Prof. Erik Stubkjær
Aalborg University, Denmark
est@land.aau.dk

# A Theoretical Basis for Cadastral Development

Lectured 2.-4. December 2008 in the context of
The Master's Programme in Land Management, Unit for Real Estate Planning and Land Law,
The Royal Institute of Technology, Stockholm, Sweden

# Cadastre as a SDI - supporting property rights (2/3)

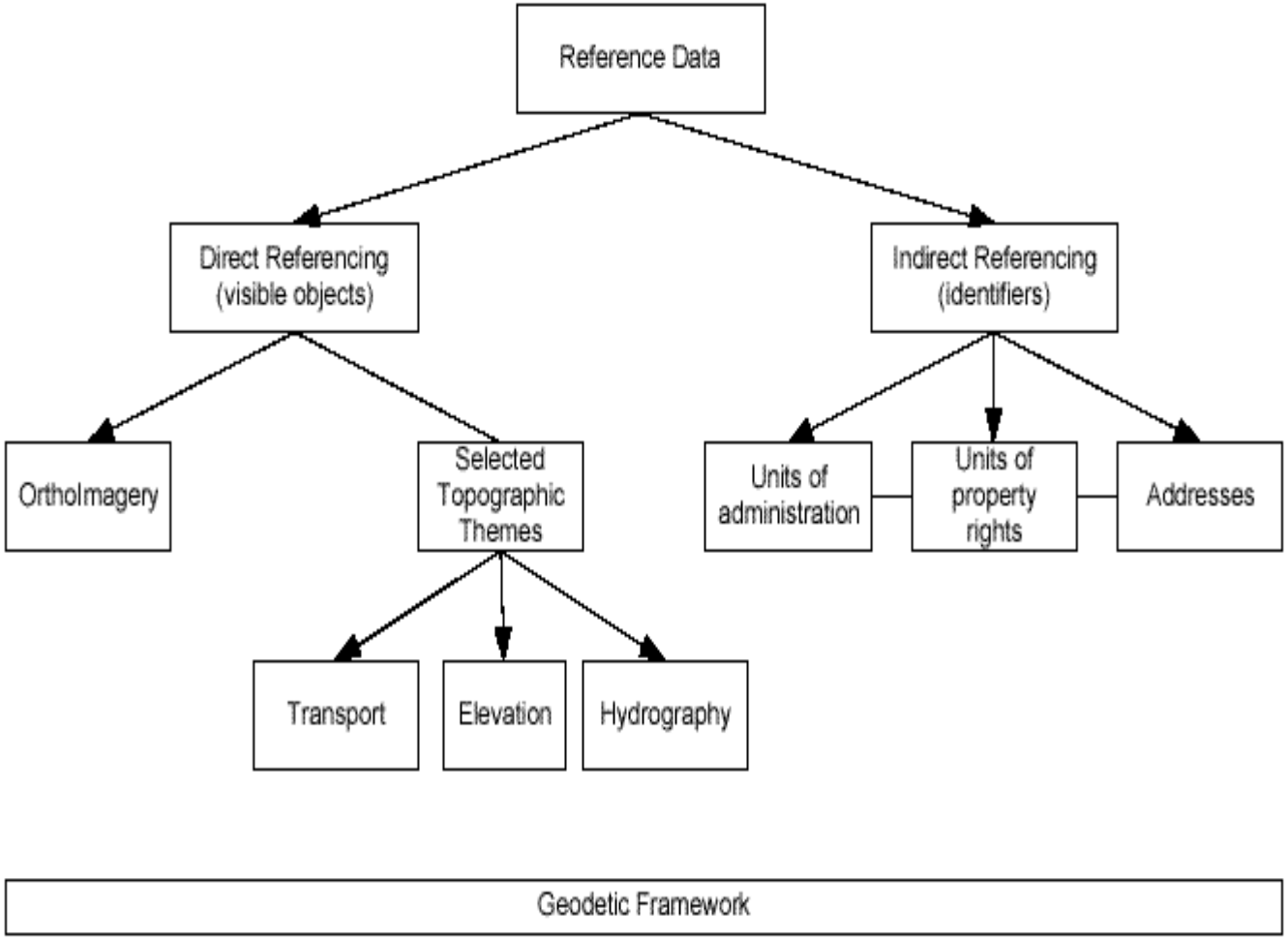
1. Cadastre among other Spatial Data Infrastructures, SDIs
    - Spatial data categories; socio-economic units
    - Territorial units of a country; jurisdictions
    - Post addresses and spatial reference frames
2. Public information services - flow of information
    - Transactions on rights in land: subdivision, sale, building permit. De Soto on procedures.
3. Real property rights (RPR) and the cadastral infrastructure
    - Physical, legal and economic aspects of RPR
    - Societal functions of the cadastral and wider system
4. Institution, organisation, and change
    - Organisations: Structure, types, components (Leavitt)
    - Institutional change: Parliament and government (hierarchy) and Policy networks

# Data categories as 'reference' for more specialized data

| **Visible objects** (direct referencing) | **Socio-economic units and identifiers** |
|---|---|
| OrtoImagery ('Landscape')<br>Selected topographic themes:<br>• Transport<br>• Elevation<br>• Hydrography | • Units of administration<br>• Units of property rights<br>• Addresses (place names, postcodes) |
| Geodetic framework | |

Source: ETeMII Reference Data White paper, Version 1.0, 31. July 2001, p 9 (Format modified)

# Categories of spatial/ geographical data




EU ETeMII White Paper, 2001.

# Information i ETeMII White Paper, Annex C:

| Geodata groups and their relative economic weight | |
|---|---|
| **Visible objects: 33%** | **Socio-economic Units: 29%** |
| Selected topographical themes:<br>• Transport: 5<br>• Elevation: 7<br>• Hydrography: 5<br>• Other environmental: 16 | • Units of administration: 2<br>• Units of property rights: 27<br>• Addresses: ? |
| Geodetic framework: 4; Utilities 19; Maritime navigation: 15; | |

Source: ANZLIC Benefit Study, 1995, as quoted by ETeMII, 2001, Annex C

Available information suggests priority of property data

# Danish territorial units, as of 1990s

| Number of units | Name of unit<br>*Jurisdictions*<br>*Districts* | Map scale |
|---|---|---|
| $10^2$ | Diocese (7), County (14) | 1:100.000 |
| | Municipality (276) | |
| $10^3$ | Parish (~1200)<br>(Settlement) | 1:25.000 |
| $10^4$ | Township (~12.000)<br>(Municipal planning districts)<br>1 square kilometre (44.000) | |
| $10^5$ | Address codes<br>in population NIS (~120.000) | 1:15.000 |
| $10^6$ | Property units<br>(Estate units, dwellings, etc. ~2 mio) | 1:4.000<br>1:2.000 |

# Information communities and categories of territorial units

| Information community | Territorial categories | Example |
|---|---|---|
| Princes, rulers, owners | Jurisdiction | Nation<br>Unit of real estate |
| Inhabitants | Place | Square, town, recidence |
| Geographer, scientist | Region | Unit for scientific analysis |
| Planner (logistics) | District (zone) | Solving adm. tasks |

**Stubkjær (2001)** Spatial, Socio-economic Units and Societal Needs - Danish Experiences ... Pp 265-279. In: Frank, A U; Raper, J; Cheylan, JP (Eds): Life and Motion of Socio-Economic Units. GISDATA Series, no. 8, London.

# Geogr. units of the Danish Building and Dwelling Info. Sys.

- Estate unit: Data on water, sewers, heating; ownership
- Building unit: Data on walls, roof, floors, area
- Dwelling (flat, rented unit): Data on kitchen, wc, bath, area

**Identification scheme (planned):**

- Estate unit: Number within municipality (property tax number)
- Building: Number within estate unit + *post addresses for ALL buildings*
- Dwelling (flat, rented unit): Label with numbers on entrance door, numbering system decided by owner (Cadastral identifiers are plated in Copenhagen)

# Identification scheme: The solution:

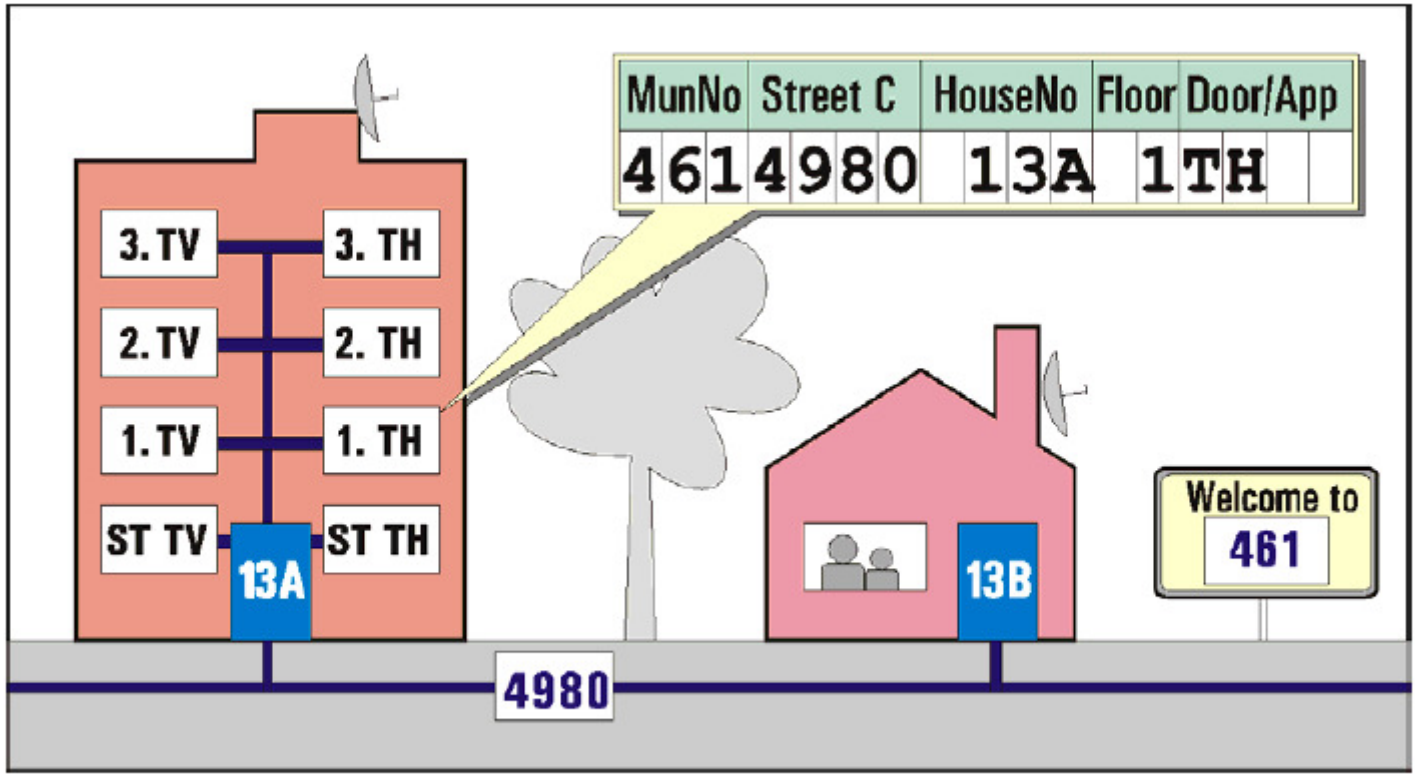



*Figure 1-2: The "architecture" of the Danish address format*

Co-ordinates were not in focus; Location by ordinal, not metric system.

Morten Lind (2001) http://www.adresseprojekt.dk/files/Develop_PublicAddress_urisa2001e.pdf

# The identification of dwellings by means of post address

Danish identification scheme:

- Municipal number (815)
- Street code (8216, coding street name within municipality)
- Plated number on entrance door (post address, managed by municipality)
- Floor: Basement, ground floor, 1st, 2nd, ...*Standardization needed*
- Dwelling identification ('left', 'centerleft', 'centre', .. or number)
- "Orient yourself by standing on the last step before the landing"

Identification of geographical units without maps!  but how ?

# Theory - a. Stevens' scales of measurement

| Scale | Characteristics | Examples |
|---|---|---|
| Nominal | Discern: A != B, A = A Classification | Names, basic colors |
| Ordinal | Order: A > B, B > C<br>Boolean operations | Number sequences |
| Metric<br>(Interval and Ratio) | Units: meter, Joule,<br>Arithmetrical operations | Co-ordinates<br>Angels (directional differences) |

Stevens (1946) Scales of Measurement *Science* Vol. 103, pp. 677-680
Supplement by Chrismann N (1997) Exploring geographic information systems

# b. Einstein and bodies in motion, 1905

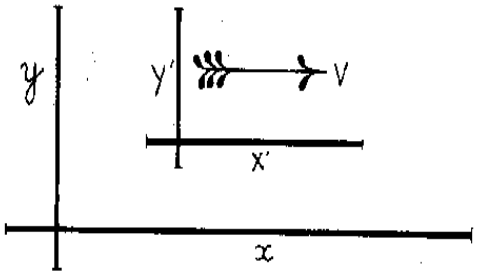
Thought experiment:
Two observers, one (1) in a moving train, other (2) on a nearby slope.
Light impulses emitted from centre of wan to open doors at both ends
Observer 1 (in train) sees doors open simultaneously
Observer 2 (on slope) sees rear door open first because of movement of train

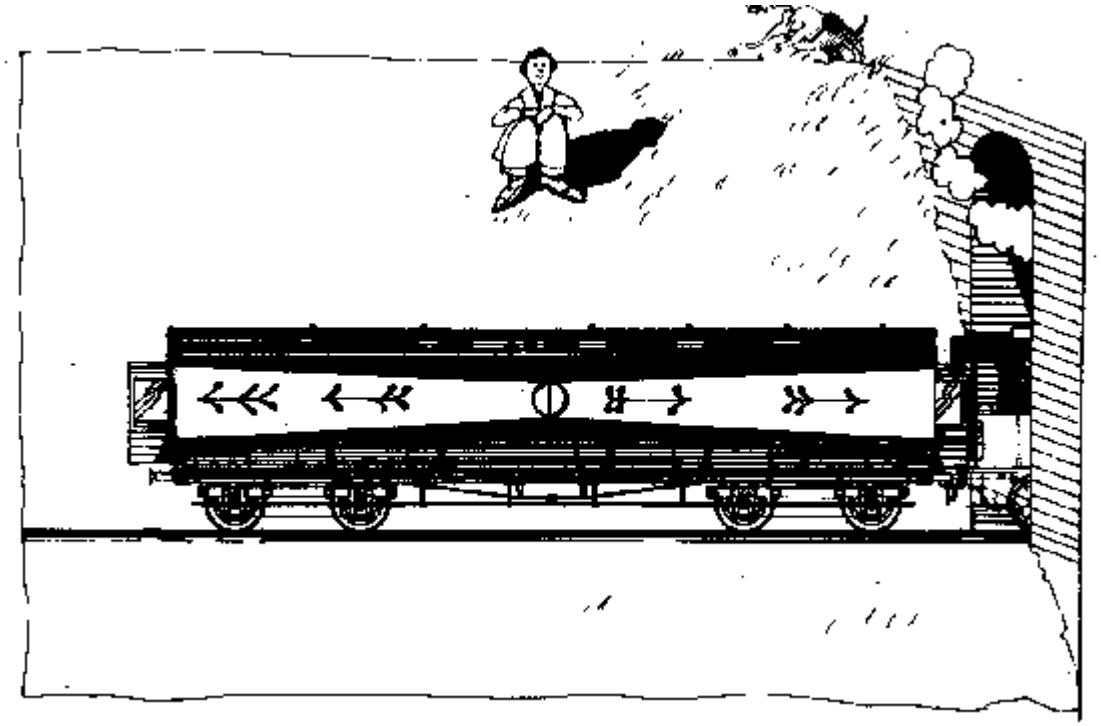
Important point: Concept of spatial reference frames used outside geodesy

Before that: The geodesists' co-ordinate systems

After that (Britting, K R (1971) Inertial navigation systems) 9 nine!

# b. Einstein and bodies in motion, 1905



# Turtle geometry: The reference frame moves with the body

Through education we (=geodetic surveyors) are familiar with analytical geometry, use Cartesian co-ordinate system, mathematical functions, etc.

An alternative is *turtle geometry* (Abelson & di Sessa, 1980):

Go forward 100 steps, turn right $90^{o}$, back 30 steps, etc.
Easier for children to learn (no abstact co-ordinate system).
Route directions (to cheap tomatos or advising tourists) are given in the same way.

The wise men of Mols (rural Denmark), using their boat as a reference frame

Abelson H & diSessa A: Turtle geometry - the computer as a medium for exploring mathematics. Cambridge, Mass., 1986.

# Spatial reference frames

- The geodesist's reference frames (co-ordinate systems)
- Einstein's generalisation
- Turtle geometry's and robots' 'moving' reference frame
- Gersmehl: Objects referenced by their enclosures
  e.g. 'KTH lies within Stockholm'

leads to: A *spatial reference frame* consists of

a mathematical construct related to a physical body

Stubkjær (1992) The development of nat.l,.. info. syst. *CEUS* 16(3)
Ph J Gersmehl (1996) The language of maps

# Interoperability

The aspects of interoperability identified as being in need of consideration by the European Interoperability Framework v.1.0 (EIF) are: Organisational, Semantic and Technical interoperability (EIF, section 2.1.2).

ORGANISATIONAL INTEROPERABILITY
..defining business goals, modelling business processes and bringing about the collaboration ... Moreover, .. aims at addressing the requirements of the user community

SEMANTIC INTEROPERABILITY
..ensuring that .. meaning of exchanged information is understandable ... enables systems to combine .. information ...and process it in a meaningful manner.

TECHNICAL INTEROPERABILITY
..the technical issues of linking computer systems and services. .. open interfaces, middleware, data presentation and exchange,.. and security services.

# Main public services to *citizens* in Europe:

1 Income taxes: declaration, notification of assessment
3 Social security contributions
4 Personal documents (passport and driving licence)
8 Public libraries (availability of catalogues, search tools)
9 Certificates (birth, marriage): request and delivery
10 Enrolment in higher education / university
12 Health related services

European Interoperability Framework v.1.0, 2004. page 17

-> A need for **a national person identification and information system**

# Main public services for *business*:

1 Social contribution for employees
2 Corporation tax: declaration, notification
3 VAT: declaration, notification
4 Registration of a new company [incl. power to sign for company]
5 Submission of data to statistical offices
6 Customs declarations
7 Environment-related permits (including reporting)
8 Public procurement

European Interoperability Framework v.1.0, 2004. page 17

-> A need for **a national company identifier and information system**

# Summary, regarding GIS / SDI

Public services for **citizens**:
1 [Property/ land] taxes: declaration, notification of assessment
6 Application for building permission
11 Announcement of moving (change of address)

Public services for **companies**:
5 Submission of data to statistical offices
7 Environment-related permits (including reporting)

ESt: Strangely, Land Registries were not mentioned (judicial, not adm.)
-> A need for **a national address coding and information system**

# Information systems are updated through data flows

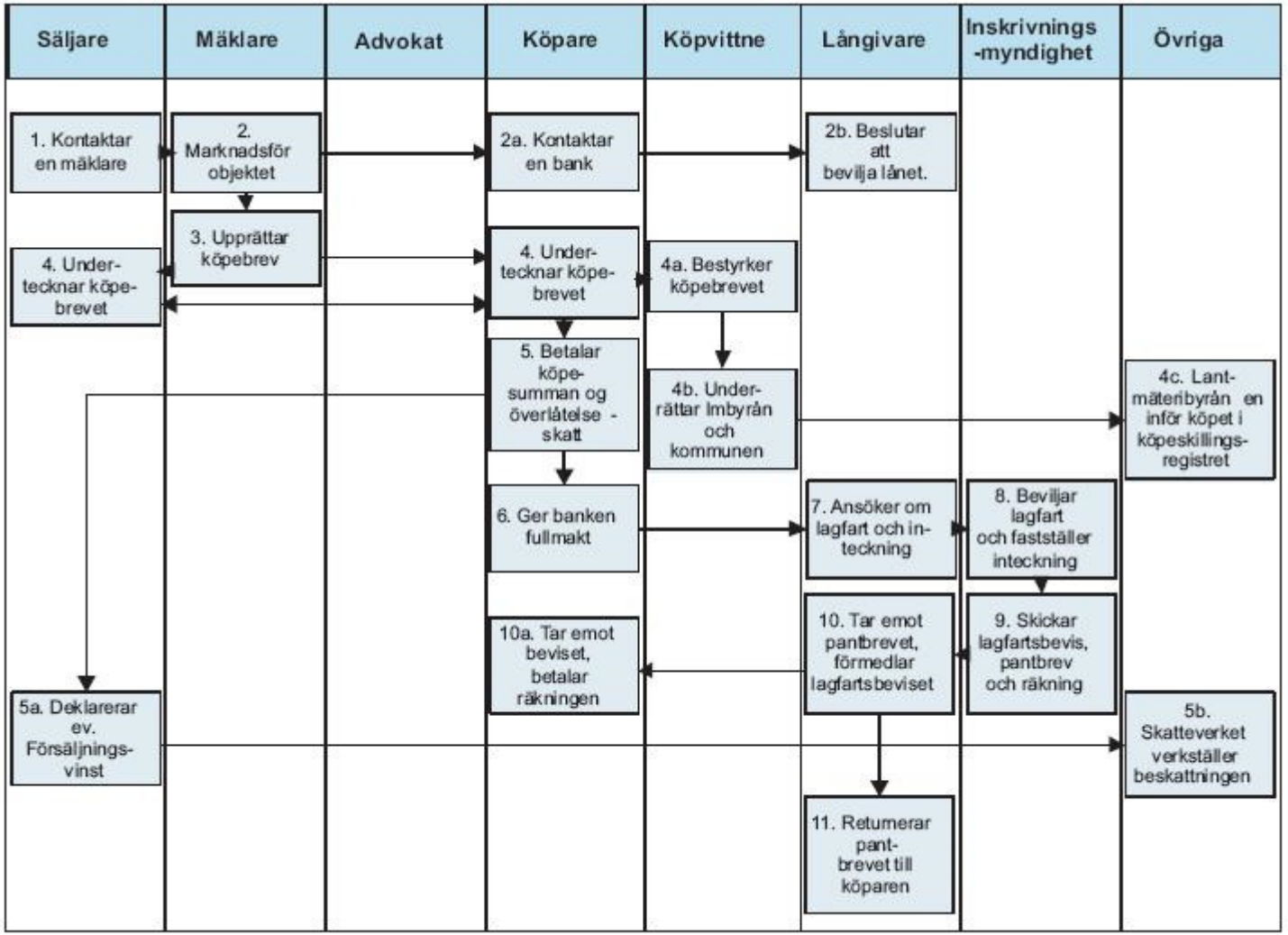
Public services for **citizens**:
1 [Property/ land] taxes: Sales abstract for statistical purposes
6 Application for building permission: Data collected from adm. process
11 Announcement of moving (change of address): Dissemination of info

Public services for **companies**:
5 Submission of data to statistical offices
7 Environment-related permits (including reporting): As 6. above

Land Registries (and Cadastre): Data flows (='business processes') needed

Property formation in the Nordic countries - Denmark
http://www.kms.dk/NR/rdonlyres/631D6233-F747-4E1F-98DA-FED3EDAD963E/0/PropertyformationintheNordiccountries.pdf

# Purchase of property unit in Finland:




Figur FIN-18: Köp av en hel fastighet, genom mäklare och belåning.

# Hernando de Soto on 'business processes'

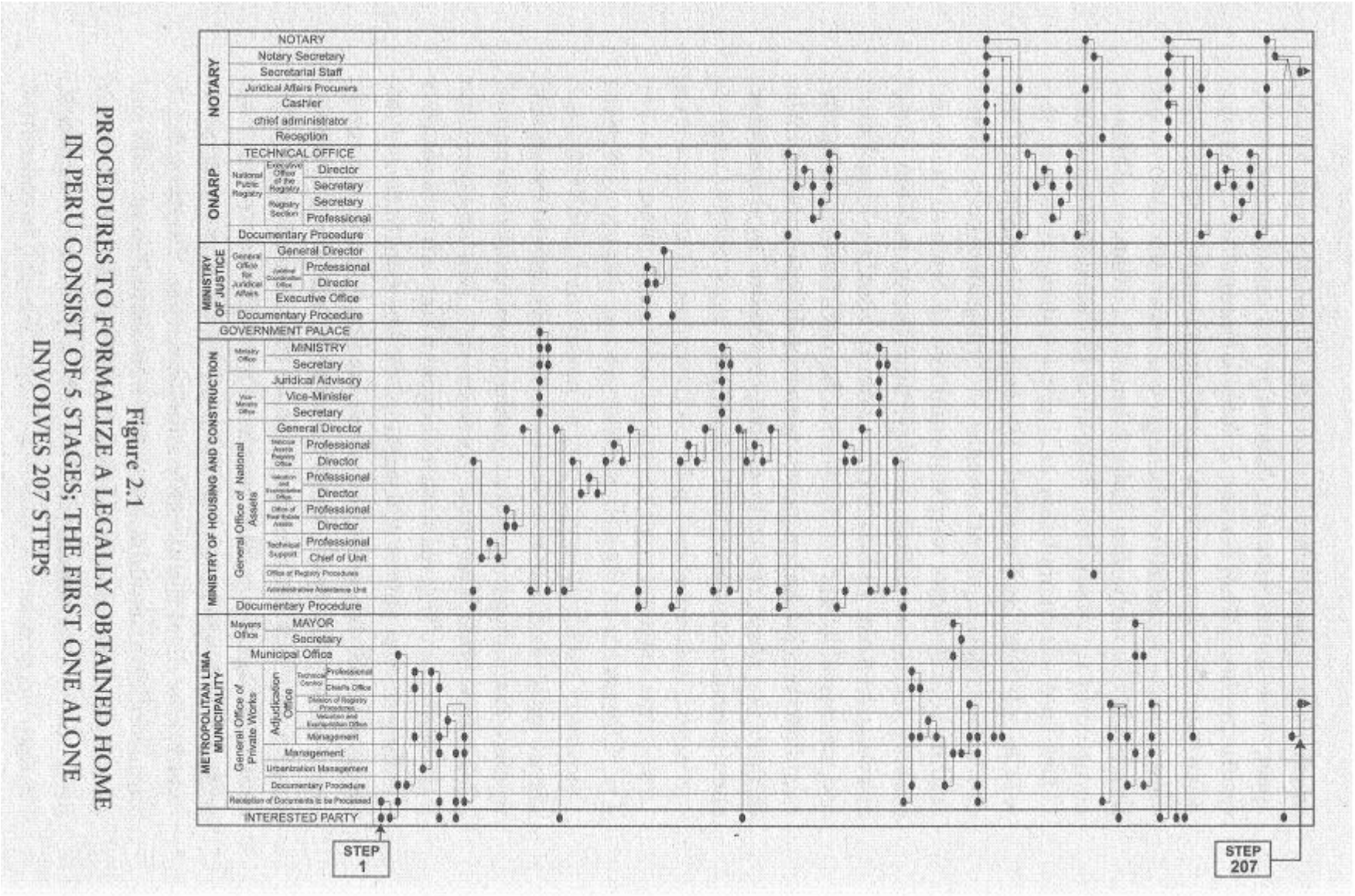



Figure 2.1
PROCEDURES TO FORMALIZE A LEGALLY OBTAINED HOME
IN PERU CONSIST OF 5 STAGES; THE FIRST ONE ALONE
INVOLVES 207 STEPS

# Land tenure and property rights

- Land tenure is a legal term that means the right to hold land, rather than the simple fact of holding (being in possession of) land
- Property rights is a set of rights and responsibilities/ restrictions concerning a thing
- Real/ immovable property is property in land, etc.;
- Personal/ movable property is property in other things
- Intellectual property rights is copyrights to works, etc.

# Land Registry and Cadastral Systems

- Land Registry: The administrative system used to record real property rights
- Cadastre: The administrative-technical system used to identify and locate units of property rights
- Cadstral System/ Land Administration System: Land Registry and Cadastre combined
- Land Management: CS + property taxation + land use planning + environmental management + ..

# The unit of real property according to Danish legal doctrine

What is generally left by the seller to the buyer of the estate,
including some movables (keys, ladder),
excluding some fixtures owned by 3rd party (utilities).

One or more parcels (continguous areas)
with plants, trees, and buildings,
but only 'traditional' minerals (e.g. gravel) in the ground
and limited towards sky according to convention.

Defined by legal doctrine and legislation, that is:
not a tangible unit (likevise the legal property boundary).
Restricted by spatial planning, agricultural law, heritage protection,

# The unit of real property according to Danish acts (2/2)

- Cadastral act: A unit is recorded in the cadastre with one or more parcels
- Land registry act: A unit may be 1) a cadastral unit, or 2) a building on leased land, if owner of building is not owner of land, or 3)a condominium unit, or 4) other identifiable and located object
- Agricultural act: A unit may be 1) a cadastral unit, recorded as an agricultural unit, and 2) such unit *together with additional parcels*, if managed as one holding
- Property assessment act: A unit may be 1) a cadastral unit, or 2) more cadastral units managed as one holding, except for agric. units

# Real Property Rights: The Property Unit

A piece of the surface of the Earth, as defined by court rulings

- horizontal and vertical boundary
- delimitation of fixtures relative to movables

Definitions according to statute laws (Example: Denmark)

- Cadastral law
- Land registry law
- Agricultural law
- Property taxation law
- Condominium law

# Real Property Rights: Dispositions

- Physical dispositions
  - possess, mark, fence, .. use: collect, harvest, construct, ..
- Dispositions in legal terms (bundle of rights):
  - sell, inherit, mortgage = use as collateral
  - lease, rent, grant easement
  - subdivide, change boundary
- Dispositions in economic terms (Eggertson, 1990)
  - (free, optimal) use of an asset
  - earn income from asset
  - transfer ownership to other party

# Real Property Rights: Restrictions

- Compulsory purchase / expropriation
- Purchase restrictions, incl. preemption rights
- Spatial planning, heritage protection, environmental law
- Easements, e.g. right of way
- Adverse possession

# Enforcement of Real Property Rights: The needed infrastructure

- (Police) Protection of privacy (e.g. removing squatters)
- Solving title and boundary disputes
- Performance of forced sales in case of mortgage default
- An operating credit market
- Maintenance of cadastral and land registry system
- Protection of boundary marks and other evidence

# Real Property Rights: Summary

| | |
|---|---|
| Dispositions:<br>The *content* of Real Property Rights | The Unit of Real Property:<br>The *object* of Real Property Rights |
| The context for dispositions regarding Real Property | |
| Restrictions of R P R | Infrastructure of R P R |

# Functional requirements of a Cadastral System (1/2)

- Property units are identified and located, and shape and physical attributes are recorded
- Rights in property units are classified, adjudicated, and recordings are preceeded by check of the powers of the signer of contract, the priority of liabilities, and further rule compliances
- Disputes on property title and boundary, as well as foreclosures, are of limited magnitude and handled in socially responsible and predictable ways
- Professionals are available, offering competent and independent advice, complying with general rules and encumbrances, balancing public planning measures with owner initiatives, and compensate in case of occasional errors.
- Mortgage credit or similar is general available at a reasonable price

# Functional requirements of a Cadastral System (2/2)

The following procedures shall be completed within 'short time', less than a few months:

- Purchase of a property unit
- Mortgage
- Subdivision and other cadastral cases
- Foreclosure (compulsory sale) in case of default

In general, *functional requirements* define what a system is supposed to *do* whereas non-functional requirements define how a system is supposed to *be*.

http://en.wikipedia.org/wiki/Non-functional_requirement

# Non-functional requirements of a Cadastral System

The CS shall grow more

- correct (mirror principle),
- consistent,
- cost effective
- transparent and understandable to the customer (end-user)

Non-functional requirements are often called qualities of a system. Other terms for non-functional requirements are "constraints", .. Evolution qualities, .. are embodied in the static structure of the .. system.

http://en.wikipedia.org/wiki/Non-functional_requirement

# Societal preconditions for operation of a Cadastral System

- People commit themselves in writing
- Behavior (dispositions of assets, political decisions) is reflected in economic terms
- Opportunism is moderated by law and order (CPI ~European level)
- Professionals with vocational attitude are available
- Government and professions improve CS where economically justified

.. Other terms for non-functional requirements are "constraints", .. Evolution qualities, ..are embodied in the static structure of the .. system.

http://en.wikipedia.org/wiki/Non-functional_requirement

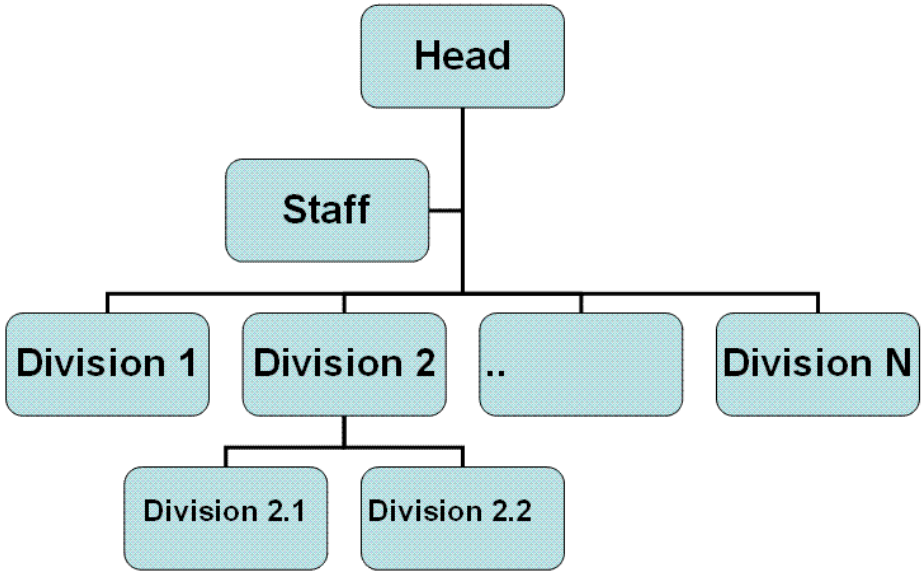
# Theory of organisations: Definition

An organisation is

- a named entity, made up of
- a group of individuals, who
  - perform work in specialized units [thereby increasing productivity]
  - coordinated by rather permanent relations and procedures
  - as stated in written articles,
- to achieve the goal of the organisation

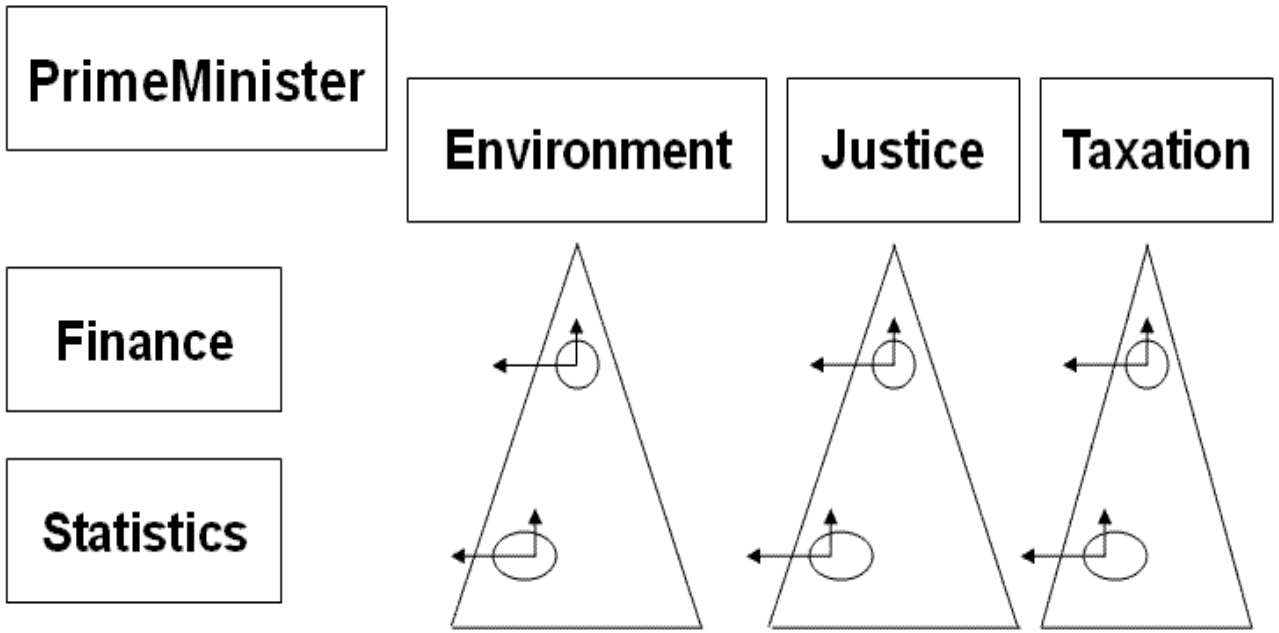
North: Organisation: by contrast, are those groups of people and the governance arrangements they create to coordinate their team action against other teams performing also as organizations. [From Part 1: Emphasizes organisational interaction]

# Theory of organisations: Formal structure Hierarchy




It is artices of the organisation, which define the structure, ...

# Formal structure: Matrix-Organisation




.. but also ordinances, job descriptions, etc. define the structure

# Other forms (3/3): Committees, Project organisations

**Committee**
a group of peers who decide as a group, perhaps by voting. The difference between a jury and a committee is
that the members of the committee are usually assigned to perform or lead actions which leads up to or extends from the decision.

**Project organisation**
a 'local' hierarchy set up to solve a specific task, e.g to build a construction

# Categories of rules

- Rules of competency: On conditions C, NN is entitled to grant applicant A the permission/ benefit P
- Rules of behavior: In situation S the behavior B by addresee A is illegal/ mandatory
- Rules of procedure:  In context X, to arrive at decision D, the steps $S_1..S_n$ have to be performed
- Definitions: In the present law, by term T is understood ..(definition)..Implies that certain documents (certificats,..) imply that the holder is granted certain rights

Acts and ordinances, etc. are made up of these categories

# Decision processes: Rational

Steps in rational problem solving:

- define problem
- establish criteria of solution
- develop alternatives
- rate alternatives
- select solution, and implement it
- restructure problem conception

# .. and not so rational , and legal decision processes

1. General administrative approach: Refrain from developing alternatives, that is: be *satisfied* with a sensible solution (Simon, 1947: Rational man, administrative man)
2. Legal and bureaucratic approach: Subsumption of data of an application to given legal rules

# Max Weber (1924) on bureaucracy

"..the exercise of control on the basis of knowledge"
in church, government, and enterprise (read: in hierarchy)

- Decisions by subsumption of cases to rules, in writing
- 'Bureau' (office: authority) with specific competence
- Officials act impersonal, duty /service, *have no ownership of means*
- Promotion based on technical skills, by superiors

Recently quoted in

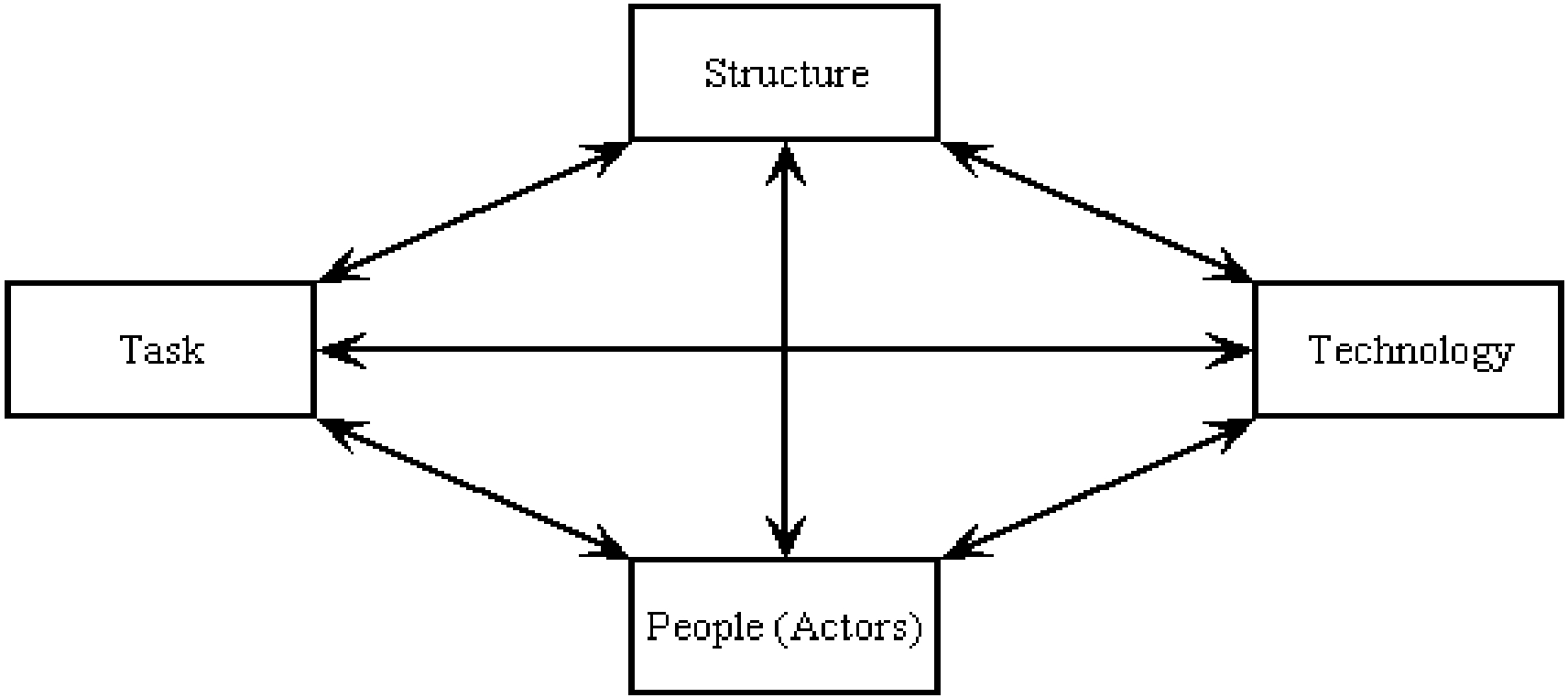
Roberts and Hite (2000) From modernization to globalization - Perspectives on development and social change. Blackwell, UK.

# Comments on Hierarchy

- (Well functioning) organisations are based on hierarchy
- Potential of hierarchy is division of tasks (specialization), leading to better productivity
- Because of order of hierarchy, it can achieve a lot, but it may suppress creativity and individual initiative

Alternatives to hierarchy: Market and (actor) network

# The Leavitt-Whisler model: Components and change




**Kilde: Leavitt, 1965. Fig 1, side 1145**

# Organisational change

An organisation is changed by

- change of organizational units: New units, or changed tasks or competencies
- change of information channel network (new, reorganised)
- change of content of information flows
- change of norms and attitudes

# The concept of 'Actor' (~='Stakeholder')

An *Actor* is a physical person,
acting on behalf of an organisation(al unit)

The *actor* is free as any human, e.g. to meet another person or not,
but bound by the norms and articles of the organisation s/he represents.

# Stakeholder analysis

| Stakeholders | Active opposition | Passive opposition | Not committed | Passive support | Active support |
|---|---|---|---|---|---|
| Suppliers | | | XO | | |
| Executive directors | | | | X → | → O |
| Staff | X → | → | → O | | |
| National politicians | | | | XO | |
| Finance Director | | | | O ← | ← X |
| Local politicians | | XO | | | |

X = current position  O = required position

Figure 42.7 Stakeholder commitment matrix

# How to facilitate/ predict administrative change

The research methodology of Volker Schneider:

- Identify scope of study: The law making process
- Collect reports and other written material, to identify *actors*
- Perform preliminary interviews, to identify further *actors*, and locate places, where they meet: *arenas*
- - - - ('Snowball method')
- Prepare and conduct essential interviews, asking for motivation for alliances, agreements, and rejections
- Reconstruct sequence and interrelation of *events* (PERT)
- Establish mutual assessment of *resources*
- - - - e.g. to identify type and amount of *resources* ('power')

# Examples of the concept of 'Arena'

- Parliament
- Permanent councils and committees
- Task forces and working groups
- Recurrent events (conferences, seminars) with strong themes
- Professional associations (e.g. of Notaries, or Geodetic Engineers)

# Observations made by V. Schneider

Schneider's groups of actors (cf. Greece):

- Governmental bodies
- Political parties
- Organised interests (Industry, Trade Unions, 'Green' organisations)
- Scientific bodies
- International organisations

# Organisational units for Schneider and cadastre

| Governmental bodies | |
|---|---|
| Management of chemical substances | Cadastral development (examples) |
| Min of Labour<br>Min of Agriculture<br>Min of Interior<br>Min of Health<br>Min of Commerce and Industry<br>Min of Research<br>Agency of Materials Testing<br>Agency of Security at Work<br>...<br>Agency of Environment | Cadastral Agency<br>Courts (Land Registry)<br>Property tax authorities<br>National Statistics<br>..<br>Local government |

# Organisational units for Schneider and cadastre

| **Political parties** | |
|---|---|
| Management of chemical substances | Cadastral development (examples) |
| SPD, CDU, FDP | MPs in relevant Parliamentary committees |
| **Organised interests (Industry, Trade Unions, 'Green's)** | |
| Association for Chemical Industry<br>Corporation for Chemistry, Paper and Ceramics<br>German Chamber of Commerce<br>... | Big land owners<br>Foreign, economic interests.<br>Semi-public computer facility management.<br>Computer and software companies.<br>Consultants |

# Schneider's organ. units, and the corresponding cadastral

| Scientific bodies | |
|---|---|
| Ass. of Chemical Engineers (BGChemie)<br>German Research Corporation (DFG)<br>Expert Committee on Environmental Issues | Association of Geodetic Surveyors;<br>.. of Notaries;<br>University departments |
| **International organisations** | |
| EU<br>OECD<br>Europ. Ass. for Chemical Industry | OECD<br>FIG<br>CLGE |

# Schneider: 'Similarity of resources'

Knowledge (Expertenwissen, Personal)

- Laboratories (staff and equipment), Expertise

Organisational skills (Entscheidungs-, Finanzen, ..)

- Accomplishing timely decisions, Keeping contact with other decision centres, Motivate high degree of membership
- Direct (govern) use of resources, Making money

Access to news media (Image, Mobilisierungskapazität)

- Reputation, Ability in mobilising interest

# Schneider's approach explains the Danish BDR- development

Concept set: actor, network, arena, resources, .. explains the structure of negotiation over (new) rules.

The methodology may be applied generally:
Use concept set to analyse your 'next step' in a development project,
like playing Chess

Other literature with similar approach:
Marsden, Peter V. & Nan Lin (publ.): Social structure and network analysis, Sage 1985

# Experiences in Slovenia

Task: Assist in adapting the Slovenian study programmes towards a more market oriented society.
Task force made up of A, DK, NL, FIN, S professors
Outcome: Formally approved and more relevant study programmes.
Method:

- Ask for the knowledge profile of graduates: What do they have; What's needed?
- Ask for local opinions/ insight: Visit a more wealthy, and a more poor region. Outcome: Change is needed beyond reasonable doubt!
- Leave the decision to the local decision makers -> They learned to negotiate a solution.
- Be gentle, but keep a stick: Stopping the project would be embarrassing for the local elite.

# A lesson from the Slovenian project

Slovenia had (1995+) no articulate (= independent) interest groups, while in Germany you have

- a high level of bureaucratic maturity, articulated goals
- a national appreciation of rational approaches
- specific expertise is objectivised (big and competitive country)

In small countries (DK, SLO, ..), similar investigations may be difficult to perform, because physical persons (rather than competing bodies) control expert knowledge.

Social behaviour is culturally bound (and methodologies should reflect that!). Stakeholder analysis is generally applicable.