



# Property rights of urban underground space in China: A public good perspective



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## ABSTRACT

With the booming development of urban underground space in China, “fuzzy” property rights of this special form of land use type are not only the cause of ownership disputation and registration chaos, but also may seriously delay the undertaking of related underground land laws or regulations. China's emerging property rights issue of urban underground space, especially the delimitation of the surface and ground or underground, is facing such a challenge. This article aims to identify the property rights of urban underground space by using a practical method that classifies the underground space as economic goods, and to analyze attributes of different property rights of urban underground space within the theoretical framework of public goods. We use civil defense projects and underground parking lots as case studies. Both case studies are the most utilized types and controversial ownership cases of urban underground space in present China. Our case studies indicate that it is a feasible method to avoid the delimitation of the start-stop height of 3D property right vertically, and directly define the attributes of surface and underground property rights in line with the supply mode of goods. Our results show that the method proposed in this study can effectively solve the dispute of property rights against problems rising with unclear contract and lags in the legislation of urban underground space and clearly delimited the interests boundaries among different parties of property rights for urban underground space. Ultimately, this study may offer better insight into the utilization and registration work of urban underground space in China as well as reference for countries with similar property rights issues.

## 1. Introduction

In recent years, rapid urbanization has led to significant population growth (Brian, 2015): the current world population of 7.3 billion is expected to reach 8.5 billion by 2030, 9.7 billion in 2050 and 11.2 billion in 2100. China still remains as one of the most populous countries in the world, representing 19% of the world's population (World Population Prospects, revision in 2015). Until 2013, urban resident population in China has reached 731.11 million with the urbanization rate of 53.73%, predicted to reach around 65% by 2030 (Wang, 2014). Very often, this percentage will increase further, which in most cities results in a prominent conflict between urban growth and limited land resources, deterioration in environment quality (e.g. traffic congestion, noise, reduction in green space, and air pollution), and shortage in energy supply. Many cities' land capacity is on the edge of satisfying their

residents' requirements. With the urban sprawl and technology boom of this century, a new concept of land use pattern, multi-layered land use (Durmisevic, 1999; Benhamu and Doytsher, 2003; Paulsson and Paasch, 2013), especially the Urban Underground Space (UUS) become a more “compact” solution for the sustainability problems facing urban areas in developed countries (Roberts, 1996; Bobylev, 2009; Kaliampakos et al., 2015). UUS also plays an increasingly important role in developing countries, especially in future 20 years for China (He et al., 2012). The UUS is emerging as an effective means to upgrade in urban capacity, alleviation of urban traffic and improvement of urban environment.

However, as land use extends spatially from a horizontal to a vertical direction, more and more three-dimension (3D) property studies have been conducted on technical, organizational, registration and legal aspects. Many studies on the management of 3D property rights<sup>1</sup> in cadastral system have been reported in developed countries,

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<sup>1</sup> 3D property: As concluded in the FIG Working Group on 3D Cadasters, no country in the world has a true 3D cadaster. The functionality is always limited in some manner. Different countries with non-unified terminology of 3D property concepts depending on national legislation makes it difficult to form the standardized concept of “3D property”. However, in the most general sense, a 3D property can be defined as property delimited both horizontally and vertically in length, width, height and depth, and sometimes can be defined as three-dimensionally determined property (Paulsson, 2007, p. 31).

such as Netherlands (e.g., Stoter et al., 2013; Ploeger, 2011), Norway (e.g., Onsrud, 2003; Stoter and Van Oosterom, 2005), Sweden (e.g., Paulsson, 2013), Australia (e.g., Aien et al., 2011), Turkey (e.g., Döner et al., 2011), Israel (e.g., Benhamu and Doytsher, 2003; Caine, 2009), USA (Van Oosterom et al., 2005), Finland (Viitanen, 2002), the Czech Republic (Huml, 2001). Even 4D cadastral systems are discussed (Döner et al., 2010; Shi et al., 2014). Although the main registration entity is still a 2D parcel in most developing countries, research efforts have been focused on 3D cadastral development, for example, China (Guo et al., 2013; He, 2011), Malaysia (Nasruddin and Rahman, 2007; Zulkifli et al., 2015), Indonesia (Hendriatiningsih et al., 2012), Republic of Macedonia (Gjorgjiev and Gjorgjiev, 2009), and Nepal (Acharya, 2011). From the perspective of international studies, the actual problems of 3D property are similar but solutions vary, depending on national legal system and non-unified terminology of 3D property concept (Paulsson and Paasch, 2013). Therefore, legal issue of 3D property is fundamental, which should be discussed before the technical, registration, and organizational aspects. However, compared with application aspects of 3D cadastral system, legal issues have lagged behind around the world (Paulsson and Paasch, 2013). In particular, the property rights disputes and registration issues involving underground development are now attracting much attention. The crux of legal perspective in China is fuzzy property rights of UUS, which will not only lead to market inefficiencies, ownership disputation, rent dissipation, and registration chaos, but also may seriously delay the undertaking of underground land laws or regulations.

This article aims to define the property rights of UUS by classifying the UUS as economic goods, and analyzing different attributes of goods on the basis of public goods theory. A clear definition of UUS property rights will greatly facilitate the resolution of problems in 3D property rights registration and UUS legislation. The article is organized into four parts. It follows with a general overview of Chinese and international UUS development and property rights structure in Section 2. Property rights of UUS problems in China are discussed in Section 3. Then, in Section 4 a practical method for the classification of UUS with respect to different attributes of goods is proposed to clearly define specific UUS property rights, which could be used in future 3D cadastral system and UUS legislation system. In Section 5, taking the civil defense (CD) projects and underground parking lots as examples, we elaborate how to define the attribute of UUS property rights. This article ends with conclusions and associated future work.

## 2. General overview of UUS Development and property rights

### 2.1. International UUS development and legal system

The utilization of UUS in various countries has gradually formed into a unique pattern for each specific situation. Europe is one of the pioneers in the utilization of UUS. Especially those Nordic cities with good geological conditions are an advanced area of UUS utilization. For example, Sweden's large underground drainage system (in a leading position in the world) is the first automated vacuum waste collection system in 1960s (Cui, 2007). Netherlands is known for its underground logistics system. Finland has a large water supply system in Helsinki (Vähäaho, 2014). UUS in North America is mainly used to cope with severe weather conditions. The most famous underground cities are Montreal (RÉSO) and Toronto (PATH). In Asia (mainly in Japan), build-up areas tend to be located underground for the purpose of mitigating overcrowding and traffic congestion. Japan's underground networks, while individually smaller, are overall most extensive in Tokyo, Osaka, Nagoya, and Fukuoka (Geng and Zhao, 2001).

Clearly, the nature and legislative model of UUS property rights are quite different, depending on national legal system (De Mulder

et al., 2015). The traditional legal doctrine in Civil Law and Common Law defined ownership as the rights of all land strata, extending from upwards to downwards (originated from the Latin maxim: *Cuius est solum, eius est usque ad caelum et ad inferos*). The infinite extent of rights is only defined in two dimensions to a certain extent, which is not suitable for 3D land in reality. Many countries around the world attempt to establish the right in “layers”, and delimit specific heights above and depths below the land parcel that limits the range of ownership rights to the parcel. In Civil law countries, the ownership of buildings cannot be independent from the land ownership beneath it, and is considered as the extension of ownership for land (Guo et al., 2013). But, as the superficies appeared in some countries of Civil law, it breaks the rules of *superficies solo cedit* (the attached buildings or constructions of land become part of it) in many jurisdictions. The rights of superficies, as separate statutory rights in rem, means that the ownership of buildings constructed (above or below) on land is separated from the ownership of land (Döner and Biyik, 2007). Regarding legislative model, many countries in Civil law have not separated legislation about the right of superficies, which is usually specified as a section of Civil Code. For example, Germany has specified the rights of superficies in Article 1012: (4) of Germany Civil Code in 1896. Then, the Superficies Command (Verordnung über das Erb-baurecht) promulgated in 1919 further improved the right of superficies. Japan has stipulated a similar right, named as *chijōken* (地上権, “above-ground rights”) founded in Article 269 of Civil Code, 1966. Furthermore, Japan has *Special Measures Act for Public Use of the Deep Underground* in 2001. Netherlands takes the right of superficies (*opstalrecht*) as “a real property right to own or to acquire buildings, works or vegetation in, on or above an immovable thing owned by another” in Article 5:101 (1) of Dutch Civil Code. Turkey defines the right of superficies (*üst hakkı*), which can be used when the owner of the construction is not the same as the owner of the parcel in Article 726 of the Turkish Civil Code (2001).

Different from Civil legal family, many countries in Common law subdivide the above-surface space into independent property units (Sandberg, 2003). One is the “independent” model of “air rights” or “air space rights” used in deed registration system, which enables the ownership of “air rights” to be subdivided. For example, the United States has an independent form of ownership. Actually, the model can also be used in underground space. The other is the “cooperative” model, which subdivides a building into several apartment units. These units are owned by different owners, but the common area belongs to co-ownership. It is referred to as the terms of condominium and strata title, adopted in countries with title registration system, for example, the New South Wales of Australia, British Columbia, and Ontario of Canada (Paulsson, 2007). With respect to legislative model, the common law countries generally adopt separated legislation for the space right law, and the USA is the first to confirm the space right through the case law. For example, a famous case is the financing of the construction of Grand Central Station in New York by the sale of “air rights” (Stoter and Van Oosterom, 2005), and the following *Oklahoma Air Space Act* 1973 detailed the rules of space right system. New Zealand has also separated legislation about “cooperative” model by defining the “space” or “unit”, such as Unit Title Act 1972 (Sandberg, 2001). The United Kingdom allows for development rights associated with the vertical size of building to be transferred to the surrounding buildings through *Urban and Rural Planning Law* in 1947 by a legislative approach.

### 2.2. Chinese UUS development and property rights

The utilization of underground space in China can be dated back to ancient times. Underground space was mainly used for cave dwelling, water supply and drainage, storage cellars, tombs (e.g. the Terra Cotta

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