveraging BIM)
- Future users vs current users, including wider array of stakeholders
- Making sense of smart data in cities eg. smart utilities, 4D data
Concluding Remarks: New connections

Collaborate. Leverage. Community-focused.

Thank you