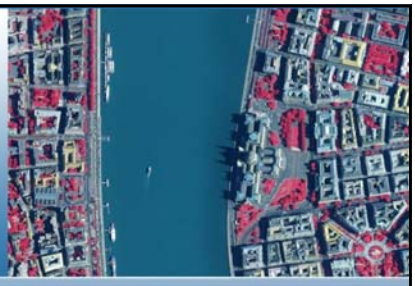

3D Cadastre Developments in Hungary

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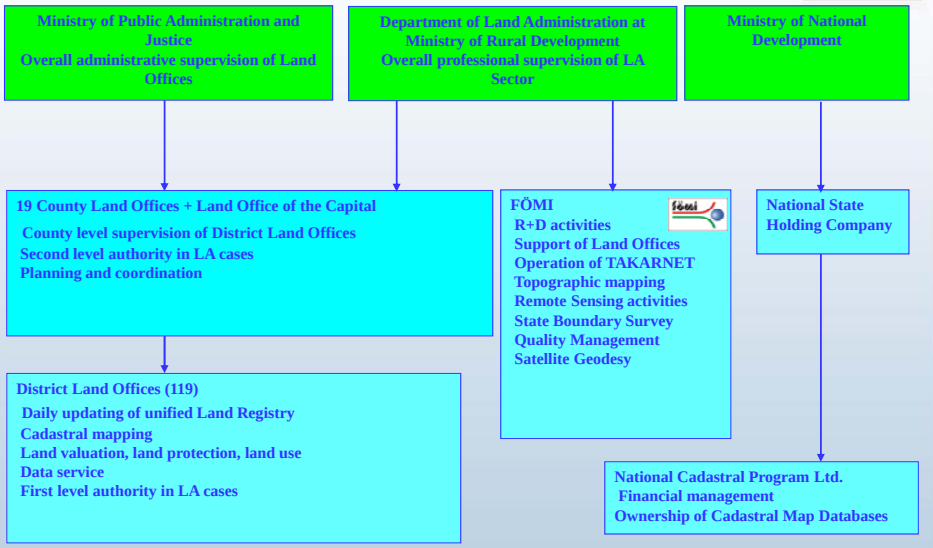
FIG Working Week 2012
Knowing to manage the territory, protect the environment,
evaluate the cultural heritage
6-10 May, 2012 Rome, Italy

Hungary

- Area: 93 000 sqkm
- Population: 10 million
- Cadastre&Land Registry:
  - No. Of Parcels: 7,6 million
  - No. Of Properties: 10 million

Hungarian Land Administration



The Unified Hungarian Land Registry

- In Unified Land Registry Cadastral Mapping and Registration of Lands (Properties) belong to the same organization: Land Office Network
- Unified Hungarian Land Registry has been operating since 1972
- Unified Hungarian Land Registry is a Title Registry, all registered rights are guaranteed by the State

Legal Framework

Act on Surveying and Mapping Activities (1996) ↔ Act on Land Registry (1997)

Unified Land Registry

New Act on Surveying and Mapping Activities (2012)

- Traditional Paper Maps->Databases (including Remote Sensing, DEMs, LIDAR etc.)
- Unified Land Registry Database (Cadastral Maps + Land Records)
- 3D Cadastre:

"Under-ground and above-ground passes objects, structures, which has homogenous ownership and/or handler relationships should be taken into account as an independent property, which must be registered in Land Registry."

New Act is accepted by the Hungarian Parliament on these days

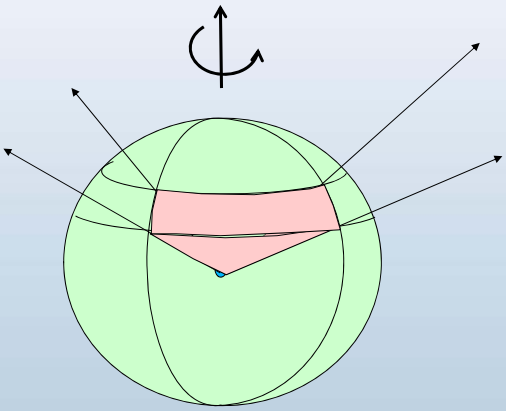
New Act come into force at the end of October 2012, except 3D Cadastre rules, which will come into force in July 2013

Implementing rules and guidelines should be elaborated till these deadlines

Legal Spaces in 3D Cadastre

Peter van Oosterom and Rod Thomson has elaborated an axiomatic definition of 3D parcels (3D Cadastre Workshop 2011, Delft, The Netherlands)

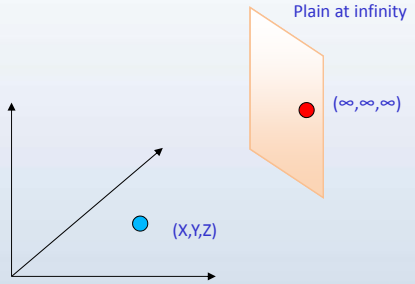
3D Cadastre speciality



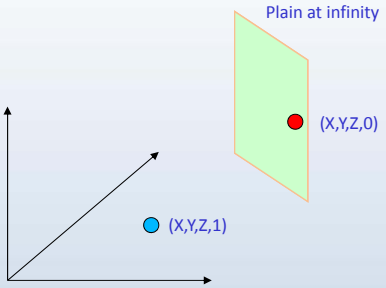
Unbounded (infinite) legal spaces in 3D Cadastre

Homogenous coordinates and infinity

Euclidean (Affine) space



Projective space



(X,Y,Z,W) (X, Y, Z, W) if ≠0.

Plain at infinity has no any special role in projective space as in Euclidean (Affine) space. Therefore unbounded legal spaces are not existing anymore, because plain at infinity closes these spaces.

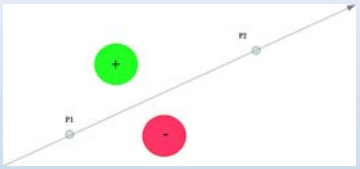
Principle of Duality in projective space:
Every definition remains significant, and every theorem remains true, if „point" and „plain" are exchanged
„3 points determines one plain" -> „3 plains determines one point"

Lines, plains and direction

Coordinates of a plain

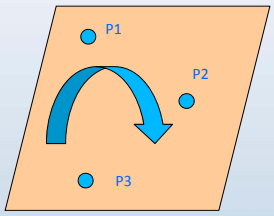
$$Det\begin{bmatrix} r_1 & r_2 & r_3 & r_4 \\ s_1 & s_2 & s_3 & s_4 \\ t_1 & t_2 & t_3 & t_4 \\ u_1 & u_2 & u_3 & u_4 \end{bmatrix} = 0$$

Space partitioning by lines or plains



Scalar product of point with a line:

+ left, - right

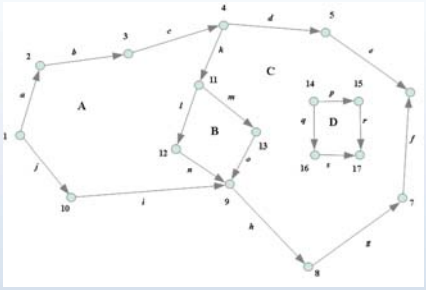


Scalar product of point with a plain:

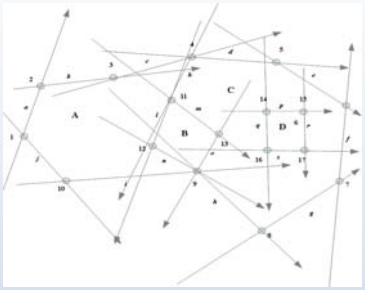
+ above, - below

Polygons and tetrahedrons

Faces and edges (2D)



Faces and infinite lines (2D)



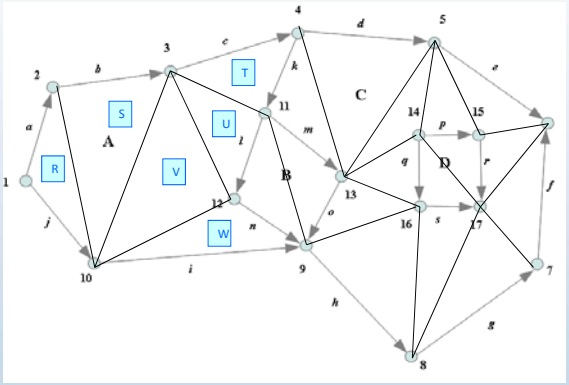
Definition of a convex face

$$\begin{bmatrix} X_1 & Y_1 & W_1 \\ X_2 & Y_2 & W_2 \\ \dots & \dots & \dots \\ X_n & Y_n & W_n \end{bmatrix} \begin{bmatrix} x_P \\ y_P \\ w_P \end{bmatrix} \geq 0$$

X,Y,W – are the coordinates of a line bounded the face

x,y,w – are the coordinates of any point within the face

Tesselations

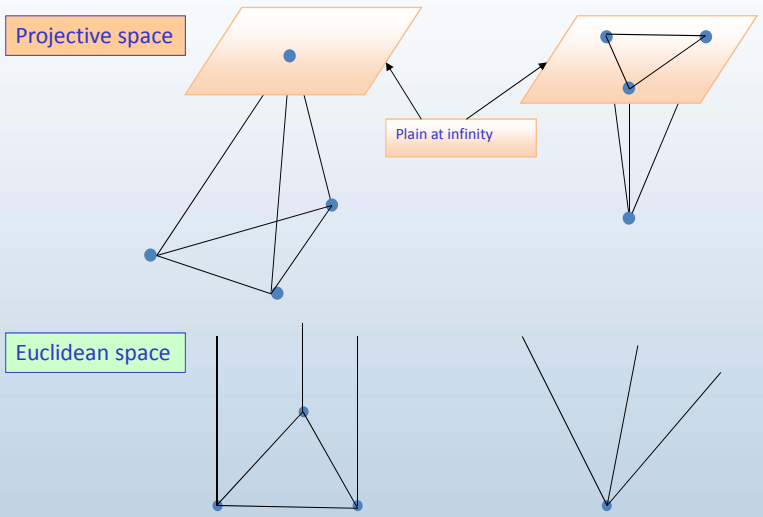


Constrained Delaunay triangulation (in 3D decomposition of space to tetrahedral meshes)

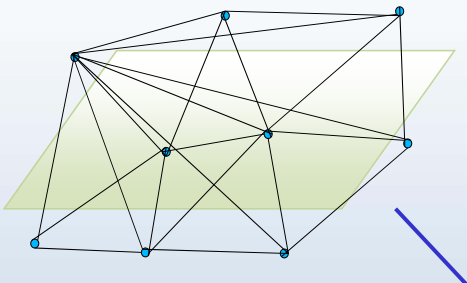
Advantages:
Optimal and unambiguous
Automatizeable

E.g.: Face „A" is a composition of R,S,T,U,V,W triangles

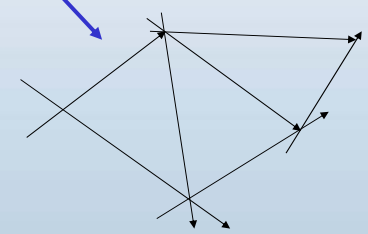
Tesselation and infinity



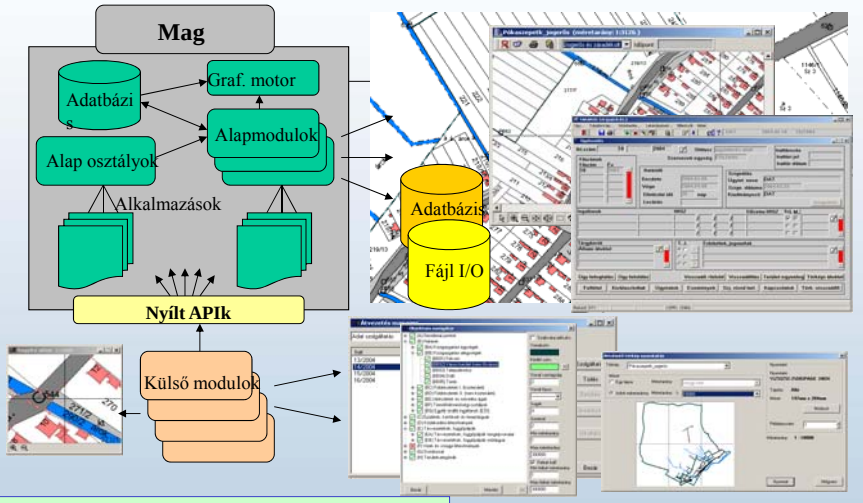
Connection between 2D and 3D



Splitting tetrahedral mesh by any plain results a triangle network, and lines inherit their direction from the direction of plains of tetrahedral mesh splitted by the plain



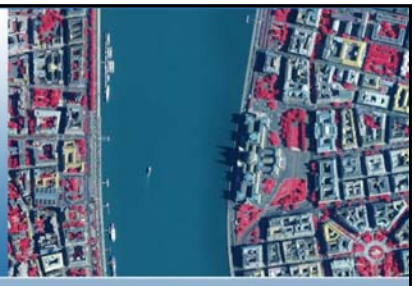
Implementation



DATR, IT system of the Unified Land Registry
Developed by FÖMI an bloc
Data Model acts as a country profile in LADM

Conclusion

- New legislation on Hungarian Cadastre has established the opportunities for future development of Cadastre
- Modeling of 3D Cadastre geometric situations has not been solved yet completely, but there are promising results
- Utilization of homogenous coordinates and projective space in 3D Cadastre modeling is at the very beginning, but it seems that could be a useful solution



Thank you for your attention

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