



Perspectives on Cadastre and Land Management in Support of Sustainable Real Estate Markets

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1. Introduction

Land is a limited resource and its responsible use requires administration, management, and planning [1]. Sound land administration, efficient land management, and sustainable real estate markets are vital for good governance [2,3] and are indispensable for economic [4], social [5] (p. 3), and environmental development [6]. Suitable systems have been developed and adapted to the technological developments and changing needs of recent centuries [7,8]. The way that people live and work is dramatically impacted by various trends and disruptive technological developments such as cloud services, distributed network systems, artificial intelligence, and machine learning. Major global challenges, such as urbanization, cybersecurity and digital ethics, repetitive financial crises, and natural and man-made disasters, like the recent pandemic, also have a dramatic impact on people's lives and the real estate market [9].

Technical, fiscal, administrative, legal, and policy issues related to land administration and land management have been evolving in response to the UN Sustainable Development Agenda 2030 [10]. There is a broad recognition that a stable and transparent land policy framework for tenure security and the development of efficient and inclusive land administration systems is essential for global and sustainable prosperity [11]. However, different countries follow different strategies in the management of land and real estate. This often leads to uncertain results the failure of countries to meet their goals.

In this Special Issue, in an effort to share best practices for solutions and risk mitigation measures, and to improve awareness and preparedness for future disruptive changes, we invited papers focusing on the following issues:

1. Modern trends in designing and building efficient land administration systems that provide secure tenure for all and support the development of sustainable real estate markets
2. Best practices, common challenges, and opportunities in the management of land.

The focus of the papers includes, but is not limited to, the following themes:

- Policy and strategy development processes in land administration and land management at the governmental level in order to meet current and future user needs and challenges:
 - Standardization in the recording of land and property;
 - Fit-for-purpose (FFPLA) land administration;
 - The formalization of informal constructions;
 - Digitalization and urban land administration (ULA);
 - Disaster management.
- Technical issues and challenges in cadastre and land management:
 - Cadastral data collection, validation, and dissemination;



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- Novel solutions for typical problems like initial data collection, crowdsourcing/volunteered geographic information (VGI), land administration domain model (LADM), distributing network systems, block chain, machine learning, artificial intelligence-based services, quality improvement, data integration, user access, open data, platform economy, etc.
- Extension of the domain into 3D, 4D, building information, and indoor modelling;
- Inclusion of public law restrictions;
- Legal issues such as tenure security for all, digital trust and ethical issues, public–private partnership (PPP) and the role of private sector, land valuation, coping with unregistered buildings and land, etc.;
- Connection to other disciplines like spatial planning, history, sociology, informal settlements (formalizing, registering, and upgrading), property valuation and taxation, housing, land use planning and development permitting, etc.

2. Recent Developments

It is a well-known fact that data collected for singular purposes are less cost-effective than data used for multiple purposes. Križanović et al. [12] analyzed the dissemination practices for cadastral data in three different countries (Croatia, England, and New Zealand) and in Green County, OH, USA. They found that, despite differences in principles and organization, the cadastral excerpts inform the concerned parties about land parcels. However, the authors propose standardization and the unification of land information, a concept that has already been discussed for some time [13]. This contribution to this Special Issue further develops the topic by presenting a workflow for data dissemination processes in future versions of the LADM.

Data dissemination is not the only procedure that is necessary; it is also necessary that cadastral organizations adapt to the changes in society and the modernization of public administration. However, the problems are complex, and critical inquiry is required to address the unknown. An essential part of changes in a land management system is to let the system and the users adapt to the changes, because the stakeholders need to explore the benefits of a new system. Since most stakeholders are land owners, efficient front ends are just as important as a solid legal foundation for proper land management, customer satisfaction, and efficiency. A contribution in this Special Issue begins with a cadastre typology to support incremental improvements. In addition, another contribution discusses the problems that can arise when plans are too ambitious.

The adaptation of novel technologies will inevitably lead to inconsistencies. The most obvious cases are caused by improvements in surveying technologies leading to more accurately described boundaries which contradict older surveys. However, inconsistencies may also emerge through the transition from a paper-based to a computerized system, the use of different systems for urban and rural areas, or changes in the political system with accompanying rule sets that might not have been implemented in the whole country. Several contributions discuss aspects of this topic including inconsistencies in boundaries and inconsistencies between different registers (e.g., housing and parcel register).

A hot topic in recent years was the third dimension. The discussion started in the early 2000's [14] and led to a series of conferences and a significant number of publications. There are a vast number of problems, including suitable height reference systems, geometrical modeling, and visualization. Although the discussion started with a focus on above-ground developments (e.g., what is the registration procedure for a building that extends across a highway?), the discussion later incorporated sub-surface structures. A discussion of challenges and research needs is included in this Special Issue.

Since traditional data collection to set up cadastral systems requires long time spans, various suggestions to adopt crowdsourcing approaches have been published [15,16]. The contribution in this Special Issue merges several current research directions by applying crowdsourcing and machine learning techniques to the problem of 3D cadastral data collection. Another paper deals with crowdsourcing itself and the inherent quality problem.

All of the above-mentioned aspects are relevant when cadastral data are used, e.g., to support real estate markets. Some of the papers in this Special Issue do not consider technical aspects of the cadastre itself; rather, they use the geometrical basis provided by the cadastre to analyze different kinds of data. The nexus between population growth, land use, and housing supply is an example of this. Since cadastral data are maintained over long periods, they can also serve as a source to analyze urban dynamics, as exemplified by the case of Spain. Finally, an interesting question is the ownership of cities. Traditionally, residents owned their cities. However, if an increasing share of a city is owned by investors, this might have an impact on sustainability, long-term stability, and livability. Investment definitely has an impact on decisions made by local governments, and these decisions can also affect the ownership structure.

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