

# Application of LADM for the integration of land and housing information in China: The legal dimension



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## ABSTRACT

The integration of land and housing registration is a key opportunity for China: improved land governance is the intended outcome. Prior to the design of any integrated information system, the legal requirements the system must satisfy need to be identified. This paper identifies and reviews the legal requirements for the integration of land and housing information in China. Specifically, the existing legislative framework relating to land, consisting of seven levels of legislation, is interrogated. A collection of legal requirements emerges: these are categorized into themes including registration, maintenance, mortgage, transfer of real estate rights, relevant materials and archives, and preliminary notice. In order to be more applicable for the next design of the Land Administration Domain Model (LADM) country profile for China, these legal requirements are further converted into packages, classes and attributes by referring to the ISO 19152 standard. The existing databases of the Chongqing Municipality are used to support the modelling process. The paper concludes that the legal requirements can be used as a foundation for an integrated system in China.

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## 1. Introduction

In contemporary China, land and housing are disparately managed by the Ministry of Land and Resources (MLR) and Ministry of Housing and Urban-Rural Development (MOHURD), respectively. The separation creates a series of problems, including duplicate house sales, multiple mortgaging without notification, incomplete certification during the real estate transaction, and so on (Wang, 2006). In response, a legalistic approach, including the drafting of laws and regulations, was used to promote integration: 'the Law of the People's Republic of China on Urban Real Estate Administration' (hereafter referred to as REAL) in 1994 and 'Property Law of the People's Republic of China' (hereafter referred to as PL) in 2007, provide examples (The National People's Congress, 2007; The Standing Committee of the National People's Congress, 2007). In 2013, in order to facilitate the process, the 'Report on State Council Institutional Reform and Transformation of Government Functions'<sup>1</sup> published on the 12th National People's Congress, planned for the

establishment of an integrated real estate registration system (The State Council, 2013). The integration of the real estate registration process must address four aspects: integration of institutions, registers, legislation and information platforms (Duan, 2013). Each demands a separate requirements analysis. Requirements analysis is the determination of the needs or conditions of the system (Hay, 2003). The legal requirements are yet to be fully investigated: there have been no analytical studies on requirements for land and housing integration in China from a legal point of view.

In response, this paper studies the relevant laws and regulations dealing with various aspects of land and housing registration in China. It develops a set of legal requirements based on the legislative analysis, and further converts these into Unified Modeling Language (UML) packages, classes and attributes, via reference to the ISO 19152 standard, and the exemplary case of Chongqing Municipality. First, the current law land system in China is introduced. Second, an outline of legislation dealing with the integration of land and housing registration is presented. Third, the collected laws and regulations are reviewed and a series of legal requirements are established. Fourth, UML packages, classes and attributes are presented. Finally, the results are discussed, conclusions drawn and recommendations for further research provided.

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<sup>1</sup> Hereafter referred to as 'the Report'.

## 2. Conceptualizing the legal framework relating to land, housing, and real estate in China

The current legislative framework relating to land in China, dealing with housing and real-estate, is based upon law and regulation. It aims to regulate the social relations within the land management domain, including land use, development, protection, and the land market (Cai and Ke, 2001). The system consists of 7 legislative layers (Fig. 1): higher layers (e.g., the constitution) override, and act as the foundation, for the lower layers. The 'Land Administration Law (LAL)' and 'Urban Real Estate Administration Law' being of high significance (Cai and Ke, 2001):

(1) **The Constitution** is the basis of the land law system: state-owned land ownership in urban areas and collective-owned land ownership in rural and suburban areas is stipulated (The National People's Congress, 2004);

(2) **Land Laws** refer to laws which are enacted by the National People's Congress (NPC) and its standing committees, such as the LAL, PL, REAL, etc.;

(3) **Land Statutes** mainly include the land related statutes enacted by the State Council, like the 'Regulations on the Implementation of the Land Administration Law', and 'Interim Regulation on Real Estate Registration';

(4) **Local Land Statutes** are enacted by the Local People's Congresses (LPC) and their standing committees at the provincial and municipal level;

(5) **Land Regulations** play an important role in the law land system and are enacted by the ministries and commissions under the State Council, including 'Measures for Land Registration', 'Measures for Building Registration', and 'Measures for Real Estate Registration';

(6) **Local Land Regulations** are enacted by the local governments of each province and municipality, autonomous region; and finally,

(7) **Other Land Standards** are enacted at the county level, which belong to the seventh level of this legal system.

The laws and regulations in the 7 layers can be divided into two main groups: universal application and local application. For the purposes of this paper, those with universal applicability are of most interest: layer 1 (the Constitution), layer 2 (Land Laws), layer 3 (Land Statutes), and layer 5 (Land Regulations) are therefore necessary to concentrate on. With this conceptual hierarchy and analytical approach, the total number of laws and regulations relating to real estate and housing registration immediately becomes apparent (refer: Table 1, 'layer'). Going further, examination of the content of the laws reveals they can be further divided into three categories: (1) those focused only one land; (2) those focused only on housing; and (3) those focused on real estate (Table 1).

## 3. Reviewing and synthesis of legal requirements

An analysis of each specific law enables identification of the relevant articles from each law.<sup>2</sup>

### 3.1. Land administration law of the People's Republic of China

The land administration law was formulated (in accordance and alignment to the Constitution) in order to strengthen the administration of land, and to protect land resources, especially cultivated lands (The Standing Committee of the National People's Congress, 2004). The change of land tenure or its content shall be realized through the maintenance of registration (Article 12). In expropri-

ating land, the compensation shall be imposed on the basis of its original use purpose, as is stipulated in Article 46 and Article 47 of the LAL. When using construction land, Article 55 requires that the land use leasing fees should be paid in advance. As for the temporary use of land, several conditions need to be taken into consideration, like contracts for temporary use of land, its use term, and so on (Article 57).

A number of key points can be extracted, including: the need for mechanisms to enable changing land tenure and land use during maintenance; the time limit for compensation registration; the compensation fees for land expropriated; land use right leasing fees for expropriated land; and the restriction on temporary use of land.

### 3.2. Regulations on the implementation of the land administration law of the People's Republic of China

These regulations were set out in 1999 on the basis of the Land Administration Law in general. According to article 6 of this regulation, 'whoever changes the land ownership and use right according to laws as a result of transfer of its appendices (hereinafter refer to the general term of buildings (as bungalows, storied houses, etc.), structures (as water towers, wells, bridges, etc.) and fixed objects (as trees, cables, etc.) on land, must file an application for change in land registration with the corresponding department which is locally wherein the land is located, the original land registration organ shall effect the change in registration of land ownership and use right' (The State Council, 1998). In other words, the change of appendices rights also brings about a change of corresponding land rights. Only filing an application of maintenance can bring a change of land use purposes into effect.

Key points to note relate to the changes of both land and its appendices, and related documents like: application forms, identification materials, certificates of rights of land and its appendices, and other relevant documents referring to the transfer of land, and its appendices, that should be submitted when registering.

### 3.3. Measures for land registration

The measures for land registration is one of the basic land regulations within the law land system in China, which was deliberated and adopted at the fifth executive meeting of the MLR in 2007. As is mentioned in Article 9 and Article 40 of this measure, the submitted materials for the application of land registration contain land related documents and its appendices-related documents as well.<sup>3</sup> Correspondingly, in the register book, the recorded information would cover both the land part and its appendices part, (refer Article 15). According to Article 40, the maintenance of land registration requires certificates of land use right, housing ownership and other documents. In addition, in the supplementary articles, it stipulates that the unified registration system of real estate is imperative for China.

Key points for land registration include the following items: certificates of land and housing rights, application forms, identification documents, survey documents and taxation documents when filing an application for land registration. The information about the subjects, rights, and objects shall be recorded in the register book. Moreover, the maintenance of land use right requires certificates of both land and housing rights, and documents about alternation of land use rights.

<sup>3</sup> Land and its appendices related documents refers to the materials that should be submitted when filing an application for registration of land, including application form, identification material, certificate of land use right/housing, etc.

<sup>2</sup> For detailed transcriptions refer to Annex 1 in Zhuo (2013).

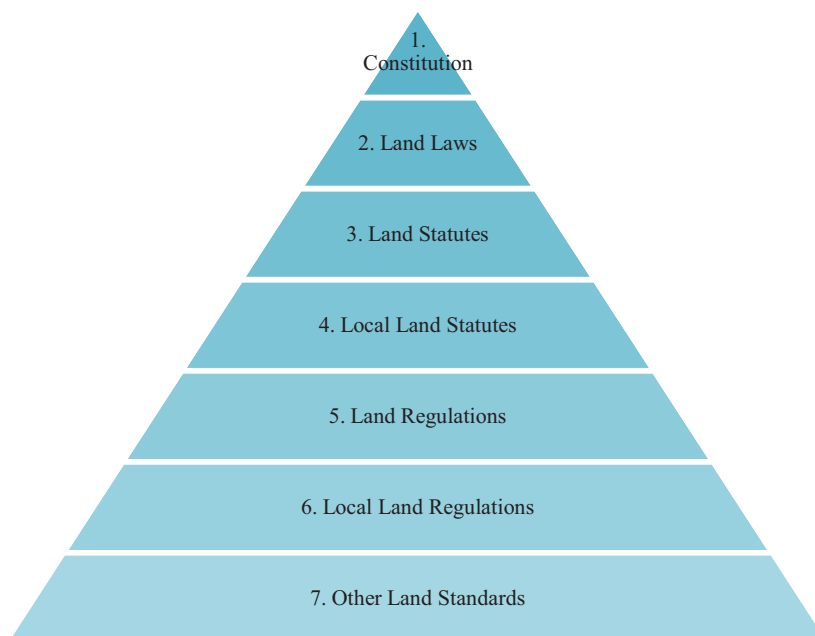


Fig. 1. The 7 conceptual layers of the Chinese legislative framework relating to land.

### 3.4. Measures for building registration

Based on the Property Law and Urban Real estate Administration Law, the measures for building registration were issued. These aim to regulate the conduct of housing registration and to maintain real estate transactions. The key points of this measure include: (1) subject consistency of land use rights and housing ownership (Article 8); (2) submitted documents for registration include both land related and housing related documents (Article 30, 60, etc.); (3) the unified registration of real estate by one department is also mentioned here (Article 95). The MLR has just reported that this one department named the 'Bureau for Real Estate Registration' will be established soon according to 'the Report', and it would generally

attach to the Division for Cadastral Management of the MLR (Xi, 2014).

Conclusively, during the registration of housing ownership, subjects for both land use right and housing ownership are required, and should be consistent based on the principle of subject consistency, which indicates that subjects for the land use right and its attached housing ownership should be the same. When applying for the registration of housing ownership, it is necessary to submit several relevant documents, including an application form, identification materials, certificate of land use right, construction planning permit, document of as-built inspection of building and report of housing surveying and mapping. Furthermore, the mortgage registration requires the contract of mortgage as an essential document for submission.

**Table 1**  
Overview of land, housing, and real estate laws and regulations.

	Laws and regulations	Layer	Articles	Source
Only land related	Land administration law of the People's Republic of China	2	Articles 12, 46, 47, 55, 57, 83	The Standing Committee of the National People's Congress (2004) Ministry of Land and Resources (2007) The State Council (1998)
	Measures for land registration	5	Articles 9, 15, 40, 75	
	Regulation on the implementation of the land administration law of the People's Republic of China	3	Article 6	
Only housing related	Measures for building registration	5	Articles 8, 30, 60, 95	Ministry of Construction (formerly Ministry of Housing and Urban-Rural Development) (2008)
Real estate related	Property law of the People's Republic of China	2	Articles 10, 12, 22, 135, 136, 138, 146, 147, 148, 182, 183, 200, 246	The National People's Congress (2007)
	Law of the People's Republic of China on Urban Real Estate administration	2	Articles 32, 34, 45, 48, 49, 61, 63	The Standing Committee of the National People's Congress (2007)
	Technical specification of Real Estate registration	5	Articles 1.0.3, 5.5.7, 6.1.3, 6.1.4	Ministry of Housing and Urban-Rural Development (2012)
	Guaranty law of the People's Republic of China	2	Articles 34, 36, 42, 55	The Standing Committee of the National People's Congress (1995)
	Interim regulation on Real Estate registration	3	Articles 2, 4, 5, 6, 7, 12, 14, 21, 22	The State Council (2014)

### 3.5. Property law of the People's Republic of China

With the development of a Chinese market economy, the government acknowledged its desire for legal protection of private property. In order to fulfill this requirement, the Property Law was promulgated in 2007 (Chen, 2012). As a key point in the law, registration has attracted more attention. Article 10 and 246 regulate that registration of real estate shall be handled by the registration authority in a uniform way (The National People's Congress, 2007). Meanwhile, the registration authorities are responsible for the examination of the ownership certificates and other necessary documents both about land and its appendices. According to Article 22, real estate registration fees shall be charged on pieces. This means that the land and its appendices will be regarded as a single entity (a combined unit or 'piece') during the real estate registration, and the fee will be charged exactly on the basis of the piece number. So the applicant would pay less for the registration of land and its appendices under this article. In addition, if the government wants to take back the construction land before the expiration of land use right, compensation shall be given to the houses and other real estates. The right to use construction land shall be entitled to its appendices by making use of such land. The land use right can be separately created on the surface, of or above, or under the land too (Article 135 and 136).

Moreover, as is shown in article 182, 'when mortgaging buildings,<sup>4</sup> the right to use its corresponding construction land shall be mortgaged together. Likewise, all the buildings shall be mortgaged as soon as their related right to use construction land is mortgaged' (The National People's Congress, 2007): land and housing are treated as a single entity in the case of mortgaging the land use right or housing ownership in urban areas. In relation to the maintenance of registration, the right to use construction land and its appendices shall be taken as a whole too (The National People's Congress, 2007). Article 146 and 147 state that 'whoever changes the right to use construction land or its appendices, the land and its affiliated facilities shall be disposed of at the same time' (The National People's Congress, 2007). Based on the provision of Article 138, the information on both land and housing should be involved in the contract on transfer of the right to use construction land, in case the right to use construction land is created through auction, bid invitation or agreement.

In conclusion, the following classes of information or data attributes are required when changes to the land use right and rights to its appendices occur:

**(1) The registration part:** the right holders of land and its appendices, and the land use right on or above or under the surface of land should be taken into consideration.

**(2) The mortgage part:** the certificates of both land use right and housing ownership are needed.

**(3) The maintenance part** (which means updating the land use right and housing ownership at responsible departments): the land use right and housing ownership should be treated as a whole during the process, and the information about both land and housing should be included, such as the name and address, boundary and area, covered space, use purpose, use term, payment methods, and dispute settlement method. In addition, the mode of transfer shall be recorded too.

**(4) Other parts:** the certificates and documents of land and housing should be examined by the registration organizations. Moreover, the registration fee of the realty will be charged on unit.

The compensation for real estate will be determined on the basis of prices of both land and housing.

### 3.6. Law of the People's Republic of China on urban real estate administration

The law of the People's Republic of China on urban real estate administration was adopted in 1994 and amended according to the "decision on amending the law of the People's Republic of China on urban Real Estate Administration" in 2007. According to the review, the requirements acquired are shown as below:

First, as is seen from Article 32 and Article 61, the housing ownership and its appurtenant land use right should be transferred or mortgaged at the same time, and it is necessary to file an application with both the land administration department and housing administration department. That means maintenance of both the housing ownership and its appurtenant land use right is required when changes occur to them. Moreover, in Article 34 of this law, it also stipulates that the evaluation price of real estate is normally determined based on the prices of both land and housing. Secondly, the advanced sale of commodity houses (i.e., a kind of house that is developed by real estate companies and sold as residential buildings, complete with supporting facilities, such as water supply, landscaping, parking lots) must be premised on obtaining the certificates of land use right and other relevant documents. Meanwhile, it should be registered at a land administration department, as well as at a housing administration department (Article 45). Moreover, Article 48 claims that 'The title of a housing property plus the right to use the land occupied by the housing property obtained lawfully may be designated as mortgage right. The right to use land obtained through lease may be used as a mortgage too'. In addition, the registration and certification system for the right to use land and title to the housing property is formally stipulated by articles in this law too. Lastly, this law also sets the unified registration and certification form to deal with situations of separated registration of housing ownership and its appurtenant use right of the land.

In summary, apart from the key points mentioned above, both land and housing prices<sup>5</sup> should be taken into consideration when evaluating real estate prices. Additionally, the advanced sale of commodity housing should be achieved on condition of certificates of both land use right and housing ownership and other relevant documents being present. Finally, regarding changes in real estate, the application of maintenance should be filed with both the housing and land administration departments above the county level.

### 3.7. Technical specification of real estate registration

The technical specification of real estate registration was mainly worked out in accordance with the announcement from the Ministry of Housing and Urban-Rural Development (MOHURD) in 2012. The aim of this specification is to clarify the business issues of real estate registration and to safeguard real estate transactions. Specifically, real estate registration should follow the principle of subject consistency. Besides these demands, the departments dealing with real estate registration must be merged, and the archives should be managed in a unified way. In this case, access to these archives including both land and housing parts through a query tool, would be easy to realize.

Following from the discussions above, the archives of real estate registration must be uniformly managed by a single department,

<sup>4</sup> During the mortgage, building here refers to parts of the building, that is apartment units, which is owned by one or more obligees.

<sup>5</sup> Land and housing prices generally consist of two parts: the land price refers to the purchase price of the land use right and its corresponding revenue within a specified period on the premise of the transfer of land use right, while the housing price is the construction price of the building within the area.

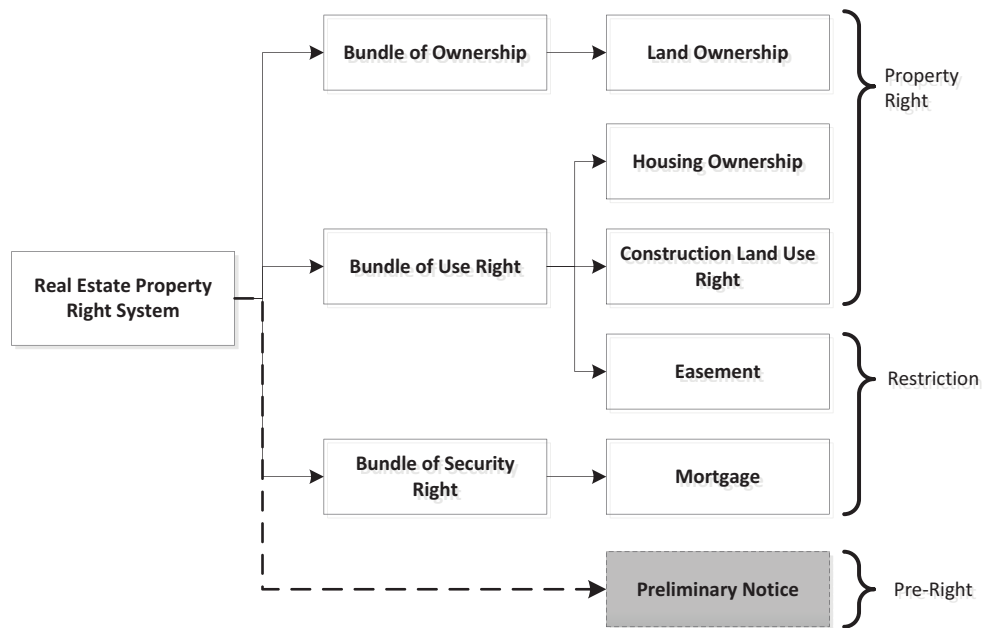


Fig. 2. Proposed real estate property system for urban China.

and the mutual query could be realized through electronic methods within or between databases. In addition, the responsible departments for real estate registration and the management of archives should be included, as well as the name of the registrar and the date of verification.

### 3.8. Guaranty law of the People's Republic of China

For the sake of promoting the circulation of capital and commodity, and realizing the protection of property rights, the Guaranty Law of the People's Republic of China was adopted at the 14th Session the Standing Committee of the 8th NPC in 1995. The part of the law dealing with mortgages mentions two kinds of objects: movable and immovable. As is presented in Article 34, the mortgaged immovable properties include land use right, housing and other appendices. Article 36 stipulates that 'if the house is to be mortgaged, the corresponding land use right within the scope shall be mortgaged at the same time' (The Standing Committee of the National People's Congress, 1995). Moreover, the existing separated registration of instrument may be a motivation for the integration of land and housing. Meanwhile, in Article 55, it is stated that newly-built housing shall not belong to the instrument when preceding the mortgage.

Key points include the need to consider including the rights of land and its appurtenant appendices, responsible departments, the construction date of each house, and mortgage date.

### 3.9. Interim regulation on real estate registration

In order to integrate relevant obligations between departments and protect property rights, the State Council decided to establish a united system for real estate registration in 2013. Then the Interim Regulation on Real Estate Registration was adopted by the State Council in 2014, and put into force on March 1st, 2015. This regulation contains rules about the registration agency, register, registration procedures, information sharing and protection, etc.

Firstly, as is stated by Henssen (1995), the subject, object and right are three key parts among registration. According to the rules of this regulation, we can figure out that the object part mainly

consists of land, housing and other things fixed on land (Article 2), and the right part includes a series of real estate rights, such as land use right, housing ownership, collectively-owned land ownership, homestead-land-use-right (Article 4). While this regulation also provides that the State Council will be responsible for guiding and monitoring the registration issue, and there will be special agencies which are responsible for the registration of real estate (Article 5 and 6).

Secondly, as for the register of real estate, each real estate unit should have its unique identity. The register book should include following items: location, boundary, area and usage of real estate, subject, content, source and change of real estate rights, and others (Article 7). Moreover, Article 14 stipulates that 'In case the applicant files an application for real estate registration, must submit the following materials accordingly: registration application form, identification materials of the applicant, certificates and prove documents of real estate rights, survey document and boundary coordinates, description of relevant subjects, and other materials.'

Thirdly, according to Article 21 and 22, a unified information management system for real estate registration would be established by responsible departments of the State Council. The registration information of different levels and different departments could be included. Then real-time information sharing will be realized.

Overall, the above legislative analysis reveals the key points that must be articulated and synthesized into requirements for the integration of land, housing, and real estate information in China—and subsequent classes and attributes in the LADM standard.

There are various ways to categorize or synthesize the key points captured in the legislative analysis, into legal requirements. For the purposes of this paper, the categorization is based upon key entities and activities in the registration process: 13 categories of legal requirement result (see the Table A1 in the Appendix A), as follows:

(1) **Initial registration:** during the initial land registration, related information about its accessories should be involved in the register, and vice versa.

(2) **Maintenance:** when an update of real estate rights caused by transfer or mortgage occurs, the land use right and housing ownership will be changed all together.

**(3) Mortgage:** for the mortgage of land or housing rights, the land and its related accessories (mainly refer to housing) must be tackled altogether too.

**(4) Subject consistency:** as is written in some laws and regulations, the real estate registration should follow the principle of subject consistency, which means that right holders of both land and housing should be consistent.

**(5) Unified registration:** in most of these related legislations, the issue of unified registration of real estate has been highlighted. Specifically, there are several aspects to be unified, including department, legislation, register, information system, etc.

**(6) Registration fee:** according to the provision of [The National People's Congress \(2007\)](#), the registration fee of real estate will be charged on pieces (or combined units). That is to say, the registration fee of land and housing will be charged only once as a whole.

**(7) Material verification:** as the responsible department for registration, it is necessary to check the certification status of the land use right, certificate of housing ownership, and other related documents.

**(8) Land use and land use right:** as is stipulated in the PL, the scope of the land use right should be extended to above and under the surface.

**(9) Transfer of real estate rights:** during the transfer of land use right or housing ownership, related information about its accessories should be included in the register.

**(10) Compensation of land acquisition:** the compensation of land acquisition is determined by the price of land, along with the prices of housing and other accessories.

**(11) Real estate price evaluation:** according to the regulation, the real estate price is generally determined by the standard land price, nominal land price, and appraised price of housing.

**(12) Advanced sale of commodity housing and preliminary notice:** the advanced sale of commodity housing or preliminary notice should be premised on holding several documents, related certificates and the permit of responsible departments.

**(13) Registration archive:** in order to support real estate market and tenure security, the registration archives of real estate will be managed by a single department to support quick database querying.

#### 4. Design of LADM country profile for China

The design of any new land information system requires that existing systems are taken into account ([Henssen, 2010](#)). Consequently, another concern in the analysis stage is the determination of the current structure for land and housing databases in China. This paper utilizes Chongqing Municipality as an exemplary case study. This is justified on the basis that the municipality is similar in size to many other developing provinces or municipalities. It therefore shares many the same development challenges. It is also one of the pilot cities for the integration of land and housing in China. Thus, its standard—the SULBRD is the main data source for this modelling component of this analytical study.

According to the [Bureau of Land Resources and Housing in Chongqing Municipality \(2010\)](#), the content of this standard is generally categorized into six key layers: positioning basis, administrative regionalization, physiognomy, land and housing tenure, land use and raster data. It is worth mentioning that land and housing tenure is the key feature brought about by this standard. To reduce complexity the third and fifth layer are left outside the scope: they were deemed less relevant for the modelling exercise.

The LADM, published by International Organization for Standardization as ISO 19152, is designed for Land Administration System (LAS) development. LADM has been broadly accepted and

can be adapted to local situations. It also has to be usable to organize land administration data within a state or national spatial data infrastructure (SDI). The design is based on the common pattern of 'subject – right – object' relationships. The model is intended to be as simple as possible and cover the basic data related components of Land Administration (legal/administrative, mapping and surveying). It should also satisfy user requirements. The Domain Model in its implementation can be distributed over different organizations with different tasks and responsibilities ([Lemmen, 2012](#)).

The LADM provides an provides an abstract, conceptual model with four (sub) packages related to parties (Party Package); basic administrative units, rights, responsibilities, and restrictions (Administrative Package); spatial units (Spatial Unit Package) and spatial sources and spatial representations (Surveying and Representation Subpackage). Generally, the LADM standard provides terminology for land administration and enables the combination of land administration information from different sources in a coherent manner ([ISO/TC 211, 2012](#)). In the case of China, this means it could support the goal of land and housing information integration.

Thus, combined with the detailed descriptions and the LADM structure above, a number of LADM classes and attributes would be extracted from these legal requirements as well as their attached packages. In other words, these synthesized results would be summarized and split into packages, classes and attributes according to the LADM standard in general (See the 'Required Packages, Classes & Attributes' column of table in the [Appendix A](#). As for the Package Subcolumn, the 'SC', 'PP', 'AP', 'SUP' and 'SRS' refer to 'Special Classes', 'Party Package', 'Administrative Package', 'Spatial Unit Package', and 'Surveying and Representation Subpackage' respectively).

Meanwhile, based on the study of the structure for land and housing cadastral database in Chongqing Municipality (it is mainly based on Standard for Urban Land and Building Register Database, hereafter referred to SULBRD), the current situation of Chinese land and housing cadastral database, along with its related classes and code lists, is clear. In order to transform these classes into the LADM context, a comparison between chosen classes of LADM standard and SULBRD was taken. Moreover, the required classes and code lists of the [Appendix A](#) will be taken into consideration in the meantime (for details of comparison results see Section 6.3 of [Zhuo \(2013\)](#)).

Next, with regard to the country profile for LADM in China, it can be summarized into four main (sub) packages according to the LADM standard: party package, administrative package, spatial unit package and surveying and representation subpackage. However, for differentiating the Chinese country profile from others, this research will use 'CN' as the prefix for classes and code lists in the country profile.

Subsequent to the analysis phase, the focus now moves to the design of the LADM country profile for China. This consists of two steps: to migrate from classes of legal requirements and the SULBRD to LADM classes, and to develop the LADM country profile.

In the migration step there are two issues requiring attention. One is to transform corresponding classes of legal requirements into LADM classes. The transformed outputs have been posed in Annex 4 of [Zhuo \(2013\)](#). Another issue is to convert classes and attributes of the SULBRD by referring to the LADM standard—ISO 19152. Specifically, this conversion procedure takes a comparison between chosen classes of LADM and the SULBRD, as well as the relationships between these classes.

##### 4.1. Special classes

According to the LADM standard—ISO 19152, several special (sub-)classes like VersionedObject, Fraction, Oid and CN.Source

have already been introduced, which continue to be adopted in this country profile for China (see Appendix A). These special classes respectively cover the following aspects: historical manipulation of data in the database, part-whole relationship, identifier data type, and prove documents within the domain. Moreover, in order to describe some common properties of spatial units, the CN.CommonSpatialUnit is developed in the country profile. While, LA.Area class and LA.VolumeValue class are respectively used to illustrate the area and volume of different types in both land and housing administration.

#### 4.2. Party package

Generally, the party package serves as the subject role in the 'subject – right – object' relationship. It can be further generalized into two main kinds: natural person and non-natural person. Moreover, through the review of relevant legislation, it can be concluded that there are several kinds of parties, like land user, housing owner, mortgagee, etc.

In order to express these specific kinds explicitly, this party package introduces three basic classes, which are CN.Party, CN.GroupParty, and CN.PartyMember (see Fig. 2). Here, the CN.Party class refers to the person or organization that plays a role in process. While, according to Chen (2007) summary, condominium ownership refers to the individual ownership of a room coupled with a share of an undivided interest in the common elements. Additionally, all of the room owners also jointly own the shared land use right and co-ownership of common elements of the building. Given this situation, the CN.GroupParty class and CN.PartyMember are introduced.

#### 4.3. Administrative package

The main classes of this package are CN.BAUnit and CN.RRR. As is elaborated in ISO/TC 211 (2012), the baunit class refers to the basic property unit belonging to one party. Thus, this paper utilizes the CN.BAUnit class as the real estate object (including both land and housing objects), which is also the key to the integration problem in this country profile for China. The CN.RRR is an abstract class that describes these related rights and restrictions to the real estate object.

According to the Property Law of China, the real estate rights can be categorized into ownership, use right and security right in China (Li et al., 2012). Nevertheless, this paper puts emphasis on the integration of land and housing in urban areas of China. As is stated in The Standing Committee of the National People's Congress (2004), land in urban areas is owned by the State, and individuals or units only have the use right according to law. Thus, the land property right system in urban areas is generally composed of state-owned land ownership, land use right and other rights (Chen, 2003).

It is noteworthy that land expropriation refers to the conversion of agricultural land into constructional land for construction purposes (The Standing Committee of the National People's Congress, 2004). This mainly involves the change of land ownership (from collective-owned to state-owned), as well as its related attributes and code lists. To meet the needs of this specific expression, this country profile creates a new specialization of property right class, namely CN.Ownership.

According to the discussion of Zhuo (2013), all these real estate rights (except preliminary notice) can be categorized into classes of restriction and property right (Fig. 2). Regarding the preliminary notice, Chen (2012) states that it serves as a pre-emptive mechanism to safeguard the owner against the third party from engaging in a future dealing with the registered owner. Considering its special feature and unique code lists, this paper introduces a new class:

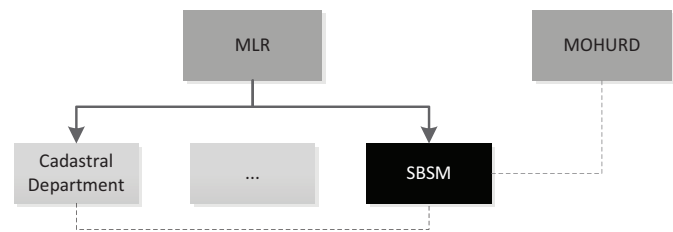


Fig. 3. Organization mechanism for SBSM, MLR and MOHURD.

CN.PreRight (see Fig. 3). It generally functions in the circumstance of suspending the registration and preserves its status quo.

As regards the administrative documents submitted or generated during the operation of land and housing administration, they are all presented in the CN.AdministrativeSource class.

#### 4.4. Spatial unit package

The spatial unit package contains two general levels: the land level and the housing level. Firstly, at the land level, parcel is the basic unit within land administration domain (Ministry of Land and Resources, 2007). While, as for housing administration, its main object is the 'mound – building – floor – room' framework (Jiang, 2007). Meanwhile, the concepts of parcel and mound are generally the same. Thus, Zeng (2008) proposes the object model for land and housing integration, which is 'parcel – building – floor – room'. As previously mentioned, the relationships between them can be presented as the aggregation with '1: M' multiplicities.

According to the SULBRD, there are five main objects in land and housing administration: parcel, building, building unit, floor and room. Due to the attribute similarity between building object and building unit object, this paper combined these two classes and treats them as one entity in the model. Correspondingly, the identifier of the building object is composed of the original building unit part and its appurtenant building part. In conclusion, this package has four basic classes: parcel class, building class, floor class and room class. In addition, the administrative area refers to a group of parcel based spatial unit, which is considered as a group spatial unit class in this country profile.

Furthermore, the CN.Level class refers to a set of spatial units with a certain level of coherence (ISO/TC 211, 2012), which functions the same as the concept of layer. It is used to illustrate the two components of real estate basic administrative unit in this paper: one is for parcel, and the other is for housing.

Finally, regarding the identification system, the SULBRD proposes a scheme, which contains three parts: administrative division part, land cadastral part and housing cadastral part. Correspondingly, its identifier is composed of these three parts too, which can be expressed as: baulD = aaID + supID + suhID (=building No + floor No + room No). Among them, the baulD refers to the identifier of BAUnit. While, the aaID, supID and suhID are identifiers of administrative areas, parcel spatial unit and housing spatial unit respectively. Moreover, in order to create a link between the integrated data model and the current data models, this paper introduces the concept of original identifier. That is, the existing identifiers of spatial units would be kept in the integrated data model as the linking key.

#### 4.5. Surveying and representation subpackage

Currently, the National Administration of Surveying, Mapping and Geoinformation (SBSM) in China is affiliated with the MLR (Fig. 3), and is responsible for both cadastral and housing surveying and mapping issues. Specifically, cadastral surveying and

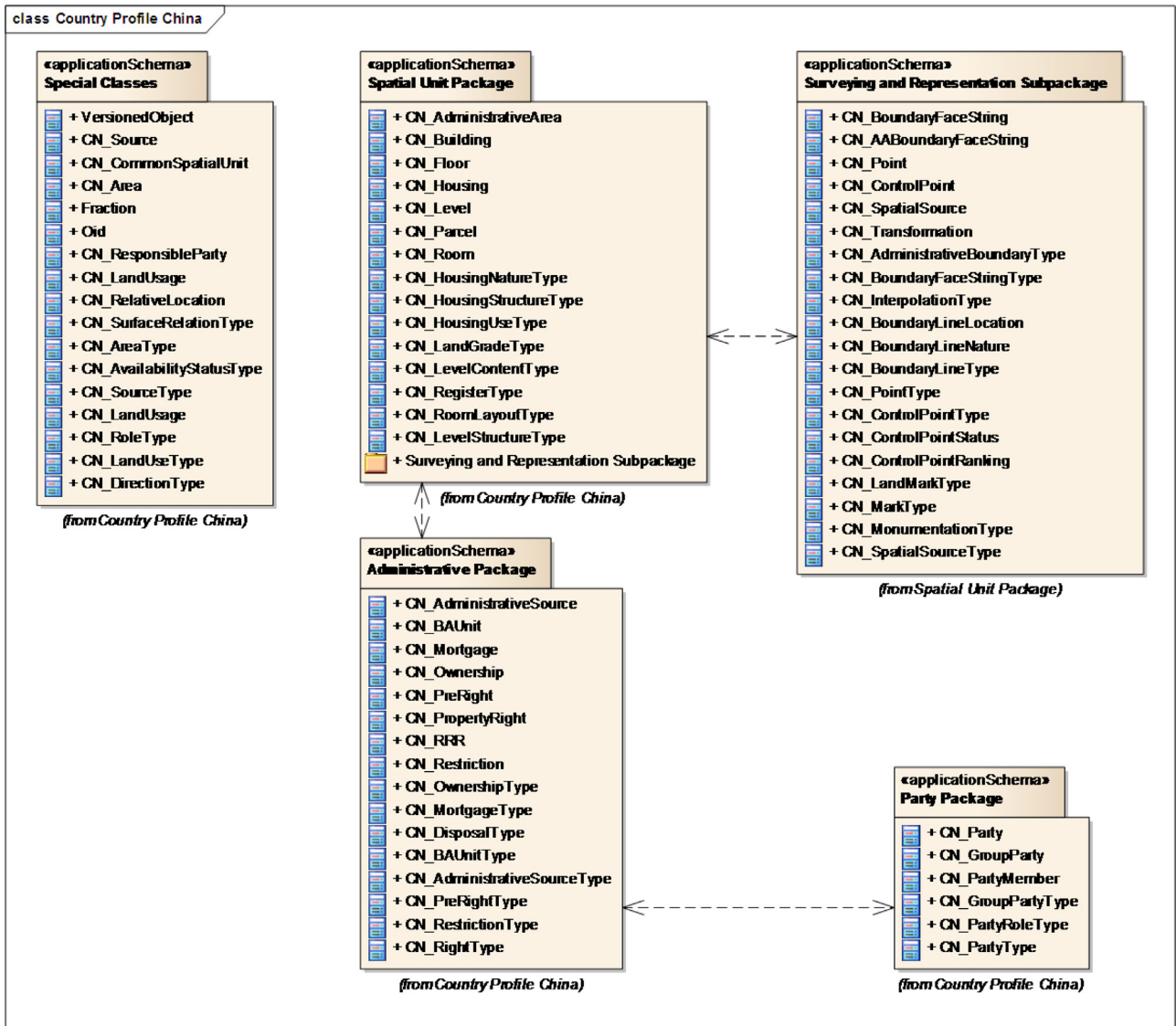


Fig. 4. The LADM country profile China overview of (sub) packages (with special classes).

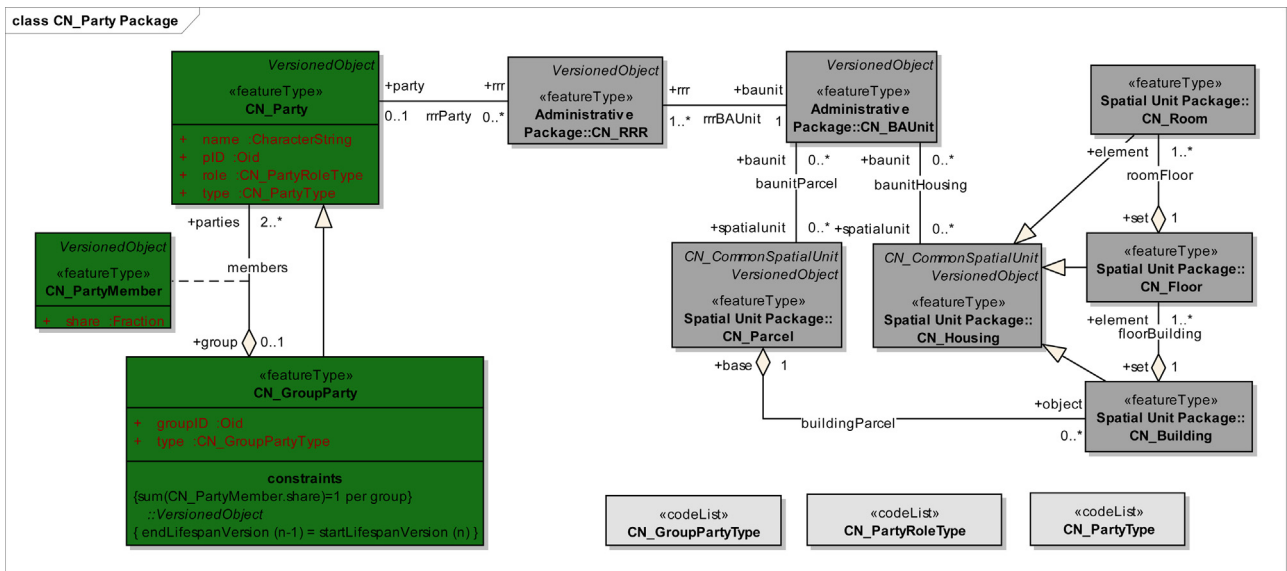


Fig. 5. Content of the party package with relationships ('green' part). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)



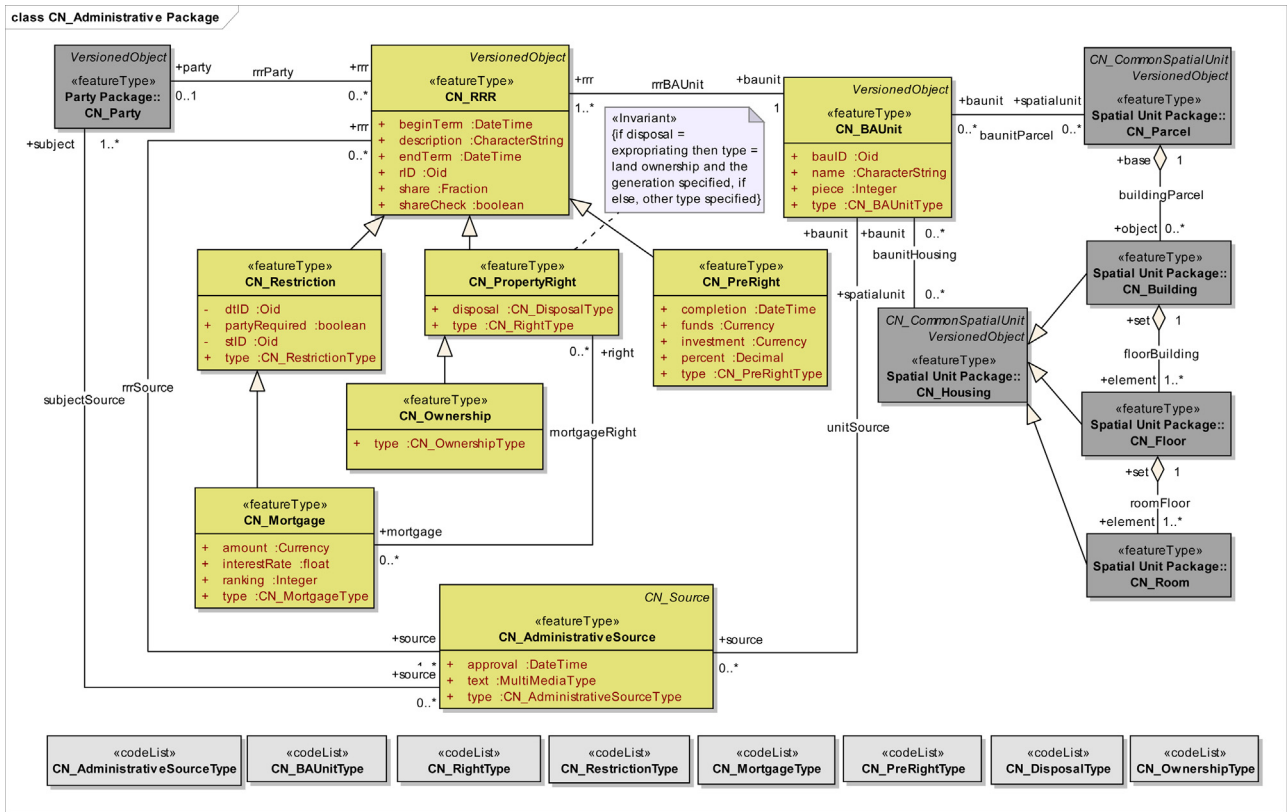


Fig. 6. Content of the administrative package with relationships ('yellow' part). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

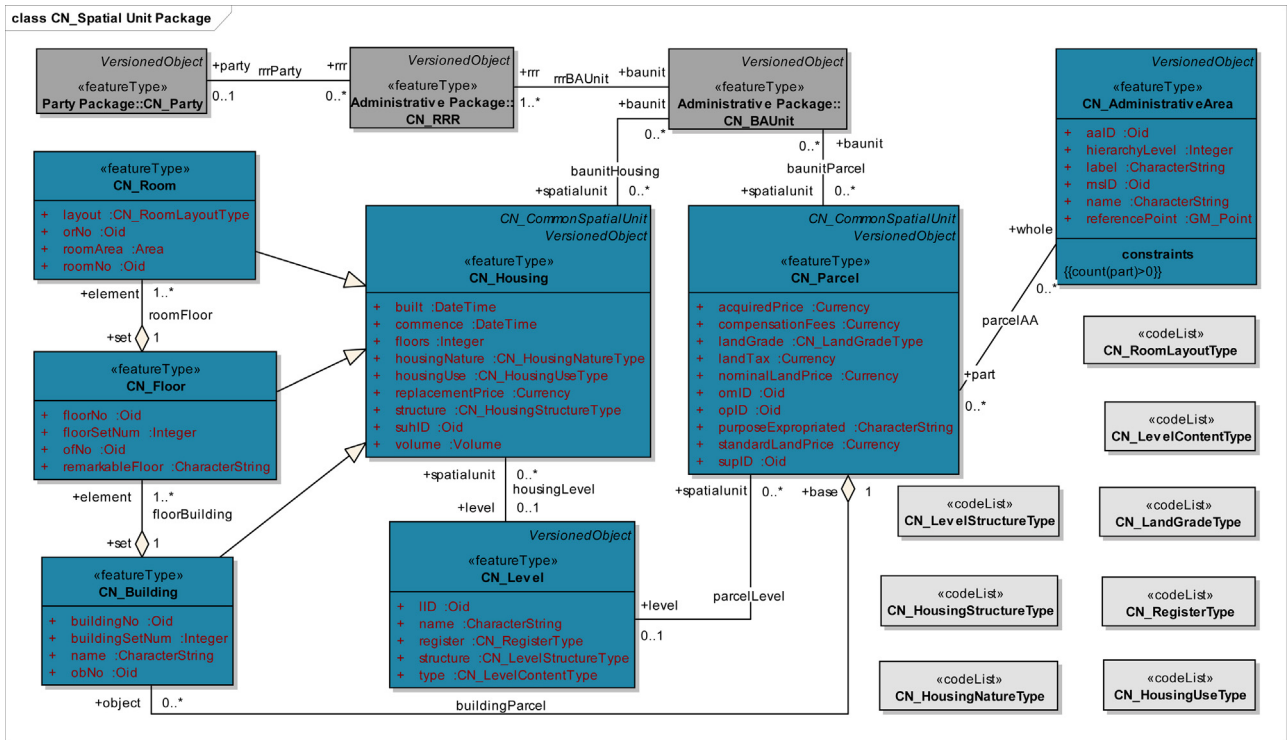


Fig. 7. Content of the spatial unit package with relationships ('blue' part). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

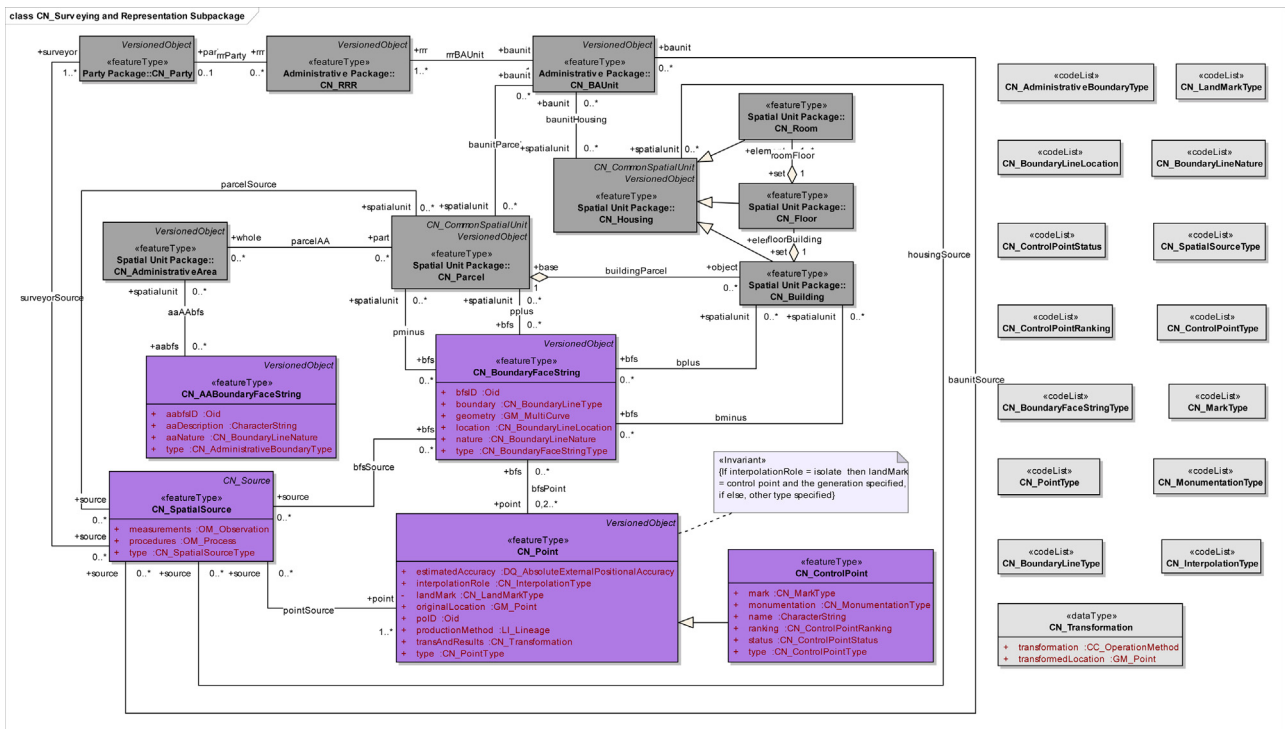


Fig. 8. Content of the surveying and representation subpackage with relationship ('purple' part). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

mapping issues are carried out and managed by the cooperation of the cadastral department under the MLR and the SBSM. While as for housing, it is taken charge by the cooperation of the MOHURD and the SBSM. Thus, the organizational mechanism and relationship between these three departments can be presented as follows.

However, such separation potentially creates a series of problems, like duplication of surveying, wasted human resource and money (Wu, 2002). Thus, in this package, the boundary face string class and point class are utilized to put these two kinds of data into an integrated schema. In general, the boundary face string, point and spatial source are three basic classes for this package. Specifically, there are essentially two types of boundary face string class: boundary face string and administrative boundary face string. Meanwhile, the point class has a specialization, namely control point. All these spatially related documents and measurements are illustrated in the spatial source class. It is worth mentioning that the CN\_Transformation class is needed to realize the transformation of coordinates between two reference systems, because there are two existing coordinate reference systems in cadastral survey and mapping nationwide: Beijing Geodetic Coordinate System (GCS) 1954 and Xi'an GCS 1980 (Liu, 2007), and the transformation of coordinates between these two systems is very common.

4.6. Relationships between classes

According to the LADM standard—ISO 19152, the relationships between the classes can be categorized into four kinds: association, generalization, aggregation. Specifically, according to Eriksson et al. (2009), the association is a connection between classes, which means that it is also a connection between objects of those classes. Among the country profile for China, it consists of three parts: inheritance from the LADM ISO standard, new associations for the country profile China, and omitted associations between these classes. As for the generalization, it is a relationship between a more general and a more specific element. In other words, it describes a relationship between groups of things with something in common.

Within the land administration domain, new added relationships of generalization mainly emerge in the spatial unit package. Moreover, this paper introduces the common spatial unit class as the common property for the spatial unit classes, which is another new added part. Finally, aggregation is a special case of association, which indicates that the relationship between the classes is some sort of 'whole–part' (Eriksson et al., 2009). In the country profile for China, the aggregation relationship mainly exists between party and group party, and among the 'parcel – building – floor – room' model.

4.7. Overview of LADM country profile for China

After completing the analytical and comparison studies above, the classes and relationships of the country profile for China are clear (Fig. 4). Next, on the basis of these outputs, the country profile for China is developed. It generally consists of three major packages and one subpackage, which are Party Package (Fig. 5), Administrative package (Fig. 6), Spatial unit package (Fig. 7) and surveying and representation subpackage (Fig. 8), as follows. Besides, these special classes are also developed into class diagrams. Taken together, these packages comprise a country profile for China, as based on the legal requirements for land and housing integration compiled earlier.

5. Discussion

As mentioned, the collection of legal requirements is derived from the current legislative framework relating to land in China, with a focus on the universal level. Thus, the selected laws and regulations mainly pertain to universal levels in the law land system. Specifically, according to the 'layer' column of Table 1, all of them laws were at the universal level, that is, layers 2, 3, and 5.

A number of legal requirements were identified on the basis of this collected legislation. Subsequently, these legal requirements were further categorized into 13 groups according to their artic-

ulated entities, activities and impacts. The categories included registration, maintenance, mortgage, and subject consistency, and also the management of registration archives in general.

The conversion of requirements into integration model made use of LADM. As already mentioned, the standard is composed of three levels: package, class and attribute. At the package level, the extraction results have been segmented into four (sub) packages accordingly: party package, administrative package, spatial unit package, and surveying and representation subpackage. Based on the statistics in the table of legal requirements, it was found that most of the legal requirements could be included in three packages, which are party package, administrative package and spatial unit package. The surveying and representation subpackage received less attention: only four classes and attributes are included. As for the classes and attributes, they all correspond to relevant packages above, and cover several aspects of real estate registration.

The process revealed that LADM adaptable and implementable to a local situation, as is claimed by Lemmen (2012). Together, the domain model and the collected legal requirements were used to design the packages, classes, and attributes of an integrated real estate registration system in China. By default, the designed packages, classes, and attributes will support achievement of the legal requirement. In this sense, the adaptability of LADM is further proven. Likewise, the ability for the Chinese legislative framework relating to land to be modelled using LADM is also demonstrated. However, as mentioned earlier, legal adherence is only one component of the land and housing integration challenge: institutional components, registers, and existing databases also need consideration. At any rate, the requirements gathering and modelling process do suggest that, for the context of housing and land information in China, LADM could be used as a basis for land administration development or upgrade.

## 6. Conclusion

This paper reviewed the legal requirements relating to the intended integration of housing and land information in China, with a view to understanding whether LADM could be used to concep-

tualize and realize the requirements in a data model. The analysis of the existing legal system, focused on laws and regulations, revealed 13 categories of legal requirements for the integration of land and housing registration. Corresponding packages, classes and attributes were also developed according to the LADM standard.

Regarding the legal requirements, the systematic process used in their capture means they are considered robust for the purpose for which they were developed: the collected legal requirements can act as a foundation for the integration of real estate registration in China. However, this work only examined those legal requirements pertaining to integration of land and housing at the universal level: local laws and regulations relating to land and housing integration could be examined as part of further research. In addition, a more comprehensive approach might consider legislation from other land related sectors including agriculture, mineral extraction, environmental conservation, and so on. These further analyses could include assessment of less authoritative governmental documents and literature relevant to administrative procedures.

Meanwhile, with respect to the resultant LADM profile, whilst in adherence to the compiled requirements, it requires further validation through the consideration of other integration components such as institutional arrangements, existing registers, and existing data sources. However, it can serve as a starting point for an LADM country profile for China: one that already considers the importance of integrating land and housing information.

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## Appendix A.

**Table A1**  
Legal requirements for integration of land and housing databases in China.

No.	Requirements	Required packages, classes and attributes		Sources
		Packages	Classes & attributes	
01	Initial registration	AP	Land use right and its appurtenant housing ownership	+ Article 9 & 15 (Ministry of Land and Resources, 2007) + Article 30 (Ministry of Construction (formerly Ministry of Housing and Urban-Rural Development), 2008) + Article 4 & 14 (The State Council, 2014)
		SC	Registration date	
		AP	Located county	
		SC, AP	Law land documents (application form, identification materials of the applicant, certificates of land use right and housing ownership, alternation of land tenure)	
		SRS	Survey documents (cadastral & housing survey, parcel map, boundary coordinates)	
		SC, AP	Tax paid proof and tax reliefs proof	
		PP, SC	Name and address of land subject	
		AP	Nature, type, acquired date, term of land tenure	
		AP, PP, SUP, SC	Changes in land tenure and content	
		SUP, SC, SRS	Location, boundary, area, identification, use purpose, acquired price of land	
		SC, AP	Housing legal documents (application form, identification materials of the applicant, Construction planning permit, document of as-built inspection of building)	

Table A1 (Continued)

No.	Requirements	Required packages, classes and attributes		Sources
		Packages	Classes & attributes	
02	Maintenance	AP, PP, SUP, SC	Changes in land tenure (includes land ownership or use right)	+ Article 12 (The Standing Committee of The National People's Congress, 2004) + Article 6 (The State Council, 1998) + Article 40 (Ministry of Land and Resources, 2007) + Article 61 (The Standing Committee of The National People's Congress, 2007) + Article 4 & 12 (The State Council, 2014)
		SC	Changes in use purposes	
		AP, PP	Changes in housing ownership	
		PP	Responsible departments (original land registration organ, housing administration department, land administration department)	
03	Mortgage	SC, AP	Legal documents about alternation (application form, approval documents,)	+ Article 60 (Ministry of Construction (formerly Ministry of Housing and Urban-Rural Development), 2008)  + Article 182, 183, 200 (The National People's Congress, 2007) + Article 32, 48, 49 (The Standing Committee of The National People's Congress, 2007) Article 34, 36, 42, 55 (The Standing Committee of the National People's Congress, 1995)
		SC, AP	Certificates of land use right and housing ownership (original & new)	
		SC, AP	Legal documents (application form (housing mortgage registration), identification materials of the applicant, mortgage contract, master obligatory right contract, certificate of land use right and housing ownership, construction planning permit)	
		SC, AP	Legal documents (application form (housing mortgage registration), identification materials of the applicant, mortgage contract, master obligatory right contract, certificate of land use right and housing ownership, construction planning permit)	
04	Subject consistency	SUP	Built date	+ Article 8 (Ministry of Construction (formerly Ministry of Housing and Urban-Rural Development), 2008) Article 1.0.3 (Ministry of Housing and Urban-Rural Development, 2012)
		AP	Mortgage date, loan, gage, priority	
		PP	Name of mortgagor and mortgagee	
		PP	Responsible departments (land administration department, housing administration department)	
05	Unified registration	PP	Subject of housing ownership	+ Article 75 (Ministry of Land and Resources, 2007) + Article 95 (Ministry of Construction (formerly Ministry of Housing and Urban-Rural Development), 2008) + Article 10, 246 (The National People's Congress, 2007) + Article 63 (The Standing Committee of The National People's Congress, 2007) + Article 1.0.3, 4.5.5, 5.1.3, 5.1.5 (Ministry of Housing and Urban-Rural Development, 2012) + Article 7 (The State Council, 2014)
		SC	Submission date	

Table A1 (Continued)

No.	Requirements	Required packages, classes and attributes		Sources
		Packages	Classes & attributes	
	PP	Responsible department AP SUP SC, AP SC, AP	Real estate registration identification Located administrative division Certificate of real estate Verification and changes in the housing ownership and land use right Name of Registrar Record identification on the register book	
06	Registration fee	AP	Piece number of real estate object	+ Article 22 (The National People's Congress, 2007)
07	Material verification	SC	Legal documents (certificates of land use right and housing ownership, other materials provided by the applicant)	+ Article 12 (The National People's Congress, 2007) + Article 1.0.3 (Ministry of Housing and Urban-Rural Development, 2012) Article 14 (The State Council, 2014)
		PP	Name of registrar	
08	Land use and land use right	AP	Right type (e.g., temporary land use right)	+ Article 57 (The Standing Committee of The National People's Congress, 2004) + Article 135, 136 (The National People's Congress, 2007) + Article 4 (The State Council, 2014)
		AP	Term of land use right (e.g., temporary land use right: $\leq 2$ years, commencement date and expiry date)	
		SUP	Payment to use of construction land	
		AP, SC	Space right to land use (surface, above, or under the land)	
		PP	Subject of land use right	
		AP	Restriction to land use right	
09	Transfer of Real Estate rights	SUP	Land use right leasing fee	+ Article 55 (The Standing Committee of The National People's Congress, 2004) + Article 138, 146, 147 (The National People's Congress, 2007) + Article 32 (The Standing Committee of The National People's Congress, 2007)
		SUP	Other fees and expresses	
		AP	Term of rights to use construction land (commencement date, expiry date)	
		AP	Disposal method	
		PP	Name, address of land subject	
		SC, SRS	Boundary, area of the land	
		SUP	Covered space of appendices	
		SC	Use purpose	
		SUP	Allotment fees and other fees	
		AP, SC	Disposal date of land use right	
		AP, SC	Disposal date of housing ownership	
10	Compensation of land acquisition	PP	Subject of expropriated land	+ Article 46, 47 (The Standing Committee of The National People's Congress, 2004) + Article 148 (The National People's Congress, 2007)
		AP, SC	Time limit for the announcement	
		SC, AP, SUP	Compensation registration time for expropriated land	
		PP	Responsible department	
		AP	Certificate of land use right	
		SC	Use purpose (original & changed)	
		SUP	Compensation fee (land, and appendices)	
		AP	Term of expropriated land use right	
		AP	Expropriated date	
		SUP	Land transfer fee	
		SUP	Purpose of public interest	
11	Real Estate price evaluation	SUP	Standard land price	+ Article 34 (The Standing Committee of The National People's Congress, 2007)
		SUP	Nominal land price	
		SUP	Replacement price	

Table A1 (Continued)

No.	Requirements	Required packages, classes and attributes		Sources
		Packages	Classes & attributes	
12	Advanced sale of commodity housing, and preliminary notice	SUP	Land use right leasing fee	Article 45 (The Standing Committee of The National People's Congress, 2007)
		AP	Certificate of land use right	
		AP	Construction project planning permit	
		AP	Funds put for construction, total budgetary investment (and per cent)	
		AP	Construction schedule	
		AP	Date of completion of the project	
		AP	Permit of advanced sale of commodity houses	
		AP	Legal documents for preliminary notice (application form, identification materials of the applicant, permit of advanced sale)	
		PP	Advanced seller, advanced buyer	
		PP, AP	Department, term of preliminary notice	
13	Registration archive	SC	Submission date	+ Article 15 (Ministry of Land and Resources, 2007) + Article 1.0.3, 5.1.3, 5.1.5 (Ministry of Housing and Urban-Rural Development, 2012) + Article 21 & 22 (The State Council, 2014)
		PP	Name and address of land subject	
		AP	Nature, type, acquired date, term of land tenure	
		AP, PP, SUP, SC	Changes in land tenure and content	
		SUP, SC, SRS	Location, boundary, area, identification, use purpose, acquired price of land	
		PP	Responsible department of register management	
		AP	Identification for query	

Note: For the package subcolumn: special classes (SC), party package (PP), administrative package (AP), spatial unit package (SUP), and surveying and representation subpackage (SRS).

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