

Institutional Aspects of 3D Cadastres

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ABSTRACT

Unlike other geographical information systems, where physical attributes to land are recorded, cadastres register rights to land and consequently are dependent on the institutions in which they have to operate. Without appropriate legal frameworks and transparent public-administrative structures, cadastres cannot operate properly. To perform the cadastral tasks of determining, recording and dissemination of information on land in a 3D situation, the development of adequate geometric 3D descriptions should therefore go together with the development of institutional conditions. It is argued that the use of 3D rights to land is possible thanks to appropriate 3D geometric description technology. The paper aims for analyzing the current situation and seeks to define some recommendations regarding future developments.

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1. PREFACE

The definition of 'land registry' and 'cadastre' -(UN/ECE, 1996) uses even the word 'land administration'- always give rise to debate. In this paper I would refer to the definition of (Kaufmann & Steudler, 1998), where -to summarize briefly- 'cadastre' comprises both land registry and cadastre (i.e. the registry component and the inventory component in registers and maps).

2. WHAT ARE INSTITUTIONAL ASPECTS

Since the work of (Douglas North, 1990) there is a common understanding that 'institutions matter'. The impact of the realm of thought of North is applied to the world of cadastre in a fine way by (Zevenbergen, 1999). Institutions are defined as 'the humanly devised constraints that shape human interactions'. More informally, they are 'the rules of the game', while the players of the game are the 'organizations'. The costs of reducing uncertainty in human interactions are fairly dependent on the quality of the institutions, and how seriously these are enforced.

3. WHY ARE INSTITUTIONAL ASPECTS IMPORTANT FOR THE CADASTRE

The (World Bank, 1998) considers land titling, land registration, and information supply in general as examples of institutional development. (Feder & Feeney, 1991) place property rights in general and land rights in particular in the context of institutional structure of society and economy. They distinguish three basic categories of institutions, namely the constitutional order, institutional arrangements, and normative behavioral codes. The constitutional order refers to the fundamental rules about how society is organized: the rules for making rules. Institutional arrangements include laws, regulations, and (*inter alia*) property rights. The normative behavioral code refers to the values that legitimize the arrangements. They conclude that property rights are an important class of institutional arrangements, as 'property' implies a system of relations between individuals, by creating mechanisms for the definition and enforcement of these rights including both formal procedures and social customs and attitudes concerning the legitimacy and recognition of those rights. (Luning, 1995) -as an example- analyses how changes in social customs in customary areas in various African countries result in institutional changes through a greater precision in the definition of property rights and boundaries.

Whatever the case, it should be recognized that the cadastre aims to record or register rights and interest to land, because the law recognizes these rights and interests as a legitimate relation between a rightful claimant and a certain lot of land. This relationship -by consequence-

is lawfully meaningful, which means that these relationships are lawfully defined and have a legally defined power against other people (*'third parties'*). After all: although land right refer to the relationship men-land, the social notion is a relationship men-men with respect to land. These other people therefore should have access to information on the legal status of land, in order determine their behavior when buying land, creating derived rights etc. Without a definition of property rights in the law and without legally defined mechanisms for acquisition, transfer, protection, restriction, creation, recording or registration of these rights and interest is meaningless. Therefore cadastres are only meaningful if they operate within an institutional context, providing regulations for

- defining property rights,
- defining mechanisms for acquisition etc.,
- defining task and responsibilities of the public administration entitled to register.

This is equally true for 3D cadastre. Without defining the third dimension (and even the 'fourth' dimension in the case of time sharing !) in property rights regimes, 3D cadastres are meaningless.

Crux is the traditional concept of 'ownership'. Netherlands Civil code (article 5:20 and 5:21) defines ownership of land as ownership of the ground including 'ownership of all space above surface, all earth layers below, all groundwater, and all fixtures'. The same e.g. in Germany in the Bürgerliches Gezetzbuch (§ 905), in the UK, in France, and in Belgium (*RAVI, 2000*).

'Ownership' therefore is the most comprehensive right that a person can have to a thing, with the following characteristics (*UN/ECE/Trade, 1995* :

- the owner is free to use the thing, while observing the rights of other persons and the restrictions on the basis of the law or rules of unwritten law,
- ownership is an exclusive right, i.e. no other person may exercise any right over the thing, unless he has legal or contractual ground,
- in principle the owner is entitled to all of his property.

Ownership may however be subject to the following restrictions:

- rights of other persons to the thing, both in real rights and personal rights,
- restrictions arising out of legislation in force,
- restrictions based on unwritten law.

I.e. it makes no sense to register and survey 3D objects if the legal meaning of 3D properties is not defined at the institutional level.

Therefore current concepts of 'ownership' very much influence the extension to and definition of 3D properties. In civil and common law jurisdictions these 3D properties owned by other persons are to be considered as rights which are separated from the 'ownership' of land : e.g. rights of superficies, accession, mineral rights, rights of apartment, and condominium. These rights affect the traditional concept of 'ownership'. The right of

superficies means that the ownership of a building is separated from the ownership of the ground below, by means of a separate title. This right breaks the rule in many jurisdictions that buildings and other structures become the property of the owner of the land on which they have been built or erected.

Accession in the context of the law means an increase of or addition to a thing, denoting a method of acquiring ownership by which a thing becomes another's because it accedes to a more principal thing of that other. There might be horizontal and vertical accession. This right, applied to e.g. tunnels, affects the same rule as above.

Mineral rights exist when ownership of minerals is separated from the ownership of land in that sense that these mineral rights may be held by a separate title. These rights affect the rule that earth layers below the surface are owned by the owner of the ground.

(UN/ECE, 1995) considers the right of apartment as a part of the civil law jurisdiction defined as a restricted right of use, giving the holder a share in a joint right of ownership with exclusive use of certain parts of the building.

The UN considers the right of condominium as a part of common law jurisdictions constituting a special form of ownership giving the holder a 'fee simple' title to individual units within a building together with an undivided interest in common areas.

As cadastres aim for registering real rights within the closed systems of real rights (at least in the Roman law families there exists a *numerus clausus*, a limited number of real rights) the registration will be limited to these rights, and so does the mapping of boundaries on the cadastral map. By consequence the registration of 3D real rights and the mapping of 3D legal objects only can be applied as far as these rights and boundaries are valid within the context of the law. Therefore the institutions ruling the third dimension of real rights are determining the scope of 3D cadastres.

4. PRINCIPLES FOR THE CADASTRE

Basic principles for the cadastre remain:

- 'publicity'
- 'specialty'

'Publicity' means that all documents regarding the creation, transfer and deletion of rights and interest to land are open for public inspection, providing opportunity to third parties to be informed about the legal status of land (these documents might be a 'deed' or 'title' depending of the system of land registration).

'Specialty' means that all subjects, objects and their mutual relationship are specified, providing opportunity to third parties to know exactly which rightful claimants claim which rights and interest to which lot of land.

Although no cadastre in the world fully meets this demand, theoretically the subjects and objects concerning all existing real rights should be specified and open for inspection.

Normally the state of the art is that the 'mother right' i.e. ownership of land is specified quite well, while objects (e.g. building, path, pipeline) subject to real rights which constitute a form of separated ownership (e.g. superficies, servitude, monument, mortgage) are poorly specified, even in the Netherlands (*de Jong, 1997*) (*Groot Koerkamp, 2001*).

As the principles of the cadastre are directly related to their function (see under-mentioned) the starting point for three dimensional (space) and four dimensional (time) situations should be that the principle of specialty requires a decent representation of 3D and 4D legal objects in the cadastre.

5. FUNCTIONS OF THE CADASTRE

That no cadastre in the world comprises all existing subjects, objects and rights within the jurisdiction, should be considered not as a matter of inanity, but as a matter of attempting to find a balance in costs and benefits. Good quality management requires after all that the cadastre performs the function asked for by society. One might even say that these arrangements should not be better than necessary to deliver adequate performance. Therefore some reflection is needed to identify the purpose of the cadastre for society.

Cadastral systems aim to support the implementation of a governments land policy. As land policy reflects the way governments want to deal with the land issue in sustainable development, which depends on the culture, history and attitude of a people, also cadastral systems will differ from country to country. However it is worthwhile to draw a picture of the support cadastral systems give to the implementation of (the most important) land policy instruments, as there are

1. *Improving land tenure security*
2. *Regulating the land markets*
3. *Implementing urban and rural land use planning, development and maintenance*
4. *Providing a base for land taxation.*

Concerning the *improvement of land tenure security*, the legal framework of cadastral systems (related to the registration or recording of rights and interest in land) is determining the nature of the security provided. Within the context of the definition of these rights 'in rem' (as an institutional prerequisite), deed-systems provide an other security than title systems. In fact one observes a continuum ranging from very basic deed recording, via deed recording with land surveying, via title deed registration, via title registration toward title registration with land surveying, all with their specific legal attributions. Other parties involved in the legal processes (like notaries) influence the level of security. The combination of a strong notary-system (e.g. *latin notary*) with a deed recording, might provide as much security as the combination of non-authentic (underhand) documents with a title registration. Other relevant aspects are the extent to which legal facts are guaranteed by the State, compulsory or voluntary registration, compulsory land survey of a subdivision prior to or after the transaction, type of land tenure (individualized, customary), and the legal object to be surveyed

(individual parcel, group parcel, object). A conclusion is that the *value* delivered by various cadastral systems might differ substantially, what induces to careful reading of benchmarks. Litigation on boundaries however is a straightforward measure for the extent to which cadastral systems provide security on parcel boundaries.

Concerning the regulations for the *land market*, cadastral systems provide transfer procedures of a different nature. On one hand there are plain procedures of submission of a transfer document and a recording after a minimum of formalities (e.g. *simple deed registration*), on the other hand more complex investigations prior to the approval of the legal impact of the transfer (e.g. *issuing of a title certificate*). Some countries require approval by a chief surveyor, a chief planner or an other authority. Advantage is that e.g. a building permit is granted together with the title, while in the first case the procedure for planning- and building permits start just after the transfer. The process-time necessary for the transfer procedure (for example from the obligatory agreement to the official recording or registration) therefore might result in a different '*value*' for the applicant. An other interesting role of cadastral systems in the land market is the extent to which it supports mortgaging. A measure for the performance of cadastral systems might be the percentage mortgaged residential homes, and the percentage long liabilities of commercial companies. However also fiscal regulations influence these figures, as e.g. tax deductibility of mortgage-rents will determine the actual popularity.

Concerning *urban an rural land use planning, development and maintenance*, the support of cadastral systems lies foremost in the phase of development and maintenance of a given land use. This activity is to be seen as an intervention of the government in private rights to dispose. Without knowledge about who owns what and where (also in *customary areas* !) land management will be hardly possible for the government. The increasing government interests in land bring (*Kaufmann & Steudler, 1998*) to the concept of ('legal') object based cadastres in stead of parcel based. From the land owners point of view, intervention from the government specifically limits his private right to dispose on the actual parcel, being an object of his private rights. Benchmark might be if the government uses parcel information for intervention purposes. The intervention take an ultimate form in the execution of pre-emptive rights and expropriation. Regarding protection of third parties in good faith, pre-emptive rights and expropriation decisions should definitely be recorded in the cadastre. Data on this topic gives a good view on the role of cadastral systems in the public acquisition of land.

Concerning the support of *land taxation*, the fact that land tax is an outstanding example of local tax, a benchmark might be the extent to which local governments cover their local expenditure with land tax revenues. Without knowledge about taxable persons, taxable objects and land values (all to be provided by cadastral systems), the generated revenue can not be high. If the revenue however is substantial, it will be an indicator of a well-functioning cadastre. The precise level is not important as it is determined by local (even national) fiscal policy.

By consequence the registration and mapping of 3D legal objects has to serve the functions of the cadastre as there are the improvement of land tenure security, the land market, land use planning and development, and land taxation. Depending of society's demands, decisions

should be made concerning costs and benefits of 3D cadastre. As this will be different from country to country, we will not further reflect on the subject. It suffices to note that investments in 3D cadastres find their rationale and their justification in its function.

6. THE RELATION OF LEGAL OBJECTS AND REAL OBJECTS

The question arises to which extent real (*'physical'*) objects should be represented in the cadastre, as its main purpose is to specify legal subjects, objects and their relationship. Legal objects are after all *'fictions'* or *'metaphysical notions'*, which do not necessarily coincide with a real object. In countries where the general boundary rule is applied (e.g. UK) -*'what you see, is what you own'*- it is obvious: real objects are the representation of legal objects. Therefore the title map is a topographic map. Unlike, in civil law jurisdictions legal boundaries have basically nothing to do with real topographical boundaries. Only when parties involved in the creation or transfer of a right to land officially declare that both types of boundaries coincide, then the boundary-line on the cadastral map will represent both a legal and real feature. So the rule is that real objects as soon as they coincide with legal objects are to be represented on the cadastral map. If a building is subject to a right of superficies, that building should be surveyed and mapped, possibly even get an proper object-identifier (*'parcel number'*). However, if the building is part of the property and not legally separated from it, then -from a legal point of view- the owner of the property becomes owner of the building (*superficies solo cedit*), and surveying and mapping that building is meaningless. If a certain path with specified boundaries is subject to a right of way, that path basically should be on the cadastral map. If the right of way is not specified and applies to the whole parcel, representation on the cadastral map is meaningless. Mutatis mutandis, if the owner of a tunnel is the same as the owner of the ground level.

The only reason why -nevertheless these legal principles- cadastral organizations aim to survey and map physical objects, is the notion that without these objects third parties cannot understand what they see on the map: mapping topography on cadastral maps aim for making cadastres accessible for the public (*'orientation function'*).

From a legal point of view, it is often not necessary.

7. CURRENT MULTI-USE OF LAND

7.1 Multi use on ground level

Multi use of land -as encouraged e.g. by the Netherlands government- hardly has any impact on the cadastre, as ownership of land stays as it is. Only the use of land is intensified: an office carpark is used for stadium car park in the weekend, residential homes might be used for small business activities, a municipal park is used for commercial market at day time etc. These forms of multi use of land are within the domain of personal rights and not within the real rights domain. However as soon as these use-rights become real rights, e.g. a lease-right which only might be executed certain moments of the day, we enter time sharing arrangements, which are eligible for recording in the cadastre.

7.2 Multi use above surface

Multi use above surface occurs e.g. in the situation of the existence of buildings and flat apartment buildings. If -as said earlier- the ownership of the building is separated from the ownership of land, representation of the ground level boundaries is necessary. Concerning flat apartment buildings, it depends on the real right which is applied. The right of apartment as applied in the Netherlands basically is a share in a joint property, comprising the exclusive use of a certain part of the building. This is called the '*monistic system*'. E.g. Belgium and Germany, however, apply the so called '*dual system*', because there is lawful ownership of the apartment plus joint ownership of common spaces. In the UK the name 'commonhold' has been adopted (although not in the law yet: the official form is 'lease') for the concept of communal freehold flat ownership, known elsewhere as condominium or strata title (*Mertens et al, 1997*). By consequence there is more justification to represent flat ownership as a 3D object in Belgium, Germany and the UK than in the Netherlands.

7.3 Multi use sub surface

If the ownership of subsurface constructions (underground shopping malls, roads, tunnel, pipelines, etc.) is separated from the ownership of the ground level, these objects should be somehow represented on the cadastral map, possibly with a own object-id. If there is only 1 subsurface construction, the representation might be 2D as a projection on the ground level. However, if the subsurface construction as such also exists of various legal objects (e.g. multi storage shopping centers, a number of pipelines at various levels), with all of them subject to separated real rights, 3D representation will be necessary. One might sometimes imagine representation in digits only (e.g. pipeline A at 2.10 m depth, B at 2.40 depth) but then the function of the cadastral map will be affected negatively because of lack of orientation function for third parties.

A related issue is the question to which extent the definition of real rights within the numerus clausus of the real rights system, is appropriate for these kind of 3D properties. A consideration is that if the principle of '*specialty*' is not met by a representation on a cadastral map, the specification of the real right concerned should follow from its verbal description. *As the introduction of the system of parcel-numbers historically can be explained by the problems of verbal description, the verbal description of a real right to a 3D-object will hardly be impossible. By consequence, the historic decision to visualize the verbal description by a geometric representation, is even more valid for 3D situations. In other words: due to the current ability to represent 3D objects, current systems of real rights might cope with 3D legal objects.*

7.4 Multi use time-dependent

The increasing number of time sharing arrangements urged the EU to adopt the EU time sharing directive (94/47 EG dd. 26-10-1994 PB EG L280). This directive currently is adopted in national legislation. The Netherlands doesn't have a regulation for such a real right. One messes around with various complex combinations of real right with personal rights (e.g. joint ownership in combination with use-rights, share in a company in combination with use-

rights). Proposals are made to introduce a 'part time apartment right', which gives the rightful claimant a right to own a part time apartment (*Mertens et al, 1997*). As the legal object remains the same, time sharing will not heavily impact on cadastral maps, but rather on the registrative aspects of land registry ('*multi-title*'?).

8. FUTURE DEVELOPMENT OF MULTI USE OF LAND

Since the seventies, multi use of land is quite common in the North America and Japan. In other countries the interest in the possibilities to use the third dimension in spatial planning and development is growing increasingly. In the Netherlands several projects in North America are considered as good examples of multi use of land (*Bouwmeester et al., 1998*). The Underground City in Montreal is a big subsurface shopping mall with about 30 km of walking aisles, while office buildings are at the ground level. Post Office Square, the central square in Boston, has a six storage underground car parking with a new park at ground level. The National Museum of Asian and African Art at the Mall in Washington DC is an underground extension of the Smithsonian Castle (the *East Building*), with renovated castle parks at ground level. Great Midwest Underground in Kansas City is the world largest underground business complex (3 million m² office space) located in abandoned mine galleries which were used for the last 50 years for limestone extraction and exploitation. The Central Artery Project in Boston will be ready in 2003 and shall comprise the demolition of the existing scheme of ring roads, the underground construction of a central arterial and the building of local traffic arrangements at ground level.

Government policy in the Netherlands is to encourage multi level use of land. Since 1998 there is a government programme to push 'intensive use of space', The fifth National Memorandum of Spatial Planning (submitted to the Parliament) promotes multi use of land. Priority is given *inter alia* to a more intensive use of space and to combining various functions of land use. (*Stoter & Zevenbergen, 2001*) show a few examples of multi use of land which are currently realized or constructed in the Netherlands.

Also the amount of underground cables and pipelines is increasing, while the recording of the location and of features like purpose and composition is quite poor. (*Groot Koerkamp, M, 2001*) considers the current situation even as risky. As at the same time the official government policy puts emphasis on the management of safety and environmental risks in order to avoid risks for the citizens (Memorandum on the risk management of transportation of dangerous substances of 1984) and the European Union is considering the development of European Directives on the subject, the recording of 3D location and specifications of cables and pipelines shall have to meet higher demands than currently is the case.

Also the amount of tunnels is growing. Recent government decisions on the track of high speed trains and on a new cargo transport rail road from Rotterdam-harbor to German industrial complexes comprise the construction of tunnels under urban and rural areas, with a length never seen in the Netherlands before. Related to that, currently a debate is going on concerning the juridical aspects (*Ploeger 1997*). The current status of cadastral registration of subsurface constructions (e.g. subways, metrolines) was analyzed by (*de Jong, 1997*), result-

ing in the conclusion that -although in notarial documents there was some evidence of the existence of subsurface constructions- almost no information on these underground features could be found in the cadastral registers and on the cadastral map. As a reaction to *de Jong's* conclusions, the Netherlands Cadastre and Public Registers Agency conducted an investigation (*Klaasse, 1998*), based on which decisions were taken to open up a special attribute to cadastral parcels comprising the recording of the creation of a right of superficies, mentioning the name of the construction, its nature, and relevant construction plans, and to map the boundaries of the underground construction based on these construction plans. These decisions are to be seen as an attempt to include 3D feature in the existing 2D cadastre.

Whatever the case, the increasing creation of 3D spatial objects causes a need to consider the definition of 3D legal objects, and their recording in cadastral registers and on cadastral maps, in order to meet the demands of society.

9. CONCLUSIONS AND RECOMMENDATIONS

- In situations where no separation of ownership is present, the law will not require representation of 3D legal objects.
- However, in such cases representation of the related real object on a cadastral map might be recommendable to maintain the orientation function for third parties (matter of accessibility).
- In situations where separation of ownership is present, the legal object should be represented on the cadastral map. If the legal object coincidences with the real object, the representation of the legal object includes the real object. If not, the orientation function of the cadastral map makes representation of the real object recommendable.
- As representation of 3D legal objects meets the requirement of '*specialty*' (as a condition) the existing system of real rights tend to be appropriate. However, without such representation, real rights should verbally specify the 3D legal object (a 3D description) which seems to be almost impossible. If so, research should be done to identify new 3D property rights concepts.
- By consequence the representation of 3D legal and real objects in the cadastre is a useful extension of 2D cadastres.
- Multi use of land impact on security of land tenure, land markets, land use planning and development, and on land taxation, which demands for appropriate changes in traditional concept of the cadastre. However the investment level should reflect a balance between costs and benefits.
- In situations where multi use of land is encouraged by governments, the development of concepts for 3D cadastres should guide the change which traditional land registry and cadastre have to make.
- By consequence, in those circumstances such development requires priority.

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