Developments in the Standardisation of the Core Cadastral Domain Model

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Madison, US, June 2005

FIG

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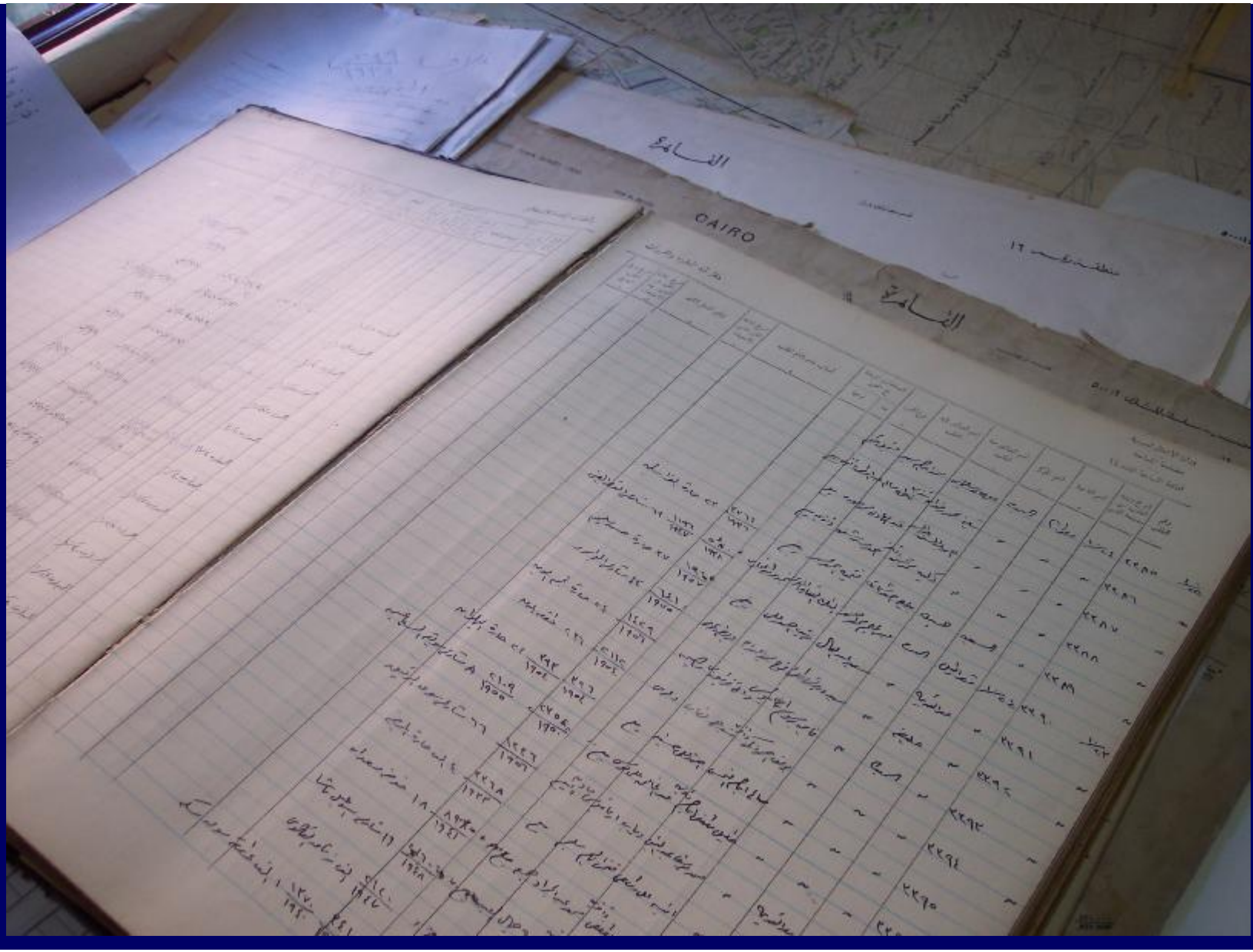

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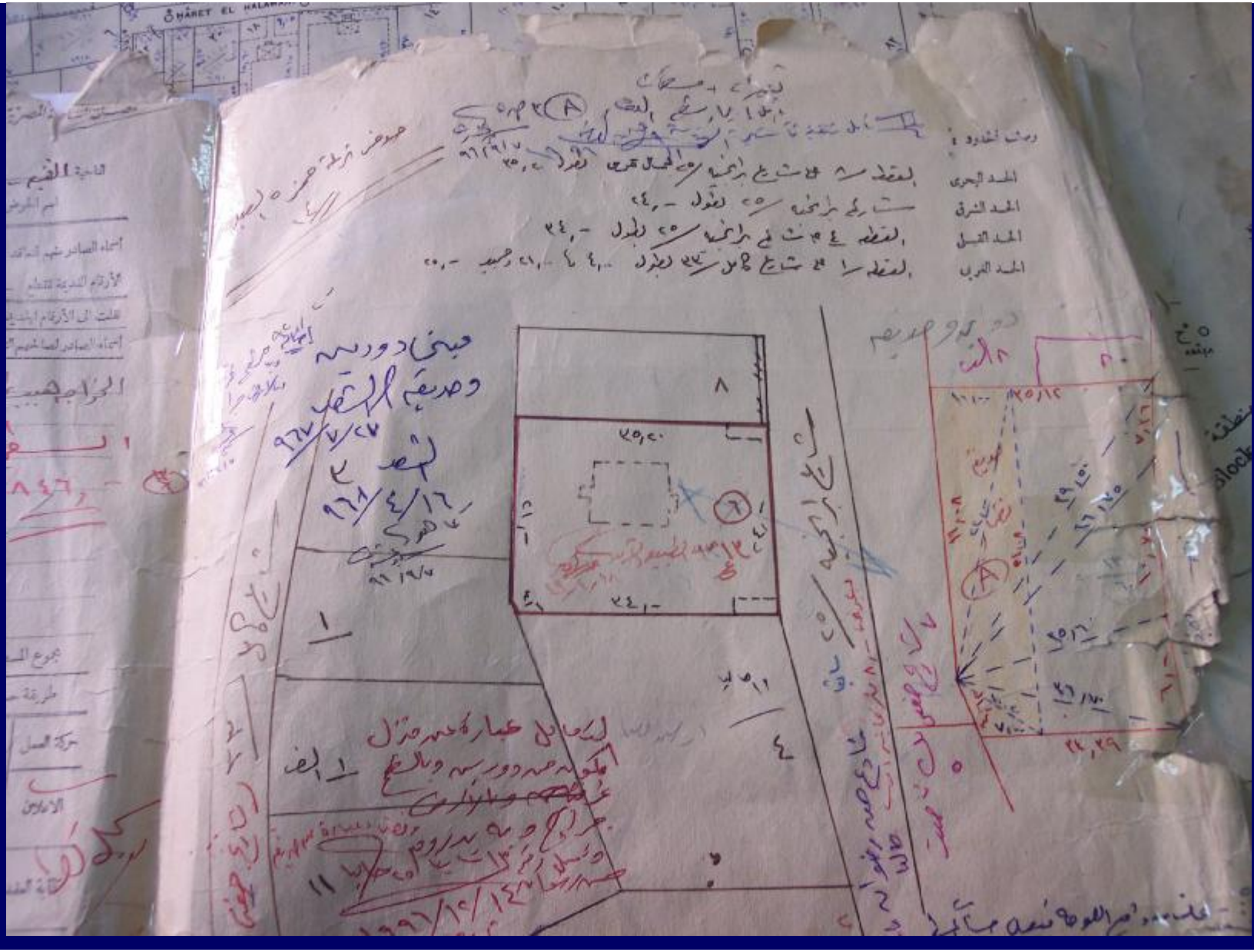

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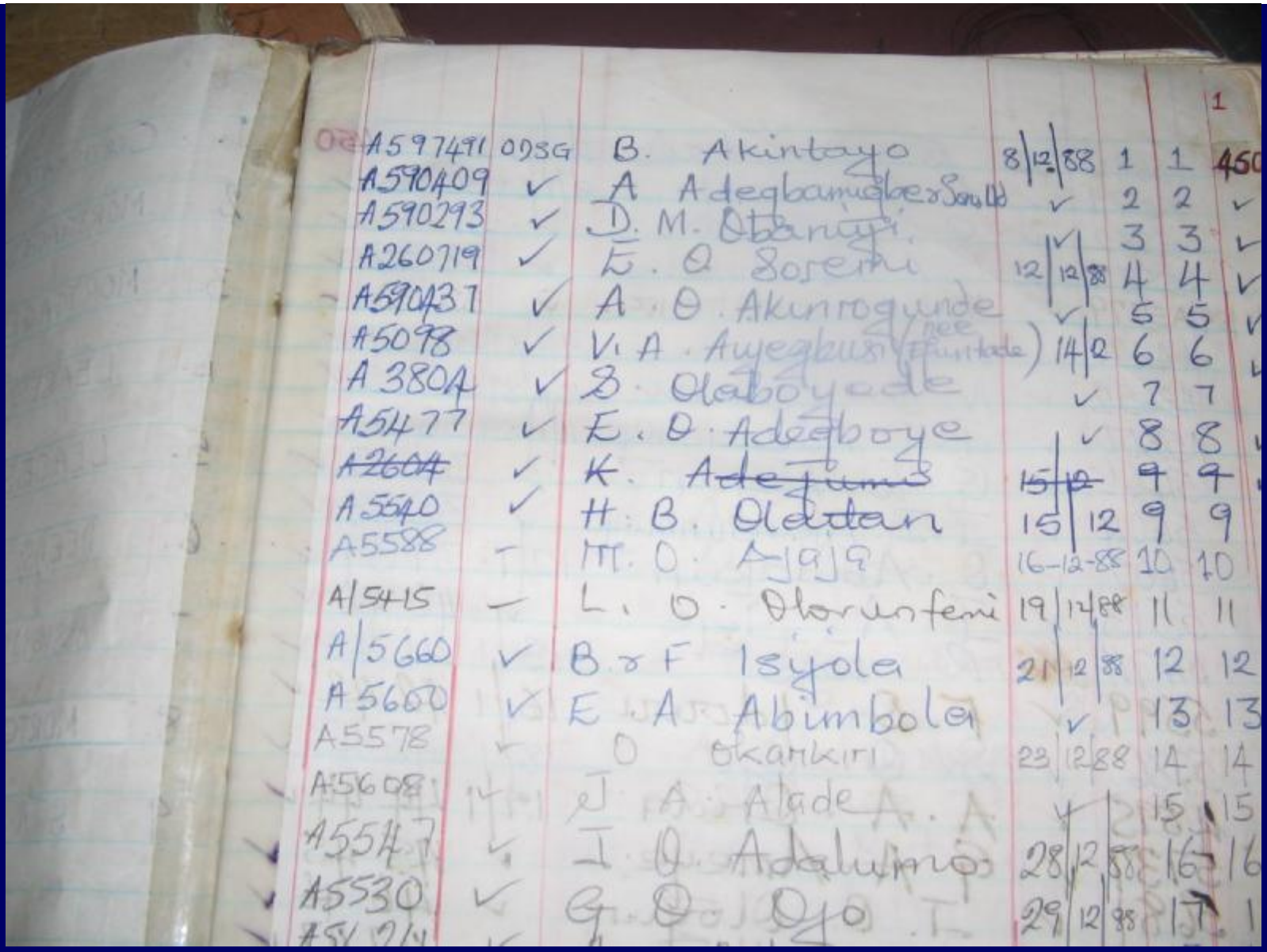
A597491 095G B. Akintayo 8/12/88 1 1
A590409 ✓ A Adegbamigbe 2 2
A590293 ✓ D. M. Obanaiji 3 3
A260719 ✓ E. O Soremi 12/12/88 4 4
A590437 ✓ A. O. Akinrogunde 5 5
A5098 ✓ Vi A. Ayegbusi (Funtade) 14/2 6 6
A 380A ✓ S. Olaboyede 7 7
A5477 ✓ E. O. Adegboye 8 8
A2604 ✓ K. Adegunwa 9 9
A5540 ✓ H. B. Oladeran 15/12 9 9
A5588 — M. O. Ajaja 16-12-88 10 10
A/5415 — L. O. Oloruntemi 19/12/88 11 11
A/5660 ✓ B & F Isiyola 21/12/88 12 12
A5660 ✓ E. A. Abimbola 13 13
A5578 — O Okanlawi 23/12/88 14 14
A5608 J. A. Alade 15 15
A5547 ✓ I. O. Adaluwo 28/12/88 16 16
A5530 ✓ G. O. Ojo 29/12/88 17 1

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Agenda

1. Introduction
2. Cadastral Data
3. Generic Cadastral Domain Model
4. Conclusions

FIG

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Standards

- There are supposed to be huge differences between cadastral and land registry systems
- Look to the common area's:
  - Standardised Model
  - Avoid re-inventing the wheel
  - Enable involved parties to communicate

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Standards

- Many countries want to computerise their cadastral data sets: modelling is complex
- There are problems in data dissemination in a distributed enviroment which is a condition in case data are maintained by (many) different organisations
- Lack of a shared set of concepts and terminology in the Cadastral Domain

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Technology push vs. Market pull

- Geo-ICT developments: Modeling standards, Database technology, Positioning systems, Internet development, Wireless communication
  à Geometry is in mainstream ICT

- User requirements of Cadastral systems change over time, due to: Change in legislation, Governmental policy, New tasks for the organization, New technology

- Therefore, generic and flexible systems needed **à** Model Driven Architecture based on conceptual models described in UML

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Scope and motivation for a standardized Cadastral Domain Model

- Covers both land registry and cadastre
- Main advantages:
  1. Avoids re-implementing same functionality again, and provides a basis extensible model driven approach
  2. Facilitate cadastral data exchange between in-country organizations and bewteen countries
- Design goals: model should be as simple as possible, transparent and modular

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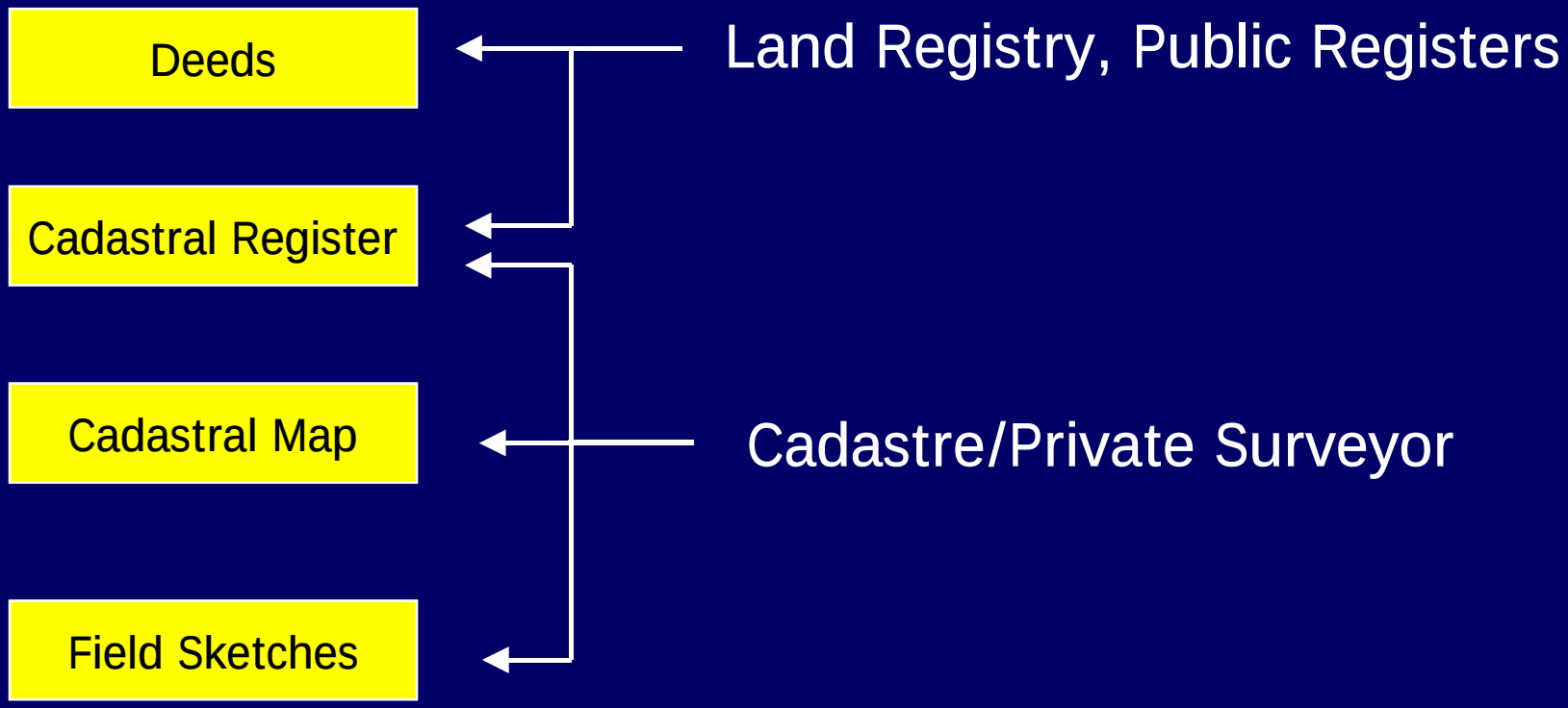
Model independent of organisation, examples of actual registrations



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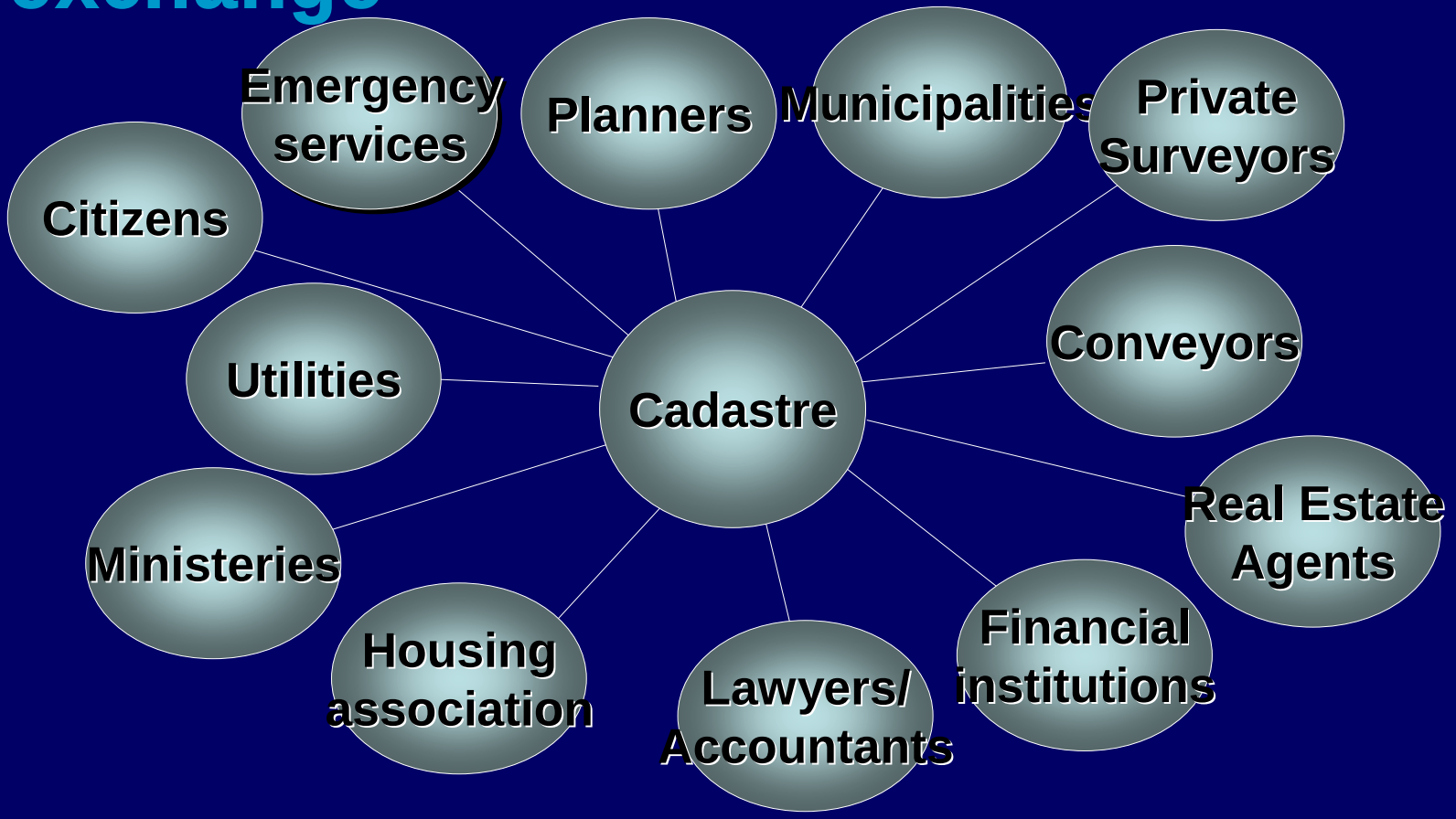
Customer Groups: cadastral data exchange



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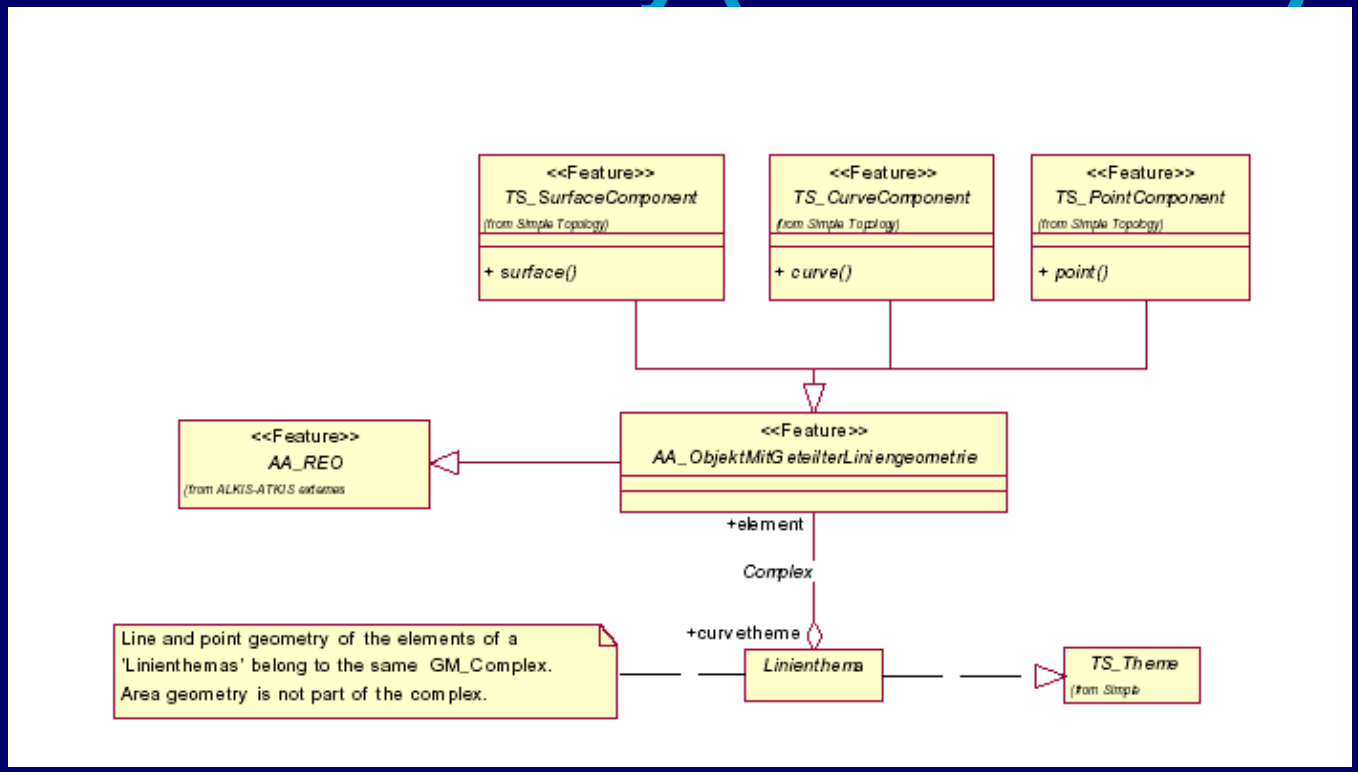
Some other (related) initiatives

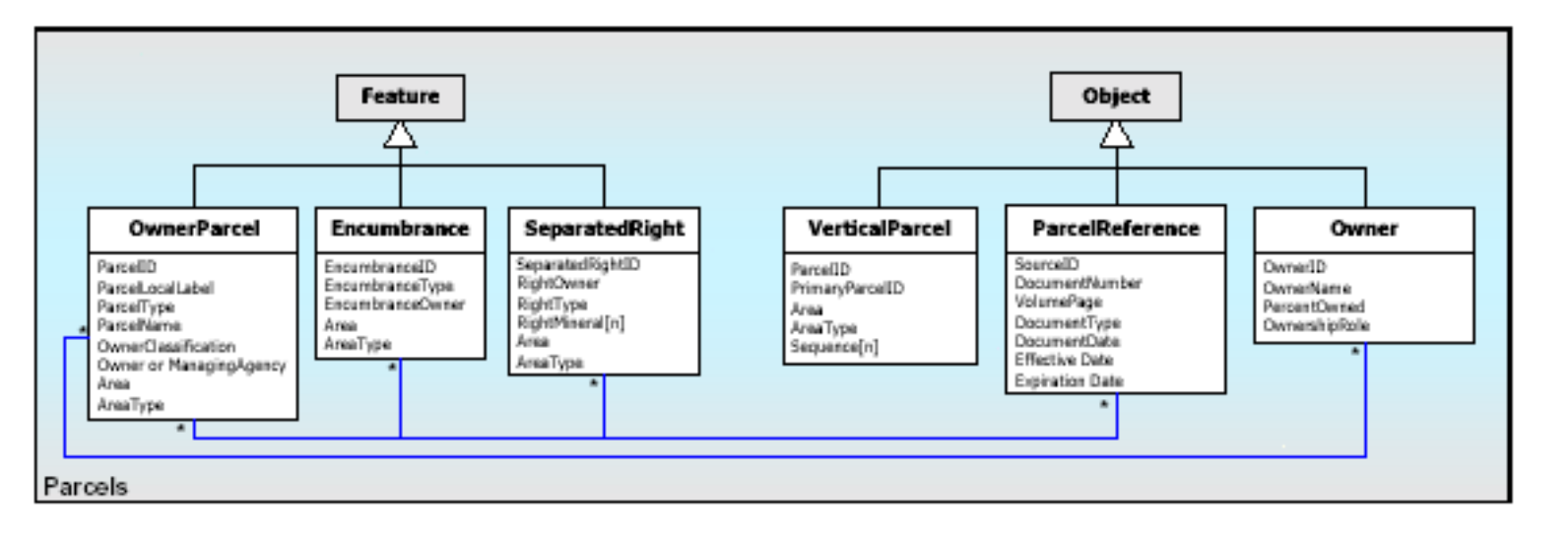
- ArcCadastre (Sweden)
- Intergraph
- Caris
- LandXML used Land*online* of the LINZ (New Zeeland)
- Australian ASDI ‘cadastral model’
- COST G9 ‘modeling real estate transactions’ (European research network)

Some other (related) initiatives: Modeling standards ISO in Germany (Seifert 2002)



Some other (related) initiatives: Modeling standards US NILS

- BLM & USDA Forrest service developed National Integrated Land System (NILS)



Based on ArcGIS Parcel Data Manager (von Meyer et al)

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Some other (related) initiatives: Modeling standards Sweden/EULIS

Initiative for EULIS (first admin data distr.):

- Landmäteriet, Sweden
- National Land Survey, Finland
- HM Land Registry, (for England, Wales)
- Registers of Scotland
- State Land Cadastre (Lituania)
- Kadaster, the Netherlands
- Ministry of Justice, Austria
- Norsk Eiendominformasion, Norway
- University of Lund, Sweden

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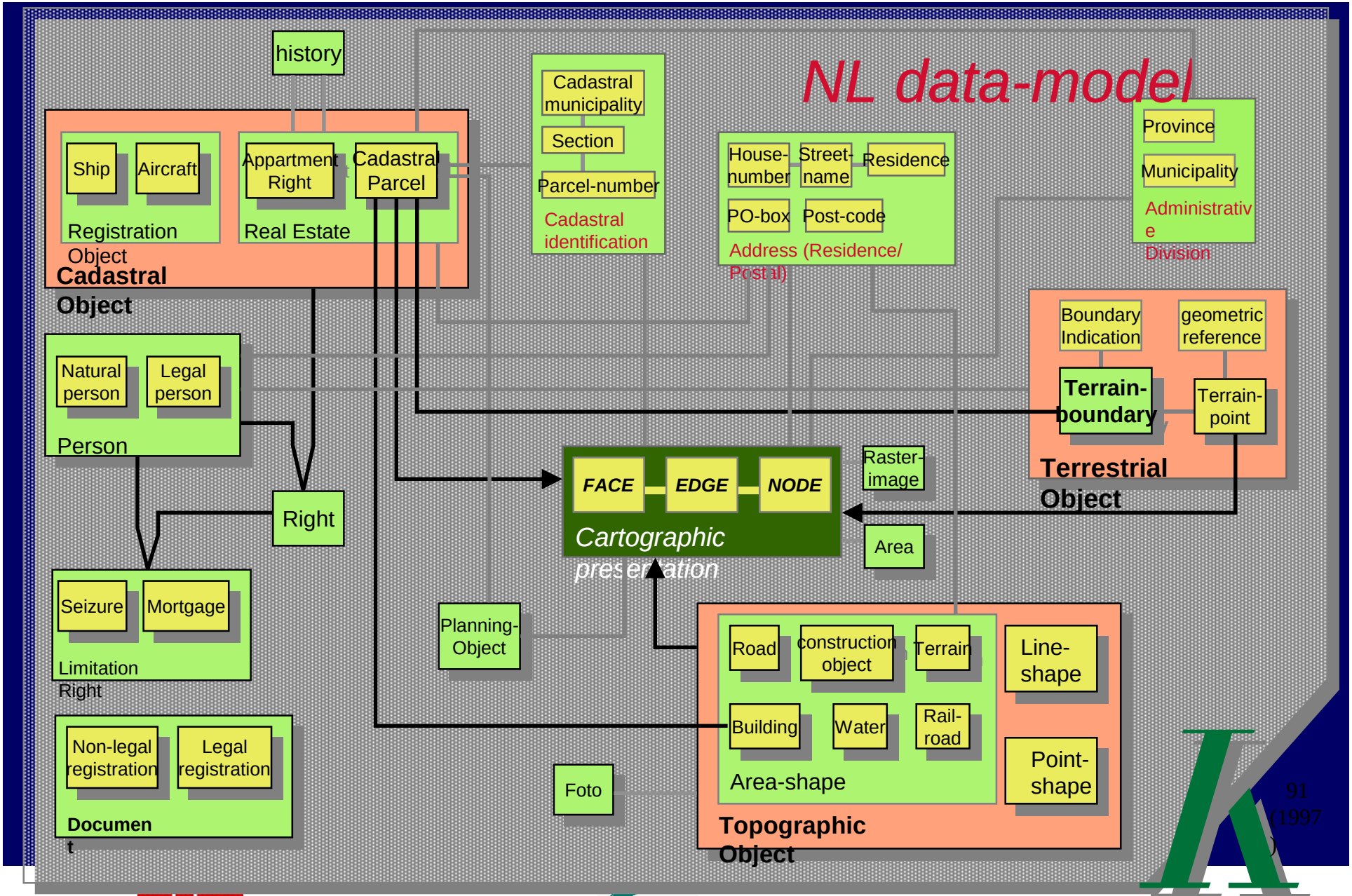
NL data-model
history
Cadastral municipality
Section
Parcel-number
Cadastral identification
Province
Municipality
Administrative Division
House-number
Street-name
Residence
PO-box
Post-code
Address (Residence/ Postal)
Ship
Aircraft
Registration Object
Appartment Right
Cadastral Parcel
Real Estate
Cadastral Object
Boundary Indication
geometric reference
Terrain-boundary
Terrain-point
Terrestrial Object
Natural person
Legal person
Person
Right
FACE
EDGE
NODE
Cartographic presentation
Raster-image
Area
Seizure
Mortgage
Limitation Right
Planning-Object
Road
construction object
Terrain
Line-shape
Building
Water
Rail-road
Point-shape
Area-shape
Topographic Object
Non-legal registration
Legal registration
Document
Foto
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(1997
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Bagdonavicius
Kasperavicius
Lithuania

DATA CONTENTS OF THE REAL PROPERTY REGISTER

Immovable items:
- **land plots;**
- **constructions;**
- **flats in multi-flat houses;**
- **premises.**

Real rights in immovable items and data about the holders of these rights

Legal facts related to immovable items, real rights in them and restrictions on these rights

Cadastral data about immovable item

Map of the Real Property Register

- **ü Data identifying a property object;**
- **ü Qualitative and quantitative characteristic of property object;**
- **ü Main objective purpose of use;**
- **ü Other.**

Graphical data about the boundaries of a registered immovable item, its location and position in the national co-ordinate system

- **ü Ownership right;**
- **ü Right of entrust;**
- **ü Right of possession;**
- **ü Servitude;**
- **ü Usufruct;**
- **ü Right to build-up;**
- **ü Long-term lease;**
- **ü Lien;**
- **ü Mortgage;**
- **ü Other real rights.**

- **ü First and family name of a physical person;**
- **ü Personal code;**
- **ü Name of a legal entity, its code;**
- **ü Address;**

- **ü Sale-purchase contract**
- **ü Contract on exchange;**
- **ü Contract of gift;**
- **ü Contract of lease;**
- **ü Contract of enjoyment;**
- **ü Contract of rent;**
- **ü Other legal facts.**

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Agenda

- Introduction
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- Generic Cadastral Domain Model
- Conclusions

Basic datamodel

1. Parcel
2. Apartment
3. Building
4. Spatial Unit

One Point
Lines
Polygon (low accuracy)
Polygon (high accuracy)

Qualilty labels

1. Formal Ownership
2. Customary
3. Indigenous
4. Tenancy
5. Starter, landhold, freehold
6. Possession
7. Mortgage
8. Usufruct
9. Long Lease
10. Restriction Type 1
11. Restriction Type 2
12. State
13. Informal
14. Unknown
15. Disagreement
16. Occupation
17. Uncontrolled privatisation
18. **Conflict**

Overlap

1. Natural Person
2. Company
3. Municipality
4. Co-operation
5. Group
6. Ministry

Biometric identification

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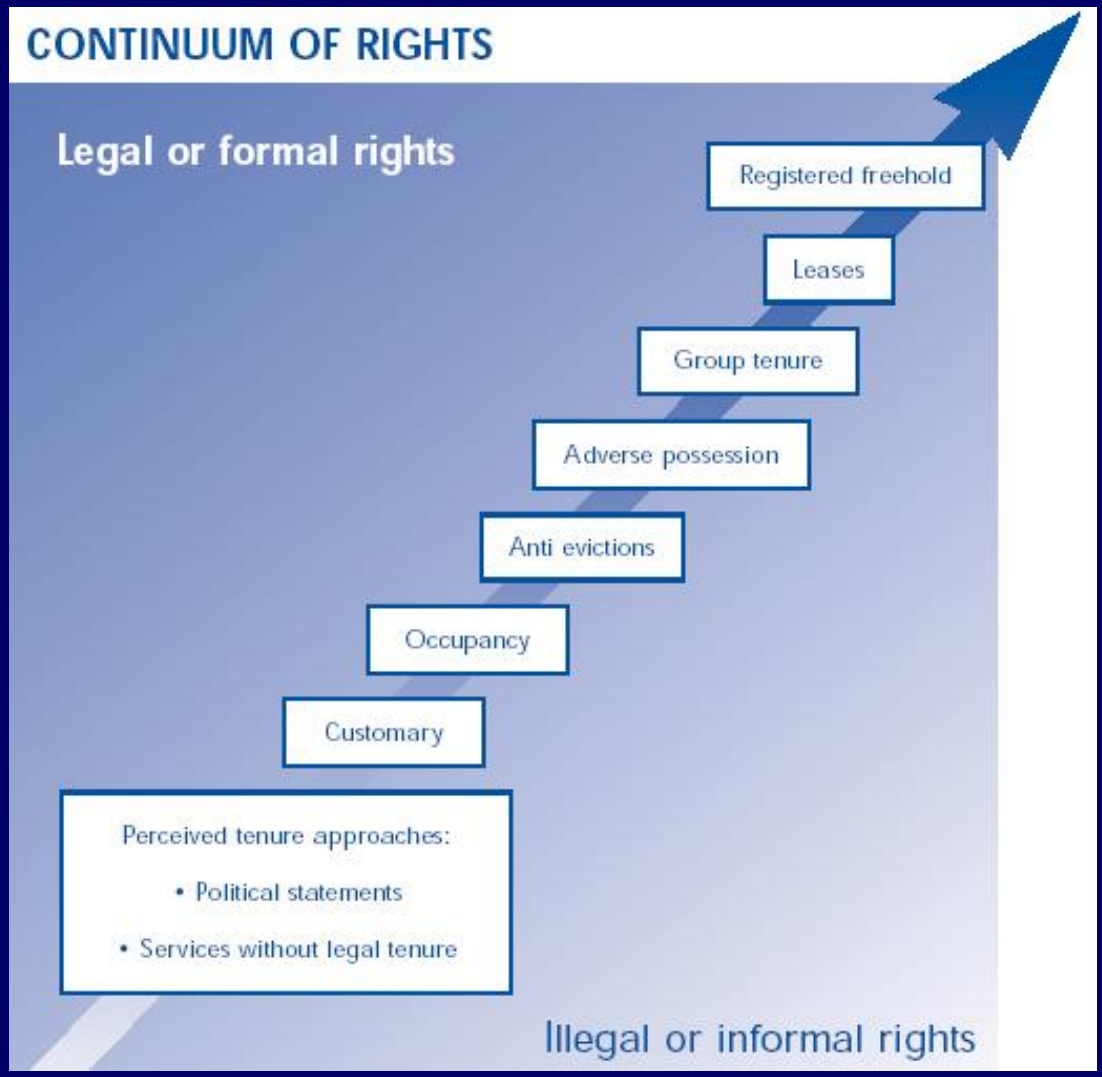

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Cadastral Data

- object (parcel, apartment, spatial unit)
- right (ownership (..,..,..), usufruct, mortgage, restriction, informal, unknown, conflict...)
- person (natural, non natural, group, group of groups)
- identifiers
- value
- Area (GIS area and legal area)
- classification
- geographic name
- person name
- date (birth, establishment, acceptance, transaction, survey, check-in)
- ranking order
- source document
- forms
- point
- boundary
- face, edge, node: topology
- GIS Layers
- apartment - 3d
- land use
- share
- transaction type
- purchase price
- history (check-in, check-out, mother-child, history class)
- right relation
- mortgage, interest

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Cadastral Update Process Data

- Transactions
- Customers request (application)
- Quality (accuracy, reliability, collection mode)
- Name of Conveyor, Surveyor, etc
- Signature
- Process step
- Archive data in use
- Next open identifier
- Type of instrument
- Distance in km
- Letters to buyer and seller
- Car in use, fuel
- Date and time
- Site
- Buyer/seller do not agree
- Authorisation
- Computer availability
- Topological erros
- Production norm
- Time regsitration
- Objection, complaint
- Salary scale
- Team
- Teammembers
- Responsible manager
- Status code
- Out of tolerance
- Line code
- Point code
- Transformation parameters
- Historical data used
- Cluster identifier
- IT Support

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Proposal (FIG Washington 2002)

- Develop standard Core Cadastral Domain Model, including:
  - Spatial part (geometry, topology)
  - Extensible frame for legal/admin part
  - Based on core object-right-subject model
- Object-orientation **à** express in UML
- Accepted by large community: FIG, OGC, ISO, user support, this means it can be **adapted by the industry**
- Maximize co-operation, minimize double effort

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Core Cadastral Domain Model - history

- FIG April 2002, Washington, proposal by Lemmen/ van Oosterom: Core Cadastral Domain Model
- Now part of FIG working plan 2002-2006
- Several versions produced: OGC TC Noordwijk, sept'02; FIG WW Paris, apr'03; Digital Earth Brno, sept'03; FIG WW Cairo, apr'05
- 2 FIG workshops: Enschede, mar'03; Bamberg, dec'04
- Involved organizations: FIG, EU COST G9, OGC, ISO
- FIG October 2006, Munich: version 1...

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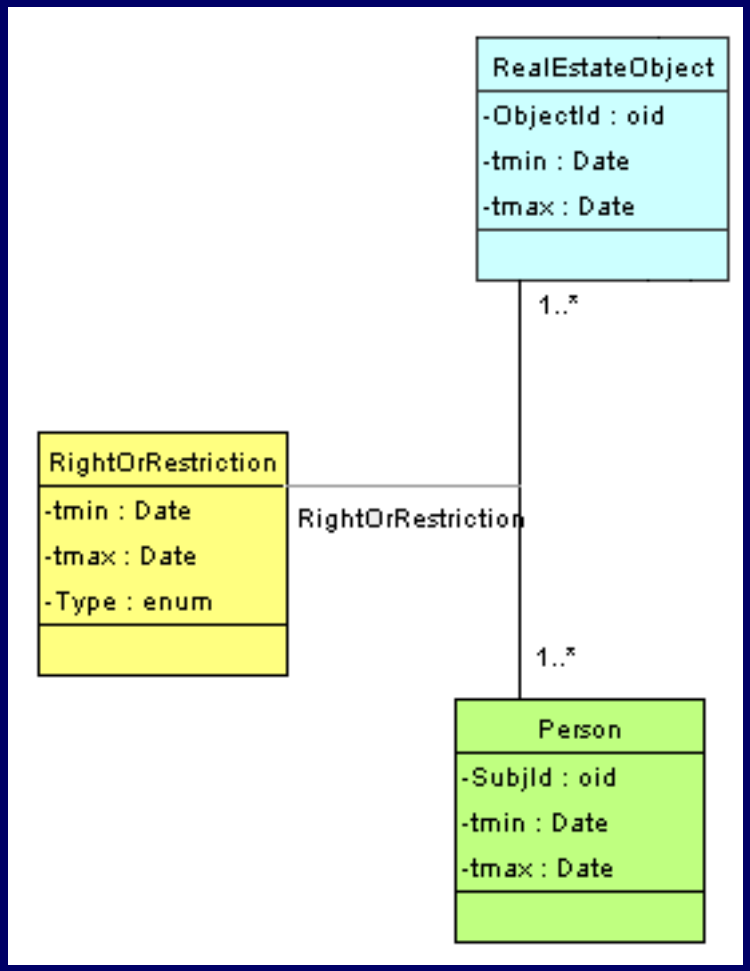
Model basis: Object-Right-Subject



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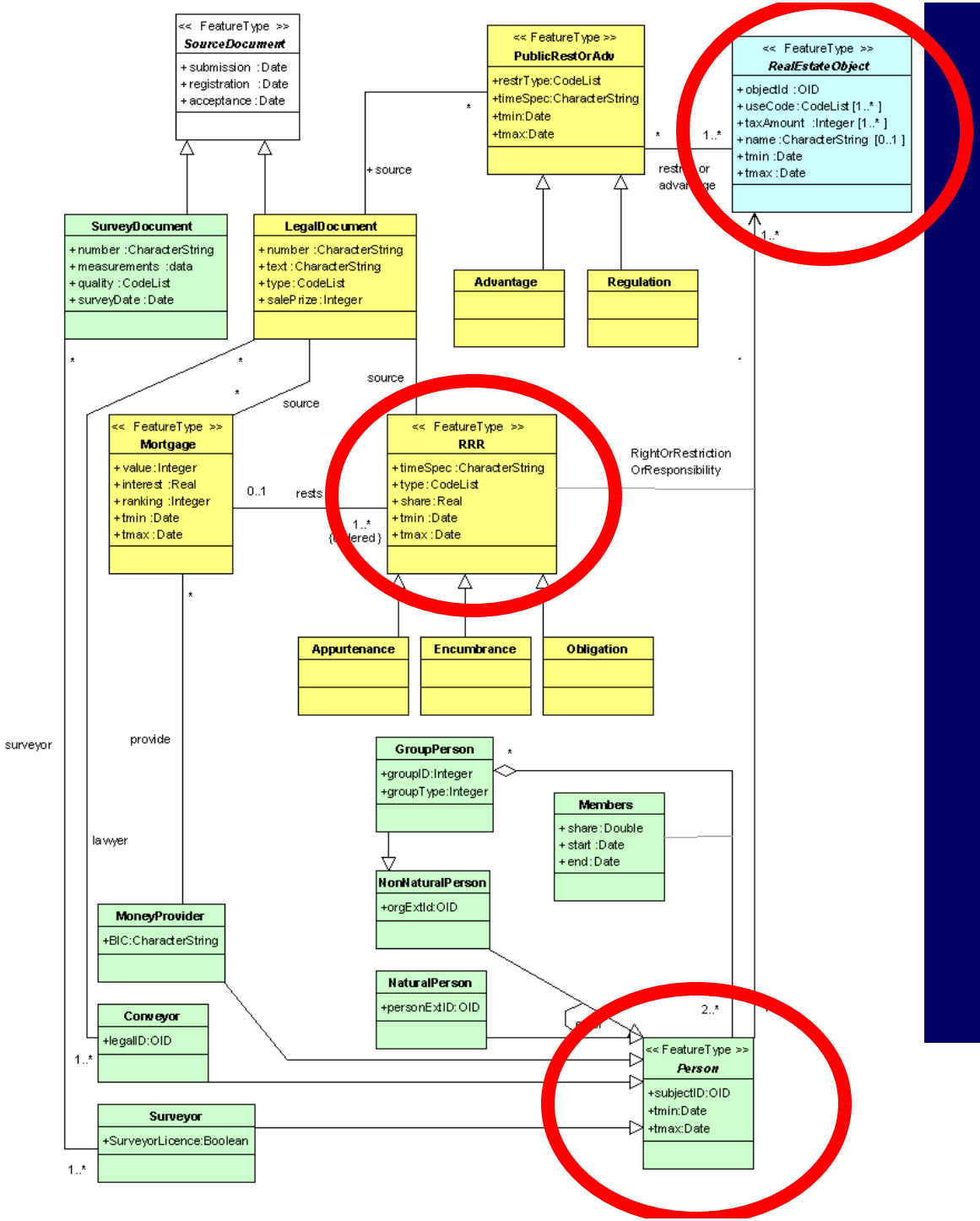
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+registration :Date
+acceptance :Date
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+restrType:CodeList
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+tmin:Date
+tmax:Date
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+objectId :OID
+useCode :CodeList [1..*]
+taxAmount :Integer [1..*]
+name :CharacterString [0..1]
+tmin :Date
+tmax :Date
+ source
SurveyDocument
+number :CharacterString
+measurements :data
+quality :CodeList
+surveyDate :Date
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+ranking :Integer
+tmin :Date
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+timeSpec :CharacterString
+type :CodeList
+share :Real
+tmin :Date
+tmax :Date
RightOrRestriction
OrResponsibility
Appurtenance
Encumbrance
Obligation
surveyor
provide
lawyer
GroupPerson
+groupID:Integer
+groupType:Integer
Members
+share :Double
+start :Date
+end :Date
NonNaturalPerson
+orgExtId:OID
MoneyProvider
+BIC:CharacterString
NaturalPerson
+personExtID:OID
Conveyor
+legalID:OID
<< FeatureType >>
Person
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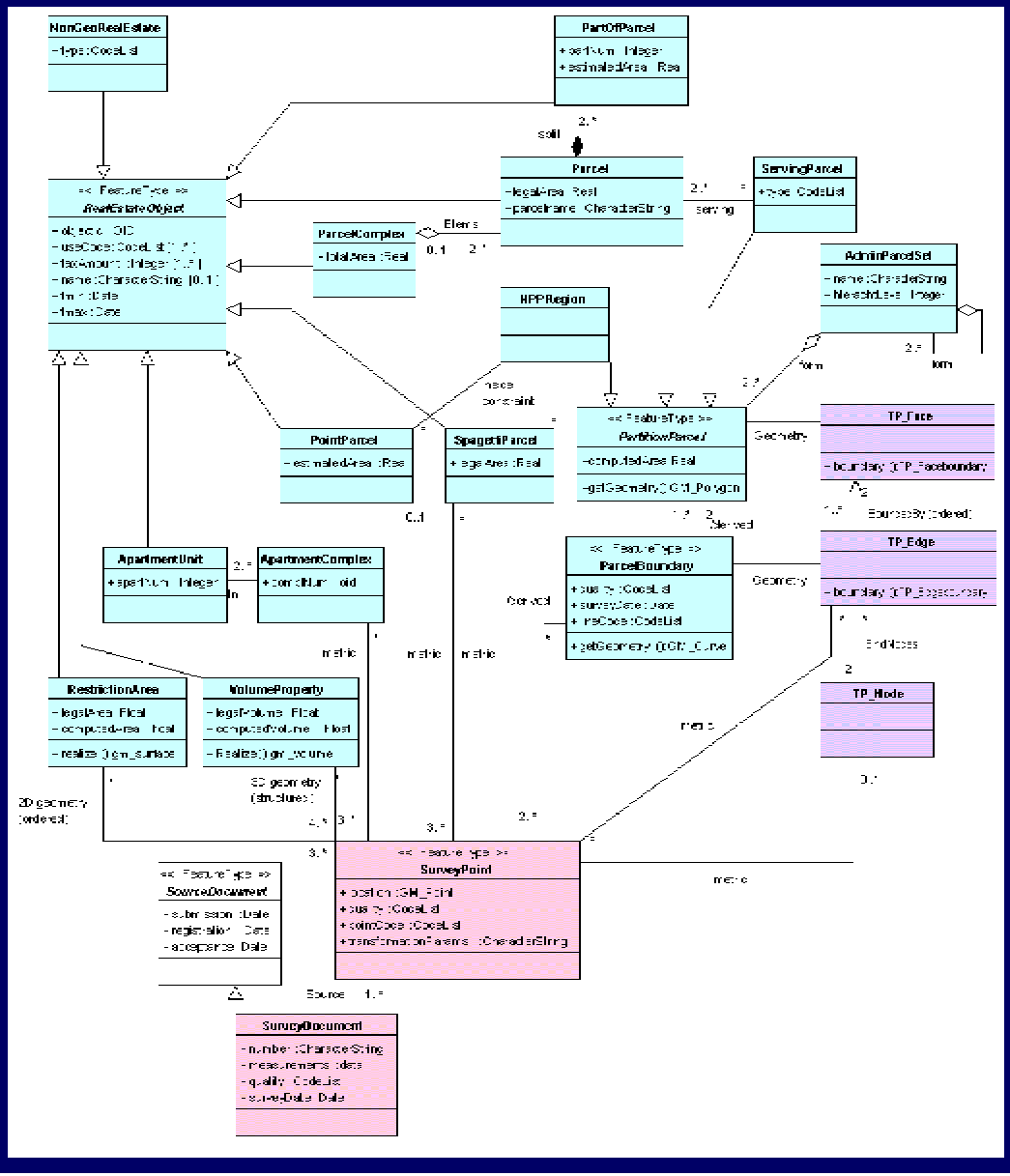
+tmin:Date
+tmax:Date
Surveyor
+SurveyorLicence:Boolean



Core Cadastral Domain Model: Geometry

- Real estate object with specialisations, e.g. parcel, parcel-complex, volume property, restriction area, point parcel, apartment unit, based on topological structure or not
- Agregations like parcels set, parcel complex, apartment complex
- Link to surveying and survey documentation
- Link to OGC standards (Nodes, Edges and Faces)

Core Cadastral Domain Model: Legal-administrative

- RRR is an association class between Person and RealEstateObject
- Mortgage, restriction and RRR are based on legal documents or decisions
- Person are specialised as natural or non natural
- Surveyor, conveyor and money provider are included, specialisations of the Persons class
- A RRR can be temporal

FIG Cadastre 2014 (Kaufmann, Steudler)

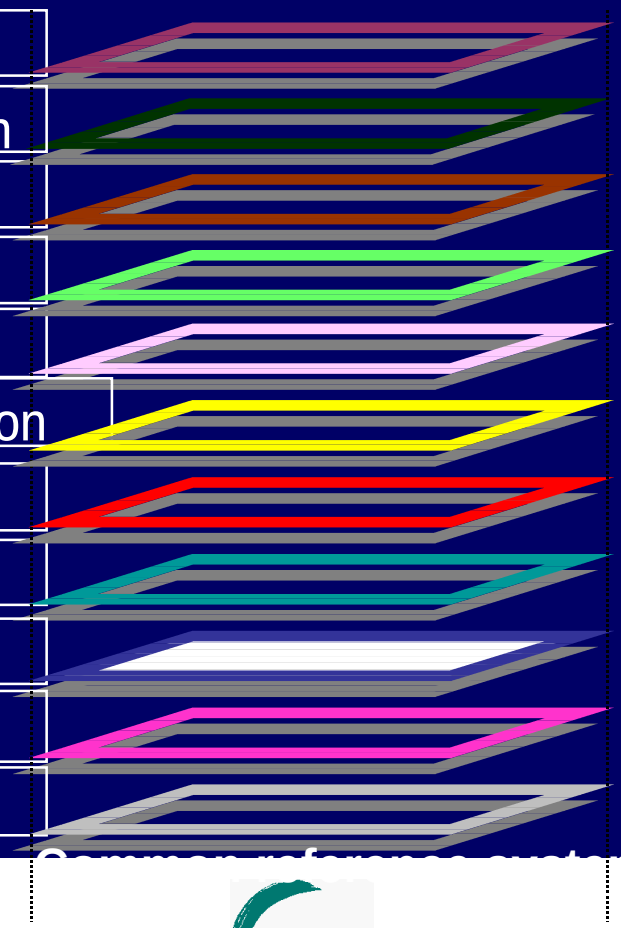
Legal Topics:	Land Object Boundaries:	Rightful Claimants:
.....		.....
Resource Exploitation		Chartered company
Collective Rights		Corporation
Water Protection		Society
Indigenous Rights		Tribe, Clan
Environment Protection		Society
Land Use Planning		Society
Land Property		Private Land Owners
Shelter and Housing		House owners
Natural Resources		Society
Natural Land Objects		Society
Common reference system		

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FIG Cadastre 2014 approach is integrated

- Cadastre 2014 is a generic, very good, abstract set of guidelines (compare to ISO standard, or OGC abstract specification)
- CCDM is refined into a more specific model using UML (compare OGC implementation specification)
- CCDM is based on OGC and ISO TC211 standards
- CCDM will enable interoperable implementations and provide foundation for database structure (DBMS DDL/SQL), information exchange format (XML/GML)

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Boundary of the system – outside (in this moment):

- Geology, geo-technical, soil
- Pipelines and cables
- Polluted area registers
- Mining right registers
- Cultural history
- (Religious) monuments
- Ship/airplane (car) registers
- ...

Aspects not yet covered

- Processes: how to maintain consistency between two related distributed systems in case of updates: the cadastral production process depends on availability and quality of data at remote servers (e.g. Persons in population database)
- Catalogues with 'types of right‘ (per country?)
- Further modelling of cadastral survey
- Inclusion of a range of spatial units
- Generation of a full XML/GML schema
- Test with real data, in EULIS context
- Harmonise with other domain models, e.g. Topography, Water, Utility Networks

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Conclusion

- Current proposal is under development, workshops, reviews, etc
- More attention to process side (in addition to data side)
- Not only the model itself is important, but the fact that there is consensus (also important role of industry)

Thank you

- www.fig.net
- www.oicrf.org
- www.gdmc.nl

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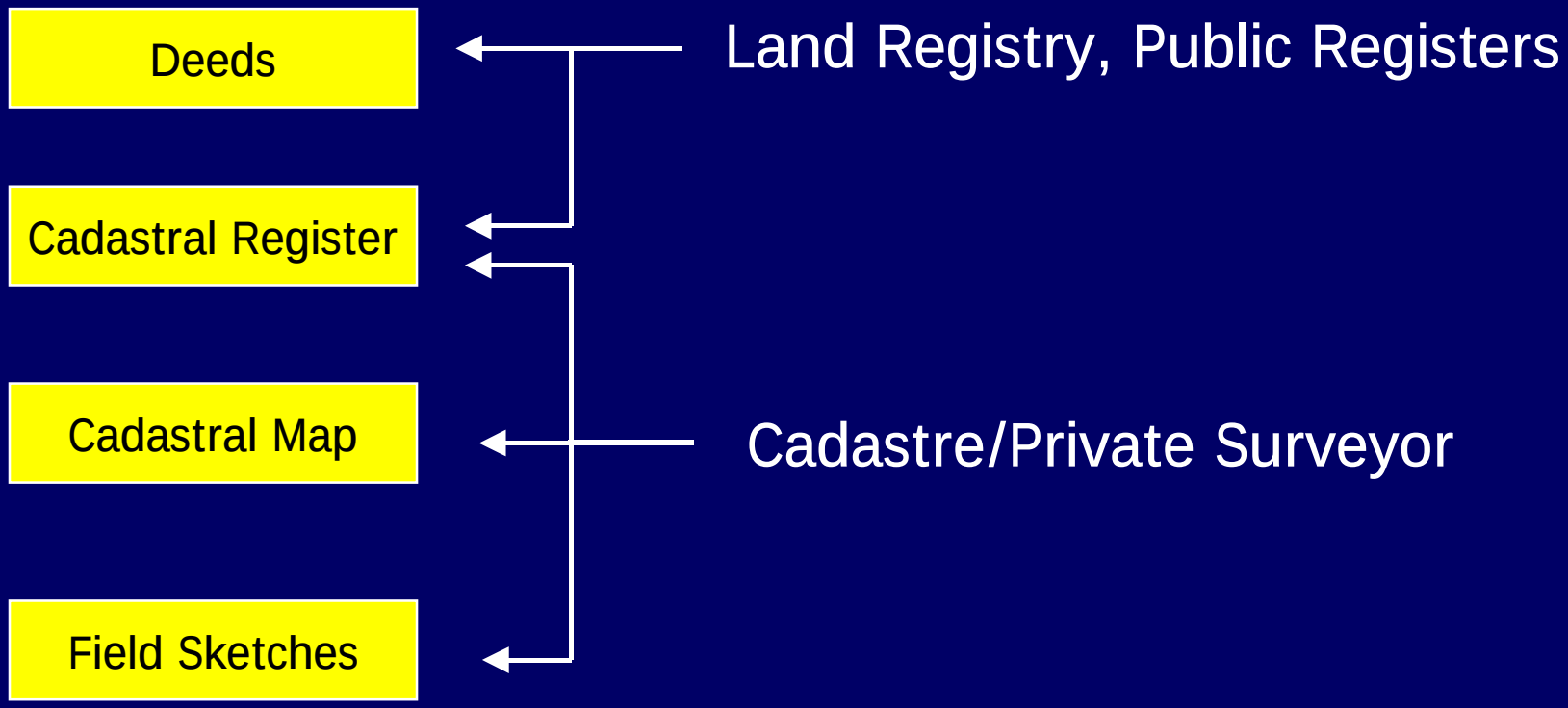
Model independent of organisation, examples of actual registrations



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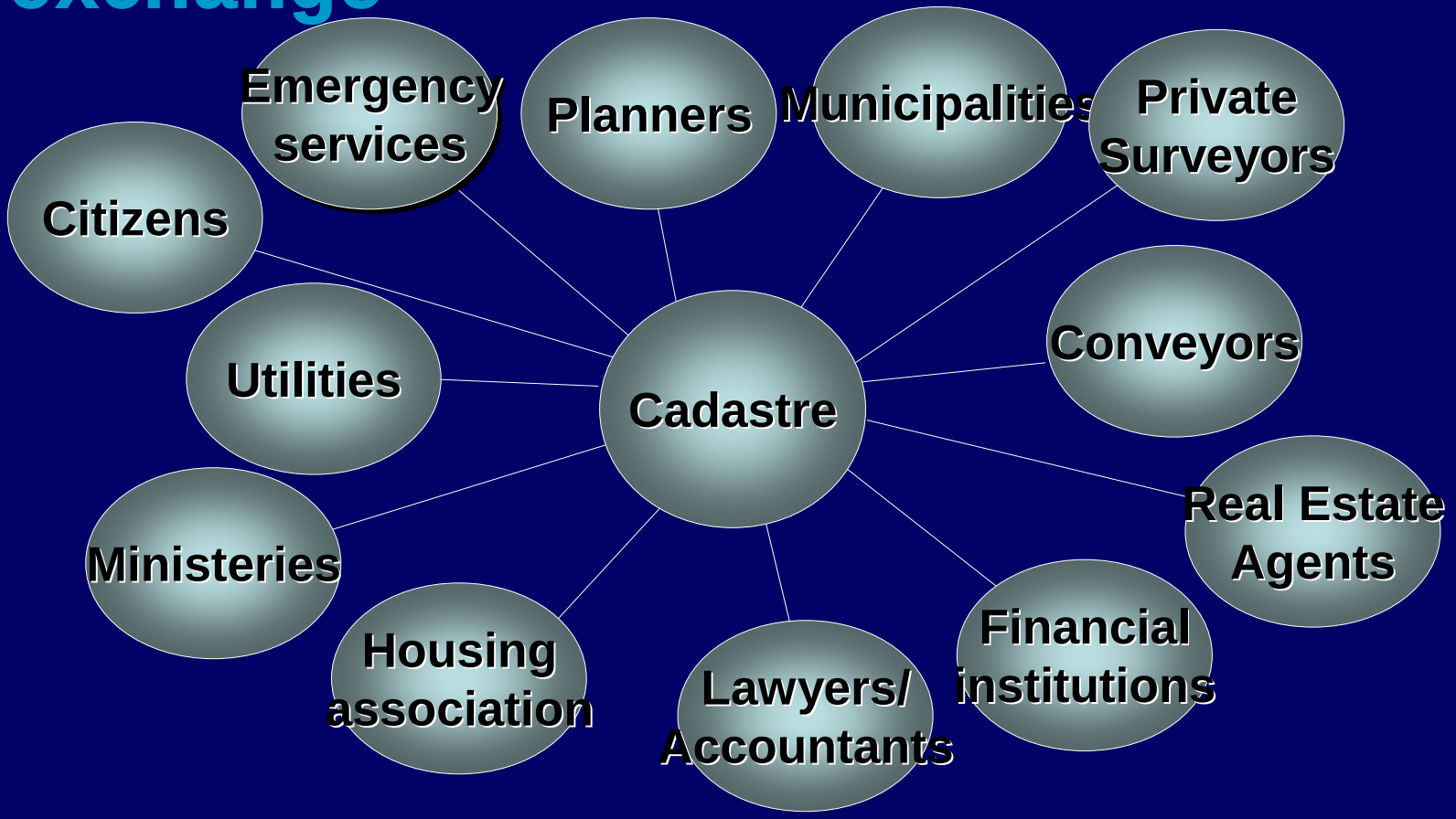
Customer Groups: cadastral data exchange



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History and dynamic aspects, data

- Two modeling approaches for discrete changes:
  1. Event based modeling: transactions as entity, start state is know, changes are known
  2. State based modeling: states are modeled explicitly, objects have 2 dates (begin/end)
- In our model hybrid approach: documents represent the transactions, but also all the states are kept
- tmin/tmax attributes inherited from root objects
- No explicit parent-child relationships (lineage), implicit

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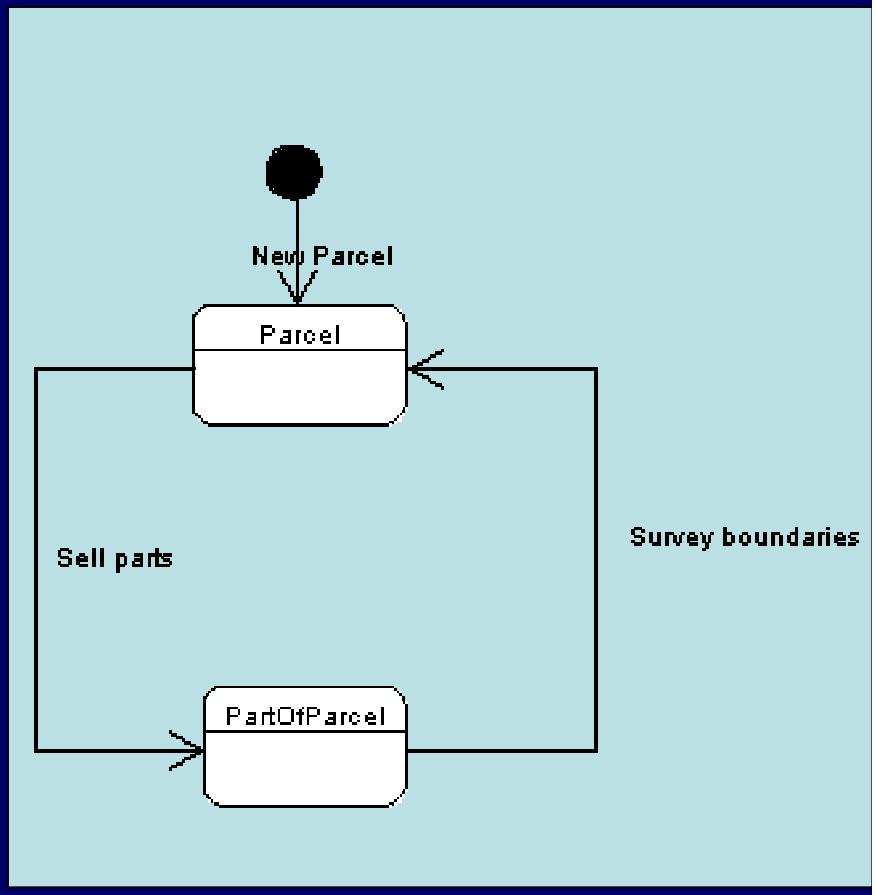
History and dynamic aspects, processes

- Other type of UML diagram used to model the processes (e.g. use case, sequence, collaboration, state or activity diagrams).
- Example of splitting a parcel described in a state diagram



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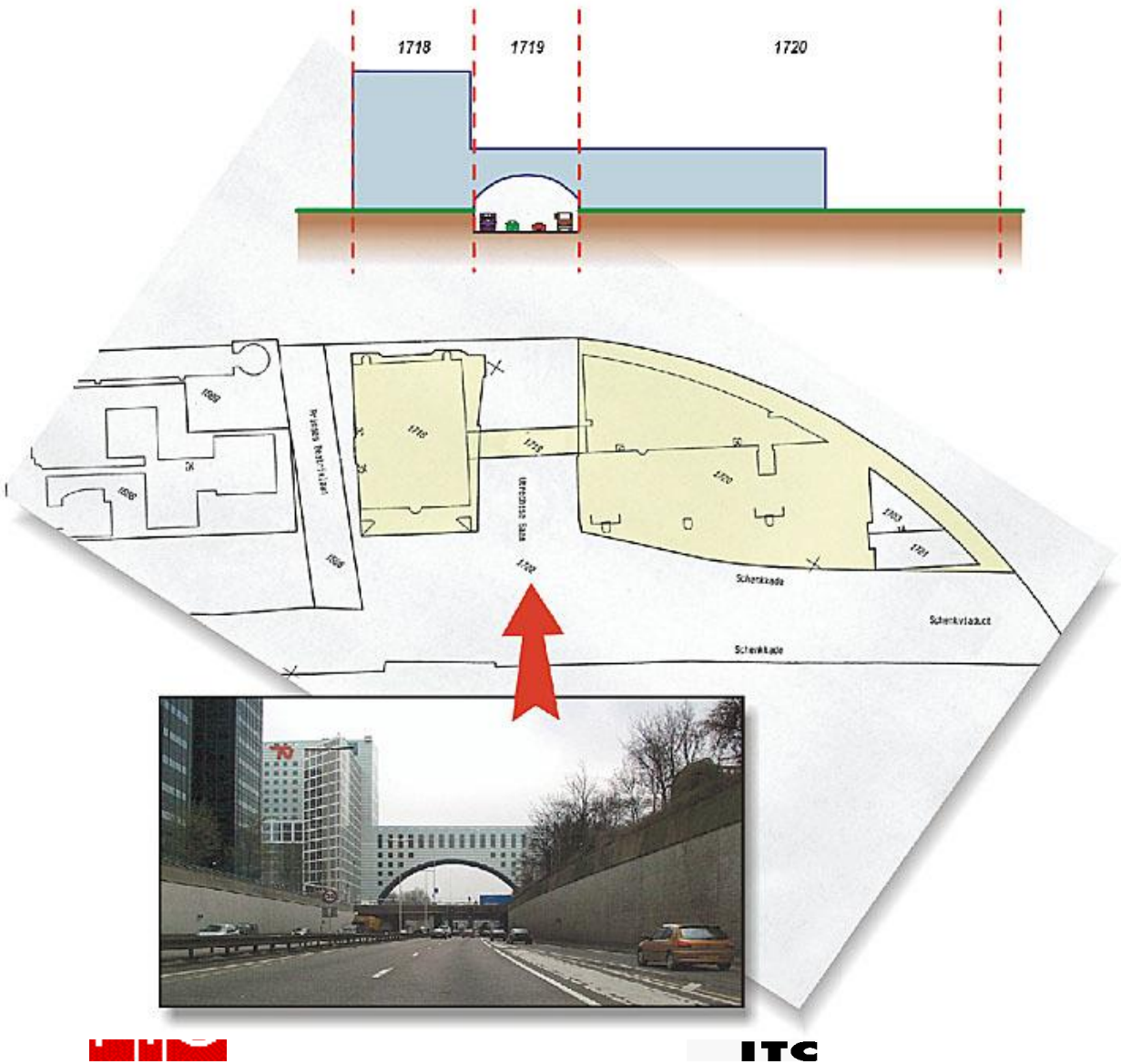
3D example in NL, current ‘solution’



3D Parcel of one building is subdivided into 3 parts with different admin tags

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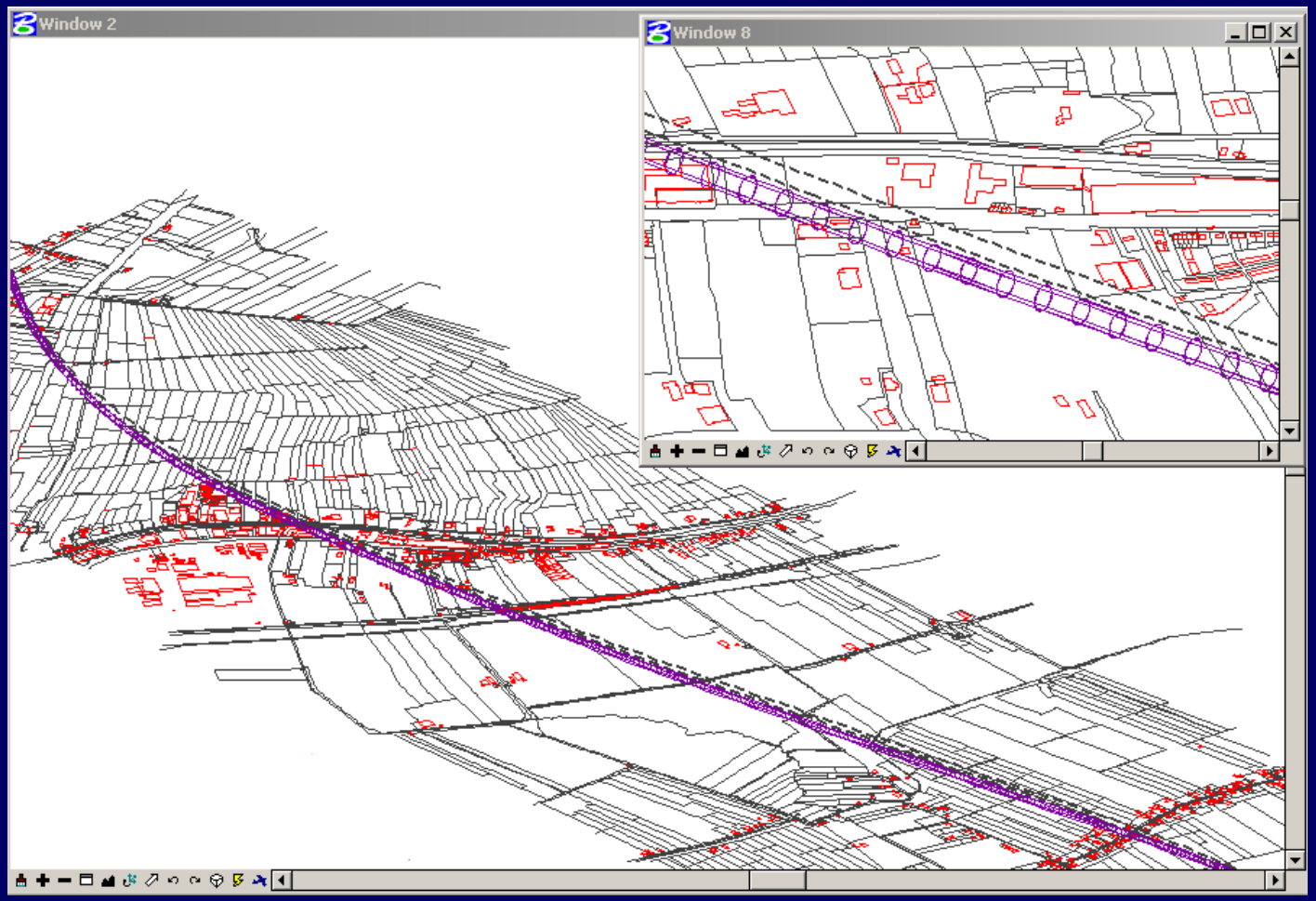
Registration of 3D object (tunnel)



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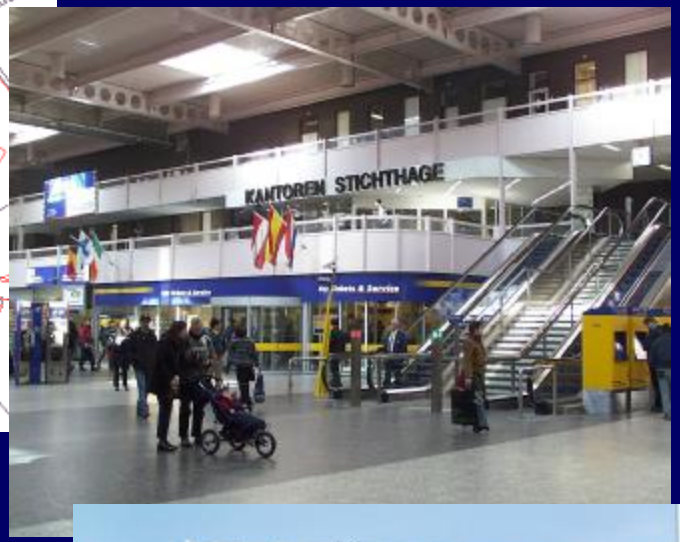
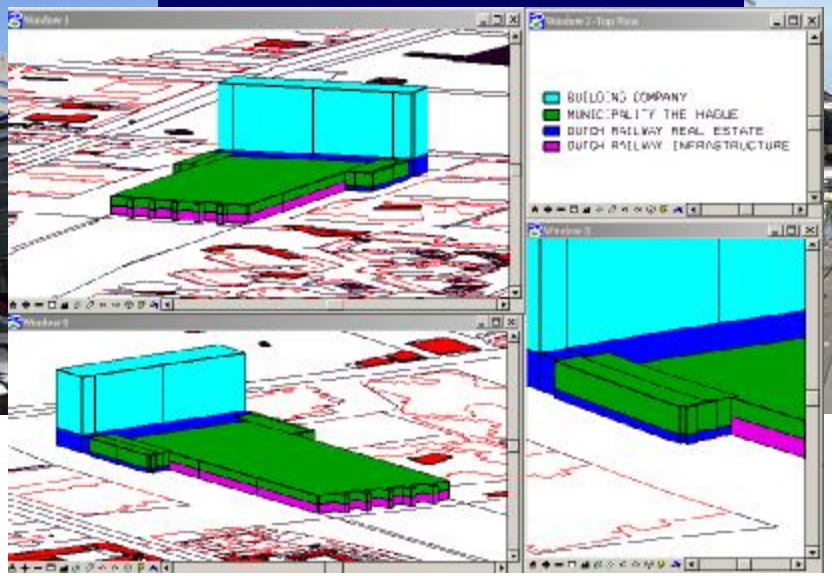
Another 3D factual situation (NL)





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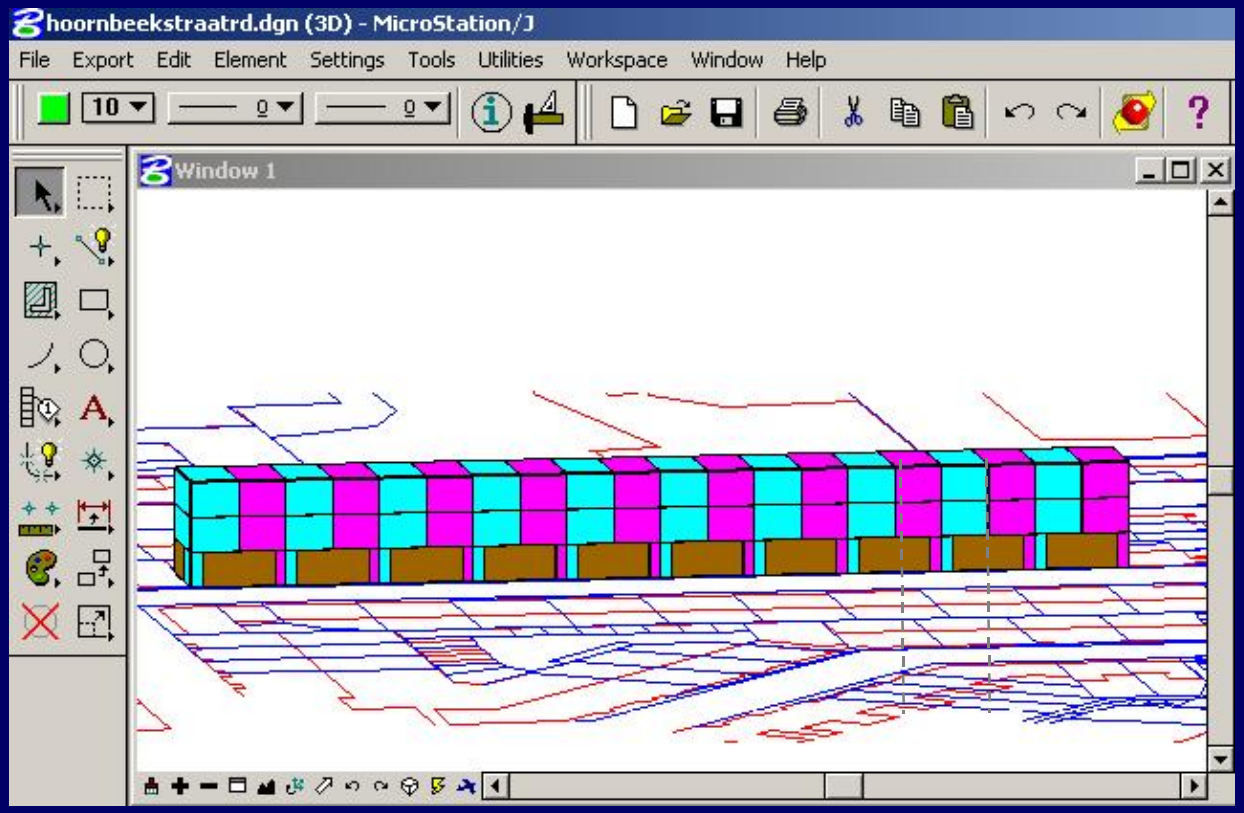
3D apartement complex on 2D parcels



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