PRAVNO ZAVEZUJOČ MEJNI KATASTER V AVSTRIJI: ZGODBA O USPEHU?

THE LEGAL BOUNDARY CADASTRE IN AUSTRIA: A SUCCESS STORY?

Julius Ernst, Reinfried Mansberger, Gerhard Muggenhuber, Gerhard Navratil, Stefan Ozlberger, Christoph Twaroch

UDK: 528.44
Klasifikacija prispevka po COBISS.SI: 1.02
Prispelo: 1. 2. 2019
Sprejeto: 19. 5. 2019

DOI: 10.15292/geodetski-vestnik.2019.02.234-249
REVIEW ARTICLE
Received: 1. 2. 2019
Accepted: 19. 5. 2019

IZVLEČEK

Avstrijski geodeti v letu 2019 zaznamujejo 50. obletnico zakonske uveljavitve avstrijskega zakona o geodetski izmeri. Z navedenim zakonom se je uradno začel vzpostavljati tako imenovani pravni mejni kataster *(nem.* der Grenzkataster*), ki je prinesel pomembno prelomnico v avstrijskem zemljiškem katastru, saj še vedno zagotavlja pravno varnost glede poteka meje zemljiških parcel. Ta pomembna obletnica prinaša priložnost, da se oceni in predstavi razvoj, uveljavljanje in delovanje* pravnega mejnega katastra *širši znanstveni in strokovni skupnosti. Kratkemu zgodovinskemu orisu avstrijskega katastra v članku sledi predstavitev prehoda z davčnega na pravni mejni kataster. Predstavljen je veljavni sistem zemljiškega katastra v Avstriji, s svojimi prednostmi in slabostmi. Dodatno so predstavljene načrtovane razvojne naloge.*

ABSTRACT

In 2019, the Austrian surveyors will celebrate the 50 years anniversary of the enactment of the Austrian Surveying Act. The date of the enactment of this law was also the hour of birth for the Austrian Legal Boundary Cadastre *(germ.* der Grenzkataster*) and with it a milestone to ensure the legal security of parcel boundaries. The jubilee is taken as the occasion to introduce the development, implementation and running of the* Legal Boundary Cadastre *to a wider scientific community. After a short history of the Austrian Cadastre, the process of its transition from the* Fiscal Cadastre *to the* Legal Boundary Cadastre *is documented in the article. The current situation with strengths and weaknesses of the system is outlined and scheduled developments are introduced.*

KLJUČNE BESEDE

zemljiški kataster, pravni mejni kataster, davčni kataster, zakon o geodetski izmeri, zemljiški administrativni sistem, zemljiška parcela, Avstrija

KEY WORDS

land cadastre, legal boundary cadastre, fiscal cadastre, surveying law, land administration system, land register, land parcel, Austria

1 INTRODUCTION

In 2017, the Austrian Cadastre celebrated its 200 years anniversary. With the enactment of the *Act on Real Property Taxation* (germ. *Grundsteuerpatent*) in the year 1817, the Emperor of Austria, Franz I. (1768–1835), initiated the surveying and mapping in a map scale of 1:2880 for the whole monarchy. The *Franciscan Cadastre* (germ. *Franziszeischer Kataster*) is characterized by completeness, standardized processes, and geocoding based on countrywide triangulation (BEV, 2017). In addition, thematic information, such as land use, quality of soil and administrative data were gathered.

In 2019, the Austrian surveyors have again a reason to celebrate: 50 years of *Legal Boundary Cadastre* (germ. *Grenzkataster*). People might be confused. Does the Austrian land administration have an additional cadastral system? No, the *Legal Boundary Cadastre* evolved from the *Fiscal Cadastre* and defined a new quality level within the *Real Estate Cadastre*. Therefore, the *Legal Boundary Cadastre*, based on the *Surveying Act* (germ. *Vermessungsgesetz*, 1968), is a part of the Austrian Land Administration System (Abart, Ernst, and Twaroch, 2017).

An important benefit of the *Legal Boundary Cadastre* can be described by the following theoretical example:

Person A is the owner of two parcels (parcel 278/2 and parcel 154/5). Both parcels are neighboured by three parcels owned by Persons B, C and D (see Figure 1). In our experiment, all boundaries of the parcel 278/2 and parcel 154/5 were negotiated between all involved persons. The boundary points were marked and all owners agreed on the parcel boundary. Afterwards, the boundary points of the parcel 278/2 and parcel 154/5 were surveyed accurately within the Austrian reference system (germ. *Referenzsystem*). The parcel 278/2 was surveyed before 1969. The surveying of the parcel 154/5 was carried out after 1969 according to the regulations of the new *Surveying Act* (*Vermessungsgesetz*, 1968), and is dedicated as a parcel of the *Legal Boundary Cadastre*. In daily life, the difference between the two parcels only can be seen in the cadastral map, where the number of the parcel 154/5 is underlined with a dashed line, and in the Land Register by the prefix 'G'.

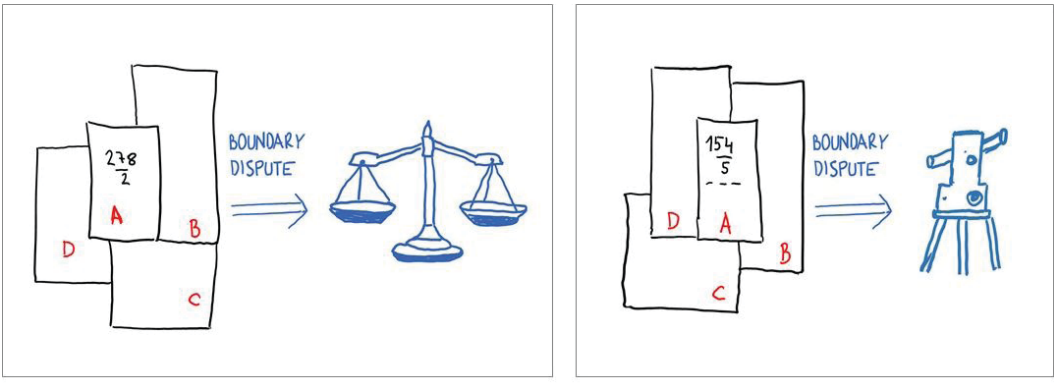


Figure 1: Conflict solving of boundary disputes in the *Fiscal Cadastre* (left) and in *Legal Boundary Cadastre* (right).

Differences between the two parcels occur in cases of boundary disputes. If the owner A struggles with one of his neighbours (B, C and/or D) about a boundary of the parcel 278/2, he has to go to court and a judge has to decide about the boundary line. If the dispute is on a boundary line of the parcel 154/5,

then the *Cadastral Office* (germ. *Vermessungsamt*) is entitled to stake out the boundary points according to the previous surveying. The reasons for the different approaches of dispute solving as well as other benefits of parcels in the *Legal Boundary Cadastre* will be outlined in the current paper.

2 SHORT HISTORY OF AUSTRIAN CADASTRE

The Austrian Real Estate Cadastre is the result of a continuous innovation since the *Grundsteuerpatent* from 1817, which initiated the systematic assessment and surveying of parcels (see Figure 2). For the first time, the Austrian Monarchy was mapped entirely. In the beginning, the primary objective of the Real Estate Cadastre was taxation. Nevertheless, since the very beginning, the cadastral system has been providing complete evidence of all parcels in the monarchy with the potential for multi-purpose use. The *Franciscan Cadastre* was known also as *Stable Cadastre* (germ. *Stabiler Kataster*) as the taxation was based on the soil characteristic and not on the actual yield and therefore not on the diligence of the landowner (Lego, 1968).

Objects of the surveying were boundaries of municipalities and of parcels that included also surveying of buildings as well as topographic elements, such as bridges, public roads, railways and water bodies. The surveying was outlined by plane table measurements with graphical accuracy according to the map scale.

In 1869, the Regulation Act for Land Taxation (germ. *Grundsteuerregelung*) introduced a countrywide harmonisation of the taxation system based on detailed valuations of the net yield of land parcels. The Regulation Act for Land Taxation caused a complete revision of the existing, to the since 1817existing, and not yet updated *Franciscan Cadastre*. As in 1871 the metric system was introduced in the Austrian-Hungarian Monarchy, the revision of the cadastral maps included a transition to the metric system. The cadastre updated and projected into the metric system was called *Fiscal Cadastre* (germ. *Grundsteuerkataster*).

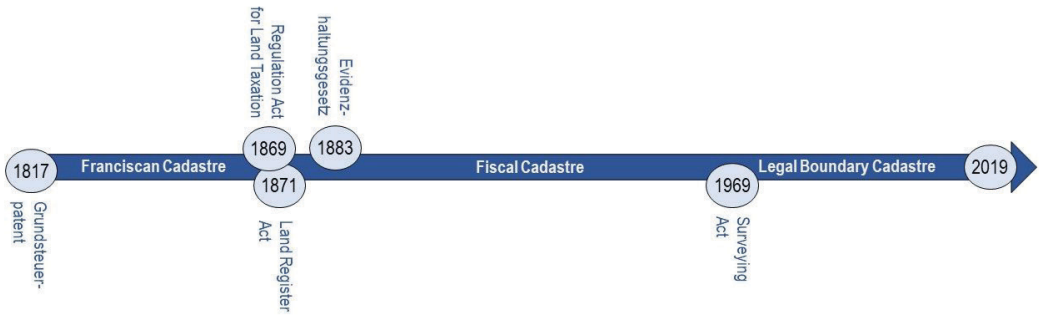


Figure 2: Milestones of the Austrian Land Administration System from 1817 to 2019.

In 1871, the enactment of the *General Land Register Act* (germ. *Allgemeines Grundbuchsgesetz*) and the *Implementation Act for the Land Register* (germ. *Allgemeines Grundbuchsanlegungsgesetz*) initiated the co-operation between the *Cadastre* and the *Land Register*. Since that time, the coherence between these two essential components of the Austrian Land Administration System is maintained. In 1883, the implementation of the *Act of Continuous Land Cadastre Maintenance* (germ. *Evidenzhaltungsgesetz*, 1883) required a continuous up-dating of *Land Register* and *Fiscal Cadastre* and with it, an improved consistence of the legal information and the physical description of parcels.

Cadastral Offices have to carry out the maintenance of the cadastre, which included also the revision of boundaries of municipalities, the updating of parcel boundaries, and the actualisation of land cover. The Federal Office of Metrology and Surveying (BEV) has to provide the fundamental survey, the implementation of the cadastre, and the production of countrywide topographic maps.

The *Surveying Act* regulates all above-mentioned tasks of the Austrian surveying authorities. As an additional task, the *Legal Boundary Cadastre* has to provide security of boundary lines.

Details about the history and the development of the Austrian Cadastre are presented in Lisec and Navratil (2014).

3 THE TRANSITION TO THE LEGAL BOUNDARY CADASTRE

3.1 The Purpose and Process of Introducing the Legal Boundary Cadastre

During the implementation of the Land Register in 1871, the cadastral map was considered an integral part of the Land Register. However, its legal significance was limited to the documentation of the site of the parcels. The increased demands for a higher and legal civil protection required improved technical documentation, which should be achieved by a new legal regulation.

Cadastral / Surveying experts were not satisfied that even highly accurate sub-division maps (cadastral plans) and results of re-measurements are not contributing to the public faith of the Land Register. Following the model of the Swiss and German legal systems, the Austrian surveying authorities and surveying experts preferred also to trust the cadastral documents in cases of deviations between boundaries in nature and boundaries documented in the cadastral maps. A new legal regulation was required to enable the transition from the *Fiscal Cadastre* to the *Legal Boundary Cadastre*, which had to provide legally binding information about the site of parcel boundaries. At the same time, the regulations of the cadastre – some of them more than 100 years old – had to be replaced. The preparation of the new law proved to be more difficult and more time consuming than expected. In addition to other questions, it was necessary to clarify and define the tasks, competencies, responsibilities between the public and private sector for carrying out sub-divisions as well as for the identification and determination of land parcel boundaries. With the *Surveying Act* (*Vermessungsgesetz,* 1968), a new legal basis was implemented and the transition from the *Fiscal Cadastre* to the *Legal Boundary Cadastre* was initiated.

The main purpose of the introduction of *Legal Boundary Cadastre* was to guarantee security about parcel boundaries. For this purpose, the boundaries have to be defined clearly, the boundary lines have to be agreed verifiably, and the boundary points have to be surveyed accurately in the national reference system. The information of the *Legal Boundary Cadastre* is the basis for the determination of boundary lines. In the *Legal Boundary Cadastre*, boundary lines are defined by the surveyed and mapped boundary points and not by the boundary marks visible in nature. The implementation of the Surveying Act was a paradigm shift in the legal acceptance of boundary points from the visible landmark to abstract mathematical coordinates. Disputes over boundaries would be avoided when the boundaries become legally binding. As mentioned in the introduction, a boundary dispute between two parcels raises different approaches for clarification. In the case of the *Fiscal Cadastre*, the property owners must bring the

question to court to resolve the dispute and to set the boundary legally by a judge. Bringing a dispute to court is not required if the parcels are registered in *Legal Boundary Cadastre*. In this case, the cadastral office is responsible to solve the dispute based on the original surveying documents.

Another intention of introducing *Legal Boundary Cadastre* was to create a higher quality in the Cadastre. In most cases, newly formed parcels must get coordinate based boundaries and recorded in *Legal Boundary Cadastre*. High quality of the coordinates is necessary to make a system of legally binding coordinates applicable in practice. In Austria, the Surveying Act requires a survey based on a sufficient number of fixed reference points to transfer parcels from the *Fiscal Cadastre* to the *Legal Boundary Cadastre*. In this way, the coordinates, and thus the boundary of the parcel, gets a sufficiently high accuracy and quality to be registered in *Legal Boundary Cadastre* (Frankenberger, 1971).

The rearrangement of the national surveying and the transition from the *Fiscal Cadastre* to the *Legal Boundary Cadastre* followed the following principles (Twaroch, 2017):

- The *Federal Office of Metrology and Surveying (BEV)* has to provide the fundamental survey (e.g. reference points), the production of countrywide topographic maps and together with the *Cadastral Offices* the implementation and the management of the cadastre.
- The quality level of the *Legal Boundary Cadastre* has to secure not only the existence of a parcel but also the boundaries of this parcel. The parcel with this new feature gets the quality mark "G" in the textual documentation. In the cadastral map, parcels of the *Legal Boundary Cadastre* are visualized with a dotted line under the parcel number/parcel identifier (see Figure 3).

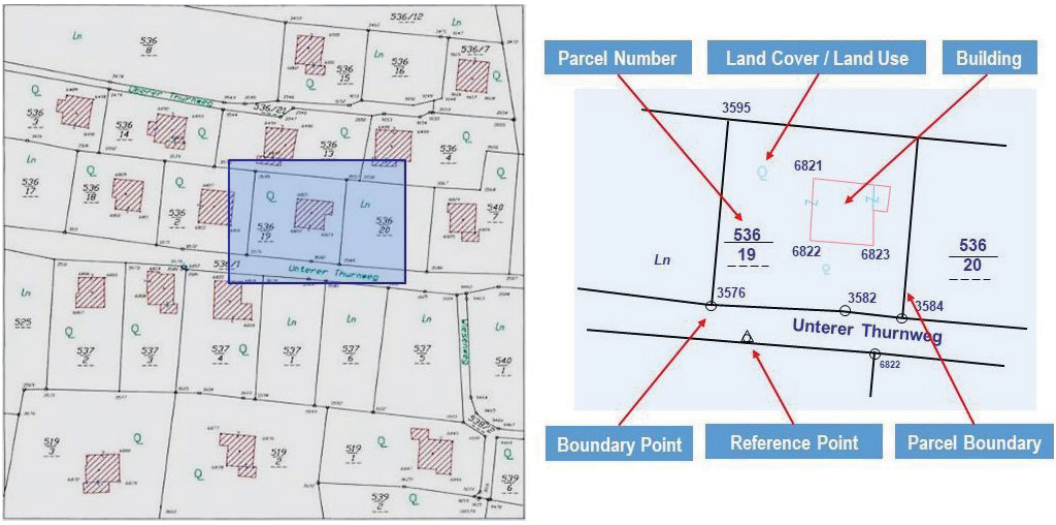


Figure 3: Digital Cadastral Map – Contents (Source: BEV).

- The quality improvements of the cadastre have to be executed by the BEV and by licensed surveyors. The private surveyors are usually performing the sub-division of parcels.
- The cadastre has to follow the structure as far as possible according to the *Fiscal Cadastre*, in order to allow a smooth transition.
- The new regulation has to be cost-neutral, this means without additional costs for the state budget.

3.2 Implementation and Elements of the Legal Boundary Cadastre

The *Legal Boundary Cadastre* is not a parallel cadastral system or data layer, as the new parcels of the *Legal Boundary Cadastre* are incorporated into the official cadastral map. In the case of inconsistencies between the existing cadastral map and new survey, a correction procedure has to be implemented first.

3.2.1 Technical Procedures in the Legal Boundary Cadastre

Two different approaches support the transfer of a parcel from the *Fiscal Cadastre* to the *Legal Boundary Cadastre,* one for systematic transfer and one for occasional transfer:

- The systematic resurvey of all parcels of a cadastral municipality or within a defined area in the municipality is called *ANA-process* (germ. *Allgemeines Neuanlegungsverfahren*). The BEV initiates and implements the process. In cooperation with the municipality, all parcels of the municipality are transferred from the *Fiscal Cadastre* to the *Legal Boundary Cadastre*. ANA-processes were primarily applied between 1970 and 1990. Since then, they have been reduced due to limited resources. Currently (2019), only one ANA-process is running.
- The occasional resurvey of parcels, called *TNA-process* (orig. '*Teilweises Neuanlegungsverfahren*') enables the transfer of individual parcels from the *Fiscal Cadastre* to the *Legal Boundary Cadastre*. The procedure is based on following initiatives of property owners:
  - Application for transferring parcels into the *Legal Boundary Cadastre* without any changes of the property formation (currently about 2600 cases/year).
  - Application for subdivision of parcels results in a changed property formation with highest quality level of the *Legal Boundary Cadastre* (about 27,000 cases/year).

The establishment of the *Legal Boundary Cadastre* is not only a task of the cadastral authority. According to § 1 of the *Real Estate Division Act* (germ. *Liegenschaftsteilungsgesetz*) from 1930, licensed surveyors and other authorized persons are involved in the process. Private licensed surveyors mainly perform the transfer of parcels in the TNA process.

The transformation of a parcel from the *Fiscal Cadastre* to the *Legal Boundary Cadastre* requires that all involved persons (owner of the parcel to be transformed as well as all owners of neighbouring parcels) have to confirm the boundary lines in nature by signature, which is legally a contract. The parcel has to be surveyed and mapped with all the boundary points referring to the Austrian Reference System, which is realised by reference points in the Gauss-Krüger reference system (Bessel ellipsoid, datum MGI) and by the GNSS-based reference stations (APOS – Austrian Positioning Service, based on ETRS89). Accuracy requirements as defined in the *Surveying By-law* (germ. *Vermessungsverordnung*) have to be fulfilled.

The transformation from the *Fiscal Cadastre* to the *Legal Boundary Cadastre* is always parcel-based, as the parcel is the smallest administrative unit. The procedures of negotiation, surveying and mapping are defined in the *Surveying Act* and in the *Surveying By-law*. The coordinates of boundary points emerging from the transfer process are legally binding.

3.2.2 Legal Procedures in the Legal Boundary Cadastre

The task of changing the boundary of a parcel requires the support of a licensed surveyor. However,

the role of the licensed surveyor changed dramatically with the *Legal Boundary Cadastre*. The licensed surveyor guarantees the improved quality level requested by the *Legal Boundary Cadastre.* The tasks of the licensed surveyor include:

- the investigation in the cadastral archive regarding documents relating to the relevant parcel,
- negotiation about the boundaries with all affected property owners,
- marking the agreed boundary,
- documenting the owners' agreement with this boundary,
- surveying and producing a surveying document, and
- applying for a certificate (germ. *Bescheinigung*) at the cadastral office confirming accordance with existing cadastral data and regulations.

The property owners' agreement on the boundaries is documented in a protocol signed by affected property owners referring to boundary points marked and measured in the field as well as recorded in the surveying document. These documents are transferred to the Cadastral Offices for final approval, for issuing the certificates and for updating the cadastre. In the first decades of the *Legal Boundary Cadastre*, this was done in analogue form, but nowadays it is part of an online process. The Cadastral Office sends the decision on the transfer of the parcel into the *Legal Boundary Cadastre* to all affected property owners. The owner and the neighbours of the parcel have the possibility to appeal within a period of two weeks. The update is carried out immediately after the expiry of the appeal period. In cases of sub-division of a parcel, the inscription into the Land Register is required before updating the cadastre.

The Cadastral Offices can perform cadastral procedures to transfer a parcel to the *Legal Boundary Cadastre* as well. Their procedure differs slightly from the process described above, as Cadastral Offices have more legal possibilities if not all owners agree on the boundaries. While licenced surveyors need the consent of all affected land owners, the Cadastral Office is authorized to force the owner with the most unlikely opinion about the boundary to initiate a judicial procedure on the boundary dispute.

The transfer to the *Legal Boundary Cadastre* has several benefits:

- Boundaries are legally binding and secured.
- The area of the parcel is determined more precisely using the coordinates of boundary points. Nevertheless – as in the *Fiscal Cadastre* – the area is not legally binding due to technical aspects.
- Adverse possession is not possible for parts of a parcel.
- Confidence in the documentation of boundaries is protected. Natural boundaries deviating from the documented status are irrelevant due to the principle 'Paper boundaries are overruling natural boundaries' (e.g. fences, boundary marks).
- Surveying authority carries out the restoration of disputed boundaries by staking out the boundary points based on their coordinates. This technical task replaces the court process.

The transformation from the *Fiscal Cadastre* to the *Legal Boundary Cadastre* is a clearly defined legal process to guarantee the above documented advantages. Transformations of individual parcels into the *Legal Boundary Cadastre* are announced by *decision* (germ. *Bescheid*), whereas systematic transformations (e.g. ANA-process, land consolidation) are announced by a *decree* (germ. *Verordnung*) issued by the BEV.

4 CURRENT SITUATION AND DEVELOPMENTS OF THE LEGAL BOUNDARY CADASTRE

4.1 Status of the Legal Boundary Cadastre

In 1969, in the year of the enactment of the *Surveying Act*, the public authority expected that most landowners would appreciate getting their parcel boundaries legally secured. Today, 50 years later, only 17% of all parcels are part of the *Legal Boundary Cadastre* (see Figure 4).

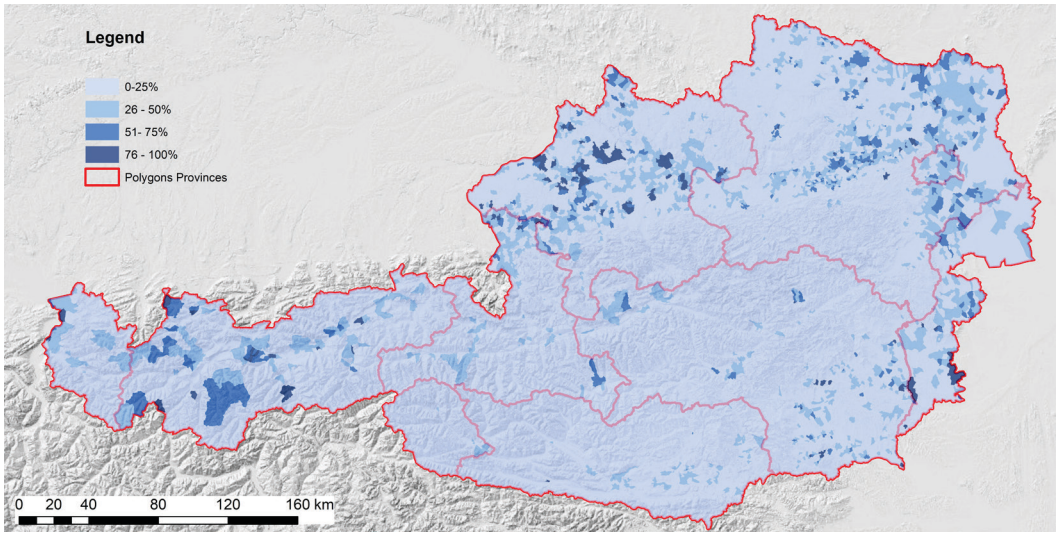


Figure 4: Percentage of parcels in the *Legal Boundary Cadastre* per cadastral municipality (Source: BEV).

Austria has 7850 cadastral municipalities in countrywide 2100 political municipalities. In total, 10.2 million parcels are registered and documented in the so-called *Real Estate Database* (germ. *Grundstücksdatenbank*). From these, 1.6 million parcels have been already transformed from the *Fiscal Cadastre* to the *Legal Boundary Cadastre*. When considering the number of boundary points registered in the *Real Estate Database,* the statistics outline better figures for the *Legal Boundary Cadastre.* From the total of 36 million boundary points, which were gained by surveying and which are available in the Austrian grid system, 11 million boundary points or 30% of all in digital format available boundary points are assigned to the *Legal Boundary Cadastre*. The analysis of the regional distribution of the "*Legal Boundary Cadastre* parcels" outlined three specific types of regions with an increased number of transformed parcels: agricultural areas, peri-urban areas, and areas with infrastructure (roads, railways, etc.).

Austria is characterized by small spatial structures. Due to inheritance law, the agricultural land was fragmented. Land consolidation processes were launched, previously to optimize arable land for agricultural production. Nowadays the projects are more multi-functionally orientated with the result of increased land mobility, of an improved land use management by considering involved stakeholders, and of an enhanced competence to find solutions for trade-offs (Mansberger and Seher, 2014). Since the enactment of the *Surveying Act* (*Vermessungsgesetz*, 1968) in 1969, all the rearranged parcels within a land consolidation scheme are transformed to the *Legal Boundary Cadastre*. The Austrian Land Consolidation Authorities are – according to § 1 of the *Real Estate Division Act* (germ. *Liegenschaftsteilungsgesetz,* 1930) – authorized

bodies for the cadastral surveying. Therefore, a concentration of parcels registered in the *Legal Boundary Cadastre* is found, among the others, in agricultural areas (see Figure 5).

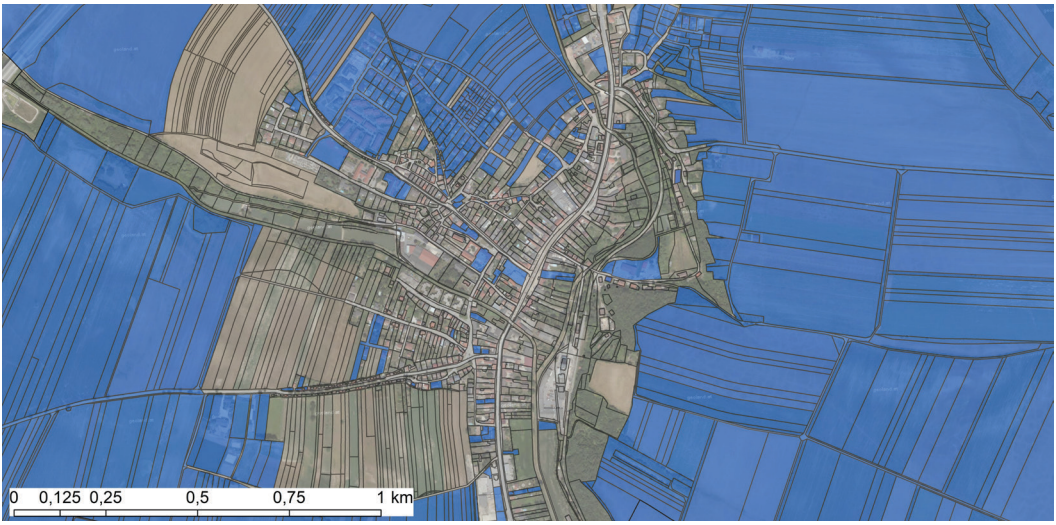


Figure 5: Example for parcels in *Legal Boundary Cadastre* (blue) in a rural area (Source: BEV and basemap.at / Orthophoto).

As in many other countries, urban sprawl is also a challenge of Austrian cities. In peri-urban areas, agricultural land has been converted to residential areas to meet the requirements of an increasing population and their needs for living room in towns. The transformation from arable land to building land is normally linked with a sub-division of land parcels and with ownership transactions. Both require updated records in the Land Cadastre and in the Land Register. As urban development is affecting larger areas and the updated parcel information will be registered in the *Legal Boundary Cadastre*, the urban fringes are also leading areas regarding the accumulation of parcel in the *Legal Boundary Cadastre* (see Figure 6).

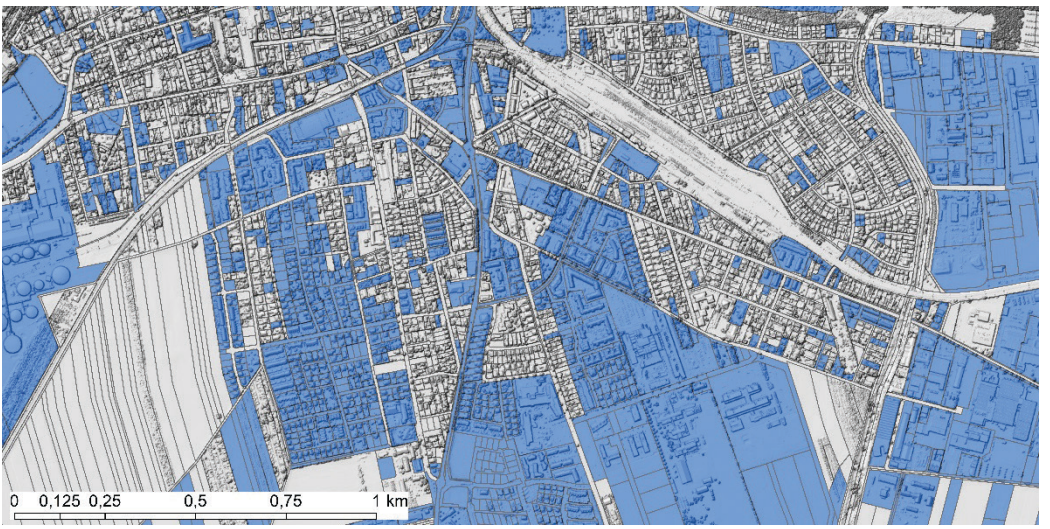


Figure 6: Example for parcels in *Legal Boundary Cadastre* (blue) in an urban fringe (Source: BEV and basemap.at / nDSM).

Figure 7 documents an accumulation of parcels in the *Legal Boundary Cadastre* close to a new track of a railway. This infrastructure has been built in the last 20 years.

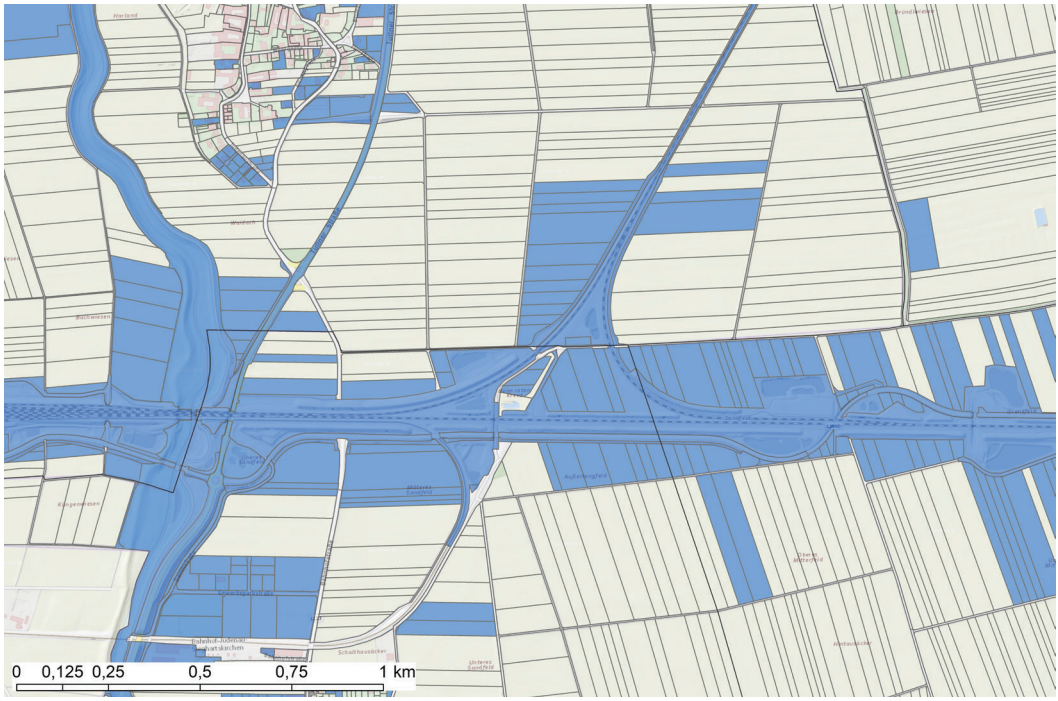


Figure 7: Example for parcels in *Legal Boundary Cadastre* (blue) close to infrastructure corridors (Source: BEV and basemap.at / Map and DTM).

4.2 Strength and Limitations

One of the main advantages of the *Legal Boundary Cadastre* is a level of trust for parcel boundaries equivalent to that of the Land Register. Prior to the implementation of the *Legal Boundary Cadastre*, the boundaries of parcels of the *Fiscal Cadastre* had no such principle of public faith. The copy of the cadastral map available at the Land Register illustrated just the location of the parcels. In contrast to the other parts of the Land Register, the location of the boundary points was not legally binding. The *Legal Boundary Cadastre* has created such a binding character. Since the cadastre forms the basis for the Land Register, such binding is very useful for all parties working with land property: Boundary disputes will no longer have to be settled at the court because boundaries can be restored at any time. Corrections of the *Legal Boundary Cadastre*, e.g. caused by the elimination of strains in the control network or changes in the *Legal Boundary Cadastre* itself, are made in a legal administrative procedure.

The fundamental provision on the protection of confidence in the *Legal Boundary Cadastre* can be found in §8 Z1 of the *Surveying Act* (*Vermessungsgesetz*, 1968). According to this norm, the boundaries incorporated in the *Legal Boundary Cadastre* are binding. This protection of confidence is further described in §§49 and 50 of the *Surveying Act* (*Vermessungsgesetz*, 1968). According to §49 of the *Surveying Act* (*Vermessungsgesetz*, 1968), a claim based on the boundaries visible in reality cannot be opposed to the

party, who has acquired a right by relying on the boundaries contained in the *Legal Boundary Cadastre*. §50 of the *Surveying Act* (*Vermessungsgesetz*, 1968) excludes the adverse possession of parts of a property contained in the *Legal Boundary Cadastre*. This prevents a "creeping migration of ownership" and links the Land Register law directly to the boundaries defined in survey documents. An additional benefit of the *Legal Boundary Cadastre* is the possibility to reconstruct invisible parcel boundaries in nature (e.g. joint cultivation of aggregated parcels, disappeared boundary marks after flood disasters).

The protection of legitimate expectations, which the *Legal Boundary Cadastre* is entitled too, is – according to the Austrian Highest Administrative Court – not limited to purely civil law aspects. It is also of importance in public law. The Highest Administrative Court refers here to the importance of the exact boundary line as a reference for distances defined in the building regulations. This is important for the construction industry because in civil engineering projects the owner can always rely on the boundaries of the *Legal Boundary Cadastre*.

The *Legal Boundary Cadastre* contains other information, such as types of land cover. The types of land cover are defined in the *Surveying Act* (*Vermessungsgesetz*, 1968) and may be related to other laws. For example, §3 Abs1 of *Forestry Act* (germ. *Forstgesetz*) links the definition of "forest" to the land cover type "forest" in the Austrian cadastre. However, the land cover type only can be seen as an indication. According to the Administrative Court, the registered land cover classes have no further legal consequence.

The *Legal Boundary Cadastre* has limitations as well. Challenges are the fixed coordinate values of the boundary points due to improving surveying equipment and changing legal regulations. Whereas the boundaries of parcels in the *Fiscal Cadastre* have to satisfy a graphical precision based on line width and drawing accuracy (at best 0.5 m for a scale of 1:1440), the *Legal Boundary Cadastre* has to achieve the precision defined in the *Surveying By-law* (*Vermessungsverordnung*, 2016). This precision of reconstruction of boundary points is varying between 20 cm in the first version (1969) and 5 cm in the current version (2016).

Another challenge is the inhomogeneity of the geodetic reference frame. The *Legal Boundary Cadastre* was initiated in 1969 with the assumption that the reference frame is accurate enough for this purpose. However, local inhomogeneity of the reference grid is affecting the practical implementation of the concept (Höggerl and Imrek, 2007). Reconstruction of points can lead to different results when referring to different control points. This happens, when e.g. the control points originally used were destroyed or have been displaced. Mathematical methods for the elimination of the inhomogeneity requires to take into account the configuration of control points. Currently, there is no automated method available to be applied for large areas in Austria.

Besides the challenge of the heterogeneity of the reference grid, problems of non-static boundary points raise in some Austrian areas. The European Terrestrial Reference Frame (ETRF) addresses only the large-area effects of plate tectonics. Resulting shifts are eliminated by known transformation parameters. Effects of local and inhomogeneous landslides can hardly be determined, delineate, and/or solved. Currently, the solution is to outline areas of ground-motion. Affected parcels are transferred from the *Legal Boundary Cadastre* back to the *Fiscal Cadastre* to avoid unwanted legal consequences (as a building moving out of a parcel).

4.3 Legal Boundary Cadastre in the Network of Registers and Data Bases

Registration systems provide services for identification of subjects, rights and objects (Twaroch and Muggenhuber, 1997). Registers for persons, companies and societies provide identification of subjects through unique identification numbers. For identification of parcels, the cadastral system provides parcel numbers, which are unique within an administrative unit. In Austria, the cadastral numbering system is linked with the Land Register, the Address Register as well as with the coordinates for each parcel and the postal address for each building. Therefore, the cadastral dataset has become a hub for access to spatial information, such as land valuation (see Figure 8), land use planning, land registry and other public registers. In the case of the *Legal Boundary Cadastre*, besides the parcel also the boundary lines of the parcels can be referenced. This approach provides higher legal security.

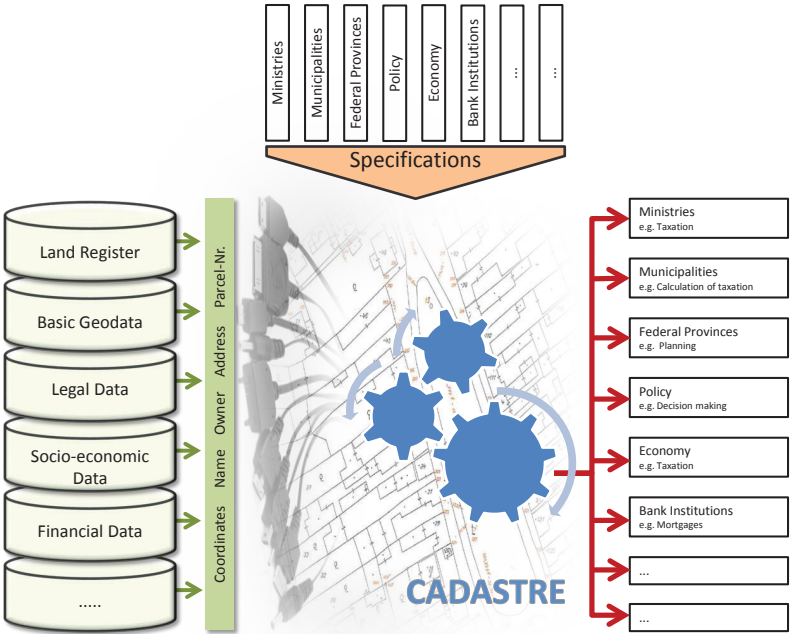


Figure 8: Cadastre as an interface of a countrywide mass land appraisal system (Source: Mansberger et al., 2015).

A weakness of the Austrian solution is that the spatial planning zones are not automatically adapted to changes of cadastral boundaries. Spatial planners create zoning plans or development plans using the cadastre as a geometrical basis. They locate the boundaries exactly in the same position as the current cadastral boundaries if feasible (i.e., if their planning concurs with the current situation). As a result, any change in the cadastre will lead to deviations between cadastre and zoning or development plans. This has to be discussed and solved in the National Spatial Data Infrastructure (NSDI) context.

4.4 Current Developments of the Austrian Cadastre

A decisive step into the digital world was made in 2012 with the introduction of a new cadastral maintaining process. The *Real Estate Database* (germ. *Grundstücksdatenbank*) was updated to modern IT standards. In particular, the processes with the Land Register were automatized. Media breaks between

analogue and digital data were eliminated. The interlinking with the digital cadastral map has qualitatively improved the internal process of managing the cadastre.

Nowadays, all business cases and the electronic documents of the cadastral offices are stored in a *central register of cases* (germ. *Geschäftsregister*), which is a long-term archive ensuring that the documents are legible even after decades. In addition, the law implies all stored documents as originals. In addition to the function as a central management tool and storage medium for the cadastre, the business register provides all the necessary documents for providing cadastral information through the web-portal of the BEV. Since 2012, all applications of the surveyors have to be submitted in digital form. The electronic legal transactions process with the Land Register has been established, which have led to an enormous acceleration of the whole process of registration. The change of the cadastral information is prepared during the process of checking the surveying documents and finally, the change process in the cadastre is triggered immediately after the land register has transmitted the decision information via the electronic interface – almost at the same time.

An important module to steering the whole process of a real property change is the so-called *subdivision table* (germ. *Trennstücktabelle*). It is the centre of the shared-cross administrative processes, which affect both the cadastral authority and the Land Register, and it is the crucial reference element for:

- notaries and lawyers, who generate their applications to the Land Register in an automated manner,
- the judicial officers in the Land Register Courts to produce decisions, and
- the staff in the cadastral offices, who carry out the changes in the cadastral data.

Amendments to the *Surveying Act* (*Vermessungsgesetz*) and the *Surveying By-law* (*Vermessungsverordnung*) have contributed to a substantial improvement in the documentation of the boundary negotiations and have increased the legal validity of the results.

In addition to the efforts to improve successively the management process, the so-called *Structured Surveying Document* (germ. *Strukturierter Plan*) was implemented in 2018, which is a big step towards a full digital surveying plan. Surveyors are submitting *structured surveying documents.* In a first version, the descriptive contents of the plan (e.g. table of parcels, owners, coordinates) can be transferred directly into the cadastral system. Better data quality and an accelerated verification procedure in the cadastral office will make the process more efficient. The automated pre-check service will eliminate sources of errors. To motivate the surveyors to apply this new approach, financial incentives are offered by reduced fees. To "*close the digital gap*" in the cadastre, BEV was launching a project to classify and digitize all surveying documents archived in the cadastral offices. The documents will be provided to the surveyors via the web portal. The digitizing process will be finished until 2024.

5 CONCLUSIONS AND OUTLOOK

The question in the title, if the Austrian *Legal Boundary Cadastre* is a success story, has to be answered definitely with "YES". The *Legal Boundary Cadastre* is a success story for the landowners, for the surveying authorities, for governmental bodies as well as for the Austrian society. Until yet, 17% of the parcels are in the *Legal Boundary Cadastre*. This seems to be a low share, but it reflects the frequency of changes of parcel shapes (currently 30,000 cases per year). The cases are not even equally distributed throughout the country, but they are concentrated on areas with a high potential of development and with it a higher

potential of boundary disputes. Landowners are able to apply for transfer of their parcels to the *Legal Boundary Cadastre*. In case of serious legal disputes, the costs for the transfer are justified by the benefit of legal security. Serious economic benefits of the *Legal Boundary Cadastre* are hard to estimate, as the reconstruction of boundary points does not require an authorized (documented) surveying approach.

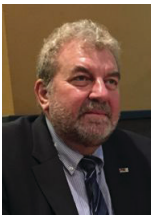
Since the introduction of this new system, the decision-making in cases of boundary disputes is simplified. Disputed boundaries can be staked out by the surveying authorities and must not be dealt at court. In addition, the legally binding parcel boundaries in the transformed cadastral system reduced the number of boundary disputes significantly. In the new system, the accuracy of boundary points is well defined and higher as in the *Fiscal Cadastre*. As the digital cadastral map is a base dataset, the improved accuracy also has positive effects for linking other in Austria available geodata.

Within the last 50 years, a paradigm shift in surveying has taken place, caused by new technologies and processes. These innovations continuously were incorporated by amendments to the *Surveying Act* and adaptions of the *Legal Boundary Cadastre*. The implementation of digital data processing led to a shift from analogue to digital. The Austrian land administration profession was launching the – today by politicians so favoured – the term of *digitalisation* already in the year 1979 with the transformation of the analogue land attribute data to a digital database. In 1989, the BEV launched the digitalisation of the countrywide available cadastral map. This process was successfully finished in 2004. Nowadays, all cadastral and land registration data can be accessed by the public in 24/7 (24 hours per day, 7 days by week) via the e-portal (bev.gv.at). GNSS (Global Navigation Satellite Systems) technologies have been further introduced to the surveying in order to mitigate the impacts of inhomogeneous reference points. The paperless data flow was implemented and the cadastral processes between authorized private surveyors and the cadastral offices as well as between the cadastral offices and the land register were accelerated within the last decades.

Approximately 100 years ago, the establishment of licensed surveyors as a model of good public-private-partnership has been launched in Austria. With the *Surveying Act* (*Vermessungsgesetz*) from 1968, the roles of private and public institutions are defined more clearly.

There are still challenges left for the future. The inhomogeneity of the reference frame will be solved with the GNSS technology, but it will take some time to transform all the boundary points with their own surveying history to a countrywide homogeneous system. Moreover, the challenges of moving local landslides and soil-motions require sound technical and proper legal solutions. Furthermore, as most of the other cadastral systems, the Austrian cadastre (*Fiscal Cadastre* as well as *Legal Boundary Cadastre*) is only two-dimensional (plane). The addition of further dimensions (space, time) is a task for the future, even though conceptual work is in progress (see for example Karabin et al., 2018; Navratil et al., 2018). The *Legal Boundary Cadastre* has a high potential for being the source for additional information, like public law restrictions (Navratil and Spangl, 2012), spatially restricted rights and responsibilities (Kollenprat et al., 2017). Finally, the *Legal Boundary Cadastre* would be a proper interface of a countrywide mass land appraisal system (Twaroch and Wessely, 2015).

Therefore, the success story is not over yet.



Acknowledgement:

The authors dedicate this article in memory of Dipl.-Ing. Rupert Kugler, head of the Department of Metrology and Surveying Offices in the Federal Office of Metrology and Surveying (BEV). Rupert Kugler was closely connected to the Austrian cadastre during his professional life. On 3rd February 2019, he passed away - shortly after his 60th birthday.

References:

Abart, G., Ernst, J., Twaroch, C. (2017). Der Grenzkataster: Grundlagen, Verfahren und Anwendungen (= Boundary cadastre: basics, procedures and implementation). Vienna, Graz: Neuer wissenschaftlicher Verlag.

BEV (2017). 200 Jahre Grenzkataster. Vienna: Bundesamt für Eich und Vermessungswesen.

Evidenzhaltungsgesetz (= Act on Land Cadastre Maintenance) (1883). Gesetz über die Evidenzhaltung des Grundsteuerkatasters. RGBl. Nr. 83/1883.

Forstgesetz (= Forestry Act) (1975). Bundesgesetz, mit dem das Forstwesen geregelt wird. BGBl. I Nr. 440/1975.

Frankenberger, J. (1971). Das österreichische Vermessungsgesetz – ein kritischer Vergleich mit den entsprechenden Normen des Vermessungswesens der deutschen Bundesländer (= The Austrian land surveying act – a critical comparison with the surveying norms in Germany federal coutnries). Veröffentlichungen der Deutschen Geodätischen Kommission, Reihe C, Heft 183.

Grundbuchsgesetz (= Land Register Act) (1955). Allgemeines Grundbuchsgesetz (GBG), BGBl. Nr. 39/1955.

Grundbuchsanlegungsgesetz (= Implementation Act for the Land Register) (1930). Allgemeines Grundbuchsanlegungsgesetz (AllGAG), BGBl. Nr. 2/1930.

Grundsteuerpatent (=Act on Real Property Taxation) (1817). Allerhöchstes Patent, December 23, 1817, PolGes. Slg. Bd.45, 391.

Höggerl, N., Imrek, E. (2007). Recent steps towards the introduction of ETRS89 in Austria. Geodetski vestnik, 51 (4), 742–750.

Karabin, M., Kitsakis, D., Koeva, M., Navratil, G., Paasch, J., Paulsson, J., Vucic, N., Janecka, K., Lisec, A. (2018). Layer approach to ownership in 3D cadastre - a subway case. In P. van Oosterom, D. Dubbeling (Eds.), Proceedings of the 6th International FIG Workshop on 3D Cadastres (pp. 111–136), Delft, 2018.

Kollenprat, D., Stix, P., Twaroch, Ch. (2017). Dokumentation räumlich begrenzter Dienstbarkeiten, ecolex 2017, 1051.

Lego, K. (1968). Geschichte des Österreichischen Grundkatasters (= The history of Austrian land cadastre). Vienna: BEV.

Liegenschaftsteilungsgesetz (= Real Estate Division Act) (1930). Bundesgesetz über grundbücherliche Teilungen, Ab- und Zuschreibung (LiegTeilG), BGBl. Nr. 3/1930.

Lisec, A., Navratil, G. (2014). The Austrian land cadastre: From the earliest beginnings to the modern land administration system. Geodetski vestnik, 58 (3), 482–516. DOI: https://doi.org/10.15292/geodetski-vestnik.2014.03.482-516

Mansberger, R., Seher, W. (2014). Landmanagement in Österreich (= Land management in Austria). Zeitschrift für Geodäsie, Geoinformation und Landmanagement, 3, 141–150.

Mansberger, R., Lisec, A., Muggenhuber, G., Navratil, G., Twaroch, C., Wessely, R. (2015). Value-describing geodata as an untapped treasure for a new mass appraisal system in Austria. In E. Hepperle, R. Dixon-Gough, R. Mansberger, J. Paulsson, F. Reuter, M. Yilmaz (Eds.), Challenges for governance structures in urban and regional Development (pp. 139–153). Zürich: VDF Hochschulverlag AG, ETH Zürich.

Navratil, G., Schwai, M., Vollnhofer, S., Konturek, P., Giannopoulos, I. (2018). From floor plans to condominium rights through an augmented reality approach. In P. van Oosterom, D. Dubbeling (Eds.), Proceedings of the 6th International FIG Workshop on 3D Cadastres (pp. 515–528), FIG, 2018.

Navratil, G., Spangl, D. (2012). Räumliche Abgrenzungen in einem ÖREB-Kataster für Österreich (Spatial extension of public law restrictions in Austria). Zeitschrift für Vermessungswesen, 137 (6), 357.

Twaroch, Ch., Muggenhuber, G. (1997). Evolution of land registration and cadastre. Case study: Austria. EUROLIS Conference, 24–26 September 1997, Bratislava.

Twaroch, Ch. (2017). Kataster- und Vermessungsrecht (=The cadastre and surveying legislation). pp338. Neuer Wissenschaftlicher Verlag. Vienna.

Twaroch, Ch. and Wessely, R. (Hrsg.). (2015). Liegenschaft und Wert - Geodaten als Grundlage einer Liegenschaftsbewertung, (=Real Estates and Values – Geodata as Basic for Parcel Appraisal) pp215. Neuer Wissenschaftlicher Verlag, Vienna.

Vermessungsgesetz (= Surveying Act) (1968). Bundesgesetz über die Landesvermessung und den Grenzkataster (VermG), BGBl. I Nr. 306/1968.

Vermessungsverordnung (= Surveying By-law) (2016). Verordnung des Bundesministers für Wissenschaft, Forschung und Wirtschaft über Vermessungen und Pläne (VermV), BGBl. II Nr. 307/2016.

Ernst J., Mansberger R., Muggenhuber G., Navratil G., Ozlberger S., Twaroch C. (2019). The Legal Boundary Cadastre in Austria: A Success Story? Geodetski vestnik, 63 (2), 234-249.
DOI: https://doi.org/10.15292/geodetski-vestnik.2019.02.234-249

Dipl.-Ing. Julius Ernst
Federal Office of Metrology and Surveying (BEV)
Schiffamtsgasse 1-3, A-1020 Vienna, Austria
e-mail: julius.ernst@bev.gv.at

Priv.Doz. Dipl.-Ing. Gerhard Navratil, Ph.D.
Technische Universität Wien (TUW)
Gusshausstrasse 27-29, A-1040 Vienna, Austria
e-mail: gerhard.navratil@geo.tuwien.ac.at

Asst. Prof. Dipl.-Ing. Reinfried Mansberger, Ph.D.
University of Natural Resources and Life Sciences Vienna (BOKU)
Peter Jordan-Strasse 82, A-1190 Vienna, Austria
e-mail: mansberger@boku.ac.at

Mag. Stefan Ozlberger
Mieterschutzverband Österreich
Doeblergasse 2, A-1070 Vienna, Austria
e.mail: sozlberger@gmail.com

Dipl.-Ing. Gerhard Muggenhuber, Ph.D.
Federal Office of Metrology and Surveying (BEV)
Schiffamtsgasse 1-3, A-1020 Vienna, Austria
e-mail: gerhard.muggenhuber@bev.gv.at

Univ. Doz. Dipl.-Ing. Christoph Twaroch, Ph.D.
Technische Universität Wien (TUW)
Rötzergasse 3, A-1170 Vienna, Austria
e-mail: ch.twaroch@live.at