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Issues related to the correction of cadastral maps in Hungary

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Abstract— The land registry map database in Hungary is continuously maintained and corrected as necessary. Deviations beyond the error limit are corrected by the Land Registry Office. This article summarizes the reasons for the deviations and the rules for correcting them. The paper also contains national statistics and examples on procedures for correcting survey, mapping, and area calculation errors.

Keywords— land registry, cadastral map, correcting survey, tematic map

I. Introduction

In the coming decade, the global shift toward digital land administration is set to have a significant impact on property transaction mechanisms. Hungary's scheduled implementation of the E-ING fully electronic land registry system in 2025 is an important milestone within this international context, marking the country's commitment to advanced cadastral modernization. Through initiatives such as comprehensive automation, implementation of three-dimensional property data models, and the requirement for e-procedures, Hungary aligns itself with leading European examples in digital cadastre transformation. Key Legislative and Technological Developments in Hungary [1]:

- With effect from 15 January 2025, the revised Land Register Act mandates digital processes for almost all registry procedures, except for a brief transition period where paper submissions are still possible.
- Electronic conveyancing is now obligatory: all applications for title changes, mortgages, and parcel subdivisions must be submitted online by authorized legal professionals.
- Digital records have been formally recognized as legally binding and equivalent to previous paper documents, effectively ending the maintenance of parallel physical archives.
- The central E-ING IT platform has replaced the decentralized county-level TAKARNET infrastructure, offering a unified, national solution managed by integrated modular back-office systems.
- Certain routine property transactions, such as straightforward ownership changes, are now registered automatically by the system once all typical criteria are satisfied.
- The cadastre's statutory framework also enables the future incorporation of 3D models representing property boundaries and apartment units, facilitating urban management tasks.

Other countries—including Austria, Estonia, the Czech Republic, Bulgaria, and regions within Australia—have already operated fully digital land registry systems for over a decade, demonstrating considerably faster administrative workflows. The United Kingdom, for instance, is pursuing a complete, seamless e-conveyancing system by 2027 [2].

Innovative methods employed by international peers include the Dutch Kadaster's large-scale digitization of historical maps powered by machine learning, and Singapore's land system, which connects 3D property layers with Building Information Modelling (BIM). In Sweden, blockchain-based land transfer pilots have substantially lowered settlement risks by time-stamping transactions, a model now being tested by U.S. counties and in Africa as a safeguard against title fraud. International donor initiatives, such as World Bank projects in Central Asia and Africa, promote the use of artificial intelligence in mapping unregistered land, while Portugal's BUPi platform leverages public data contributions to improve cadastral records [3].

Yet, it is important to recognize that the current national map database is a product of processes and technologies inherited from earlier surveying eras. Initially, measurements were taken with legacy tools such as measurement chains and angle prisms, and many source maps were analog, produced under diverse projection systems and instructions—ranging from stereographic and cylindrical projections to the standardized national system. When these analog materials were digitized, inconsistencies arose: while relative geometric accuracy is usually reliable, absolute position accuracy often requires post hoc adjustment, for instance with GNSS-based coordinates [4].

Correction of mapping and cadastral errors is typically initiated either ex officio or upon notification by stakeholders with surveying authority. Hungarian land registry offices are engaged in systematically addressing such inconsistencies. The overarching objective is that, after each correction, boundary points and the corresponding area calculations comply fully with the precision requirements set out in Government Decree 8/2018 (29 April 2018).

The regulations governing map corrections are rather incomplete, however there are several publications on new technologies [5] [6] [7] and their usability in mapping [8] [9] [10].

II. Analysis of Cadastral Maps in Hungary

This study utilized openly accessible datasets obtained through the TAKARNET platform as well as supplementary data provided by the Lechner Knowledge Centre. The

TAKARNET data comprised information on the coordinate projection systems, mapping scales, survey dates, and dates of subsequent corrections related to the digitized analog cadastral maps, covering the internal, external, and zonal territories of Hungarian municipalities. Additional insights were drawn from the Lechner Knowledge Centre regarding the number and types of cartographic instructions applied in the different municipal subdivisions, alongside records of the initiated procedures aimed at rectifying surveying, mapping, and spatial discrepancies following the digital conversion of these maps. The data screening took place on March 25, 2025. The data may be used for research purposes in accordance with the agreement between the two institutions.

Since the outer municipal areas were frequently digitized from more detailed analog sources, the analysis and resulting thematic maps focused primarily on the typically more variable inner (built-up) areas to highlight potential accuracy issues in cadastral data (Fig. 1).

Fig. 1. Difference between the land registry map and the orthophoto – Szákszend, Hungary
(source: ekozmu.e-epites.hu, access date: August 25, 2025)

The spatial distribution of projection systems was examined, revealing that about 57% of the municipality internal areas are represented in the EOV (Egységes Országos Vetület - Unified National Projection) coordinate system, which includes the DAT (Digitális Alaptérkép Szabályzat - Digital Base Map Regulations) standard. Cylindrical projections such as HÉR (Henger Északi Rendszer - Northern Cylinder System), HKR (Henger Középső Rendszer - Central Cylinder System), and HDR (Henger Déli Rendszer - Southern Cylinder System) account for approximately 22%, while the remaining 21% are based on stereographic projection systems. The stereographic method involves a two- step transformation: first projecting the surface of the Bessel ellipsoid onto a Gaussian sphere, followed by casting onto a tangent plane. The cylindrical projection, as defined by Antal Fasching, likewise involves a double projection, with the second step being an inclined cylindrical slit projection. The EOV system relies on the HD72 horizontal datum, founded on the International Union of Geodesy and Geophysics 1967 ellipsoid, with the map surface being an oblique intersecting cylinder. Historical note: The Rollographic Datum system dates back to 1864, the cylindrical datum to 1908, and the Uniform National Datum was introduced in 1975.

Figure 2. clearly shows that the situation is even more complicated with regard to map-making instructions than with regard to projections.

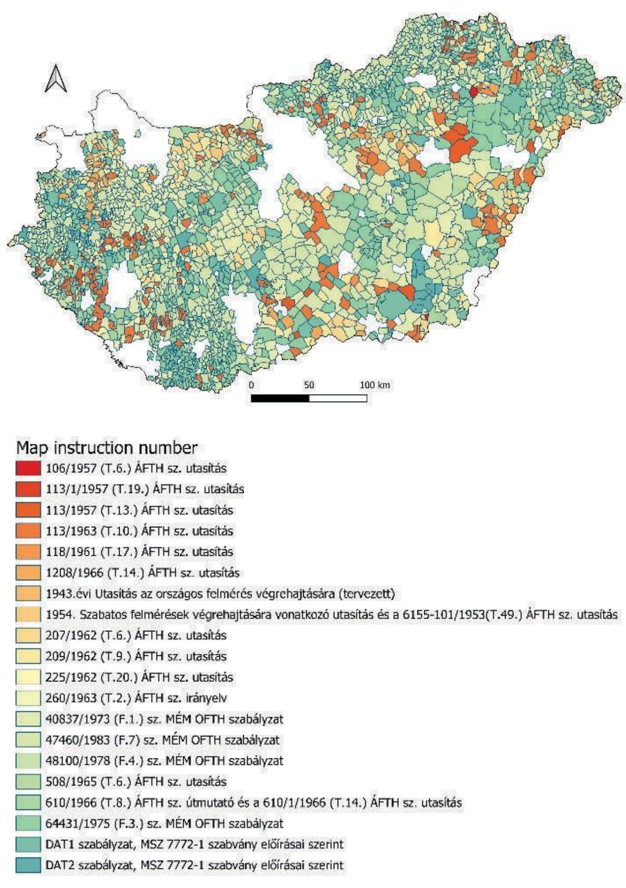

Fig. 2. Thematic map of mapping instructions
(source: own editing from LECHNER source, March 25, 2025)

There are no nationwide statistics on the accuracy of maps. We can only guess at the condition of maps based on the number of map correction procedures. Since the creation of the digital map database, 63,212 procedures have been initiated in the past 18 years in the categories of surveying, mapping, and area calculation errors. Land registry officials who perform map corrections obviously have experience in this area, but this has not been published to date. The following chapter attempts to formulate principles and practical advice on this topic.

III. Proposals for map corrections

The solution is not simple and involves many factors. The recommendations for each stakeholder are listed below based on Vincze [11] [12].

- Under the guidance of the main authority
  - the differentiated quality of digital maps must be made clear at all levels;
  - the potential damage resulting from this must be anticipated;
  - lobbying (in a positive sense) must be carried out to update the data sets;
  - the representation of basic data must also be made possible in legislation, with stipulations.
- Promote the preservation of the original (good) quality of data through professional and prudent legislation.
- Uniform interpretation and application by land registries is necessary for differentiated data management.
- In the case of new surveys, consistent application of DAT regulations error limits is necessary.
- During any digital "conversion," the deviations permitted for previous mapmaking must be applied.
- Numerical data and coordinates that did not fit into inner area vector map (BEVET) must be replaced ex officio at a later date.
- After a thorough investigation of discrepancies exceeding the error limits indicated by land surveyors must be thoroughly investigated, and the necessary adjustments (corrections) must be made by the authorities.
- Newly generated original measurement results must be requested and collected and stored separately in accordance with the provisions of the new legislation (expected to be published in the near future).
- Until the new surveying program is resumed, so-called "office map updates" must be carried out, and the necessary technological requirements must be met.

Certain regulations must also be observed in relation to new surveying technologies (GPS, measuring stations):

- all points received for the work area that can be considered "identical" must be measured, at least 3-3 land parcels on each side (including the other side of the roads and the farmland side);
- check the points considered to be common using a planar similarity (Helmert) transformation – not an affine or other transformation! Points exceeding the error limit (after careful consideration, always only the most contradictory ones) must be removed from the common points;
- based on the remaining points, it must be decided: whether to keep them in place (if the point is considered identical), or e) to calculate and mark the non-identical (or non-existent) points;
- the marking must be checked by comparing it with points that can be considered identical or by repeating the marking;
- the original measurement results must be submitted for the examination and the land registry office must collect them in a separate file.

There is much to be done to improve the map database Remapping the entire system is a substantial undertaking, demanding significant financial investment and a considerable amount of time, yet it promises substantial benefits for the national economy. Increased efforts in reassessment are justified by several factors:

- establishing an accurate foundation for registration,
- providing reliable data for technical planning and operations,
- reducing the volume of complaints and legal disputes that consume administrative resources and user capacity,
- enabling businesses and organizations that rely on all supplementary location-based data to operate with much greater efficiency.

Subsequent renovation of maps created through digitization (based on field measurements) would also be useful.

Office map correction is a feasible and cost-effective technology. The basic principle of the proposed office map renewal can be summarized as follows:

- the coordinates of the digitized land parcel boundary points can be considered as preliminary data for coordinate adjustment
- based on the measurement and marking data accumulated at the land registry offices, they can be adjusted as an independent network (in a specified unit: block, section, or even parcel)
- based on the measurement and marking data accumulated by the land registries, it can be recalculated as an independent network (in a specific unit: block, section, or even location) using adjustment (i.e., the relative consistency between the field dimensions and the coordinates can be optimized);
- based on any existing or subsequently measured (e.g., with GPS) numerical points, the independent system can be "positioned" and corrected in an absolute sense; – care must be taken to transfer the inevitably changed boundary point coordinates to the connecting line sections;
- finally, the content outside the land parcel boundary breakpoints must also be transformed (if necessary) and the topological consistency must be restored.

All these tasks could be performed economically with the appropriate software support. Of course, the adjustment can be performed subject to certain constraints. The coordinates of points determined from measurements and possibly determined retrospectively (e.g., with GPS) should not change, but their preliminary (digitized) equivalents should be included in the adjustment. Points falling within 10 cm of a straight line should belong to that line (but only if they are connected property boundary points). The measurements should be given different weights, e.g. data from before the last map update/correction should not be given half weight; – measurement/marking data created from this point onwards should be given as many weights as they occur; the dimensions of continuously measured data should be given as separate distances; control dimensions prior to setting out (which are changed by the setting out) should not be included (unless it becomes apparent from subsequent work that the field use has been left unchanged). The measurements should be used "backwards in time" (if a measurement from a later date is available and a previous one differs from it, the previous one should not be taken into account, or only after careful consideration).

To summarize the tasks, we can conclude the following:

- Land registries ought to enhance the digitized BEVET datasets by integrating numerical information, ensuring there are no inconsistencies (particularly if this step was omitted during earlier preparation).
- They should systematically request and gather original measurement records, applying differentiated approaches, while contractors are expected to cooperate, considering their long-term interests.
- Existing measurements should be leveraged to refine our databases (for instance, following the outlined methodologies).
- It is essential to actively advocate for prompt digital re-measurements, enabling us to provide the national economy with more dependable technical foundations.

IV. Summary

Hungary is modernizing its land administration with the 2025 launch of the fully electronic E-ING land registry system, integrating automated decisions, 3D cadastral models, and mandatory e-procedures. This aligns Hungary with advanced European digital cadastres, improving legal frameworks and administrative workflows. The national cadastral maps, originally created using diverse analog methods and projections, suffer from heterogeneous geometric accuracy. The study uses TAKARNET and Lechner Knowledge Centre data to analyze these variations, focusing on inner municipal areas with the most significant disparities. Map correction procedures have exceeded 63,000 in 18 years, highlighting ongoing accuracy issues. Recommendations include clarifying data quality, uniform application of regulations, collecting original survey data, and advocating for digital re-measurements. Adjustments use accumulated measurement data to enhance positional accuracy, creating a reliable technical foundation essential for efficient land administration and economic benefits.

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