

FIG WORKING WEEK 2019

22-26 April, Hanoi, Vietnam

Presented by the FIG Working Week 2019,
April 22-26, 2019 in Hanoi, Vietnam

"Geospatial Information for a Smarter Life
and Environmental Resilience"



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Positional accuracy improvement for heterogeneous geodata integration

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What I am going to say

- Role of Integration Heterogeneous Geodata in using Map Legacy in Vietnam
- PAI Workflow For Cadastral Data using Rubbersheeting Transformation
- Test Results PAI Cadastral Maps according National Geographical Database

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1. Integration Heterogeneous Geodata

- Unresolved problem in all countries: Integration of multi-origin data, different in spatial reference system, established method, time and precisions
- GIS databases :built with layer-to-layer integration, overlapping thematic data layers mechanically
- Unsolved spatial conflict = Difficulty in Use map legacy for computer aided spatial analysis
- Use of map and geodata legacy requires improved positional accuracy according to high-precision reference topodata

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Somewhere in the world ...

- Pioneers: Ordnance Survey, Bureau of Census, Swisstopo
- US Census Bureau :improved TIGER database from 150m error to reach RMSE 3.8m after PAI.
- UK Ordnance Survey: improved RMSE of LandLine and OS Master Map 2.8m to 1.1m in rural areas and 0.4 m in urban areas using GPS results

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Spatial integration problem in Vietnam

- National Geographical Database 2011: High accuracy (1: 2000 - 1:10 000) reference data, provided by Ministry of Natural Resources and Environment
- Heritage thematic data:
 - Geology, hydrography, soil, landcover, forest cadastral ... based on old, low accuracy topographic maps 1: 5 000 -1: 100 000
 - Old, low accuracy cadastral maps 1: 200 -1: 10 000 were basis for public transport maps, underground, urban and rural planning

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Case of cadastral data

- Main part : between 1999 and 2009 according to different regulations (1999 and 2008)
- Basic cadastral map of 1: 10 000 for forest land. Regular maps- 1: 200 to 1: 5 000
- In the past: Used as a basis for large scale thematic maps: public transport maps, underground works, urban planning, landuse and agriculture planning

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Cadastral vs. Topographic

- Cadastral maps:
 - RMSE 0,6mm for parcel points and 0,9mm for other objects
 - Controlled by local authority
 - inconsistencies in positional accuracy
- Topographic: RMSE 0,5-0,7mm
- Cadastral maps and Land database : part of VNSDI (Law of Surveying and Mapping 2016).

Integration is inevitable!

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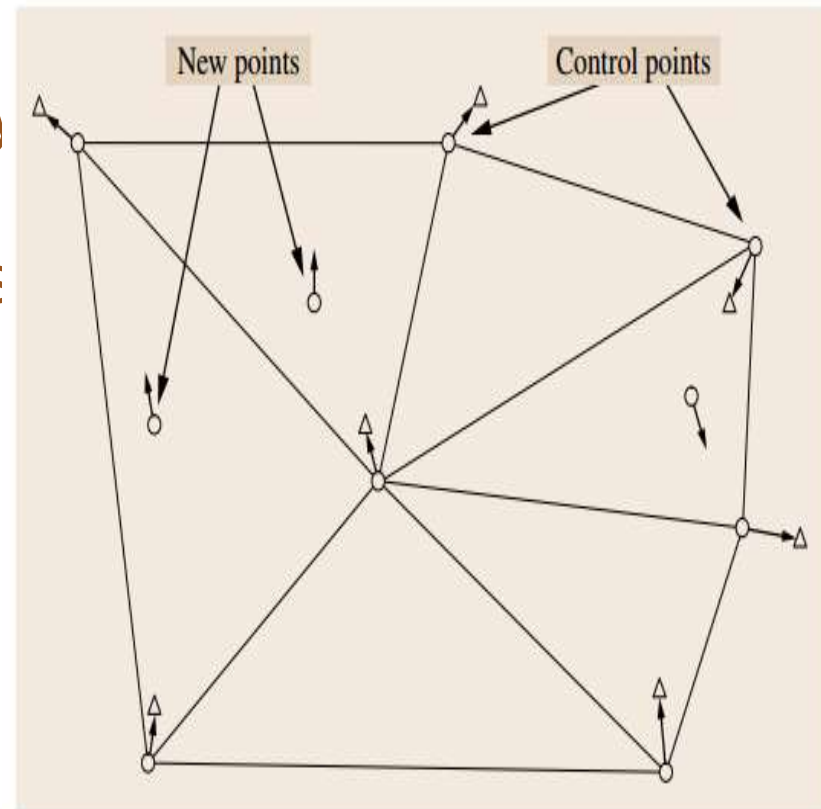
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2. PAI Workflow For Cadastral Map Legacy

Rubbersheeting: a set of local transformations based on the Delaunay Triangle Network. Within each triangle, the difference in coordinates δX_i , δY_i is interpolated by one of the common transformation algorithms, such as the Helmert or Affine, based on the difference in coordinates δX , δY of the linked points between the source and destination data



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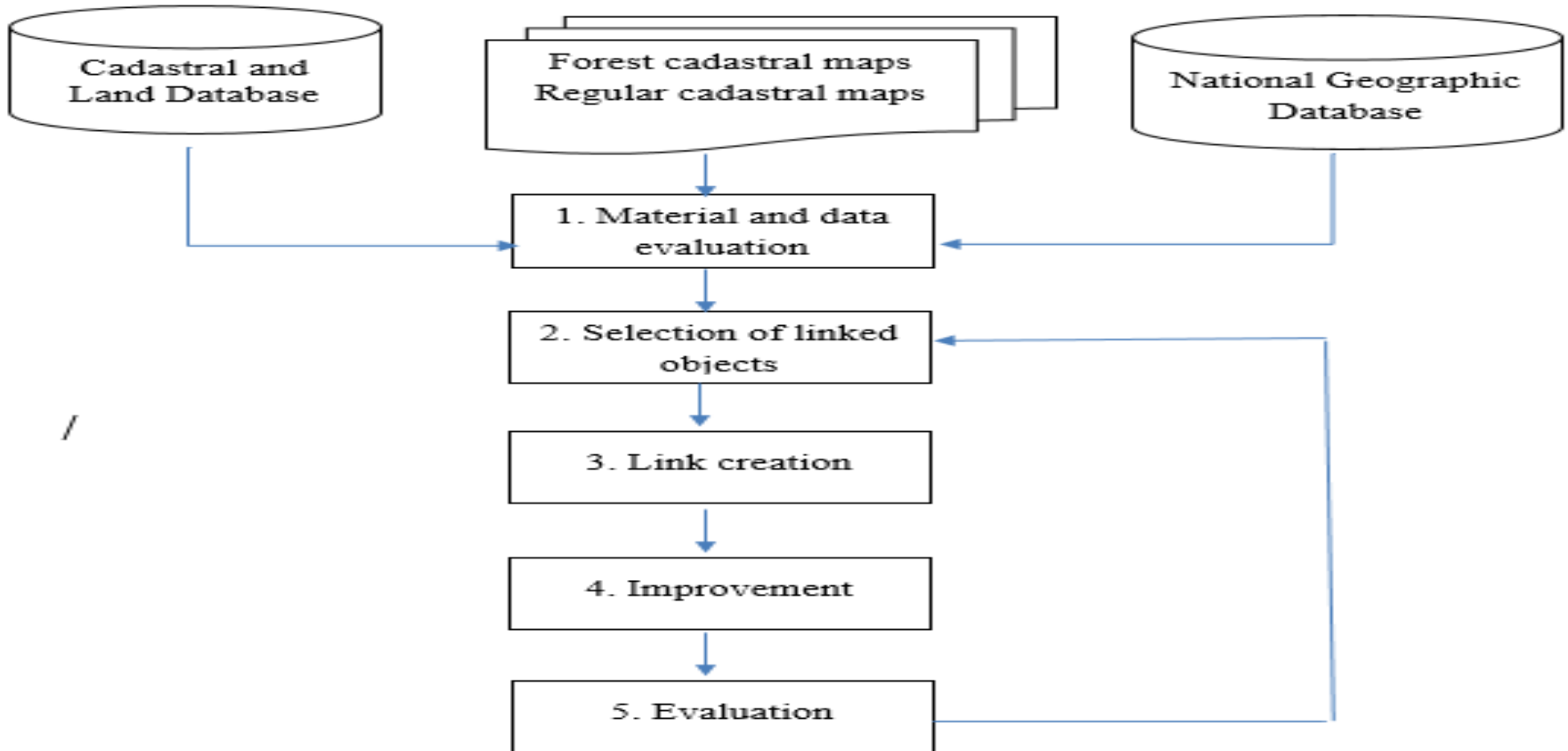
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Workflow



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3. Test

- Data: 1: 10,000 cadastral map established in 2004 and national geographic database of 1: 10 000 (2012) Thai Nguyen province
- Tool : ArcGIS 10.2 Conflation Toolkit with the Generate RubberSheet Links and Rubbersheet Features tools.
- Link features: Roads, rivers, boundaries and elevation points
- Search radius : 10m (1mm at map scale)

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Results

- Maximum parcel area change : $4 \cdot 10^{-6} \text{ m}^2$
- Maximum length of the parcel edges change: $5 \cdot 10^{-9} \text{ m}$
- Maximum point shift : 15m
- Topology relation: unchanged
- Attribute data: unchanged

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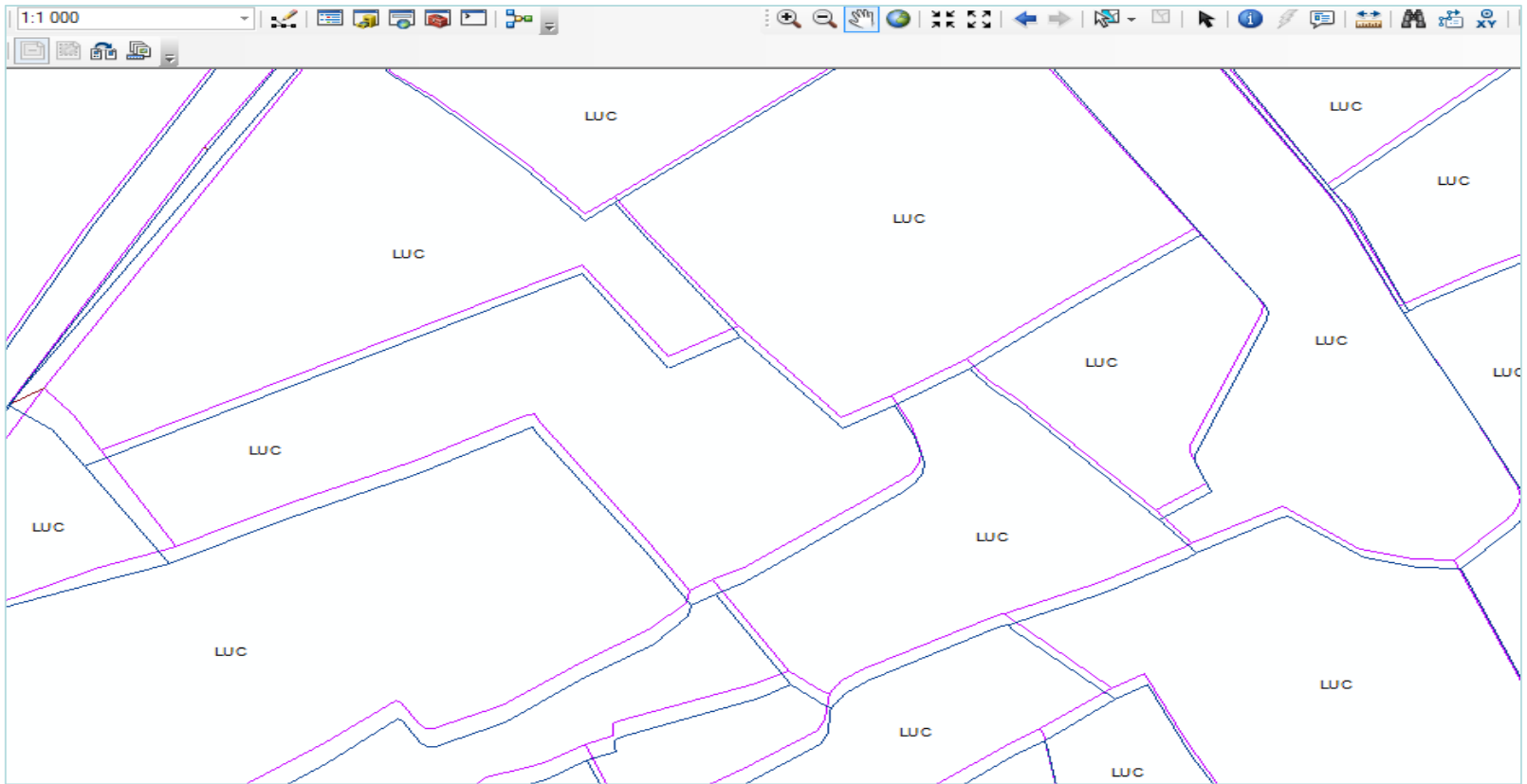
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Before and after PAI



Overlay of land parcels at 200% magnification

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CONCLUSION

- Improvement geodata accuracy based on data with higher accuracy is a key to solving the problem of integrating multi-source data and enabling the use of map legacy.
- Proposed PAI workflow of cadastral data can be applied when the it has a lower positional accuracy than national geographic data.

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Thank for Your Attention

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