Cadastral data tomorrow: what do the users need?

Karolina ITÄINEN, Pauliina KRIGSHOLM and Kirsikka RIEKKINEN, Finland

Key words: land administration; cadastre, cadastral data; user needs

1. SUMMARY

Cadastral systems are expected to adapt to the many societal changes in their operational environments, including digitalization, climate change, and geopolitical changes. Often the development of cadastral systems is considered from the perspective of cadastral authorities and the core land administration system. However, to fully utilize the potential of cadastral systems and the data they contain, the variety of uses of cadastral data and needs of various user groups should be considered. To explore the possible development paths for cadastral data, we interview Finnish cadastral data users from both public and private sector to determine, what their core needs regarding cadastral data are and how they expect these needs to change in the next ten years.

The results indicate that increasing regulation, technological development, and safety concerns are expected to have a significant impact on future cadastral data. These drivers highlight the increasing importance of both up-to-date data, and georeferenced data. Additionally, emerging uses of artificial intelligence may lead to expectations for availability of larger quantities of data for a cheaper price, to facilitate the training of machine learning models. The relevance of high quality, up-to-date cadastral information is expected to increase due to tightened regulation.

Cadastral data tomorrow: what do the users need?

Karolina ITÄINEN, Pauliina KRIGSHOLM and Kirsikka RIEKKINEN, Finland

2. INTRODUCTION

The future of cadastral systems is a topic of constant interest. There are great expectations for these systems: they are expected to adapt to the may societal changes in their operational environments, such as digitalization, climate change, increasing economic pressure (see e.g. (Riekkinen et al., 2016), while constantly providing value and solutions to complex challenges, such as rapid urbanization, societal disparities, and economic volatility (FAO, UNECE and FIG, 2020).

Cadastral systems, here defined as encompassing the land registry, the cadastre, and the institutions upholding these systems, contain a variety of information about land, ownership, and related rights (see e.g. Larsson, 1991). While the implementation and exact data contents of cadastral systems varies, they share the basic purpose of depicting the relationship between people and land (Seifert & Salzmann, 2022), and such information is valuable for many user groups both internally in cadastral organisations, and externally in both private and public sectors (Todorovski & Lemmen, 2007). Examples of prominent external user groups of cadastral data include municipalities, banks, tax authorities, real estate agencies (Krigsholm et al., 2018). Krigsholm et. al (2018) recognized four major themes of cadastral data use: land use, markets and valuation, governance, and juridical decision-making.

The future of cadastral systems has been a topic of constant interest in both the scientific literature and among practitioners. Multiple cadastral authorities have published their strategies and visions for future cadastral systems. These visions highlight what features are perceived to be of particular relevance in the future, for example, in Land Information New Zealand's (LINZ) strategy for 2034, goals for high spatial accuracy, inclusion of all land-related rights, and efficient information exchange with various sources are set to achieve "a cadastral system that enables people to readily and confidently identify the location and extent of all rights, restrictions, and responsibilities related to land and real property" (LINZ, 2014). Similarly, in their 10-year strategy, Land Use Victoria (LUV) strives for "a fully digital, highly automated and spatially accurate cadastral system that enables creating, managing and visualising the location and spatial extent of all known interests in Victorian land", and considers standardization, automation and 3D-technologies some of the key pillars for achieving the vision (LUV, 2024).

One significant international guideline for the development of cadastral systems is the Land Administration Domain Model (LADM). LADM is a descriptive standard that offers a shared

vocabulary for land administration and thus promotes interoperability and exchange of information (Lemmen et al., 2025). The model is developed to support different functions of land administration, such as land use planning and securing tenure (Lemmen et al., 2025). The model also other applications, such as using it to evaluate how sustainable development goals (SDGs) are promoted with land administration (Chen et al., 2024).

Constant development and improvement of cadastral systems is necessary, as the functionality of cadastral systems effects society widely: for example, inaccuracies and deficiencies in cadastral data may lead to harm, such as loss of tax revenue (Cienciała et al., 2021). Thus, it is important to thoroughly consider user needs regarding cadastral data and its future. While cadastral authorities are generally a rich source of information on the functionalities of cadastral systems, they may lack crucial information on the specific applications for cadastral data and the specific needs of users (Itäinen et al., 2025). Thus, support development of cadastral systems that are tailored to future needs, there is still need for research into the future of cadastral data use, that widely considers different user groups and their needs. In this paper, we explore the future needs for cadastral data from the perspective of the Finnish users of cadastral data. To that end, we interview users from both the public and private sectors, from different prominent user groups of the data. We aim to answer the question “what kind of needs to users have for cadastral data in the future?" By amplifying the voices of users of the data, we strive to contribute to a more multifaceted discussion on the future of cadastral systems.

3. METHODS

To explore the variety of needs that affect future of cadastral information, 33 interviews were conducted with representatives of 29 organizations. The organizations included were chosen to represent prominent user groups of cadastral information, and the selection was with help from cadastral data use experts at National Land Survey of Finland. The interviews were conducted using Microsoft Teams. In the interviews, the users of cadastral data were asked about the changes they have observed in their operational environments, and what changes they are expecting to occur in the next ten years, and how they expect these changes to affect their needs regarding cadastral data. Additional information about their uses for cadastral data, stakeholder groups, and types of data used was also collected in the interviews for

further context. The interviews were transcribed, and the transcripts were analyzed using thematic analysis (see. e.g. Braun & Clarke, 2006).

The interviewed organizations represented the following user groups:

- Municipalities
- Regional authorities
- Forestry
- National security and defense
- Energy
- Data integrators and resellers
- Waste management
- Digital service platforms
- Law and justice system
- Real estate development, construction and management
- Banking and finances
- Taxation
- Other national authorities

This study considers the use of cadastral data in the context of Finnish cadastral system. The Finnish system consists of the cadastre, where the boundaries, easements, and other properties of real estate are registered, and the land registry, where the ownership, right of use, and related obligations are registered (Vitikainen, 2014). These registers, upheld by the National Land Survey (NLS) form the core cadastral system. Additionally, information related to land administration is stored in various other registers, such as the private road register, the property purchase price register, and the residential and commercial property information system.

4. RESULTS

Multiple themes and drivers for change regarding the use of cadastral data emerged from the interviews. While exact use cases for the data vary greatly between the users, their perception of future of cadastral data use converged around shared themes, such as quality of data, interoperability, and changes in technology. In this section, we describe these overall themes observed from the interviews.

The increasing importance of up-to-dateness of the information was mentioned frequently. Expectations are shifting from regularly updated information to constantly real time information. One notable driver of this change is the tightening regulation regarding, for example, environment permit processes and sustainability in banking. Increasingly common

digital service platforms developed for different tasks have also increased the expectation of instant information and decision making.

Many interviewed users wished for more georeferenced cadastral data. Georeferenced data allows for more diverse utilization of the data, for example, map-based user interfaces were often considered the future of accessing cadastral data. Additionally, georeferenced data is easier to combine with other types of geoinformation and allows for new applications of the data. To allow for these new applications, the interoperability of the data is key: while cadastral data itself is valuable, many users see additional value in combination with other data sources. Thus, thorough documentation and standardization of data is needed to allow new, valuable applications to be developed based on cadastral data.

The increasing prevalence of artificial intelligence was also reflected in the answers. The previously mentioned expectations: up-to-dateness, interoperability, and high-quality documentation are also needed for the users to be able to fully utilize artificial intelligence in processing cadastral data. The usage of artificial intelligence also is expected to somewhat change the needs regarding volume of data: more data is needed to reliably train these models. However, as the current pricing of cadastral data is seen as a hinderance to this kind of use, as the volume of data needed would be exceedingly expensive.

To facilitate the creation of value in combination with other data sources, the ease of access to different governmental data sources is of importance to the users. In the interviews, it was observed that many users do not specifically know what is considered cadastral data, and what is related data about land administration. For example, land use plans and building information is not considered cadastral data in the Finnish system, but for many users, is of equal interest to cadastral data and is used in concurrence with it. Thus, access to different types of land administration information from the same user interface would increase the efficiency of many users, and the users see no reason to keep these data types separate.

Conflicting needs were also observed: most notably, the defense sector would prefer spatial information to be more restricted to prevent hostile actors from utilizing open data to endanger national security. For many private actors, on the other hand, there is a preference for as much openly available data as possible, to enable different applications and, for example, training machine learning models. Additionally, many actors would prefer less restricted information to personal information stored in the cadastral system, but regulation on the distribution of personal information (such as the European Union’s General Data Protection Regulation GDPR and national legislation) may prevent that.

The impact of national security concerns on cadastral data use was observed beyond the concern of misuse of open data. Due to changes in legislation made in response to changing geopolitical landscape, property ownership of foreign citizens has become a subject under increased scrutiny. This has increased the need to access information about personal information, such as the nationality of property owners and buyers. Additionally, the need for

expropriation and use of right of pre-emption has increased and is expected to remain a prominent security-related use of cadastral data.

Climate change was found to be one driver of changing future needs, that was of especial prevalence for the banking sector. Climate change and related adverse effects, such as increased flooding, are expected to add future complexity to the process of estimating value of securities. Additionally, climate change and regulation combating it increases the complexity of environmental permit processes, for both the applicants and the authorities evaluating the applications. Both national and EU-level regulations relating to climate was found to affect multiple interviewed sectors, such as authorities, banking, and forestry.

While the way cadastral data is processed and implemented to other functions may change, the interviewees agreed that the relevance of cadastral data will remain high and increase in some cases. The authoritative, reliable nature of the data is also seen as a major strength of cadastral data, that will keep the upkeep and improvement of cadastral systems a topic of interest.

5. DISCUSSION AND CONCLUSIONS

The observed themes and drivers for change highlight areas of importance for development that leads to cadastral systems that can provide increasing value to users. Some of the results were in line with previous research and development strategies, such as the importance of georeferenced data and spatial accuracy. However, themes such as artificial intelligence and rise of national security concerns are newer developments that reflect the need for ongoing evaluation of drivers and forces of change.

Changing uses of the information may apply pressure to cadastral authorities and policy makers to rethink how cadastral data is distributed and priced. Expectations for large amounts of data on a cheaper price may disrupt the attempt to be cost returning, thus calling for political decisions to decide what should be prioritized. Difficulties rising from contradictory needs were present in other aspects of future data use, as well. The conflict between increasing transparency and openness and protecting privacy and security has been similarly observed by, for example, Salzmann (2022) and Riekkinen et al. (2016), and the pressure for cadastral systems authorities to adapt to changes in geopolitical environments by e.g.(Riekkinen et al. (2025).

Features promoting ease of use were a reoccurring theme in the interviews, with the users calling for interoperability and high-quality documentation. These needs highlight the importance of initiatives such as the LADM (see e.g. Lemmen et al., 2025), to ensure that the data is sufficiently structured, versatile, and supports various applications. More structured data also allows for a smoother transition to automized data processing. Combability with other systems is also crucial for better cross-sectoral value creation. The users are rarely interested in what branch of administration exactly is responsible for each type of data, and ease of access is much more crucial for their usage of the data. Thus, collaboration across

silos in administration is called for to promote more efficient and diverse use of governmental data.

Rapid changes in operational environments may be challenging for authorities to adapt to. The development of technologies utilizing machine learning and artificial intelligence is a topical example of such change. Many interviewees mentioned it as a notable driver of change in their operations and expect cadastral data to accommodate the use of AI. However, artificial intelligence is absent from many strategies of cadastral authorities, indicating the need for constantly ongoing work on developing systems and monitoring changes in operational environments. The demands created by AI use beyond the initial boom should be monitored closely.

Some limitations apply to our results. The Finnish system is a mature system with high levels of trust from the public, so the responses assume a certain level of base functionality and reliability from the system. Thus, needs regarding the base functions of a cadastral systems, such as securing tenure, were less prominent in the answers. However, the observations made in this study can still be of interest to all types of systems, as the advancements in technology and changes in operational environments are by no means limited to mature systems.

Many of the interviewed users expressed delight over being interviewed on these topics: there is clearly need for cadastral authorities and researchers to listen to users of cadastral data. Understanding their needs and the forces of change affecting them is crucial to develop future cadastral systems that can benefit all actors, and there is a great need to stay adaptable in constantly changing environments.

REFERENCES

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Chen, M., Van Oosterom, P., Kalogianni, E., Dijkstra, P., & Lemmen, C. (2024). Bridging Sustainable Development Goals and Land Administration: The Role of the ISO 19152 Land

Administration Domain Model in SDG Indicator Formalization. Land, 13(4), Article 4. https://doi.org/10.3390/land13040491

Cienciała, A., Sobolewska-Mikulska, K., & Sobura, S. (2021). Credibility of the cadastral data on land use and the methodology for their verification and update. Land Use Policy, 102, 105204. https://doi.org/10.1016/j.landusepol.2020.105204

FAO, UNECE and FIG. (2020). Digital transformation and land administration – Sustainable practices from the UNECE region and beyond (No. 80; FIG Publication). Available at: https://www.fig.net/resources/publications/figpub/pub80/figpub80.asp

Itäinen, K., Krigsholm, P., & Riekkinen, K. (2025). Beyond the title-deed division – developing a holistic framework for characterising mature cadastral systems. Survey Review, 0(0), 1–11. https://doi.org/10.1080/00396265.2025.2510819

Krigsholm, P., Riekkinen, K., & Ståhle, P. (2018). The Changing Uses of Cadastral Information: A User-Driven Case Study. Land, 7(3), 83. https://doi.org/10.3390/land7030083

Larsson, G. (1991). Land registration and cadastral systems: Tools for land information and management (2. repr). Addison Wesley Longman.

Lemmen, C., Van Oosterom, P., Kara, A., & Kalogianni, E. (2025). The Land Administration Domain Model (LADM) An Overview (No. 84; FIG Publication). https://fig.net/resources/publications/figpub/pub84/figpub84.asp

LINZ. (2014). Cadastre 2034—A 10-20 Year Strategy for developing the cadastral system: Knowing the 'where' of land-related rights. https://www.mcguinnessinstitute.org/wp-content/uploads/2021/04/9b.-Cadastre-2034-A-10-20-Year-Strategy-for-developing-the-cadastral-system.pdf

LUV. (2024). A 10-year strategy for Victoria's cadastral system. https://www.land.vic.gov.au/__data/assets/pdf_file/0040/695659/10-Year-Strategy-for-Victorias-Cadastral-System-2022-2032.pdf

Riekkinen, K., Krigsholm, P., & Penkkilä, O. (2025). Monitoring and restricting real property ownership on national security grounds: The case of Northern European countries. Land Use Policy, 157, 107630. https://doi.org/10.1016/j.landusepol.2025.107630

Riekkinen, K., Toivonen, S., Krigsholm, P., Hiironen, J., & Kolis, K. (2016). Future themes in the operational environment of the Finnish cadastral system. Land Use Policy, 57, 702–708. https://doi.org/10.1016/j.landusepol.2016.06.039

Salzmann, M. (2022). Open Access Data: Why we want access to all data, but are hesitant to share our own data. The issue of trust revisited. FIG Congress 2022: Volunteering for the Future - Geospatial Excellence for a Better Living.

https://www.fig.net/resources/proceedings/fig_proceedings/fig2022/papers/ts08d/TS08D_salzmann_11466.pdf

Seifert, M., & Salzmann, M. (2022). Cadastre. In W. Kresse & D. M. Danko (Eds), Springer handbook of geographic information (2nd edn, p. 985). Springer Nature Switzerland AG.

Todorovski, D., & Lemmen, C. (2007). Analyses of User Requirements – The First Step towards Strategic Integration of Surveying and Cadastral Services. FIG Working Week 2007, Hong Kong, China. https://www.fig.net/resources/proceedings/fig_proceedings/fig2007/papers/ts_7g/ts07g_01_todorovski_lemmen_1202.pdf

Vitikainen, A. (2014). Kiinteistötekniikan perusteet. Aalto-yliopisto**.** ISBN 978-952-60-6002-6

BIOGRAPHICAL NOTES

M.Sc. (Tech.) Karolina Itäinen works as a research scientist at Finnish Geospatial Research Institute (FGI) at National Land Survey of Finland (NLS).
D. Sc. (Tech.) Pauliina Krigsholm works as Senior Research Fellow at Nordregio, Stockholm.
D. Sc. (Tech) Kirsikka Riekkinen works as an assistant professor in land management at Department of Built Environment, Aalto University School of Engineering, Finland. This position is partly funded by the National Land Survey of Finland.

CONTACTS

Karolina Itäinen
Finnish Geosaptial Research Institute (FGI)
Vuorimiehentie 5 Espoo FINLAND
Tel. +358 50 320 2992
Email: karolina.itainen@nsl.fi
Web site: nls.fi