

# Reading Cadastral Data: Ownership as Morphological Frame in Taiwan

by Chih-Hung Chen & Chia-Che Hsu

National Cheng Kung University

**Keywords:** urban morphology, ownership, plot system, cadastral data, morphological frame.

**Abstract:** The private ownership of real properties, in Taiwan, enables owners to have the right to dispose of their lands arbitrarily, and thus it becomes the critical factor that affects planning and real estate development. To ensure the security of ownership, the government establishes a central register, cadastral system, which completely documents the right of each plot. Besides, the cadastral data also records the comprehensive information of real properties, including land activities, land uses, land taxations, and constructions. The interpreting of these data helps to clarify connections between plot systems and different dimensions of cities.

This study intends to bridge the urban morphology studies and the application of cadastral data. It starts with identifying the nature of the cadastral system, which contains the evolution and structure of the register, and successively clarifies the attribute of registrations to correspond with the various aspects of the plot systems. The outcome reveals that constitutions of plot systems are part of the morphological frame, constraining developments of the urban form. It also lays a foundation for exploring mechanisms of plot formation and the evolution of physical environments.

## 1. Introduction

The morphological frame, a background concept in town-plan analysis, is usually recognised as a set of outlines providing a morphological influence on subsequent of future development (Conzen, 1960; Conzen MP, 2018). The influence of the frame can be observed from the structure of the basic elements of the town plan: streets, plots and buildings. Besides, the formation of these three elements has its autonomy and internal logic, and at the same time have a reciprocal relationship affecting each other. We can identify these three elements separately to find out the morphological frame between them and clarify the factors in shaping the physical environment.

Among these three basic elements, the plot is mainly discussed for its multiple nature. Conzen (1960) described the plot as the fundamental organisational element of urban form and a legal entity. Caniggia and Maffei (2001) defined the plot as the module of the urban tissue, and it is a fundamental component of their analytical methods. Different sources indicate that the plot is at the same time a legal unit defining property rights, a spatially defined physical entity and an institutional tool designating land use in urban planning (Kropf, 1997; Moudon, 1997; White-

hand, 2001). Hence, the importance of the plot system is not only it is a fundamental element of urban form, but also an interface between different dimensions of urban space. This nature connects the physical and non-physical dimensions of cities and constitutes part of the morphological frames, which can help to explain the transformations of physical form (Kropf, 2017).

Different countries have different land registration system making plots as the entity to provide a legal and spatial framework for action (Berghauser Pont *et al.*, 2017). It is necessary to clarify the essential nature of the plot system and define its significance in the development of urban form more clearly. The concept of plot system, in Taiwan, is related to full ownership of real property that the owner owes no feudal duties to any other person and has the right of alienation the land. Hence, the land is regarded as one of the essential properties and thus forms an active real estate market. It turns out that the ownership of land serves as the critical factors that affect fields of urban design, planning and real estate development.

According to the legal procedures, the government establishes a central register, which is known as “cadastral system”, to protect the ownership of the people. It is also a database for land taxation, the security of real estate transactions and the implementation of the land policy. Within the cadastral system, a plot is an entity as property, which could be subdivided, amalgamated, exchanged, inherited and even assigned the title to different people. In other words, the plots as properties do not necessarily correspond to specific physical features on the lands. It turns out the contents presenting on the cadastral data are more complex and challenging to clarify. Therefore, interpreting the cadastral data is also an essential step before analysing the plot systems with morphological measures.

In seeking to bridge the urban morphology studies of plot system and the application of cadastral data, this paper has three main parts. First, the methodology part of this paper describes the evolution and structure of the cadastral system, which is used to clarify the meaning of each registration in cadastral data. Second, the result part classifies the registrations and associates with the different aspects of plot systems which potentially contribute to the studies of urban morphology. Last, the concluding part summarises the results of the empirical study and presents a theoretical framework which lays the ground for future research: exploring the pattern of land activities and the interaction between different aspects of plot systems to get more understanding of the dynamics of urban form.

## 2. Methodology

The cadastral data includes two types of records: cadastral maps and cadastral documentation. These two types of cadastral data are considered as or geographic information system (GIS) which complement each other. Cadastral maps usually present a geometric description of land parcels and boundaries of different ownership. Cadastral documentation describes the nature of the interests (e.g. rights, restrictions and responsibilities), the ownership or control of them, and often the value of a parcel and its improvements. Besides defining the past, current, and future rights and interests in real property, these data also record the description of the spatial information. That is, the immediate consequence of getting a more precise understanding of the plots is to verify the recorded reasons and methods of each item in cadastral documentation.

The cadastral data is continuously in use since the first cadastral survey, which has been revised several times. It retains the records of all land activities and other kinds of information, such as land use, taxation, ownership, land value, construction. In addition to analysis the cur-

rent condition of plots, it is also possible to conduct a diachronic survey of land use changes by comparing the old registrations. These registrations display as the evidence of the process of urban formation. Therefore, the following sections present the evolution and structure of the cadastral system in order to clarify the meaning of each registration and expand the application of cadastral data.

### *2.1. The evolution of Land registration system and cadastral data in Taiwan*

Before the land registration system was established, as a Han-centred society, the people were primarily using land deeds to ensure ownership. These deeds were usually drawn up following, depending on their nature, a typical but not standard format in an ad hoc manner. Indeed, even the location may be recorded in a local convention which is unfamiliar to the outsiders, making the government not able to take full control of the actual situation on lands. This practice was kept in use until 1895 when Japanese Empire took over Taiwan.

In order to control the production resources and increase the income from agricultural land tax, the colonial government thus conducted topography and cadastral surveys. The cadastral surveys took seven years to measure a total of 24,168 square kilometres of Taiwan island. The works of the land surveying at that time, comprised of determining the scope of the land, making cadastral map, and survey the data of each land, including (1) location, (2) tax, (3) ownership, (4) area, (5) land use, (6) condition, (7) rent and some description of the land. The government not only distinguished the private and public property, but it also took this opportunity to establish the registration system. However, the reform of land registration had not established individual ownership completely. The regulation kept remain the old habits in Han people society and retained the concept of concurrent property that holding with family.

After WWII, the land law was significantly changed. Land taxation was no longer based on the land output value. Besides, the information about the land situation was not updated immediately. Therefore, the cadastral system became focusing on the protection of private property. The cadastral system, in Taiwan, is a modified version of the 'Torrens system' which regulates the dealings of lands need to be recorded. It means the complete information of the right to immovable property, obtained, set, lost or altered by legal acts shall be subject to the information published in the register.

Over time, the cadastral documentations were gradually digitised with the boundary re-measurement project of the cadastral map since 1976. However, the digitisation not only conducted on the original cadastral documentations and cadastral maps but also aggregated the building registrations, land value registers and coordinate data as an integrated cadastral database. It is possible to find out whether any changes in the land registrations by checking the latest register transcripts through the land authorities.

### *2.2. Structure of the cadastral documentation*

The current cadastral documentation is composed of two parts: the land register and construction register. Each register includes three sections: basic information, ownership and limited real right. Due to the security of real estate transactions and the privacy of personal data, the information about the rights holder in the ownership and the limited real rights part is not fully available. In addition, the columns of ownership section and limited real rights section in the land register are the same as the construction register.

As to clearly described the contents of the cadastral documentation, the following parts divide the register into 4 sections: (A) Basic information of land, (B) Basic information of construction, (C) Ownership, (D) Limited real right, and presents the registrations of each.

#### *Land Basic information section*

The registrations of this section are the necessary information of the land which includes (1) Survey district names, (2) Cadastral numbers, (3) Record dates, (4) Record reason, (5) Land use categories (地目), (6) Land grades (等則), (7) Land use and zoning, (8) Plot size, (9) Current land value, (10) Land value, (11) Construction number and (12) The other registration information. The information in this section is open in public and easily accessible from the Cadastral and Land Registry.

#### *Construction basic information section*

The content in the construction register is mainly reproduced from the Construction License. The registrations include (1) Record date, (2) Record reason, (3) Construction number, (4) Cadastral number of the construction located, (5) Use, (6) Main materials, (7) Floors, (8) Floor area, (9) Date of completion, (11) Use and the area of the annexed structure, (12) Condominium and (13) The other registration items. However, constructions are not mandatory to be registered in the land and construction register. As a result, there are many old buildings did not conduct the “Initial registration of construction ownership” and did not document in the register.

#### *Ownership section*

There are 11 registrations in the ownership section, which mainly record the information of ownership and the rights holders. It contains (1) Registration order number, (2) Record date, and (3) Record reason. The information of the right holder includes (4) Name, (5) Address, (6) Identity card number, and (7) Birth date. Also, it records the interests of the owner, such as the (8) Type of ownership and the proportion of holdings, the (9) Range of holdings obtained by the owner each time. At last, the register has present (10) the previous taxation and (11) whether this registration has any other limited real rights.

#### *The limited real rights section*

The limited real rights section documents the information about the other real right except for the ownership, such as superficies, easement, pledge and mortgage of the real property. The registration items include (1) Registration order number, (2) Record dates, (3) Record reason, (4) Type of limited real rights. It also retains the information about the right holder: (5) Name, (6) Address, (7) Identity card number, and (8) Birth date. This section has different registrations items depending on the type of limited real rights.

### 3. Results

The storage format of the cadastral data forms a framework to record a variety of information about lands. This feature also makes the cadastral as an interface to link the physical and non-physical dimensions of cities. Therefore, this study classifies the cadastral data in the register into five categories, based on the nature of the registration, to clarify the interaction between the different dimensions of the urban space. The following sections will further describe the correspondence of the data and discuss the application in urban morphological studies.

#### 3.1. Land activities on plot systems

In terms of urban morphology, there is much discussion about the pattern of plot divisions. As one of the basic organising elements of urban form, the divisions of plots are directly influenced both by building and the street (Moudon, 1994; Whitehand, 2001). Hence, by identifying the patterns of plot division can help to explain the transformations of physical form over time (Conzen, 1960; Moudon, 1994; Kropf, 2018). However, in Taiwan, a plot mostly refers to a unit of property, which is a relation as intangible. In other words, the boundaries of plots as properties do not necessarily correspond to specific physical features on the lands. It also means the subdivision and differentiation of properties mainly involve the changes in economic activities and ownership (Webster & Wai-Chung Lai, 2003). Table 1. presents the columns in the land register that is associated with the records of the changes of the land.

According to the registrations of Record reason in the cadastral register, it is possible to check the evolution process of each plot. Besides, this information also can apply to clarify the association between land activities and the changes in physical form. There is a total of 166 types of land activities in the land registration system. Some of the land activities are related to the transformation in the shape of the plots; some of them are referred to the transaction of ownership, the others are associated with the changes in the registrations. Although these activities of properties do not directly change the form of the physical environment, it still might

Table 1. *The cadastral registrations about land activities.*

	Registrations	Content
A-1	Survey district names	After the cadastral survey was conducted, each parcel is given a unique number which can be cross-referenced with the information on cadastral maps and documentations.
A-2	Unique identifying numbers for parcels	
A-3	Record date	The date and reasons are noted in these columns. According to the land registration system, there are a total of 166 Record reasons.
A-4	Record reason	
A-12	The other registration information	The other registration information records all the history of the plot since the registration of the land, such as the number before merger, the number before divided, the number before re-measurement, number before re-allotment. The current cadastral number had been re-programmed after the re-measurement of the cadastral map. Therefore, this column is the key of corresponding with the old cadastral register.

have influences on the non-physical dimensions of cities. It is necessary to clarify the influence of land activities, which might be helpful to understand the process of urban development.

### 3.2. Land use on plot systems

The registrations about land use control reveal the distinction of lands is controlled by individuals or by the public. However, there is another form of control, which is simultaneously controlled by the individual and the planning. This kind of control is generated as that the planning mandates the route and declare it a public right of way but would not necessarily expropriate the land. Known colloquially as an easement, right of way or wayleave, which gives an individual or group a right of access over land without any other property rights. There are two situations of the public easement, in Taiwan, including private land for public use and private land that has been planned as a road. The conditions of overlapping control may simultaneously result in changes in the boundaries of physical and property. These phenomena also present that planning is dynamic, which might directly change the pattern of the plot systems.

### 3.3. Land price of plot systems

As Table 3. below, the land register records the transaction prices and the taxation of the lands. When it comes to regional economics, there are a serious of studies that attempt to discuss land use patterns and urban spatial organization through the relationship between land price and size. Most of the results show that there is a nonlinear relationship between land price and size. This phenomenon may be due to land subdivision and amalgamation in the process of land acquisition of real estate development.

For example, the plot in Taiwan is relatively small. The real estate developments often have to amalgamation several lands to attempt the ideal development size. Hence, the price of lands will increase increasingly as the land size increases. In addition to the problem of plot size, the concurrent ownerships also increase the difficulties of development (Brownstone and De Vany, 1991). These factors all affect the development strategies of the owner, which is essential implications for real estate development and regional economic. From another point of view, land prices are the result of a combination of land ownership, real estate development strategy, land use and land size. Therefore, by clarifying the impact of various factors and land price, it is possible to describe the difficulty of real estate development in the region.

### 3.4. Built form on plot systems

Table 2. *The cadastral registrations about land use.*

	Registrations	Content
A-5	Land use categories (地目)	Land use categories (地目) is a classification of land use in the past, which is divided into 21 categories. Land grades (等則) is the tax rate divided by the per unit area income of each Land use type. Due to the cancellation of agricultural land tax, it is not necessary to do a comprehensive land situation survey. These two fields are no longer update and can only be recognized as past land conditions.
A-6	Land grades (等則)	
A-7	Land use control and zoning	The land use control in Taiwan is divided into urban planning and non-urban land use control. This column only recorded the non-urban land use control status.

Table 3. *The cadastral registrations about land price.*

Registrations	Content
A-9 Current land price	<p>The current land price which are announced once every year are the basis for levying land value increment tax. The local government announce current land value react the market value.</p> <ul style="list-style-type: none"> <li>- Announced every year.</li> <li>- Current land values is about 90% of the market price of the land.</li> <li>- It is the reference price for the exchange of property rights, for example, mortgaging, expropriation and compensation of land prices.</li> <li>- Basis for land value-added tax, inheritance tax, and gift tax.</li> </ul>
A-10 Land value	<p>According to the current land tax law, the government will first investigate the land purchase price or income price in the most recent year. Divided the district into different land price segments through the market conditions, prosperity and land price. The Land Value is the standard of Land Value Tax.</p> <ul style="list-style-type: none"> <li>- Land Value is announced every 3 years.</li> <li>- Land Value is only about 20% of the real market price of the land.</li> <li>- The purpose of the Land value is to use the declared land value tax.</li> <li>- It is the basis for Land Rent Fee.</li> </ul>

Conzen (1960) introduced the concept of 'burgage cycle': the evolution of built space over time, bound by the spatial and legal framework of the plot. The French school of typo-morphology described the plot as a physical element, which lies between the building and the block in the hierarchy of elements (Moudon, 1997; Kropf, 2014). These concepts explored the idea that plot system is a framework for the arrangement buildings, which can be used to recognize the evolution of built form over time.

In the cadastral document, the registrations of constructions are transcribed from the information in the construction license, such as the use, primary materials, floors, construction completion date (see Table 4). According to Land Law, the constructions are not mandatory to register, and thus there are many old buildings not registered in the register. However, these data still can be used as a basis for the classification of building types and building ages in the study of building typology and the evolution of built form.

### 3.5. *Ownership of plot systems*

The nature of ownership is constituted of three factors. One is the entity, another is the agent of control, and the third is the connection of ownership between them. In legal literature, the ownership could be understood as the bundle of rights. It referred that the owner has the rights to fully controlling the property. In other words, the owner strategies will directly influence the form of the entities. There is much discussion about the diversity of owner strategies, which serve as the critical factor affecting the result of real estate development (Marcus, 2010; Love & Crawford, 2011). Despite the strategies of the owners or developers, the types of ownership also influence the process of development. In order to further describe

Table 4. *The cadastral registrations about construction.*

	Registrations	Content
A-1	Cadastral number	The cadastral number of the plot where the building is located.
B-1	Construction number	The land administration authorities compiled the numbers for registered constructions for management and inquiry.
B-5	Use	The use of the building such as tenements, factories, schools.
B-6	Main materials	The primary materials of construction, such as wood, reinforced brick, reinforced concrete, steel.
B-7	Floors	These columns record the number of floors and the floor area of the building.
B-8	Floor area	
B-9	Date of completion	The date of the construction completion.
B-12	Condominium	This column records the status of condominium, which define the area of the parts concurrent by all owners and the parts tenancy in common.

the interaction between the ownership and the physical form, the following section presents the types of ownership in Taiwan.

According to Land Law, the type of ownership can be divided into personal ownership and concurrent ownership (see Table 5). Concurrent ownership is derived from the traditional habits of Han people that a real estate can hold by more than one person at a time. In the past, lands are considered as the most important property which is usually owned by a family. Also, in the tradition of Taiwan, there was another type of concurrent ownership for of worship gods, ancestors, and even to the establishment of schools. The owners of these concurrent properties might increase through inheritance over time. In real estate development, the concurrent properties involve many different holders and cause land acquisition to be costly. It also difficult the process of land activities, such as transfer, exchange and subdivision. These phenomena serve as the persistence of plot system in the old town. As the primary purpose of ensuring the security of ownership, the cadastral data not only define the boundaries of ownership but also record the types of holding. In addition, it also documents the limited right of the property, such as superficiary, easement, pledge and mortgage of the real estate. These factors are also affecting the difficulty of land acquisition during real estate development or planning and the divisibility of plots.

#### 4. Discussion

The multiple natures of plots present the relationship between different dimensions of cities is complicated and difficult to identify separately. Adams (1994) pointed out that land ownership, planning system, physical land conditions and land price are all the main factors affecting the supply of the land. It is impractical to discuss the formation of the plot system while leaving out the influence of various aspects of cities. The cadastral data is a comprehensive land recording of real property, which serves as plot systems, to protect the security of ownership. It records not only the right of the property but also information about the lands, such as land use, taxation, land value, ownership, architecture. The corresponding of these data helps interpret the linking of different dimensions of cities, which could explain the interactions between human activities and physical environment.

Table 5. The cadastral registrations about ownership.

Registrations		Content
C-4	Owner	This column records the information of the owner, but it will be hidden on the transcripts of register.
C-8	Type of ownership	Ownership can divide into four types: public ownership, individual ownership, Co-ownership, Total property ownership. Co-ownership is that each owner owns separate and distinct shares of the same property. Total property ownership is the concurrent ownership that everyone is the owner of the whole thing.
D-4	Type of limited real rights	The type of limited real rights includes superficiary, easement, pledge and mortgage of the real property.

By reading the cadastral data, this study proposes a new integrated framework for advancing the understanding of the plot systems (see figure 1). To conclude, this study identifies plot systems into three aspects. Firstly, plot systems are spatial entities that constitute affordances, which could be analysed by morphological measures. It is often discussed in the field of morphology and has clear connections with the built form, street pattern, planning, and owner strategies. Secondly, it is a framework which integrates the various conditions of the non-physical dimension of cities, including land use, land price, and ownership. These conditions have a potential influence on each other and owner strategies. Thirdly, plot systems act as an interface between the physical and non-physical dimension of cities. In other words, it is the consequences of dynamics in cities which serve as the morphological frame constraining the physical environment.

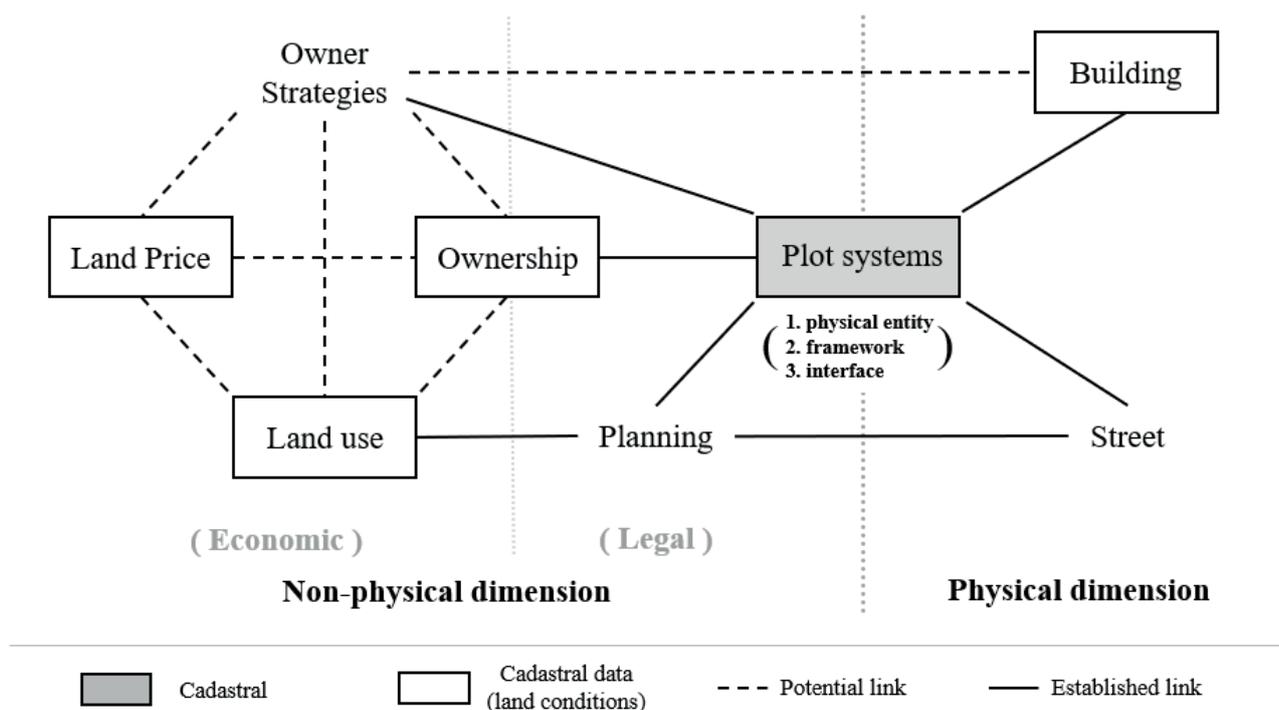


Figure 1. Theoretical framework integrated the relation between different aspects of plot systems.

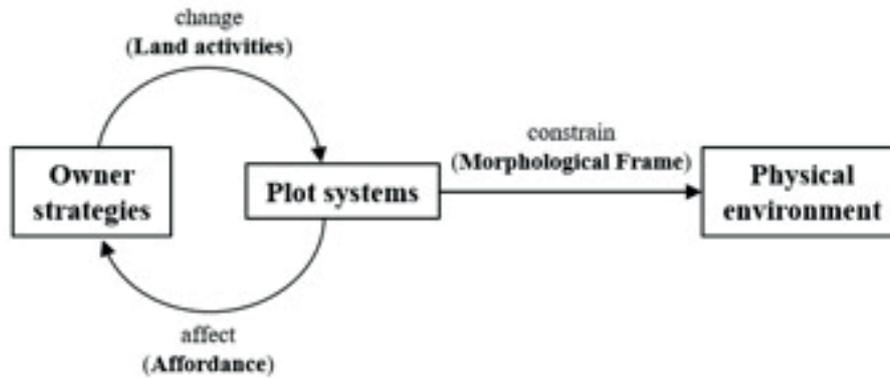


Figure 2. *The mechanism of plot formation.*

Furthermore, this theoretical framework not only clarifies the relation of the various aspects of plot systems, but also reveals the mechanism of plot formation (see figure 2.). This mechanism is composed of plot systems, owner strategies and land activities. Specifically, the conditions of plots will affect the owner strategies, which cause the owners, in turn, to change the plot conditions. Among them, land activities serve as the critical factors integrating the influences in non-physical dimensions, which cause changes in plot systems. More precisely, it might be a necessary process of the evolution of the physical environment.

The private property ownership enables landowners to dispose of their own properties arbitrarily, and thus it generates a wide variety of land activities. In order to explore the influences of the land activities, this study further classifies them into four main types, such as (1) Parcel establishment and cancellation, (2) transfer, (3) exchange, (4) property formation (see figure 3). Among the classifications, Type (1) is conducted by the Registry without alteration of ownership. Type (2) and Type (3) relate to the transaction of ownership and limited real right. Type (4) indicates the changes in both ownership and the shape of plots. Although these land activities do not directly change the form of physical environment, it causes changes in conditions of the land, such as the ownership, land price, land use, and shape of plots. These changes might indirectly influence the process of urban development. It is a necessary precursor for future research in the process of plot formation and the pattern of plot systems, which is contributed to summarise the changes in urban form and morphological processes.

## References

- Adams D. (1994), *Urban Planning and the Development Process*, UCL Press, London.
- Bobkova E., Marus L., Berghauser pont M. (2017a), *Multivariable measures of plot systems: Describing the potential link between urban diversity and spatial form based on the spatial capacity concept*, in *Proceedings of the 11th International Space Syntax Symposium*, pp. 47.1-47.15.
- Bobkova E., Marus L., Berghauser pont M. (2017b), *Plot systems and property rights: morphological, juridical and economic aspects*, in *Urban Morphology*, 17, pp. 11-23.
- Brownstone D., De Vany A. (1991), *Zoning, Returns to Scale, and the Value of Undeveloped Land*, in *The Review of Economics and Statistics*, 73(4), pp. 699-704.
- Caniggia G., Maffei G.L. (2001), *Architectural composition and building typology: interpreting basic building*, Alinea, Italy, Firenze.
- Conzen M.R.G. (1960), *Alnwick, Northumberland: a study in town-plan analysis*, in *Institute of British Geographers*, 27, pp. 1-122.
- Conzen M.P. (2018), *Core Concepts in Town-Plan Analysis*, in Oliveira V. (ed.), *Teaching Urban Morphology*, Springer, American, pp. 123-41.

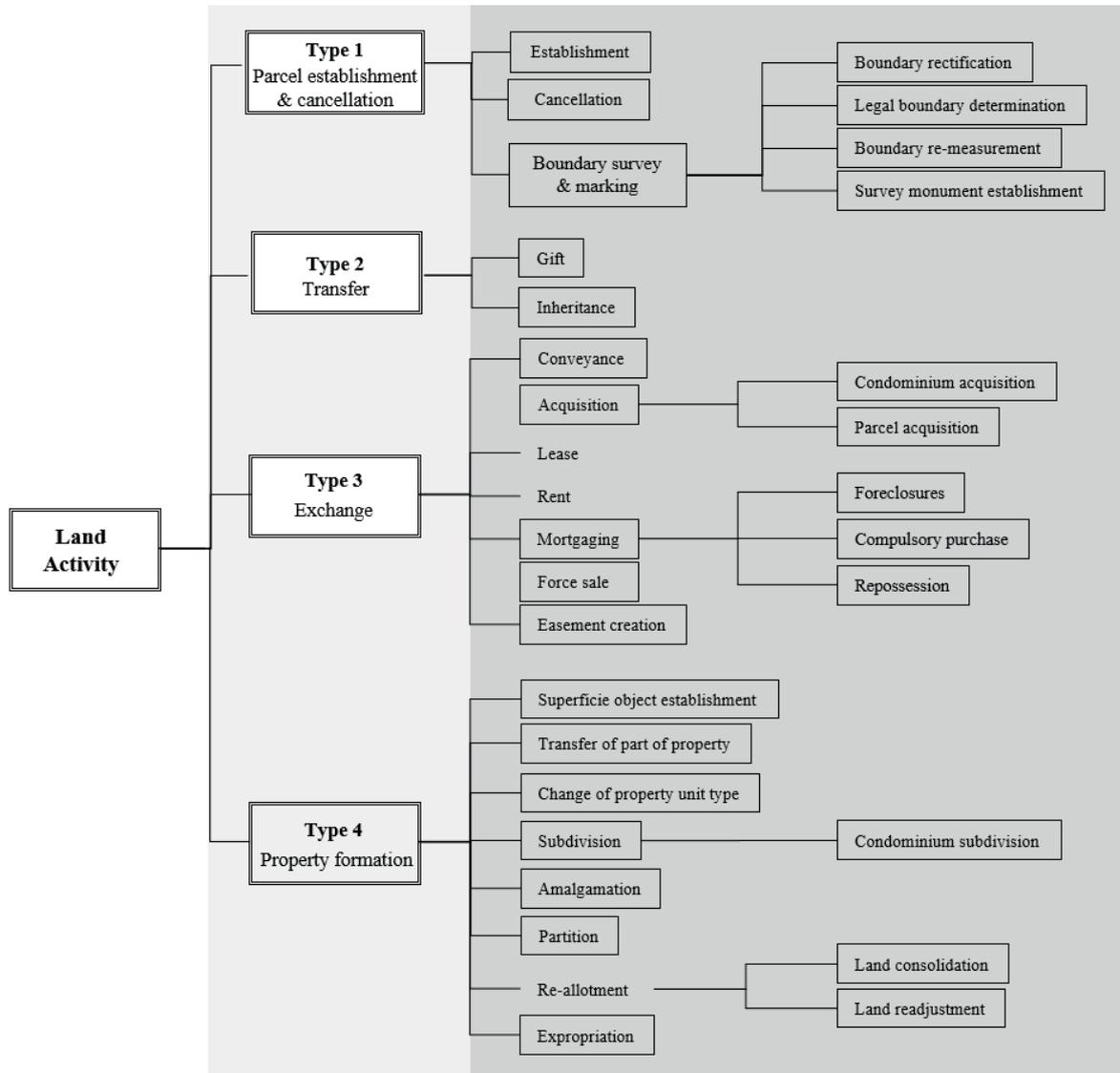


Figure 3. Classification of land activities in Taiwan.

- Kropf K. (1997), *When is a plot not a plot: problems in representation and interpretation*, paper presented at the Fourth International Seminar on Urban Form, Birmingham.
- Kropf K. (2014), *Ambiguity in the definition of built form*, in *Urban Morphology*, 18, pp. 41-57.
- Kropf K. (2018), *Plots, property and behaviour*, in *Urban Morphology*, 22, pp. 1-10.
- Love T., Crawford C. (2011), *Plot logic: character-building through creative parcelisation*, in Tiesdall S., Adams D. (ed.), *Urban design in the real estate developments process*, WileyBlackwell, England, pp. 92-113.
- Moudon A.V. (1997), *Urban morphology as an emerging interdisciplinary field*, in *Urban morphology*, 1, pp. 3-10.
- Marcus L. (2010), *A proposal for an Extension of Space Syntax into a More General Urban Morphology*, in *The Journal of Space Syntax*, pp. 30-40.
- Scheer B (2016), *The epistemology of urban morphology*, in *Urban Morphology*, 20, pp. 5-17.
- Ünlü T. (2017), *Morphological processes and the making of residential forms: Morphogenetic types in Turkish cities*, in *Urban Morphology*, 21(2), pp. 105-122.
- Vialard A. (2012), *Measures of the fit between street network, urban blocks and building footprints*, in *Proceedings of the 8th International Space Syntax Symposium*, pp. 8101:1-8101:17.
- Whitehand J.W.R. (2001), *British urban morphology: the Conzenian tradition*, in *Urban Morphology*, 5(2), pp. 103-109.
- Webster C., Wai-Chung Lai L. (2003), *Property Rights, Planning and Markets: Managing Spontaneous Cities*, Edward Edgar, England, Cheltenham.