Developments of 3D Land Administration in China – advancements and challenges

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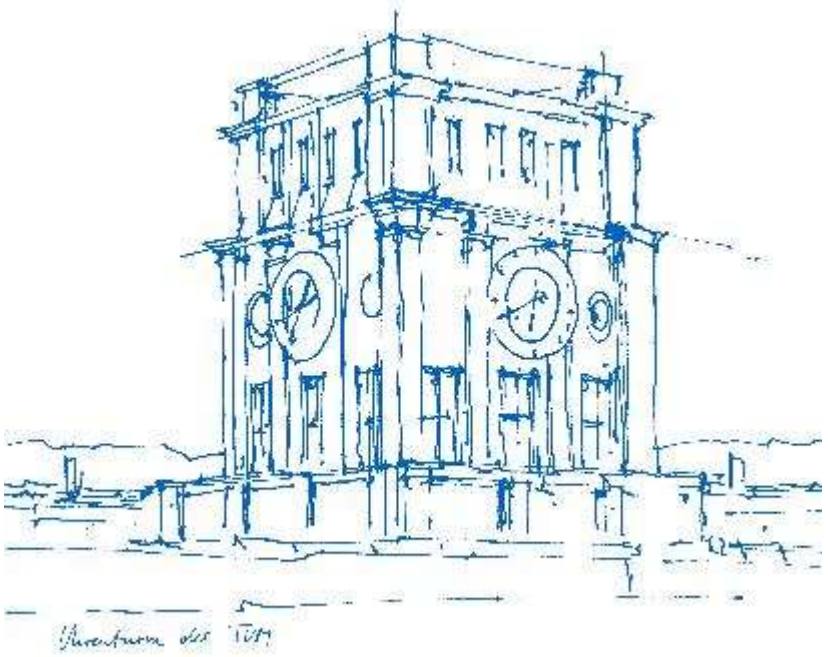


Content

- Motivation
- Methodology
- Result
- Discussion
- Conclusion

Motivation

- Limited land
- 3D land use
- Traditional 2D cadastre no longer sufficient
- No one-fits-all cadastral development

- Main research objective
  The problems, challenges and opportunities that 3D cadastre faces in China

Methodology

Literature review and analysis

Reading and compilation of literature

Keyword co-occurrence analysis of literature

Questionnaire survey

A questionnaire with 14 questions were sent by emails

Word cloud analysis on the returned answers

Cost effective and distance independent

Comprehension bias

Uncertainty about the number of respondents

Interview

Random interviews with the general public

1. In your perspective, what is a cadastre, or what are the necessary elements and functions that a cadastre should have?
2. In your perspective, what is a 3D cadastre and what elements must it record?
3. How do you perceive Digital Twins?
4. How do you think the connection between 3D cadastre and digital twins?
5. What do you think are the most common methods for obtaining 3D cadastral data (digital photogrammetry, laser scanning, digitised maps, original IFC/BIM/CAD data, etc.)? What are the advantages of these techniques?
6. Do you know of any methods for building 3D geometrical models? (e.g. TIN, B-rep, TEN, etc.)
7. What do you think is the biggest technical challenge in developing from 2D to 3D cadastre? What are the current technologies that need to be developed?
8. What domestic 3D cadastral models are you aware of and how are 3D data stored in these models?
9. how will the integration of different types of data from different sectors be achieved after the implementation of the unified registration of immovable property and the unified registration of natural resources?
10. Which laws, policies and regulations are relevant to 3D cadastre in China? Which part of the laws and regulations do you think can be improved to help guarantee and realise the application of 3D cadastre and digital twins?
11. Which departments and organisations are involved in the implementation and research of 3D cadastre and twin cities? What is the relationship between them?
12. What are the changes in organisational structure for the implementation of 3D Cadastre and Twin Cities?
13. You are _____. A. a researcher B. a government employee C. a business technician
14. What projects have you heard about or participated in?

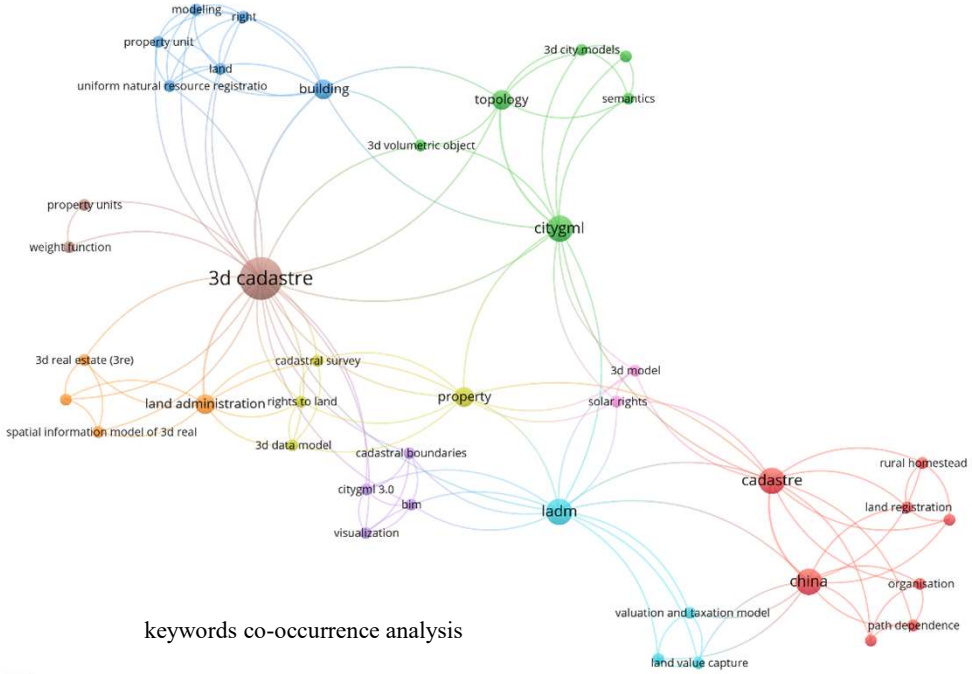
Results-registration in China

- Separate registration stage----Land registration and building/housing registration
- Unified registration stage
  The *Property Law of the People's Republic of China*
  Implementing Rules for Interim Regulations on Real Estate Registration
- *Unified registration of natural resources rights----since 2019*
  Ministry of Natural Resources of the PRC was formed in 2018
  Interim Measures for Unified Registration of Natural Resources Rights
  Natural resources include land, water areas, sea areas, farmlands, forests and grasslands

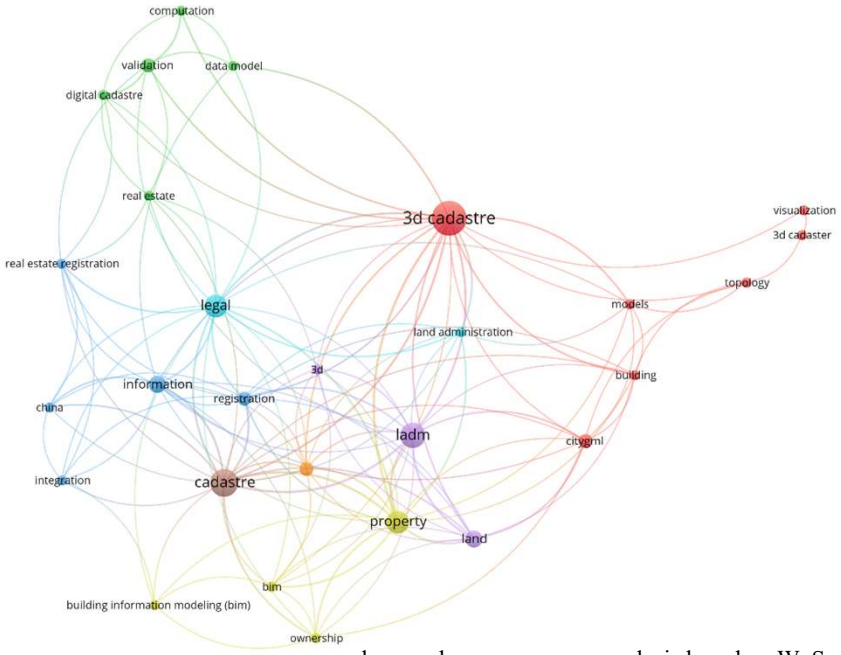
Results-keyword occurrence analysis

High-frequency keywords appears in both analyses

- Data model/3D data model/spatial model
- Real estate



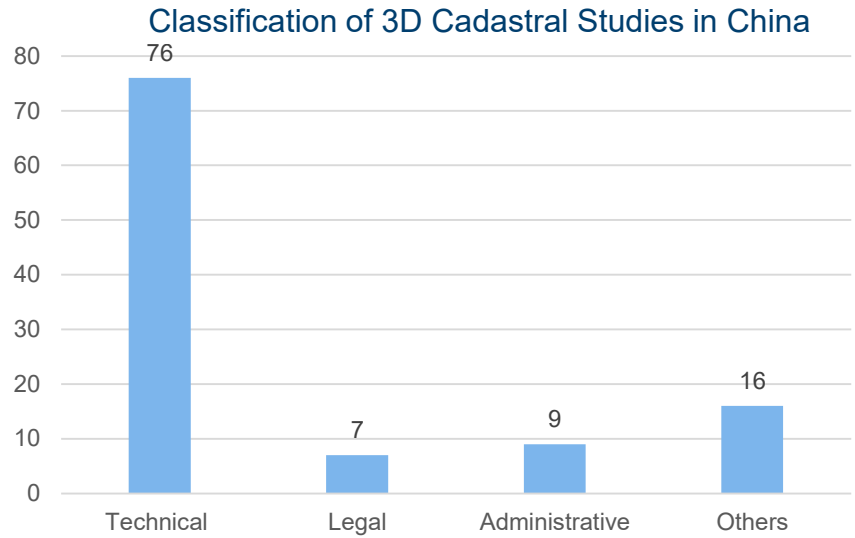
keywords co-occurrence analysis



keywords co-occurrence analysis based on WoS

- Topology
- Land administration
- LADM and CityGML

Results-3D cadastral studies in China



Technology development

- 3D property definition, type and spatial relationship
- Model for 3D cadastre

  Unified Registration Data Model for Immovable Project Object

  Hybrid 3D cadastral data model
- 3D cadastral visualization
- Models for unified natural resources registration

Results-3D cadastral legislation in China

- Legislation and regulation related to space

  Article 136 of The *Property Law of the People's Republic of China(2007) and*

  Article 345 of The *Civil Code of the People's Republic of China*, which came into force on 1 January 2021*, state* 'the right to use land for construction purposes may be established on the surface of the land, above the surface or below the surface, respectively'

  The *Interim Regulation on Real Estate Registration:* clearly establishing the concept of three-dimensional space of land at the legal level

- Policy document and regulation on 3D development, 3D information and 3D cadastre

  In 2020, the State Council issued a notice (Letter No.96[2020] of the State Council), proposing to replicate and popularized "the three-dimensional land management model with a three-dimensional cadastre at its core" nationwide.

  Two national level norms: The *Representation of 3D features of urban real estate and* The *Technical specification for three-dimensional modelling of urban underground space*

  Local standards and norms

Results-questionnaire

The questionnaire was sent to a total of 25 practitioners, and 9 valid questionnaires were obtained including 7 researchers and 2 corporate staffs.

Understanding on cadastre

- Land is the object
- Information about land
- Basis for management
- In the form of map book
- Land‘s *‘huji’*

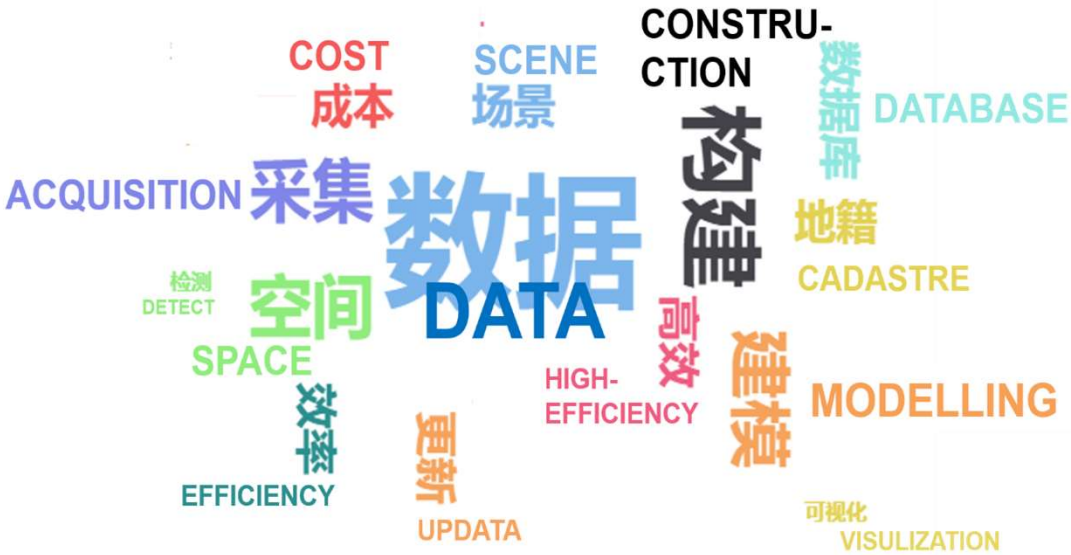
Understanding on 3D cadastre

- 3D use of land
- 3D elements
- Precise definition of 3D objects
- Spatial relationship

Results-questionnaire

Challenges met in 3D cadastre in China

- Surveying: boundary
- 3D data: acquisition, processing, storage
- 3D modelling: high-efficiency



Results-questionnaire

Legislation about 3D cadastre in China

- A broad legal framework exists
- Local regulations exist
- Gaps in legislation

Results-questionnaire

Problems need to be solved in data integration after unified registration of natural resources

- Consistency of data standards and format
- Data sharing
- Data quality in database
- Standardized in operational procedures
- Cross-sectoral cooperation mechanisms
- One respondent states “ why do we need data integration’

Results-interview

Random interviews were conducted with three other individuals.

- Interviewee 1 works in natural resources department

In the provinces and cities in which this interviewee work, the unified registration is still at an early stage and lags far behind the pilot cities.

- Interviewee 2 and 3 are general public

They are not familiar with cadastre and 3D cadastre.

Discussion-basic definition

	Literature	Questionnaire
Basic definition	• No harmonized definitions in laws and regulations • Is 3D cadastre a presentation of data or a system?	• No uniform definition • Cadastre is regarded as a simple recording in forms of an atlas • 3D cadastre is a natural extension of 2D cadastre • 3D property representation is essential
Discuss	• Traditional concept can no longer fully cover the content of modern cadastre • 3D cadastre is still in development and research, it's difficult to define by its characteristics • Less understanding of the legal and administrative aspect	

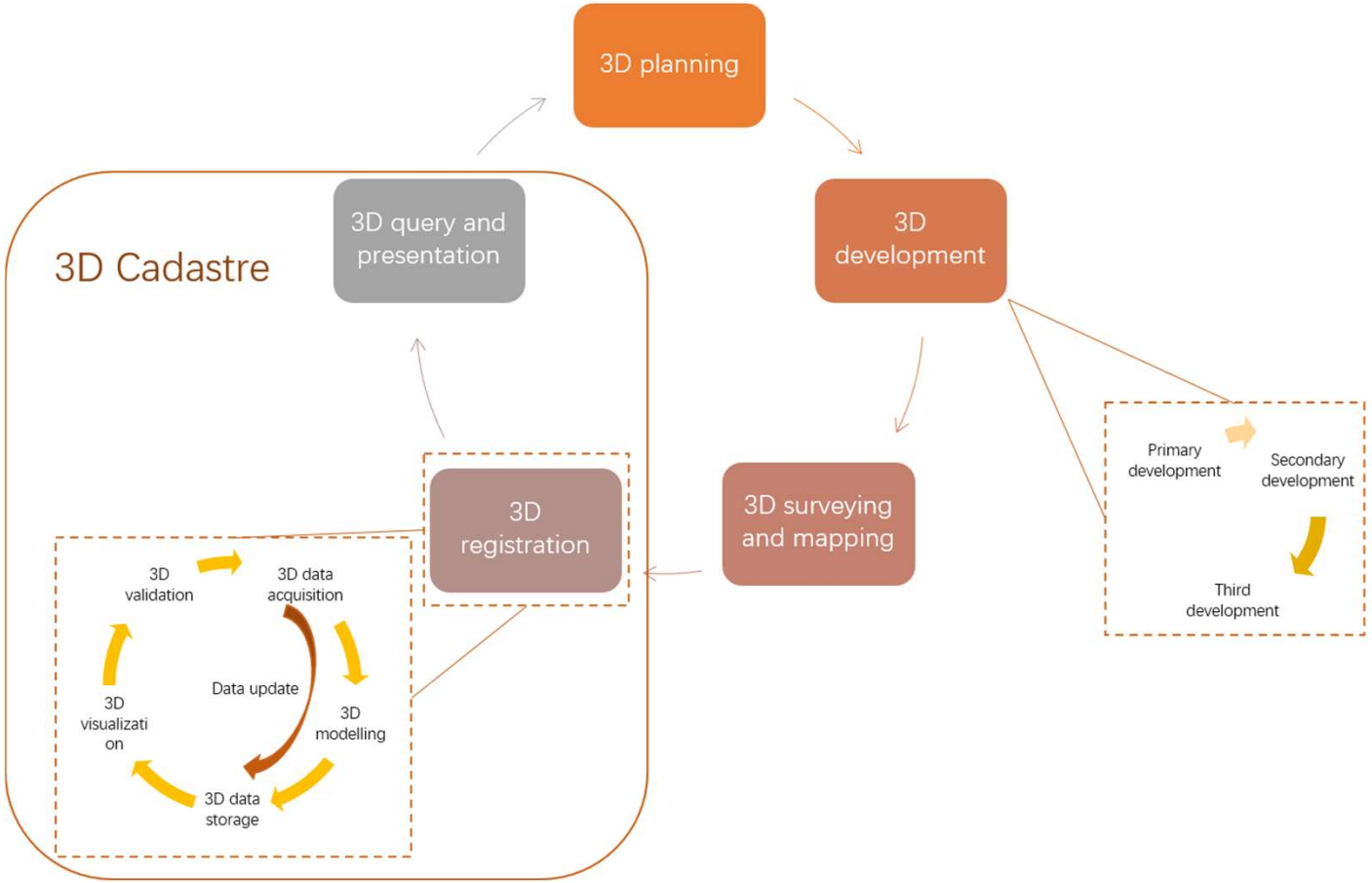
Discussion-technical questions

	Literature	Questionnaire
Technical	• Technology studies account for a large proportion • Methods suitable for China • Research focus transited to data models and platforms construction under unified registration • Renewal of technologies	• High efficiency, accuracy and ease of updating and maintenance are features • Problems Difficulty in measuring and surveying Difficulty in database construction Difficulty in ensuring timeliness of 3D scene Difficulty in data fusion • Unified registration Unified coordinate system Unified data standards and formats Data sharing platform Improve data quality
Discuss	• The technology of realizing 3D cadastre in pilot projects is nearly perfect • How to efficiently and accurately implement the 3D cadastral platform technology that supports real-time updating of large-scale and massive data	

Discussion-legal questions

	Literature	Questionnaire
Legal	• Policy guidelines and requirements • Lack of clear regulations and standards • Lack of administrative regulations concerning management and norms concerning spatial registration • The right to use construction land established on a stratified basis	• Lack of legal definition • Lack of top-level design of legislation • Lack of standards and operation instruction (data security) • Lack of legislation on space above the surface
Discuss	• Legislation lags behind the breakthrough of 3D cadastral technology and implementation • But for the national promotion of 3D cadastre, legislation should precede practice • Low legislative level, lack of top-level design, and insufficient implement ability • Local regulations are important reference for national laws • Transition and articulation of laws	

Discussion-3D cadastre life cycle



Discussion-other responses

- Why do we need data integration?

  The policy is still at an early stage of implementation

  Data integration is a process that take times and requires multi-sectoral collaboration, before the realization of 3D cadastre, it may be not necessary

- Regional incoherence

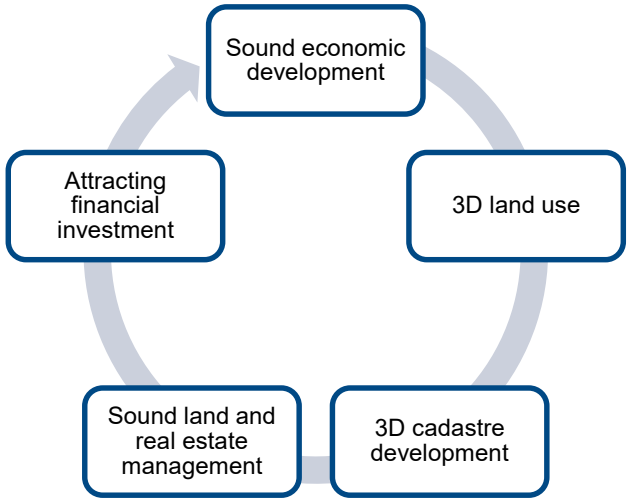
  For pilot areas like Shenzhen, Shanghai,

  Virtuous cycle

  For less economic developed areas:

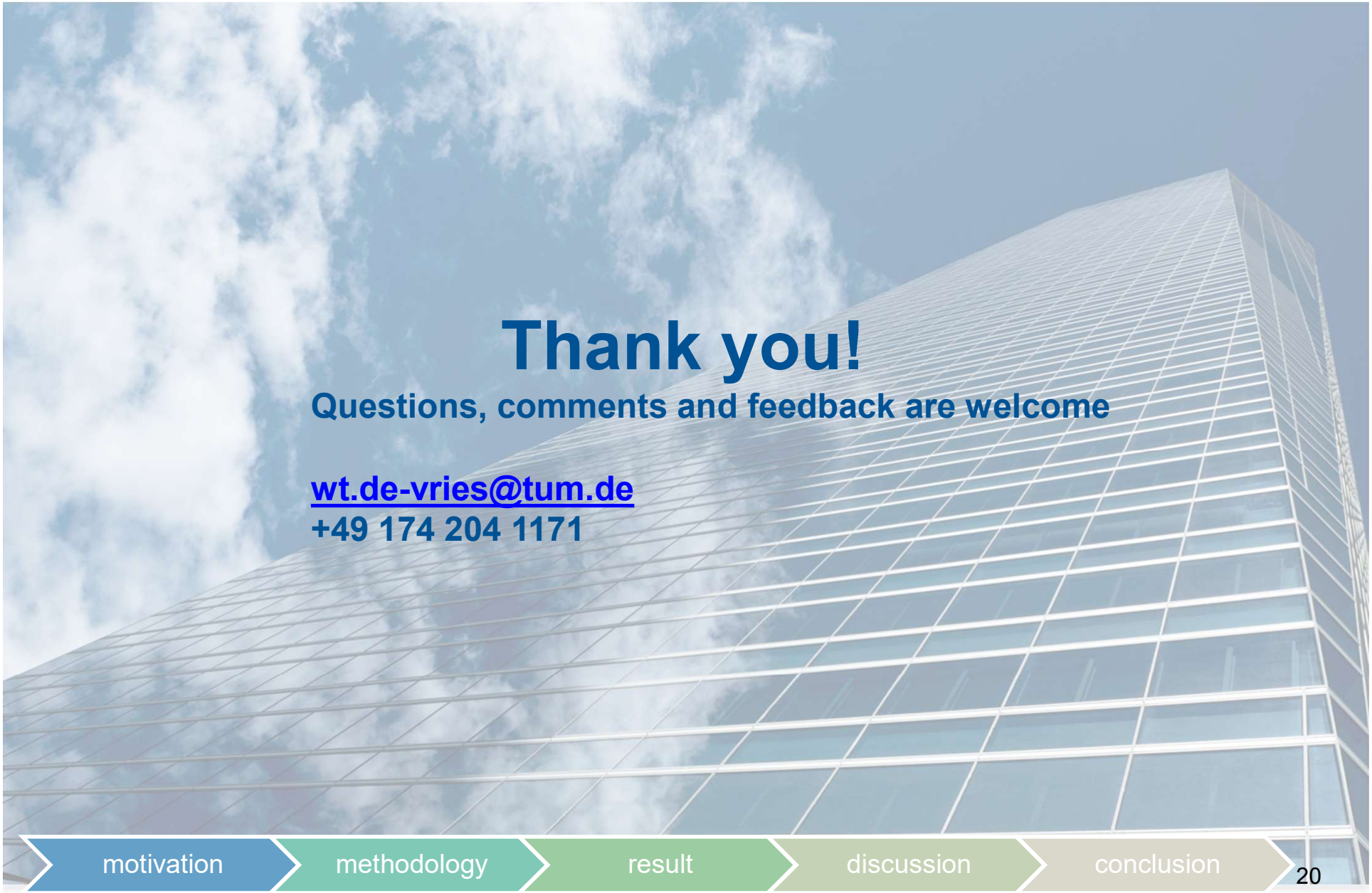
  The need for 3D cadastre is not urgent

  The high cost of developing and maintaining 3D cadastre



Conclusion

Definition	Situation	Problems	Challenges	Recommendation
Vague concept Need to be defined in a more standardized way	New models are constantly proposed Visualization and platform design are underway	Legal system cannot support further development of 3D cadastre	Efficient and highly accurate in dealing with data related issues	3D cadastre in less developed areas Joint stakeholder research



Thank you!

Questions, comments and feedback are welcome

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