

LADM Patterns to Support the Efficient Modelling of Cooperative (Community and Strata) Titles for Land Registers

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SUMMARY

In many jurisdictions sub-ownership rights can be separated from the main body of ownership. In Scotland these are referred to as *separate tenements* and encompass such ownership rights as minerals, salmon fishing, mines of gold and silver, and petroleum (Reid et al., 1996, pp. 168-171). The main body of ownership may be further encumbered with ancillary rights (such as access) to ensure that holders of sub-ownership rights can effectively enjoy the right they hold. However, these further encumbrances are, in general, not seen as excessively onerous by owners of the main body of ownership. Separated ownership rights, as thus described, have been successfully used in a number of jurisdictions for centuries.

Strata (airspace subdivided by reference to structures built in that air) is another form of separated ownership used to define flats in a flatted (shared) building. Ownership within shared buildings requires the division of a building into individually owned property (strata (airspace)) and collectively owned (shared) common property, governed by a set of rules. Owners of flats have interdependent community cooperative rights relationships with other members of the flatted building. These relationships are significantly more complex and onerous than rights required to support other separate tenements (as described above).

Similar ownership relationships can be modelled where there is no flatted building, but there are facilities, for example common landscaped areas, that are shared between owners. Hence, a distinction can be made between vertical and horizontal subdivision. The term 'strata title' can be used for vertical subdivisions representing apartment buildings. The term 'community title' can be used for horizontal subdivisions representing planned communities (Sherry, 2016, p. 4). In this paper we refer collectively to horizontal and vertical ownership as cooperative ownership. While 'cooperative ownership' can represent different forms of ownership types, they have relationships with shared property (lifts, stairwells, halls, car park, roof and surrounding land) that usually require maintenance.

Where orthodox property law is not adequate for describing community ownership these jurisdictions have created additional property law to allow such community titles. Such laws provide rules outlining how separate owners should be granted rights over shared property. Critically, such laws tend to involve the establishment of a corporate body (housing associations, or their equivalents) with powers to create 'positive obligations' (Sherry, 2016, pp. 9-15). Praedial covenants, which bind all subsequent owners to the conditions of a contract, are used to express these 'positive obligations' which allow the corporate body to

levy and administer the necessary fees and funds. In this manner maintenance costs for the entire building or complex can be imposed on successive owners.

The Land Administration Domain Model (LADM (ISO TC/211, 2012)) is a conceptual model which supports the modelling of social relations with land articulated through *rights*. There are three principal concepts within LADM: the party (*the who*) that has a rights relationship (*the what*) with a plot of land (*the where*). Community ownership titling introduces a range of specialised patterns within LADM as described by Sherry (2016) and van der Merwe (2002), including:

- Shared praedial ownership of common areas,
- Praedial inheritance - the chaining of praedial ownership,
- The ability of corporate bodies to restrict rights across the community.
 - Potentially establishing a localised fiefdom where reserved rights have an *in rem* effect and are 'good against the world'.

This paper will introduce these topics, and introduce registration patterns based on top-level party-right-land primitives. Exemplars are provided in the paper supported by a live presentation which simulates an automated registration process.

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1. INTRODUCTION

The Land Administration Domain Model (LADM (ISO TC/211, 2012)) is a conceptual model which supports the modelling of social relations with land that are articulated through *rights*. There are three principal concepts within LADM: the party (*the who*) that has a rights relationship (*the what*) with a plot of land (*the where*).

As an abstraction the party-right-land model makes it easy to conceptualise the *state* of real rights (all *real rights* are *rights in land*). It is simple to model who owns a piece of land and who else has rights, such as access, over all, or part, of the same land. As such it is also reasonably obvious that a party-right-land model is closely related to a Title. Title, as defined by Dale & McLaughlin (1999, p. 17), is "*demonstrable proof of ownership*": this reflects the current state of the party-ownership-land relationship after all the transactional changes have been taken into account (the *chain of title*).

Things become slightly more complex when sub-ownership rights are separated from ownership of the principal land (*principal land* has many names in different jurisdictions including *freehold* and *solum*). In Scotland these separated sub-ownership rights are referred to as *separate tenements* and encompass such ownership rights as minerals, salmon fishing, mines of gold and silver, and petroleum (Reid et al., 1996, pp. 168-171). Such separation originally represented the reservation of rights which were held by the crown or jurisdiction. A good example of this is the Scottish ownership right of Salmon Fishing. As stated by Reid et al. (1996, p. 242): "*In feudal theory the right to fish for salmon is, like many other heritable rights, vested originally in the Crown. The Crown right is an exclusive right to take salmon in all waters without territorial limits, and without regard to whether the waters are tidal or non-tidal.*" Separated ownership rights have been successfully used in a number of jurisdictions for centuries. In Hohfeldian terminology (see Hohfeld (1917); Hjelmblom et al. (2019, pp. 37-38)) such sub-ownership rights become *duties* (restrictions) for the principal land. The principal land may be further encumbered with ancillary rights (such as access) to ensure that holders of sub-ownership rights can effectively enjoy the right they hold. However, these further encumbrances are, in general, not seen as excessively onerous by owners of the principal land.

At first glance it would appear that there is no difference between strata ownership and the other forms of sub-ownership discussed above. In many instances this may be true: for example, where strata is used to describe bridges or sub-strata to define tunnels. However, where strata is used to define residential units in a flatted building such vertical ownership can be "*viewed as a series of separate houses, one built on top of the other*" (Reid, 2000). Conceptually, a flat is airspace subdivided by reference to structures built in that air. Owners

of flats have interdependent community cooperative rights relationships with other members of the flatted building (see Figure 4 below and the associated discussion). These relationships are significantly more complex and onerous than rights required to support other separate tenements (as described above). For example, there is a clear need to determine who owns the property above, below and around each flat. This includes the residual parts of the flatted building (the common or shared areas) not encompassed by a flat: e.g. the lifts, stairwells, halls, and roof. More importantly, as maintenance of these attracts a cost, who pays for the maintenance of these 'shared areas'?

van der Merwe (2002, pp. 110-111) provides a useful illustration of an early attempt at strata ownership within what would later become Germany. From the 12th Century a number of mixed use multi-storey buildings were allowed to have different units held by different owners. However, the rights and duties of the owners in terms of the management and maintenance of the building were not clearly demarcated. This led to disputes. So many disputes that such apartment ownership was no longer legally recognised in the subsequent codification of the legislation for the German states.

The inability to resolve maintenance of shared ownership is a significant issue: in many jurisdictions the general property law alone does not permit positive obligations in perpetuity on owned land (this includes the payment of fees: see, for example, Dixon (2018, p. 341)). Hence, in general, orthodox property law is not adequate for the ownership of vertical property where encumbering *positive obligations* are required.

The approach taken in England and Wales to solve this problem is to ignore strata ownership completely. Instead vertically subdivided properties are leased rather than owned (Paulsson, 2007, p. 39). The fundamental difference between a leasehold and ownership is twofold:

1. leasehold is time limited - meaning that the contract expires and is not 'in perpetuity'.
2. leasehold can be used to reflect a wider range of positive and negative rights than ownership. This generally includes the ability to grant positive obligations (e.g. for rent and repair) that '*run with the land*'.

It should be noted that while commonhold ownership was introduced into England and Wales in 2004, according to Great Britain & Law Commission (2020) less than 20 commonhold developments have been registered demonstrating an overwhelming developer, citizen or lender preference for leasehold. However, citizens in many jurisdictions value ownership over leasehold (van der Merwe, 2002, p. 126; Sherry, 2016, p. 11) and so the solution chosen by England and Wales is not universally appealing.

Throughout the 20th Century different jurisdictions enacted legislation which permitted or strengthened the rules governing the creation of cooperative residential and commercial complexes (Paulsson, 2007, p. 44). Such legislation allows the division of a building into individually owned property (strata (airspace)) and collectively owned (shared) common property, governed by a set of rules supported by a juridical body corporate or equivalent (e.g. a housing association). Significantly, from a legal point of view, such legislation permits

positive obligations which '*run with the land*'. These approaches resolved a range of social housing pressures and have been extended to include horizontal '*cooperative*' ownership.

Horizontal '*cooperative*' ownership differs from vertical ownership by virtue of the nature of ownership: the former is principal land and the latter is strata. Sherry (2016, p. 4) refers to horizontal subdivisions as 'community titles'. While vertical and horizontal *cooperative* ownership have different forms of ownership types, they both have relationships with shared property (lifts, stairwells, halls, car park, roof and surrounding land) that usually require the ongoing recurring payment of associated charges to support maintenance. In this paper we will refer collectively to horizontal and vertical ownership as cooperative ownership (Paulsson (2007, p. 55) discusses this cooperative dimension). It should be noted that, conceptually, there is nothing that stops the creation of a community which comprises of both horizontally and vertically owned units.

This paper focusses on the efficient modelling of cooperative ownership rights to support registration in a Land Register. Land Registers are formal systems that operate under a legal mandate. The legal concepts represented in a Land Register reflect the changing relationship between citizenry and the state that have evolved over time. Modern land registers are digital: data needs to be structured and managed effectively so that services can be efficiently delivered. Viewing the register, and the associated registration process, as a data storage, indexing, and retrieval problem is crucial. The need for effective indexing is well understood: all registers need to consider efficient information retrieval whether they are paper-based or digital.

There are certain patterns that can be adopted to support efficient modelling: these will be discussed. This paper is in part idealised - it has been developed to support (semi-) automated registration and inference by formally describing rights and rights relationships. It does not adopt a position of providing complete or '*semantically rich specifications*' (Çagdas et al., 2018, p. 46). Rather, and in common with registers around the world, registration provides enough detail for legal certainty about the registered rights. While the register is legally complete it may not necessarily be regarded as explicit for a lay-person: by necessity the interpretation of rights is supported by the defining legislation. Hence, the legislation expresses many operational and functional properties of rights independently of the register itself. When the legislation changes, any changes may re-frame rights interpretation retrospectively or have no retrospective impact.

This paper does not concern itself with specifics of any individual jurisdiction. However, it does attempt to draw out generic patterns which can be used to support efficient indexing and retrieval in a Land Register.

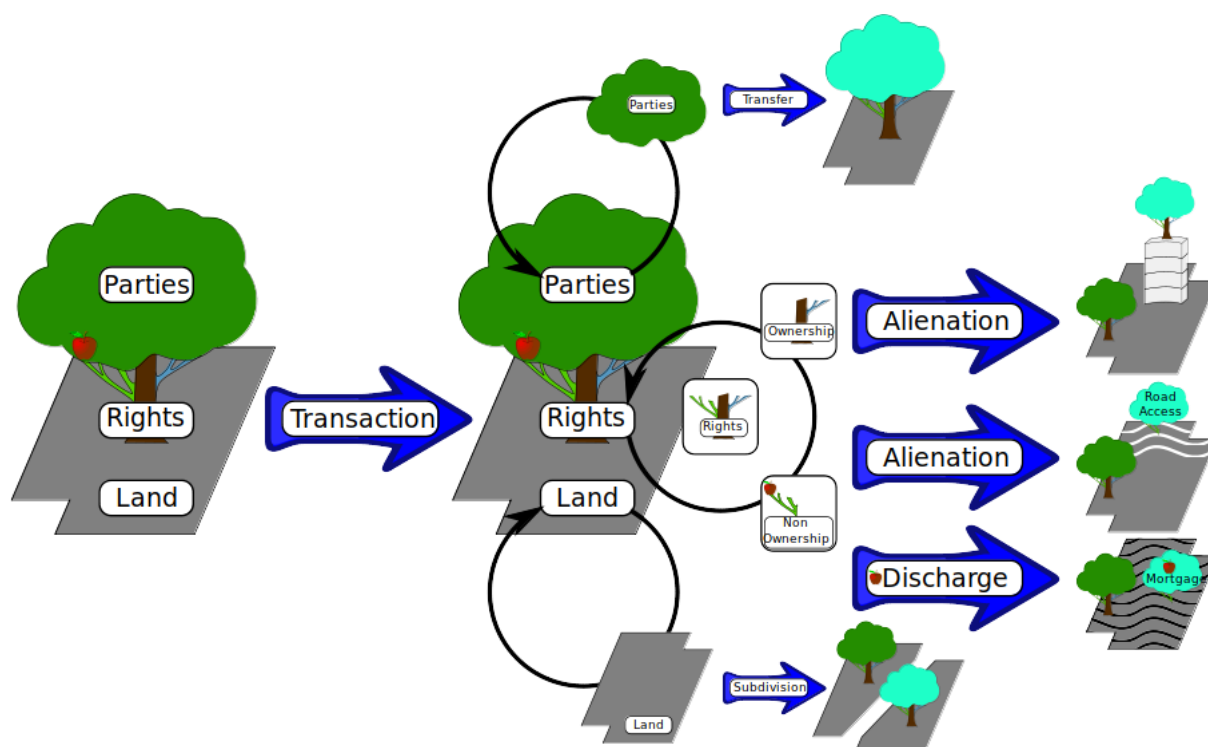


Figure 1. How in personam transactions can change Party, Rights and Land relationships (Beck, 2021). Similar thinking is seen in Figure 1 of Bennett et al. (2021) and Figure 4.8 of Zevenbergen (2002)

2. REGISTRATION PROCESSES: CONVEYANCING AND TRANSACTIONS

General conveyancing practice tends to be based on legal instruments: *in personam* contracts between a granting party (normally a right holder) and a grantee (benefitting) party. By alienating 'use and service' rights and granting them to third parties, owners can develop nuanced governance strategies associated with land. This is essential for establishing cooperative community ownerships with complex shared ownership schemes (such as condominiums or flats). Rights granted in this manner could be considered as the equivalent of *sticks* in the *bundle of sticks* model (see Baron, 2013; Simpson, 1976, p. 7; Merrill & Smith, 2011, p. 10).

As described in Figure 1 owners can vary their ownership in terms of a party, right or land dimension. A *party variation* allows an owner to transfer (sell) all or part of their property. All such transfers are *in personam* - the legal instrument which describes the variation specifically identifies the third party grantee who benefits from the rights transfer. A *rights variation* allows an owner to alienate rights (such as access, or security) which can then be transferred to third parties. A *land variation* allows an owner to split their ownership in to multiple spatial parts some of which can then be transferred to third parties. Under certain circumstances right holders have powers to discharge the right they hold (most commonly seen with security rights).

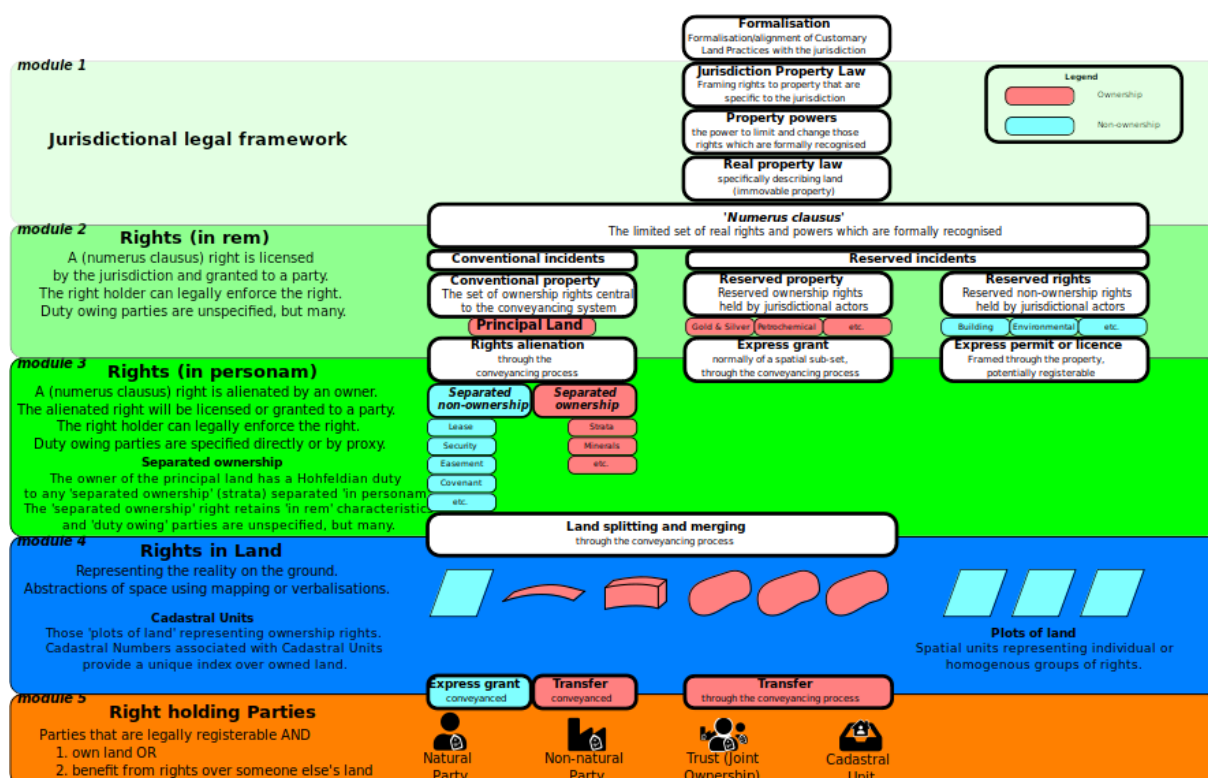


Figure 2. The modular arrangement of rights relationships (Beck, 2021). Conveyancing activities are described in modules 3-5 where respectively right, land and party variations occur

Party, right and land transactions are required in order to support a developer transforming principal land in to a cooperative title with potentially complex rights relationships between owning parties and land. The nature of these transactions are summarised in Figure 2. Where *real rights in land* are legally separated (alienated) from the **owned land**: the separated real rights can represent *ownership* or *non-ownership* rights.

The ownership and non-ownership rights will have a spatial extent (either expressed as geometry or verbally (grounded in respect of the principal land from which the right was separated)). Land owners have a duty to non-ownership right holders to allow them to enjoy their right. Right holders have a claim over the land owner framed through the spatial extent of their right.

As outlined in Figure 3 the separation of ownership rights is more complicated. While the separated ownership right has been granted *in personam* and falls within the spatial volume implied by the principal land, the owner of the separated ownership has an exclusive right *in rem*. This means that the owner of the principal land owes a duty of non-interference to the separated strata ownership. The separated ownership is an *encumbrance* on the principal land. Where ownership is expressed in 2-dimensions then the implication of this duty should be clearly articulated on any Title derivative from the Land Register.

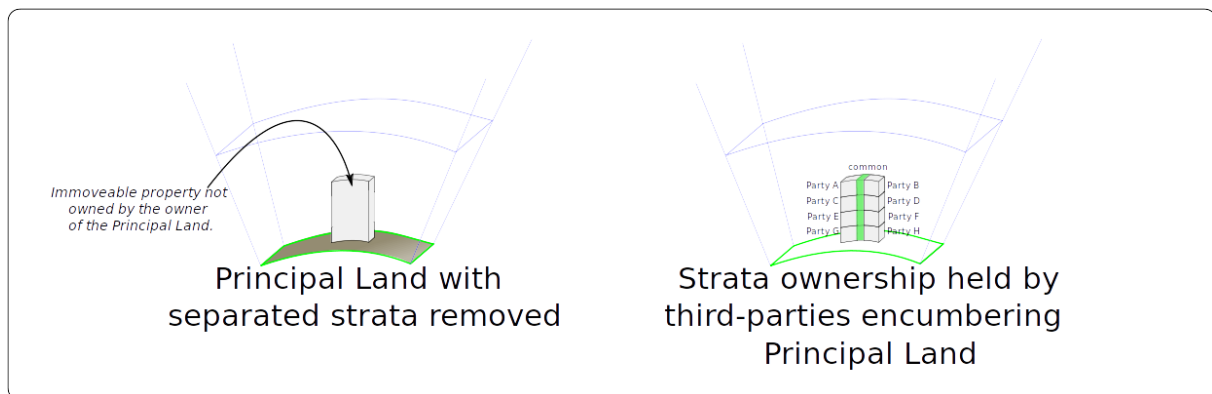


Figure 3. Separation of strata ownership rights. The illustration conceptually describes how a volume of strata (that represents, for example, a flatted property) becomes separated from the volume of ownership implied by the principal land (Beck, 2021). It describes how the new owner owns the strata and the owner of the 'principal land' is owner of the remaining implied strata

Lawyers and notaries need to know *what* rights are registered, *where* they have affect and *who* they are held by so that they can write deeds that change the rights relationships in the Register. This requires the ability to unambiguously reference party-right-land relationships (this is defined as the specificity (originally *speciality*) principle by Henssen (1995, p. 7)). Party, right, land and deed indexing provides an unambiguous way to directly reference each element of the party-right-land bundle. Party verification and designation during registration allows *the who* to be uniquely identified. The formalised sub-set of registerable rights (*numerus clausus*) allows *the what* to be easily identified. Where the right is ownership *the where* is a *cadastral unit* that uniquely identifies each owned *plot of land* and the associated spatial representation in the **cadastral map**. Deeds can be uniquely identified along with their associated party-right-land bundles. Where such indexing exists it is also possible for a party-right-land model to emulate a Deed and can therefore represent state-change.

2.1 An illustrative conceptual example

An example will help to illuminate the above discussion. Figure 4 is a conceptual representation of how different principal land and strata ownership cadastral units can be created from the original land parcel and the resulting party-right-land relationships which can be used to articulate rights and responsibilities. It should be emphasised that this is only one way to model these relationships. There are other ways in which these relationships can be modelled: some of these approaches may be mandated in the registration legislation that is unique to each jurisdiction. This is a sparse model: it demonstrates the relationships between the indexed entities in the land register. To understand the full legal ramifications of these relationships reference will need to be made to the supporting legislation.

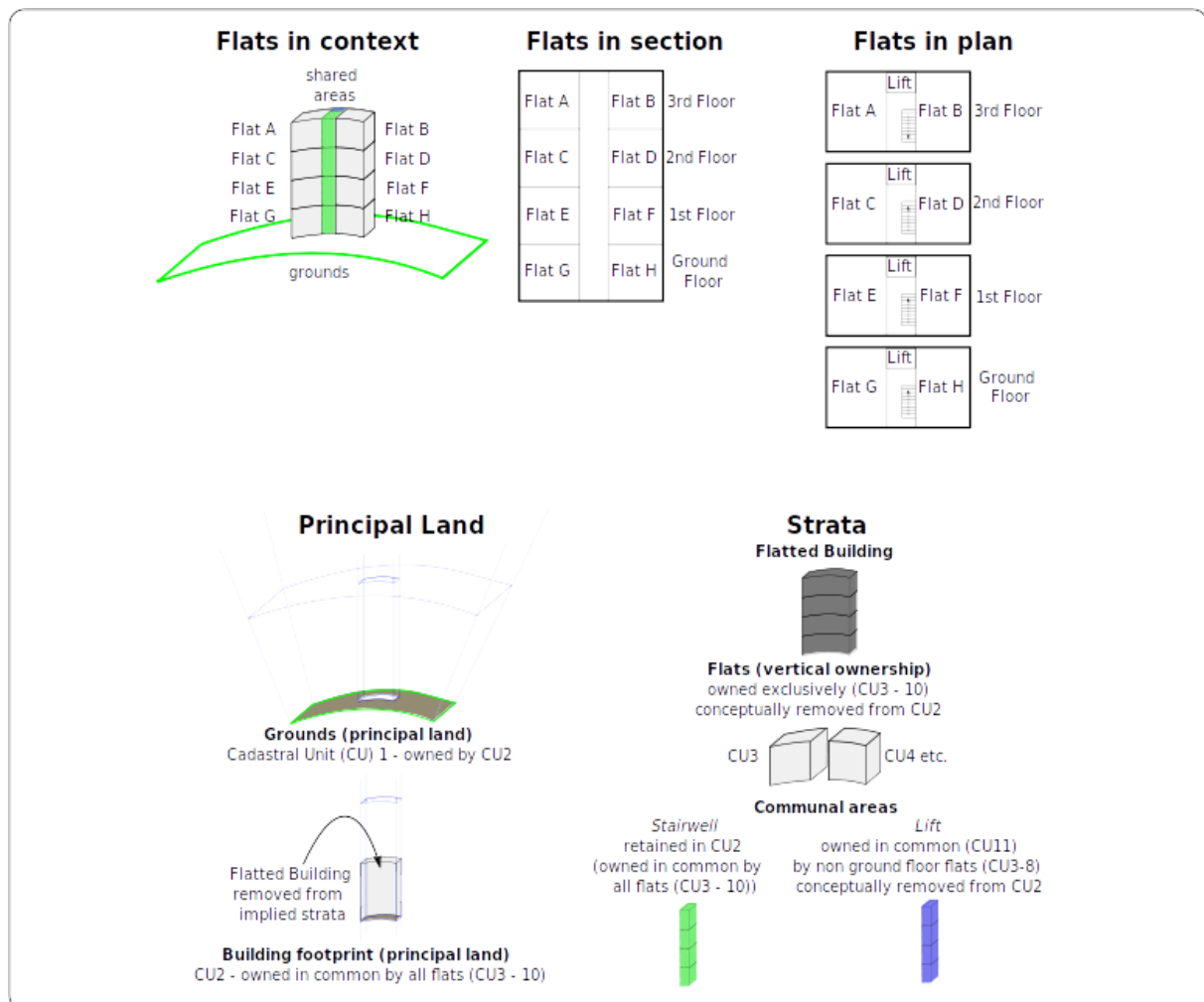


Figure 4. A conceptual illustration demonstrating the evolution of a cooperative strata title (Beck, 2022)

The registration process is as follows. The developer would:

1. purchase the principal land: Cadastral Unit (CU) 1.
2. alienate the building footprint as principal land from CU1 (a land transaction as described in Figure 11) resulting in CU2.
3. transfer the ownership of CU1 to CU2 (a party transaction).
 - This is a praedial relationship - land has rights in other land: CU2 owns CU1.
 - From a legal point of view land can not own land. However, the owner of CU2 (the developer) *inherits* the ownership of CU1 by proxy.
 - A praedially held right *runs with the land*: when CU1 is transferred to a third party the inherited, proxy, ownership of CU2 is also transferred.
4. build the block of 8 flats with associated *shared areas* for stairwells and a lift.
5. alienate each flat from CU2 (a rights transaction as described in Figure 5) resulting in CU3-10.
 - The flats are no longer, conceptually, part of CU2 (the owner of CU2 (the developer) has a Hohfeldian duty on CU3-10).

- The owner of CU2 (the developer) is still the owner of the *shared areas* in the flatted building.
- 6. alienate the lift space from CU2 (a rights transaction) resulting in CU11.
 - The lift is no longer, conceptually, part of CU2 (the owner of CU2 (the developer) has a Hohfeldian duty on CU11).
 - The owner of CU2 (the developer) is still the owner of the *shared areas* in the flatted building.
- 7. transfer a 1/8 ownership share of CU2 to every flat (CU3-10: a party transaction).
 - CU2 is now owned in common by the owners of the flats (which, at this stage, are still all owned by the developer). Hence, the flats are the owners in common of the *shared areas* in the flatted building.
- 8. transfer a 1/6 ownership share of CU11 to the non-ground floor flats (CU3-8: a party transaction).
 - CU11 is now owned in common by the owners of the non-ground floor flats (which, at this stage, are all owned by the developer).
- 9. transfer ownership of each flat (CU3-10) to a third party (a party transaction).

The developer now no longer holds any legal interest in the development

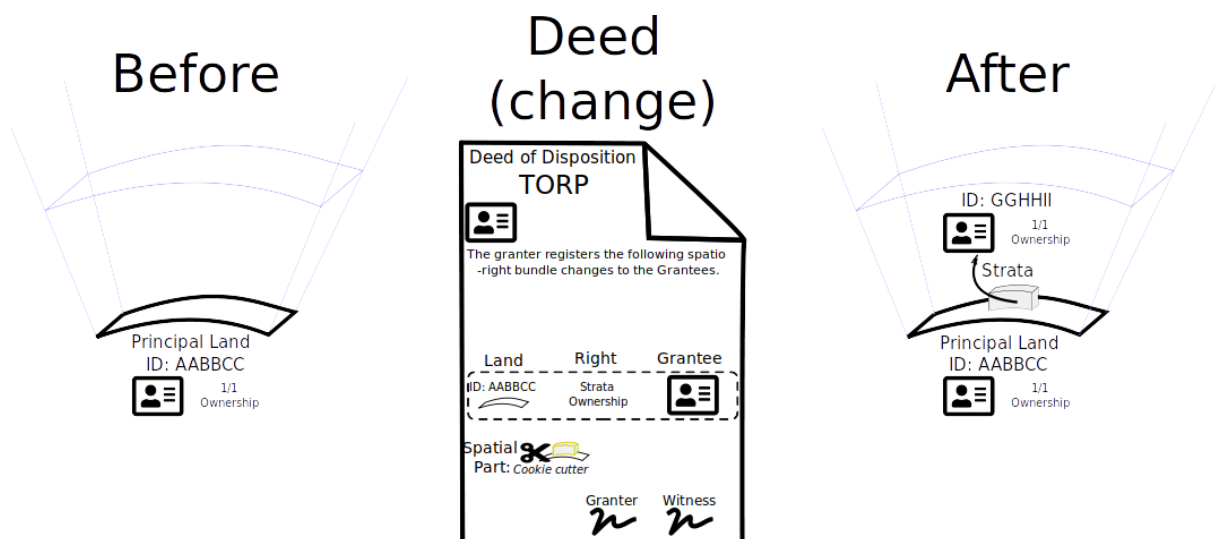


Figure 5. Transfer of Right Part (TORP) - a parent principal land (solum/freehold) cadastral unit is legally subdivided to create an alienated strata cadastral unit (Beck, 2022)

Until the final stage the developer is the named owner of all the flats. By logical entailment of the praedial relationships the developer is also the proxy owner of a 1/1 ownership right in all the strata and principal land cadastral units. By transferring the ownership of the flats to third parties, the developer ultimately relinquishes their interest in the cadastral units. By selling the final flat the developer no longer holds any legal interest in the development. However, the owners of the flats now have a formalised rights relationships which is augmented by the supporting legislation. For example, the owner of flat CU8 has the following rights articulated directly in the register (see Figure 6):

- Exclusive strata ownership of the flat (CU8).
- An inherited (child) 1/6 ownership interest in the strata representing the lift (CU11).
- An inherited (child) 1/8 ownership interest in the principal land representing the flatted building (CU2):
 - This includes the shared areas and the remaining strata above and below the flatted building.
 - This excludes the duty restrictions to any of the other exclusively owned flats and the lift.
- An inherited (grandchild) 1/8 ownership interest in the principal land representing the grounds (CU1) due to ownership interests with CU02.

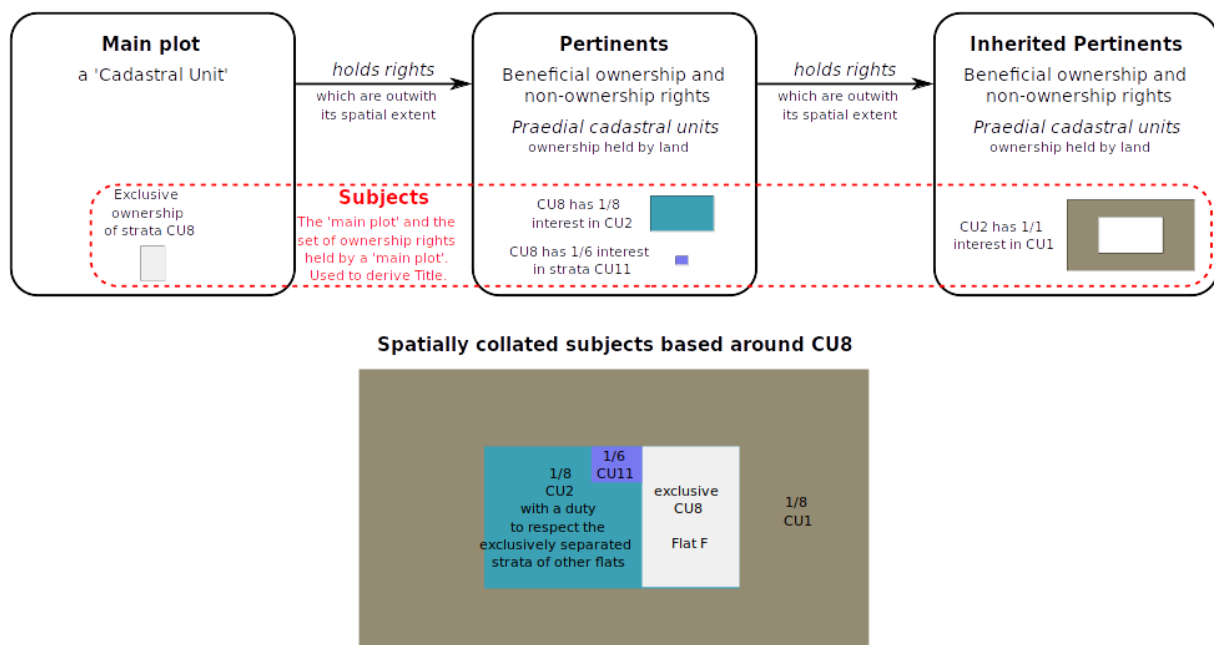


Figure 6. A conceptual representation of the subjects derived from registered cooperative community data: a combination of strata and principal land ownership (Beck, 2022)

Beyond the duty to the other flats all further restrictions and responsibilities will be articulated in the supporting legislation (which is likely to also provide rules relating to the physical limits of any recorded boundaries (van der Merwe, 2002, p. 105)). Common ownership of the communal areas has obvious implications. Each individual owning party must respect that the other owners have equal rights of use and enjoyment to the common property. Any alterations or improvements can only occur with the co-operation of the other owners. Maintenance becomes a collective responsibility, resting either directly with the owners or indirectly through the corporate body (van der Merwe, 2002, p. 102). In this model it is likely that lift maintenance will become the responsibility of the owners of the non-ground floor flats. Nuanced relationships, such as this, are essential for effective governance of cooperative titles (Paulsson, 2007, p. 310). Obvious variations to this illustrative model include scenarios where:

1. there is no need to separate CU2 from CU1 (although this scenario is required if multiple blocks of flats share the same grounds).
2. disconnected praedially owned principal land or strata exist. In such scenarios new cadastral units can be created and praedially allocated to the appropriate flat cadastral unit (van der Merwe, 2002, p. 113) .
3. the body corporate own the flatted building and flat owners are trustees in the body corporate.
4. some jurisdiction may not be interested in fractional subdivisions of any praedially owned common areas. They may simply model 'collective ownership' or 'tenancy in common' where ownership is equally shared between all owning parties (van der Merwe, 2002, p. 101; Paulsson, 2007, p. 37).

2.2 Sparse registration

The point on what needs to be included for registration is important. For example, the determination and distribution of fractional shares is clearly important to owners in common and can have a relationship with voting rights in any body corporate (Paulsson, 2007, pp. 64-67; Çağdas et al., 2018; Çağdaş et al., 2020). However, from a registration point of view common ownership fractions from cooperative ownership are no different from fractional ownership of other land owned in common. While the Registrar may be aware of the fact that fractional ownership shares have a role to play in voting rights within a body corporate, it is generally not the Registrar's responsibility to record off-register legal implications on the Register itself. If such information is, or becomes, inaccurate then the Registrar may be liable for the error. If the owners or body corporate decide that they want to change the nature of the share allocation then this must be legally communicated to the Registrar where, if accepted, it will be registered for a corresponding fee. This paper assumes a position of minimal or sparse registration.

3. LEGAL CONCEPTS

The literature defines two general legal approaches to structuring cooperative titles (Stoter, 2004, pp. 32-33; Paulsson, 2007, p. 36; Paasch & Paulsson, 2021, p. 17):

1. Dualistic (condominium ownership) model and
2. Monistic (condominium user right) model.

Stoter (2004, pp. 32-33) defines the dualistic model as follows:

Every apartment owner has the full ownership of a part of the building (apartment). The communal areas of the building, such as staircases and elevators are held in co-ownership. This can be described as compulsory co-ownership, or an accessory restricted co-ownership. "Accessory" because it cannot be separated from the ownership of the apartment, "restricted" because during the time the building is divided into apartments, the separation and division of the common areas is not possible.

The dualistic approach relies on the ability to distinguish between the different ownership relationships between registered cadastral units. Both the *accessory* and *restricted* elements

are important distinctions. *Accessory* is semantically equivalent to *pertinents* (ownership and non-ownership rights which benefit owned land (a cadastral unit): see Figure 6). *Restricted* describes the set of parties who are allowed to participate in the rights relation (flat owners - see CU2 in Figure 4). Using such specialisms we see how strata ownership can be refined using rules to reflect the needs of residential ownership within a flatted building. We will formalise concepts that describe these specialisms below.

Stoter (2004, p. 33) defines the monistic model as follows:

The owners of the apartment units are joint owners of the entire building and the ground below. The underlying ground may consist of several parcels which can be disjoint. The co-ownership includes the right to have the exclusive use of a certain part of the building: the apartment unit. This means that the persons do not legally own a separate apartment unit, although the apartment ownership can be mortgaged.

The monistic approach relies on the ability to register a party share in a flatted building while enumerating the exclusivity associated with each ownership share. The owner has a real right in the flatted building, but exclusive access to an apartment in the same building granted *in personam*, by the developer, at point of first registration. The share in the flatted building and the right to exclusively use an apartment are treated as one. When an apartment is sold, the share of ownership in the flatted building (which includes exclusive use of part of the building) is transacted to a third party. Each owner will need an agreement with the other owners that exactly describes the part of the building to which they have exclusivity. This agreement is also likely to contain provisions regulating a variety of matters including costs of maintenance and general upkeep. Bodies corporate, or their equivalent, support these management activities.

The major distinction between the two types appears to be framed around the '*superficies solo cedit*' principle. "If the owner of the land is considered also as the owner of any buildings erected on it" (Paulsson, 2007, p. 56) the *monistic* model is used. If strata representing an apartment is recognised as distinct and registerable real property (independent of the principal land from which it has been separated) then the *dualistic* model can be used. In terms of *cooperative* titles which comprise of mixed horizontal and vertical ownership condominiumia then it is possible to encounter a jurisdiction that requires to use both models simultaneously: the dualistic to model horizontal ownership and the monistic to model vertical.

3.1 A note on by-laws and the bypassing of numerus clauses

Legislation supporting cooperative titles tends to mandate the creation of a body corporate (or similar organisation) with the power to raise levies for the maintenance, insurance and administration of the building, as well as the power to create and enforce by-laws (Paulsson, 2007, p. 61; Paulsson, 2007, p. 67). While these by-laws are required to create enduring restrictions and obligations affecting the multiple ownership entities that make up the community, the range of possible by-laws can be broad. These can include the general provision for by-laws relating to 'use'. The tension is that by granting housing associations the power to make by-laws, the legislature has authorised private citizens to make rules regulating other people's homes. Unchecked this threatens to undermine the numerus clausus principle,

allowing all manner of rights to be arbitrarily enforced by the housing association. It is therefore important that the powers expressly or impliedly given to housing associations by statutes are well understood and mechanism put in place to ensure that they are not abused (Paulsson, 2007, p. 68; Sherry, 2016, p. 165).

4. CONCEPTS TO SUPPORT REGISTRATION PATTERNS

In broad terms the dualistic and monistic approaches respectively take a *cadastral unit* (owned land) and *party* approach to registration. We shall initially consider the party concept.

4.1 Party patterns

In terms of *registration* parties describe the *things* that can hold *registerable rights* defined by *land*. The types of registerable party that participates in a rights relationship is described in Figure 7.

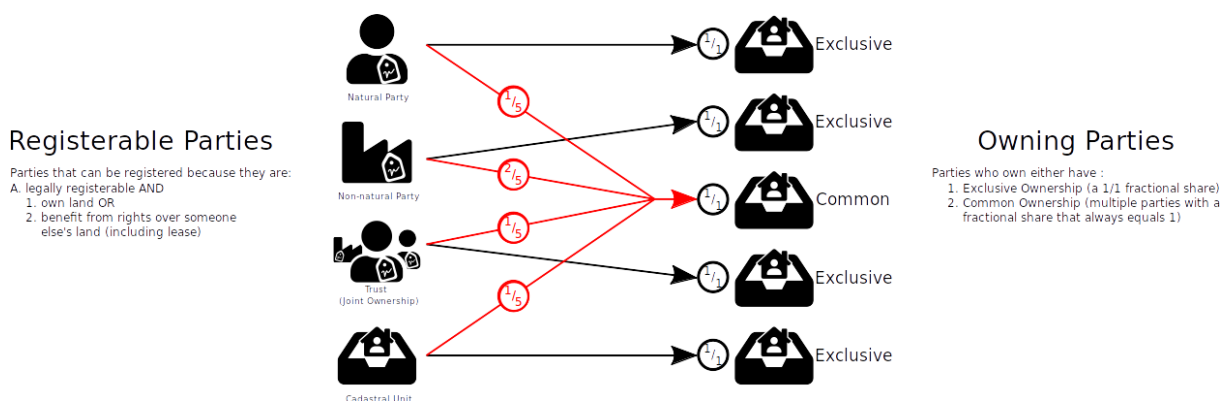


Figure 7. Registerable parties and how they can own land (exclusively or in common). After Beck (2021)

As described above, the monistic approach relies on the ability to register a party share in a flatted building while enumerating the exclusivity associated with each ownership share. This involves registering a party and ensuring that this party can have their beneficial rights articulated either on or off-register. There are a number of ways in which this can be achieved.

Parties can either own things exclusively or in common (a fractional share with other parties). When property is owned in common each party with a fractional share generally has the ability to independently transfer some or all of their share, without requiring the permission of the remaining share owning parties. Any transfers from exclusive or common ownership tend to be recorded on the Land Register.

However, non-natural parties and trusts can be used for the monistic approach. Non-natural parties are formalised legal entities such as companies, and charities. Trusts, also referred to as joint ownership, are a legal vehicle and can articulate land ownership for trustees on behalf of beneficiaries (in this case, residents). The trust acts as an independent vehicle representing the collective views of the trustees.

There is some debate over the definitions of joint and common ownership. In Scotland they are defined by (Reid et al., 1996, pp. 28-29) as follows: "*common property is the dominant form of pro-indiviso (shared) ownership and joint property is probably confined to the two cases of trust ownership and ownership by unincorporated associations.*" However, the Wikipedia page on *Concurrent Estate* demonstrates a lack of consensus globally. It would help if such cross jurisdictional terminological and conceptual inconsistencies could be bridged.

Irrespective of the semantics both non-natural parties and trusts, as juristic parties, can be used as vehicles for registration in the monistic model. The juristic party is the formal owner on the register and grants rights of occupancy to residents. In such a model the juristic entity would also take on the role of management and maintenance. It is also likely that trustees or the company board would comprise of all the residents. This could be classed as a form of ownership, however, it is indirect, and the resident will, at best, have a personal, rather than a real, right (Paulsson, 2007, pp. 39-40).

4.2 Cadastral unit patterns

Pertinents are a concept in Scots law that have important generic modelling ramifications (see Figure 8). Reid et al. (1996, p. 161) describe pertinents as follows: "*a landowner may sometimes hold rights in respect of heritable property beyond his own boundaries. Rights of this kind are known as 'pertinents'.*" Pertinents is legal shorthand for describing both ownership and non-ownership rights which automatically pass to successive owners of land by implication (Reid et al., 1996, p. 164; Gretton & Steven, 2017, p. 224). Conceptually, a real right in land is held by a party in their capacity as *owner of land*. Hence, a cadastral unit is the right holding party as a proxy for the owning party.

Relationships where a cadastral unit is the holder of rights in other land are referred to as praedial. The most common form of this relation is a non-ownership easement right (normally a right of access) which is (after Paulsson, 2007, p. 79): "*granted in favour of one or more other property units.*"

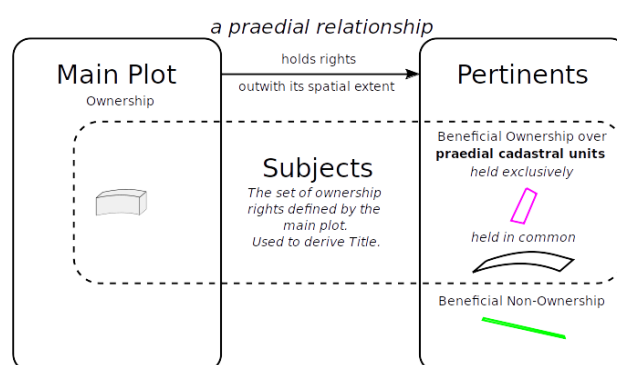


Figure 8. The main plot, pertinents, praedial relationships and the definition of subjects (Beck, 2022)

Praedial relationships result in an important emergent property: rights which are held praedially are automatically transferred when the right holding cadastral unit is sold. Praedial rights are said to *run with the land*. Where rights *run with the land*, such as a *right of access* over a neighbouring property, a real right in land is held by a party in their capacity as *owner of land*. Conceptually, the right is registered as a benefit to the dominant, right holding, cadastral unit acting as a proxy party for the real owners. When the dominant cadastral unit is sold the benefit automatically travels with the land and becomes a benefit to the new owner (Simpson, 1976, p. 6).

While praedial relationships are most often used to describe non-ownership rights relationships, they can also be used to describe ownership rights relationships. Such ownership rights will be held over cadastral units based on principal land or any other alienated sub-ownership right (such as strata). We have referred to cadastral units which are owned by other cadastral units as praedial cadastral units (see Figure 8). Praedial cadastral units can be used to model a range of scenarios including:

- shared driveways,
- the remaining areas of a housing development that are held in co-ownership,
- flatted building (when conceptually co-owned by flats (see Figure 4)),
- pends (see below),
- car parking spaces and bin stores.

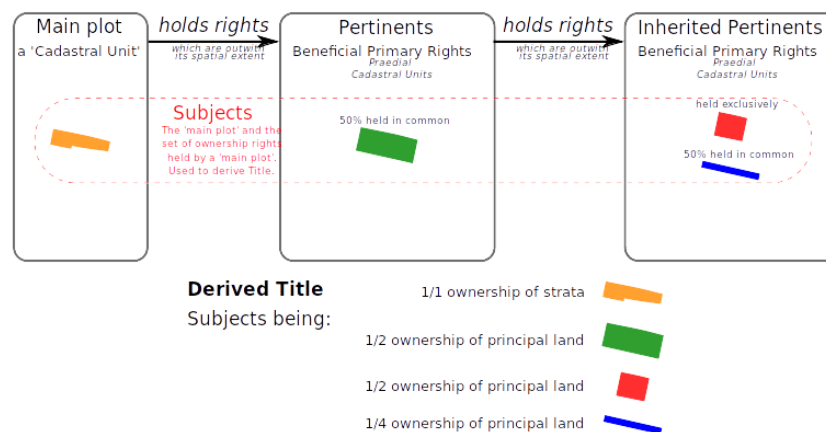


Figure 9. The concept of inheritance between a main plot cadastral unit and praedial cadastral units, and the impact this has on the set of subjects (Beck, 2021)

Inheritance (see Figure 9) is an emergent concept which is implied by chained praedial cadastral units. For example:

**if a cadastral unit 'A' has:
ownership interest in a praedial cadastral unit 'B' which in turn has:
ownership interest in a praedial cadastral unit 'C'.
What is the relationship between 'A' and 'C'?**

Conceptually, 'A' inherits a beneficial ownership interest in 'C' from 'B'. This should be narrated when Title is derived for 'A'. This inheritance principal is theoretically infinite. Subjects (see Figure 8 and Figure 9) is also an emergent concept which is implied by praedial cadastral units. Subjects represents the set of ownership rights that are implied from a single cadastral unit. The set of subjects is essential when deriving Title in a rights driven register. Within a rights driven register Title can be defined as follows:

- the principal ownership right (the main plot cadastral unit)
 - which directly benefits the owner.
- other beneficial rights *held by* or *inherited from* the main plot (a party indexed relationship):
 - non-ownership rights and
 - ownership rights
 - the main plot cadastral unit and the set of praedial cadastral units define the subjects.
- non-ownership rights that encumber the subjects (a spatial or party indexed relationship):
 - rights of use over the land that are shared for the benefit of third parties (responsibilities).
 - rights granted to third parties that produce positive obligations on the owner (responsibilities).
 - rights exclusively held by third parties (restrictions).

In such an approach subjects are a key element of the index which supports the identification of those rights which encumber the set of ownership rights held by the owner.

Finally, there is the special case of cadastral units which act as a main plot (see Figure 8 and Figure 9). A *main plot* cadastral unit is the cadastral unit from which Title is derived. The implication is that there are some cadastral units which will never be used to seed the derivation of Title. This is the case for praedial cadastral units which are held exclusively by another cadastral unit. Where the data quality and registration law in a jurisdiction is appropriate there is a strong argument to mandate that where a praedial cadastral unit is fractionally owned then the remaining fractional share **must** also be held by a cadastral unit. This would mean that the praedial cadastral unit concept is never used as a main plot to formally derive Title.

4.3 The application of registration patterns

Transactions are tools that allow a deed, or collection of deeds, to place a Land Register in a new target state. As long as it is legal the granter can use any transactional pathway they desire to achieve a new registration state. Hence, the registration process is not idealised and in many jurisdictions the Registrar must unquestioningly follow the instructions in a deed. However, the Registrar also tends to have a range of powers that support the management of the register. Key to this is ensuring that indexes (especially spatial indexes) do not become too fragmented. For example, in Scotland the Registrar has the power to merge distinct cadastral

units which appear on the same Title (see section 12.3 in LRSA (2012, p. 5)). The registration concepts described in the previous section can be used to support the indexing of relationships and individuals in a party-right-land model. If the concepts are used to support the creation of a deed, or if a Registrar is granted appropriate powers then the Registrar can combine the concepts to generate efficient registration patterns.

4.4 A refined example: a pend

In this paper we have described the use of registration concepts to address dualistic or monistic approaches. These concepts are generic. To demonstrate this we will use them to model a pend scenario. According to wikipedia a pend is: "*a Scottish architectural term referring to a passageway that passes through a building, often from a street through to a courtyard or 'back court', and may be for both vehicles and pedestrian access or exclusively pedestrians.*" One of the terraces exclusively owns the strata (representing the connecting structure of the terrace above the void created by the pend). In addition, the owners of the adjacent properties must both be able to access the 'back court'. This could be modelled as a simple right of access that is granted to the neighbour who does not own the connecting structure. However, as a right of access the ability to share costs for the maintenance of the pend is reduced.

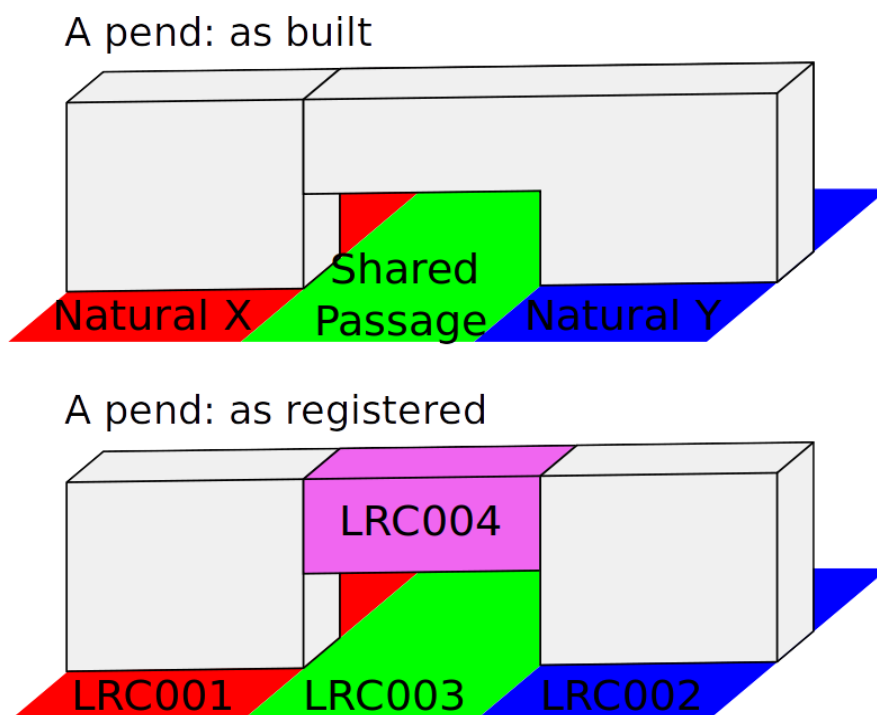


Figure 10. The pend scenario (Beck, 2022). This scenario occurs when a pend between two terraces in which one of the terraces exclusively owns the strata (representing the connecting structure of the terrace above the void created by the pend)

The registration concepts described in this paper provide more ways to model this scenario. For example, to register the scenario outlined in Figure 10 the developer would:

1. purchase the principal land: Cadastral Unit LRC000 (not seen).

2. build the terrace, including the pend.
3. split the footprint of the terrace and the pend from LRC000 (a land transaction as described in Figure 11) resulting in LRC001, LRC002, and LRC003.
4. alienate the connecting structure of the terrace above the void from LRC003 (a rights transaction as described in Figure 5) resulting in LRC004.
5. transfer the ownership of LRC004 to LRC002 (a party transaction).
 - resulting in the strata representing the connecting structure to be a pertinent of the adjacent land.
6. transfer a 1/2 ownership share of LRC003 to LRC001 and LRC002 (a party transaction).
7. transfer ownership of each terrace LRC001 and LRC002 to a third party (a party transaction).

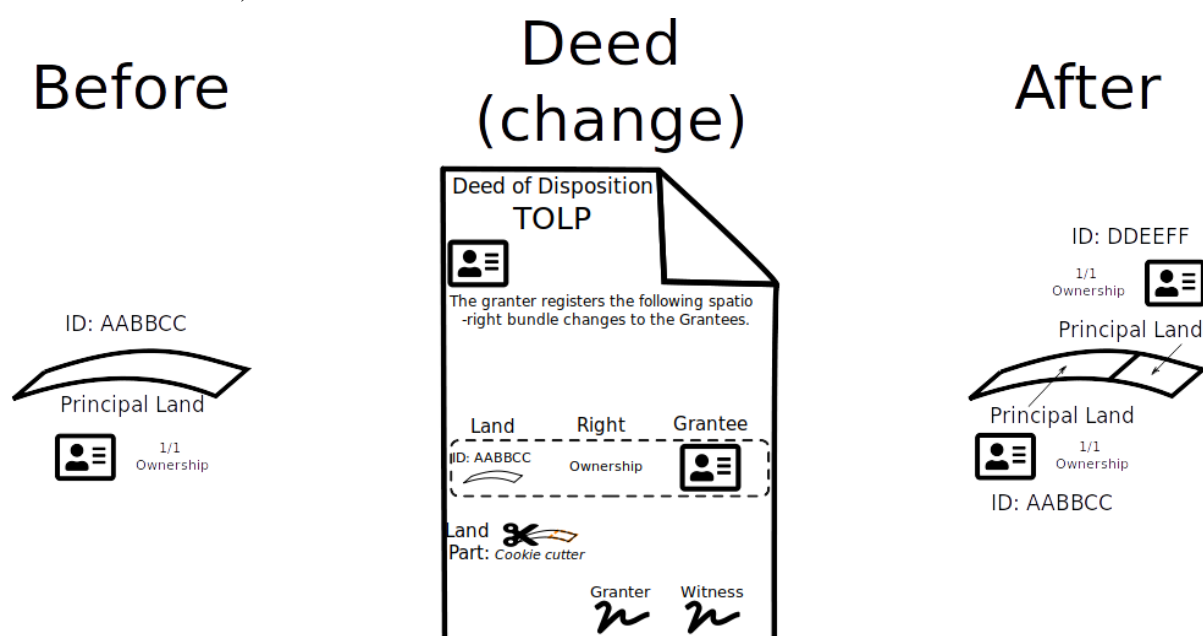


Figure 11. Transfer Of Land Part (TOLP). A cadastral unit is spatially subdivided to create two smaller cadastral units (with the same right type). After Beck (2022)

5. CONCLUSION

Cooperative Titles represent complex rights relationships between property owners who have a formalised, cooperative, relationship with other property owners. While every jurisdiction uniquely frames these relationships in a manner which suits their citizens there are common structures and patterns which can be generically applied to cooperative Titles. These patterns can support efficient indexing and registration practices. This paper has described conceptual primitives which can be combined to create efficient registration patterns. Such patterns will support (semi-) automated registration and the derivation of state models (such as a Title) from registered rights. However, the application of these patterns will, in part, be dependent on the nature of the legislation in each jurisdiction.

Praedial cadastral units are key to this conceptual approach. A cadastral unit is a registered representation of owned land. A praedial cadastral unit is a cadastral unit which is owned (held) by another cadastral unit (a similar rights relationship to an easement). In such a situation the dominant cadastral unit *inherits* the share of the ownership from the praedial cadastral unit. Inheritance from praedial cadastral units can be chained in a theoretically infinite manner.

As demonstrated in the pend example, using such approaches it is possible to articulate complex rights relationships in a refined and granular manner. As the range of *numerus clausus* rights evolve in new ways to reflect on-going social and technological developments then more refined ways are needed to segment rights, articulate rights relationships and register their implications.

We agree with Paasch & Paulsson (2021, p. 12)) on the importance of terminology. In this paper we have attempted to explicitly ground our terminological concepts. Unfortunately, in the process, we have invented new terminology as we found semantic ambiguity in some of the terms. We will be incorporating this work in a *first order logic* OWL ontology that explicitly grounds the terms, articulates the relationships between terms and supports automated reasoning and inference.

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BIOGRAPHICAL NOTES

Ordnance Survey is the national mapping agency for Britain, and a world-leading geospatial data and technology organisation. Accurate location data is used for smarter solutions to the world's most complex problems including resource management, urbanisation and population growth. As a trusted partner to government, business and citizens across Britain and the world, our expertise and technology helps customers in government, business and infrastructure deliver efficient services.

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Anthony BECK is a geospatial and analytics professional with a strong mix of technical, commercial, academic and policy skills. He has experience of delivering repeatable solutions using an inclusive and interdisciplinary approach, involving GI-Science, Knowledge Engineering, and Data Modelling. One of Anthony's key skills is demonstrating the link between concepts, data, policy, and practice. Anthony is a Concept and Data architect. He is lead author on many academic journal publications that cover different domains: these include land administration, utilities, heritage, smart cities, and addressing. He holds a PhD in heritage remote sensing applications and advises specialist, policy, and standards bodies. He has won a number of industry awards including work on the integration of underground utility assets and the PAS128 utility standard. He was short-listed for the Institute of Civil Engineers entrepreneur of the year award. Anthony is fluent with ISO19152 (Land Administration Domain Model (LADM)) and is contributing to the ISO19152 version 2 revision. He is interested in approaches that improve registration automation and first-order logic modelling of the registration domain.

Duncan MOSS has over thirty-five years' experience working for world-renowned national mapping organisation Ordnance Survey (OS). Based in Edinburgh, Scotland (UK) Duncan is currently a Principal Consultant within OS's Consultancy & Technical Services Team where he focuses on supporting public sector organisations around the strategic and operational use of geospatial technology and information to deliver positive impact as part of the Public Sector Geospatial Agreement. Duncan has worked closely with Registers of Scotland on many projects from 2000 onwards and has a keen interest in land administration. He has also acted in an advisory capacity to OS's international customers in a range of areas such as; major events, resilience, geospatial intelligence and land administration. Duncan is very active in his professional body the Royal Institution of Chartered Surveyors (RICS) where he currently serves as a member of its Global Land & Resources Sector Advisory Forum and as part of the Boundaries Expert Working Group. He also represents RICS as Head of UK Delegation to the Council of European Geodetic Surveyors (CLGE), where he is elected Vice-President.

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