EuroSDR

European Spatial Data Research

October 2024

EuroSDR Advancing FELA II – The Framework for effective Land Administration

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Official Publication Nº 77

Published by EuroSDR

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EUROSDR ADVANCING FELA II – THE FRAMEWORK FOR EFFECTIVE LAND ADMINISTRATION

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Abstract

Land administration systems play a crucial role in managing land and have evolved over time to meet societal needs. Recent global initiatives, including the UN-GGIMs Framework for Effective Land Administration (FELA), aim to modernise these systems to support sustainable development. FELA emphasises that land administration must be effective, interoperable, and inclusive, aligning with global standards and practices to accelerate efforts to document and manage land relationships effectively.

In response to these goals, the UN-GGIM and EuroSDR conducted a survey across 22 European countries to assess the adoption of FELA's pathways: Data, Standards, and Innovation. The survey revealed that many countries prioritise critical data themes like parcels and buildings, aligning with the goal of reliable data and secure service quality. However, gaps remain in ensuring dataset-specific security and reducing data duplication.

Innovation in land administration is mainly driven by government initiatives, supported by citizen and private sector engagement. While some regions have formal innovation processes and state-of-the-art infrastructures, others rely on ad-hoc methods, indicating a need for more structured approaches to foster technological advancement.

The survey also shows strong engagement with international standards such as ISO and INSPIRE, promoting interoperability. However, some regions still manage standards independently, limiting collaboration and integration. Compliance systems are generally in place, but the consistent adoption of standards remains a challenge in certain areas.

Overall, the survey indicates partial conformity with the FELA objectives and requirements. To achieve full alignment, improvements in automation, innovation management, and the coordinated adoption of standards are needed. These enhancements will be critical for advancing land administration systems and achieving sustainable development across Europe.

Key words: UNGGIM, FELA, Assessment, Land Administration

1 INTRODUCTION

Land administration systems provide the basis for the management of the most valuable resource – land. These systems have been developed over decades, even centuries, for different purposes. In recent decades, it has been shown that a multipurpose land administration system brings many advantages to society and might importantly contribute to sustainable development and its prosperity (Williamson et al., 2010). Due to the vital role of land administration for society and new technological perspectives, land administration systems have become the topic of several international scientific and professional discussions and initiatives (Steudler, 2014; UN-GGIM, 2020; FIG, 2024). Aiming to contribute to the development of contemporary land administration systems globally, the UN Committee of Experts on Global Geospatial Information Management (UN-GGIM) adopted the Framework for Effective Land Administration – FELA (UN-GGIM, 2020). The document outlines the importance of an effective land administration system for reaching the Sustainable Development Goals (SGD) from Agenda 2030 (UN, 2015) and states that an effective land administration must be "fit-for-purpose, appropriate and adequate, interoperable and sustainable, flexible and inclusive, and able to accelerate efforts to document, record, recognize, and monitor people to land relationships, in all forms" (UN-GGIM, 2020). The FELA is aligned with the UN-GGIM's policy guidance, i.e. the Integrated Geospatial Information Framework – IGIF (UN-GGIM, 2018, Unger et al. 2020). The FELA further includes references to existing concepts, approaches, mechanisms, and standards, such as the continuum of land rights (Barry & Augustinus, 2015), the Land Governance Assessment Framework (Deininger et al., 2012), the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests (VGGTs) in the Context of National Food Security (FAO, 2012), and ISO standard on Land Administration Domain Model (ISO, 2012 and ISO, 2024). Even though approaches to develop and implement contemporary land administration systems differ among the countries and are conditioned by historical development, the political and economic situation of a country and other factors, there is international consensus to develop and work on standardised approaches in land administration.

Currently, the FELA is being adopted by various UN Member States, and this is an opportunity to contribute to and advocate the FELA. For this reason, the UN-GGIM Expert Group on Land Administration and Management (EG-LAM) and EuroSDR have initiated a small project to raise awareness of the merits and benefits of effective land administration, primarily through dialogue and online surveys of European National Mapping and Cadastral Agencies (NMCAs) on the use and implementation of FELA (see also Unger et al., 2022 and 2024).

Due to limitations on time and resources, and the fact that the work was considered pilot in nature, the online survey was divided into three parts. The aim of this report is to present the preliminary findings of the collaborative work on FELA, undertaken by EuroSDR and UN-GGIM, reflecting the results of the second online survey related to the technological branch of the FELA pathways, i.e. Data; Standards; and Innovation. Following this introduction, the methods used are presented in more detail. This includes information on the online survey conducted and provides background information on the FELA. Partial results of the online survey are then presented, summarising the results of the participating countries in relation to the above-mentioned three FELA pathways. Finally, a brief discussion and conclusion section highlights the key takeaways and next steps.

2 METHODS

The FELA (UN-GGIM, 2020) with its nine pathways seeks to provide the reference and guidance for United Nations Member States when establishing, strengthening, co-ordinating and monitoring their land administration nationally or sub-nationally. The nine pathways of the FELA provide a mechanism towards effective leadership, advocacy, mobilisation and actions to effectively document, record and recognise people to land relationships in all forms for the wellbeing of society, environment and economy. Partially inspired by the FIG Cadastre 2014 work from the mid-1990s and subsequent Cadastral Template surveys (see also Steudler, 2014), the applied online survey approach aimed to gain an overview of the different stages of awareness and uptake of FELA by the members of EuroSDR and/or UN-GGIM.

To this end, the FELA framework was transformed into a series of questions addressing a selection of FELA strategic pathways. The nine pathways have been thematically divided for the purpose of this research into three subgroups that shaped the survey in three parts.

Figure 1: Focus Areas (Governance, Technology, People) of UN-GGIM Framework for Effective Land Administration (FELA) (Source: Unger et al., 2022)

Part 1 – Governance - focused on the following pathways (the results were already presented in the preliminary report – Unger et al., 2022):

- Governance, Institutions and Accountability;
- Law and Policy;
- Finance;

Part 2 – Technology - focuses on the following pathways (the results are presented in this paper):

- Data;
- Standards;
- Innovation;

Part 3 – People - focuses on the following pathways:

- Partnerships;
- Capacity and Education;
- Communication and Awareness.

A set of questions was created for each group of FELA strategic pathways, allowing for a mix of quantitative and qualitative data to be collected. The questions were created based on lessons learned during the development of FELA, as well as the specific context and discussions during the various EG-LAM meetings. The survey included both closed and open-ended questions to have a more comprehensive view. The closed-ended questions contained multiple-choice answer options. Respondents were thus offered a range of answers from which to choose. The open-ended questions provided the opportunity to gain deeper insights at a country-specific level. The survey was initially trialled with at least two land agencies and converted to an online Google Form web service.

The preliminary results related to the governance branch of the FELA, i.e. (i) Governance, Institutions and Accountability (mainly referring to accountable and transparent governance), (ii) Policy and Legal (referring to inclusive and recognises all forms of tenure), and (iii) Financial (referring to affordable with sustainable business models) were already presented (Unger et al., 2022). The online survey (ran with EUSurvey tool), which is presented in this report, focused again on three technology FELA pathways, and this time, they are: (iv) Data, (v) Standards and (vi) Innovation. The results are presented using the same structure as in the previous report (Unger et al., 2023).

The selection of participants was restricted to European countries that have a relationship with EuroSDR and UN-GGIM. Invitations were sent via email between February and April 2024. In total, 22 countries participated: Albania, Armenia, Austria, Bosnia and Herzegovina (Republic of Srpska), Croatia, Cyprus, Estonia, France, Germany, Ireland, Luxemburg, Denmark (North Jutland), Norway, Poland, Scotland (United Kingdom), Slovenia, Spain, Sweden, Switzerland, The Netherlands, Ukraine and the United Kingdom. Participating countries represent all regions of Europe. All survey participants across Europe had in-depth knowledge of land administration/cadastre/ registration/policy-making and were generally working in governments, national mapping and cadastral authorities, land registries or recognised academic and research institutions in the land administration domain. These competences were considered in approaching the concept of effective land administration.

The multiple-choice answers were summarised using descriptive statistical tools such as bar charts, and percentages. The answers to open-ended questions were analysed using qualitative methods such as identifying themes and potential outlier perspectives.

3 RESULTS

As already mentioned, the online survey focused on three (out of nine) pathways of the FELA, i.e. Data, Standards and Innovation. In each case, a reference to the specific FELA pathway is presented, followed by each question and the quantitative result, followed by additional qualitative information. Additionally, comments from participating countries and professionals are included throughout the text.

3.1 FELA Pathway IV: Data

Within the FELA pathway 4 – Data, the requirement for land administration data is described as necessarily being maintained, secure and not duplicated.

FELA states: ‘Data relating to land tenure, land use, land value, and land development are fundamental geospatial data themes within any jurisdiction. This data informs on the ‘how’, the ‘what’, the ‘who’, the ‘when’ and the ‘where’ of land tenure, land use, land value, and land development. It underpins the processes and transactions that enable changes to the status of land tenure, land use and land value.’

Like the United Nations Integrated Geospatial Information Framework (UN-IGIF), FELA calls for a wide range of sources, scales, and sensors – that should deliver metadata to enable standardised identification of the spatial extent, time and people to which the RRRs (Rights – Responsibilities – Restrictions between spatial units and parties) pertain to. For effective land administration, land data and its processes must be appropriate, accessible, affordable, and integrable with other data. Further, the FELA calls for data custodianship, data to be acquired and managed in a transparent and secure way that focuses on people’s activities and service needs.

The first question focused on land data themes within the organisation: ‘Which land data themes are within the domain of the land administration system within your organisation?’ Here, a trend can be identified towards parcels, buildings, addresses and rights with the related RRRs (Table 1).

Table 1: FELA Pathway – Data: Land data themes (Q: *Which land data themes are within the domain of the land administration system within your organisation?)*

		Answers	Ratio
Parcels		28	84.85%
Buildings		26	78.79%
Addresses		22	66.67%
Ownership rights		18	54.55%
Restrictions/responsibilities		16	48.48%
Land valuation – parcel level		14	42.42%
Land valuation - real property level (land parcel, buildings, part of buildings)		13	39.39%
Land valuation – zones		11	33.33%
Land Use – parcel level		10	30.30%
Land Use - zones		8	24.24%
Others		8	24.24%
Land Use - regional		7	21.21%
No Answer		0	0%

'Parcels' is obviously the most covered theme at 84.85%, indicating that it is a priority within most land administration systems. Themes with higher percentages (e.g., 'Parcels', 'Buildings', and 'Addresses') can be considered essential to most land administration systems. Lower percentage themes (e.g., 'Land Use - regional' at 21.21%) might be less managed by land agencies or are considered less essential across the organisations because they may be managed together with other governmental organisations. **Generally, themes with lower percentages could indicate areas where further development or integration could be beneficial for organisations**. This might suggest opportunities for technology improvement, policy changes, or specific training. The 'Others' category at 24.24% can be insightful to explore further for organisations. Understanding what these 'Others' means could reveal emerging themes or niche areas for an organisation not fully captured by the main categories listed. Within the

survey the organisations submitted answers like cable and pipeline services, real estate taxation data, melioration networks, property price register, mortgage bonds etc.

The questionnaire then focused on the processes that assess land and property data and data services needs in the various countries (Table 2). 'Through governmental/ministerial request/consultation' has the highest percentage (81.82%), indicating that this is the primary method through which data needs are assessed. Further, the data shows significant involvement of both government and private sectors in the processes. Community or end-user engagement through requests or consultations also play a role (63.64%). This suggests a level of participation in the assessment processes, where feedback from the end-users of data is important. This is especially highlighted in EU-funded projects but also through statistical coordination and surveys between statistical institutions in accordance with the statistical law.

Table 2: FELA Pathway – Data: Assessment of data and data services needs (Q: *Through which processes are land/real property Data and Data services needs assessed in your country?*)

		Answers	Ratio
Through governmental/ministerial request/consultation		27	81.82%
Through community/end user request/consultation		21	63.64%
Through industry/private sector request/consultation		17	51.52%
Others		4	12.12%
There is no data/data services needs assessment		3	9.09%
No Answer		0	0%

Within the FELA Pathway I – Governance, Accountability, and Institutions – there is a call for cooperative data creation, co-creation and data sharing. The following question, e.g. 'Which option best describes the collaboration in the production and distribution of land/ real property data in your country?', therefore, describes the collaboration in the production and distribution of data (Table 3).

Table 3: FELA Pathway – Data: Collaboration in data production and distribution (Q: *Which option best describes the collaboration in the production and distribution of land/ real property data in your country?* [single choice])

		Answers	Ratio
Collaboration in data supply between agencies is well-established and supported by government policy but involves substantial manual intervention.		10	30.30%
Collaboration agreements for data production and exchange exist between some agencies but interoperability issues arise frequently.		7	21.21%
The sequence of processes involved in the production and distribution of land data across all levels of government are enabled through automated data exchange processes.		12	36.36%
Collaboration is ad hoc and there are no government data procedures that formalise the sequence of processes involved in the production and exchange of land data.		3	9.09%
There is no collaboration.		1	3.03%
No Answer		0	0%

These results suggest varying degrees of maturity in data management practices within the various organisations, with significant room for improvement, especially in adopting more automated systems and standardising data exchange to overcome interoperability issues. Recommendations for further development would likely focus on enhancing the automation of data processes in already established systems, addressing technical issues in existing collaborations, and enabling formal policies and procedures where probably lacking. Here are the answers are given to "If collaboration exist, then please provide the official reference (e.g., name of the national strategy and/or website URL)":

- Austria: Defined by several laws
- Croatia: https://oss.uredjenazemlja.hr/map;
- Cyprus: https://portal.dls.moi.gov.cy (DLS portal)
- Germany: https://www.gdi-de.org/; https://www.adv-online.de
- Ireland: https://www.tailte.ie/en/tailte-eireann-publications/tailte-eireann-publications.html
- Luxemburg: Système de la publicité foncière
- Denmark (North Jutland): https://en.digst.dk/media/14139/grunddata_uk_web_05102012_publication.pdf
- Poland: Geodetic and cartographic law and others legal acts
- Slovenia: http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO7952#
- Spain: http://www.catastro.minhap.gob.es/esp/convenios_colaboracion.asp?var=menuleft4; http://www.sedecatastro.gob.es
- Sweden: Collaboration in both data supply and with agreements. (one answer not sufficient)
- Switzerland: https://www.cadastre.ch/en/home.html; https://www.cadastre-manual.admin.ch/fr
- Ukraine: https://dzk.gov.ua/diialnist/
- United Kingdom: https://www.gov.uk/government/publications/uk-national-data-strategy/national-data-strategy#data-1-3

The following two questions related to data security, i.e. 'How is the data security organised within your organisation?' (Table 4), and updating data, i.e. 'How is it ensured that data security is up to date?' (Table 5).

Table 4: FELA Pathway – Data: Data security (Q: *How is the data security organised within your organisation?* [single choice])

		Answers	Ratio
It is organised at the organisational level.		16	48.48%
It is organised at the country level.		11	33.33%
The data security policy is partly In House IT Department and partly outsourced by a specialised company.		3	9.09%
Others		2	6.06%
The data security is outsourced.		1	3.03%
It is organised at the dataset level.		0	0%
No Answer		0	0%

Table 5: FELA Pathway – Data: Data security update (Q: *How is it ensured that data security is up to date?* [single choice])

		Answers	Ratio
The data security policy is continuously monitored and enforced.		26	78.79%
The data security policy is once a year monitored and enforced.		3	9.09%
There is limited updates to the data security policy.		4	12.12%
None		0	0%
No Answer		0	0%

The majority manage their data security at the organisational level (48.48%), suggesting a preference for internal control over security protocols (Table 4). A significant portion also organises data security at the country level (33.33%), indicating centralised approaches possibly driven by regulatory requirements. Only a few organisations outsource their data security fully (3.03%) or partially (9.09%), relying on specialised external services, while no respondents organise security at the dataset level, showing a lack of granularity in their security measures.

When it comes to updating data security policies (Table 5), a large majority of organisations (78.79%) ensure their data protection measures are continuously monitored and enforced, reflecting a proactive approach essential in the face of evolving security threats. A smaller number update their policies annually (9.09%), which may be adequate depending on their specific risk profiles and data sensitivity. However, a few organisations (12.12%) report limited updates to their security policies, potentially exposing them to increased risks from emerging cyber threats. Overall, the results indicate a robust approach to data security within most organisations, with a strong emphasis on internal management and continuous updates. However, the variations in how data security is organised and updated highlight the need for strategies and guidelines that are tailored to the specific needs and characteristics of each organisation, ensuring that data security measures remain effective and responsive to new challenges.

The last question related to data refers to data management: 'Is there a centrally coordinated Data Management Program to reduce data duplication?'. Based on the answers we can conclude that there are still many challenges related to land-related data management but the data management has been proven to be essential (Table 6).

Table 6: FELA Pathway – Data: Centrally coordinated data management program (Q: *Is there a centrally coordinated Data Management Program to reduce data duplication?* [single choice])

		Answers	Ratio
The planning, recording, acquisition and management of land data are driven through one governance channel that oversees the national needs and priorities.		13	39.39%
Duplicated land datasets exist, but there is a plan to resolve this.		10	30.30%
The need for a coordinated data management program has been recognised but currently there is a high degree of duplication in land data across all sectors.		7	21.21%
None		3	9.09%
No Answer		0	0%

The survey results on the presence of a centrally coordinated Data Management Program to reduce data duplication in land data management indicated various stages of implementation among the respondents. 21.21% of the respondents recognise the need for such a program but still face significant duplication issues, indicating an awareness but a lack of practical implementation. Another group (30.3%) acknowledges existing duplications but has plans in place to resolve them, showing proactive steps towards improvement. The largest group (39.39%) reports that their data management is efficiently centralised, with a single governance channel effectively overseeing national needs, which suggests a mature and integrated approach. However, a small group (9.09%) indicates a complete absence of coordinated data management, highlighting a gap in strategic data handling that could lead to inefficiencies and redundant data accumulation.

3.2 FELA Pathway V: Innovation

Within the FELA pathway 5 – Innovation, the requirement for land administration innovation is described as upgradable systems and approaches which are responsible and innovation oriented. FELA states: 'Land administration innovation can be driven by societal pull on the one hand, and technological push on the other. Together these forces encourage process improvement and technical advancement for the recordation, access and dissemination of land data for all, and the promotion of creativity and innovation.' For societal pull results in new techniques that re-concentrate land administration efforts on being flexible, accessible (including open access), participatory, achievable, upgradable, cost-effective, easy-to-use, conflict sensitive, ensuring dignity and equality, ensuing preparedness and resilience, and sustainable resource management, amongst other characteristics. For the technology push, it is noted that transition or transformation should always be coupled with societal readiness and need. In all cases, each development and innovation require assessment of data protection as well as ethical aspects in line with the country's context and 2030 Agenda.

Therefore, the first question focused on how the main innovation processes are defined within the various organisations (Table 7).

Table 7: FELA Pathway – Innovation: Main innovation processes (Q: *Which option best describes how the MAIN innovation process is defined within your organisation?*)

		Answers	Ratio
Innovations are initiated through ad hoc governmental/ministerial request/needs.		15	45.45%
Innovations are discussed/evaluated through an Innovation board.		12	36.36%
Innovations are initiated through citizens request/needs or consumer demand.		10	30.30%
Innovations are initiated/developed through cooperation with industry partners (Technology push) and are private sector driven.		6	18.18%
Innovations are happening in an ad-hoc manner.		6	18.18%
There is no defined innovation process.		2	6.06%
No Answer		0	0%

The survey results regarding how the main innovation process is defined within organisations illustrate a diverse array of approaches. The most common method, reported by 45.45% of respondents, involves innovations initiated through ad hoc governmental or ministerial requests, indicating a significant

influence of government needs on innovation activities. Following closely, 36.36% of organisations have structured their innovation processes around an Innovation Board, which suggests a formalised approach to evaluating and discussing new ideas. About 30.3% of innovations are driven by citizens' requests or consumer demands, highlighting a responsive approach that prioritises external input. Meanwhile, 18.18% of respondents collaborate with industry partners, leveraging external expertise and market trends to drive innovation. The same percentage describe their innovation activities as occurring in an ad-hoc manner, suggesting a less systematic approach. Only a small fraction (6.06%) report having no defined innovation process at all, which could hinder effective innovation management. The complete engagement from respondents underscores the relevance and importance of innovation processes within these organisations, suggesting areas where improvements could be beneficial, such as establishing more structured processes or enhancing collaboration with external partners to foster innovation.

In addition, participants were asked about the engagement of the private and academic sectors in the innovation processes (Table 8).

Table 8: FELA Pathway – Innovation: Academic and private sector processes engagement (Q: *Does the government actively engage academic or private sector processes?* [single choice])

		Answers	Ratio
Yes: numerous innovation collaboration examples exist with both sectors, and these are linked to an Innovation Program.		6	18.18%
Yes: some innovations examples exist, and government is engaging with academic and private sector.		16	48.48%
Partially: there are several innovation collaboration examples with both sectors but there is no formal work program.		10	30.30%
Partially: some collaborative innovation examples exist, but only with academic sector.		0	0%
Partially: some collaborative innovation examples exist, but only with private sector.		0	0%
There is no engagement of the academic and private sector.		1	3.03%
No Answer		0	0%

The survey results show varying levels of government engagement with academic and private sectors in innovation processes. While a small group (18.18%) indicates robust engagement through structured Innovation Programs involving both sectors, the majority (48.48%) of respondents note some examples of innovation collaborations without the support of a formal program. This suggests general but irregular engagement. Another significant group (30.3%) acknowledges informal collaborations that lack a structured work program, pointing to a recognised value in such partnerships yet a gap in formalisation. Notably, no responses indicate exclusive collaboration with only the academic or private sectors, and very few (3.03%) report no engagement at all. The uniform response rate underscores the relevance of this issue among the surveyed entities, highlighting a prevalent yet varied approach to innovation collaborations. **The findings suggest an opportunity to enhance the effectiveness of these interactions through more structured and formalised programs, potentially leading to more consistent and impactful innovation outcomes**.

Additionally, the answers given to "If yes, then please provide the official reference (e.g., name of the example and/or website URL)" are listed in the continuation:

- Austria: government sponsored research

- Cyprus: Provision of Data through the DLS Portal to both Academia and Private Sector (Land Surveyors and Valuators) and vice versa
- Germany: Co-operation with selected universities and private companies;
- Poland: https://www.gov.pl/web/ncbr-en
- Slovenia: https://www.aris-rs.si/en/
- Spain: www.catastro.meh.es
- Sweden: one example: https://smartbuilt.se/; also organisations and authorities like Vinnova, Digg, eSam
- Switzerland: https://www.cadastre.ch/en/home.html; https://www.stdl.ch; https://www.swisstopo.admin.ch/en/swisstopoedu-for-master-students
- United Kingdom: https://geovation.uk/; United Kingdom (Scottland): deliver a Geovation Program for start-ups looking to use OS and our Land Registration Data

The survey addressed further innovation strategies in the participating countries in land administration domain (Table 9).

Table 9: FELA Pathway – Innovation: Strategy to trigger innovation (Q*: Is there an innovation strategy to trigger investment in innovation?* [single choice])

		Answers	Ratio
A land administration innovation strategy exists and is approved.		11	33.33%
A land administration innovation strategy is under development.		5	15.15%
A government innovation strategy exists but land administration technologies are not well-considered.		5	15.15%
The need for a strategy is recognised.		6	18.18%
No strategy exists.		6	18.18%
No Answer		0	0%

The survey results reveal diverse stages in the development and implementation of innovation strategies for land administration. One-third of respondents (33.33%) report that a dedicated land administration innovation strategy is already approved and operational, indicating a mature approach to fostering innovation in this sector. Meanwhile, 15.15% are in the process of developing such a strategy, showing proactive steps toward structured innovation management. However, an equal percentage note that while a broader government innovation strategy exists, it inadequately addresses land administration, highlighting a gap in strategic focus. About 18.18% recognise the need for a strategy but have not yet implemented one, suggesting awareness without corresponding action. Similarly, another 18.18% of participants indicate a complete absence of any innovation strategy, pointing to a significant oversight in strategic planning. **The uniformity in response rates suggests a clear relevance of the issue, with opportunities highlighted for enhancing strategic development to ensure targeted and effective investment in land administration innovation**. The participants also shared official references to such a strategy if it exists:

- Austria: not yet published
- Cyprus: There are several strategies (Geodesy, Photogrammetry, Hydrography); information can be found in the following URLs: https://portal.dls.moi.gov.cy/to-tmima/anaptyxiako-programma/; https://portal.dls.moi.gov.cy/to-tmima/orama-apostoli/stochoi-drasiriotites/
- Estonia: https://www.riigikantselei.ee/avaliku-sektori-innovatsioon
- France: Government is funding new large scale land use & land cover data set

- Germany: Working Programmes of the 5 Working Groups of AdV (not published)
- Denmark: https://eng.gst.dk/about-us/danish-geodata-agency-strategy
- Slovenia: http://www.pisrs.si/Pis.web/pregledPredpisa?id=RESO133
- Spain: https://www.bing.com/search?q=plan+estrat%c3%a9gico+de+catastro&qs=NW&pq=plan+estrat%c3%a9gico+de+catastr&sc=10-27&cvid=58EE4CFF19D244F68B0811EA971C13AB&FORM=QBRE&sp=1&ghc=1&lq=0
- Switzerland: https://www.geo.admin.ch/en/strategy-and-implementation; https://www.cadastre-manual.admin.ch/fr/strategie-de-la-mensuration-officielle; https://www.cadastre-manual.admin.ch/fr/vision-et-strategie-du-cadastre-rdppf"
- United Kingdom: https://geovation.uk/

The participating organisations saw many opportunities for innovations, particularly in the areas of data acquisition and data collection processes, as well as in interoperability (Table 10), but fewer opportunities are associated with data dissemination and security.

Table 10: FELA Pathway – Innovation: Future focus on the innovation (Q: *Where do you see the future focus on the innovation for your organisation?*
(rating from 0 –very unlikely- to 10 -very likely the five following themes))

	On data acquisition and data collection (recordation) processes	On interoperability	On data dissemination processes	On data accessibility processes	On data security processes
average rate	8,0	7,7	7,3	7,2	6,7
lower rate	5	3	4	4	2
higher rate	10	10	10	10	10

Majority of responders further claimed that the existing operational infrastructure and geoportals are on a high level (Table 11).

Table 11: FELA Pathway – Innovation: Existing operational infrastructure (Q: *Is there an operational infrastructure and geoportal in your country that facilitates advanced sharing, viewing, accessing and using of land information?* [single choice])

		Answers	Ratio
A state-of-the-art scalable, enabling infrastructure and geoportal is in operation and used widely.		21	63.64%
The enabling infrastructure and geoportal are partly in operation but needs enhancement.		10	30.30%
A need for an enabling infrastructure and geoportal is recognised and design agreed.		0	0%
The enabling infrastructure and geoportal are under development.		1	3.03%
There is no established infrastructure nor geoportal.		1	3.03%
No Answer		0	0%

The survey results indicate that a substantial majority of respondents (63.64%) report their country operates a state-of-the-art, scalable geoportal and infrastructure for land information that is widely used, signifying a high level of technological integration and effectiveness in managing land data. A significant minority (30.3%), however, notes that while such infrastructures are in place, they are only partly operational and require further enhancements, pointing to existing frameworks that may lack full functionality or optimal performance. A very small number of respondents (3.03%) reveal that the necessary infrastructure and geoportal are still under development or completely absent, highlighting gaps where technological deployment is either in initial stages or has not been initiated. The complete participation from all respondents underscores the relevance of this infrastructure across varied contexts, with most countries showing progress toward fully operational systems but also indicating areas where improvements are necessary to meet user needs and ensure efficient data management. Most of the responders also shared the reference to such an infrastructure/geoportals:

- Albania: https://geoportal.asig.gov.al/
- Austria: https://data.bev.gv.at
- Croatia: https://oss.uredjenazemlja.hr/map; https://geoportal.dgu.hr/; https://geoportal.nipp.hr/
- Cyprus: https://portal.dls.moi.gov.cy/
- Estonia: https://geoportaal.ee/
- France: IGN has moved from a simple GeoPortal to a new and more ambitious GeoPlatform. New functionalities are quite recent and so, not yet be widely used
- Ireland: www.landdirect.ie; https://www.geohive.ie/; https://www.landdirect.ie/
- Luxemburg: www.geoportail.lu
- Denmark: https://datafordeler.dk/
- Poland: www.geoportal.gov.pl
- Slovenia: https://www.e-prostor.gov.si/inspire/; https://www.e-prostor.gov.si/; https://gis.arso.gov.si/geoportal/catalog/main/home.page
- Spain: www.sedecatastro.gob.es; https://idee.es/
- Sweden: https://www.geodata.se/geodataportalen/
- Switzerland: https://map.geo.admin.ch; https://geodienste.ch/; https://maps.ch; https://www.swisstopo.admin.ch/en/geodata-and-applications
- The Netherlands: www.pdok.nl
- United Kingdom (Scotland): "Land registration public portal https://scotlis.ros.gov.uk/, INSPIRE https://www.spatialdata.gov.scot/ then search for Registers of Scotland
- United Kingdom: https://www.planning.data.gov.uk/map/

The survey results on governmental support for upgrades and innovations in land administration systems show a varied landscape of engagement and implementation (Table 12).

Table 12: FELA Pathway – Innovation: Governmental support (Q: *Does your government actively support upgrades and innovations in the land administration system?* [single choice])

		Answers	Ratio
Research and innovations are performed within the governmental organisations in collaboration with research institutions and there are some good examples of innovative solutions for the land administration system.		10	30.30%
Research and innovations are actively performed within the governmental organisations in collaboration with research institutions, and innovations are adopted in the land administration system.		9	27.27%

Plans are underway to support research and innovations in land administration systems and research and innovation opportunities have been identified.		5	15.15%
The need to support research and innovation for the land administration system is recognised.		7	21.21%
There is no/a lack of governmental support for new/innovative solutions for the land administration system.		2	6.06%
No Answer		0	0%

A substantial portion of respondents indicate that their governments are not only involved in collaborative research and innovations with institutions but also actively integrate these innovations into the land administration system. This is evidenced by 30.3% of participants reporting good examples of innovative solutions already in operation, and an additional 27.27% noting active adoption of such innovations. Meanwhile, 15.15% of respondents are at the planning stage, identifying opportunities for innovation, indicating a proactive yet early phase of support. A further 21.21% recognise the need for support in innovation, although this has not yet translated into action, suggesting a gap between recognition and implementation. However, a small number (6.06%) report a lack of governmental support, highlighting potential barriers that hinder the integration of new solutions. The complete engagement from respondents underscores the relevance of this issue, suggesting that while many governments are moving towards more innovative land administration systems, there remains room for improvement in turning planning and recognition into systematic action and broader implementation.

The survey results on the use of advanced technologies in land administration presents a mixed picture of integration and planning across different regions (Table 13).

Table 13: FELA Pathway – Innovation: New technologies use (Q. *Are relevant technologies (e.g. 3D data models/visualisation; 4D data modelling and change detection; AI involvement; automated feature extraction etc.) being used in your country to deliver new services and insights to the broader community of users (beyond specialist/expert users) and for strategic decision-making?* [single choice])

		Answers	**Ratio**
Yes: state-of-the-art methods for data creation are frequently used.		5	15.15%
Yes: there are examples of state-of-the-art data creation and processing methods in use.		14	42.42%
Partially: plans are underway to modernise data creation and processing methods.		8	24.24%
Partially: the need for improved data creation and processing methods is recognised.		3	9.09%
None		3	9.09%
No Answer		0	0%

Over half of the respondents (57.57%) report using state-of-the-art methods for data creation and processing, with a portion of these using such methods frequently, indicating a robust integration of advanced technologies in their systems. However, a significant number of respondents (33.33%) are either in the planning stages or have only recognised the need for modernising their data creation and processing methods, suggesting that while the intention to upgrade is present, actual implementation is

yet to be fully realised. A small percentage (9.09%) indicate no use of advanced methods at all, highlighting gaps in technology adoption. The complete engagement from all participants suggests a broad relevance of the issue, with varying degrees of technological maturity evident across the surveyed regions. This situation underscores the opportunity for some regions in Europe that are lagging behind to develop and implement strategic plans aimed at adopting technologies such as 3D and 4D modelling, AI, and automated feature extraction, to enhance their services and improve strategic decision-making capabilities. Among the technologies that are currently very interesting for the land organisations, participants outlined:

- AI, machine learning, deep learning, 3D, 4D, datapods, blockchain;
- Automated feature extraction in aerial imagery data to identify new buildings and development;
- Digital twins, 3D data models, AI, ATE;
- Feature extraction using ML, 3D Viewing;
- 3D data models, 4D data modelling and change detection, AI and Automated feature extraction are already used;
- 3D Landscape Modelling;
- Remote sensing using different sensors/platform like satellite optical imagery and UAV
- 3D data models/visualisation, change detection;
- AI, remote sensing, INSAR;
- 3D building models, 4D coordinate system, AI feature extraction;
- AI for illegal buildings detection; 3D building cadastre;
- AI in different processes; digital twin.

Some further interesting references were listed here, e.g.:

- https://www.stdl.ch/;
- https://www.catastro.hacienda.gob.es/ayuda/Manual_de_usuario_visor3D.pdf"
- www.geoportal.gov.pl; https://geoportal.lublin.eu/mesh/#/ http://sip.poznan.pl/model3d/#/legend"

3.3 FELA Pathway VI: Standards

Within the FELA pathway 6 – Standards, the requirement for land administration is described as to consider adopting internationally agreed standards which support interoperability and integration. FELA states: 'Across all initiatives, the objective is to enable different information systems to communicate and exchange data through interoperability (legal, semantic, and technical). In this regard, the use of standards for effective land administration is strongly encouraged.' Standards for land administration policies, laws, organisations, financing, transactions, and particularly data and technology are increasingly available at national, regional, and global levels. Effective land administration seeks to ensure the adoption of best practice standards and compliance mechanisms that enable legal, data, semantic and technical interoperability, which are considered fundamental to delivering integrated geospatial information and knowledge creation. Standards also assist cost reduction and support removal of duplication and maintenance efforts.

Therefore, the first question focused on how the organisation is engaging with and informing itself on land administration standards (Table 14).

Table 14: FELA Pathway – Standards: Working group existence (Q: *Is there a working group in your country that focuses on land administration standards?* [single choice])

		Answers	Ratio
The importance of standards is recognised and a Working Group is fully committed to maintain the used standards.		9	27.27%
A Working Group on land administration standards is operational.		13	39.39%
The terms of reference for a Working Group, inclusive of relevant stakeholders, on standards have been agreed.		1	3.03%
The need for land administration standards is recognised, but not established nor operational.		7	21.21%
None		3	9.09%
No Answer		0	0%

The survey results indicate a varying level of engagement with land administration standards across different countries. Most respondents report active working groups that either maintain existing standards or are currently operational in developing standards, reflecting a strong commitment to standardisation in land administration. However, a small percentage (3.03%) are in the preliminary stages with agreed terms of reference for a working group, suggesting that while the initiative has begun, it is not yet (fully) functional. Another 21.21% recognise the need for such standards but have yet to establish or operationalise a working group, highlighting a gap between recognition and action. Additionally, 9.09% of respondents indicate no efforts toward establishing working groups for standards, pointing to a lack of standardisation efforts which could affect the efficiency and interoperability of land administration practices in these regions. The complete engagement from all respondents underscores the relevance of the issue, suggesting both progress and potential for development in standardising land administration practices globally.

Answers to the second question related to the adoption of standards in land administration in the country illustrate varying degrees of progress in the adoption and implementation of technology and data standards for land administration across different countries in Europe (Table 15).

Table 15: FELA Pathway – Standards: level of adoption (Q: *Have technology and data standards been endorsed/mandated in your country to support interoperability and enable different systems and diverse data types to work together seamlessly?* [single choice])

		Answers	Ratio
Comprehensive adoption and implementation of data standards and technical specifications has been achieved across the land administration domain.		11	33.33%
A national action plan has been agreed for rolling out data standards and technical specifications for land administration.		3	9.09%
National data standards and technical specifications have been defined for the land administration domain.		14	42.42%
A few technology and data standards have been informally agreed and adopted by some stakeholders in the land administration domain.		4	12.12%
None		1	3.03%
No Answer		0	0%

One-third of the respondents report comprehensive adoption and full implementation of these standards, indicating a high level of integration that supports seamless interoperability across systems. The largest group, however, indicates that while national standards and technical specifications have been defined, they are not yet fully implemented, suggesting that many are still transitioning from policy formulation to practical application. A smaller fraction of respondents is in the preliminary stages with national action plans agreed upon but not yet executed, reflecting early efforts in systematic standardisation. Additionally, some respondents note informal adoption by certain stakeholders, indicating grassroots efforts that lack widespread formal endorsement. A very small number report no adoption of standards at all, highlighting significant gaps that could impede effective interoperability in land administration. **These insights show a spectrum of engagement with standardisation, from well-established frameworks to initial planning phases, suggesting ongoing global efforts to enhance data and technology standards critical for effective land management**.

The survey results on the use of compliance systems to ensure the correct implementation of endorsed standards reveal a strong commitment across most surveyed countries (Table 16).

Table 16: FELA Pathway – Standards: Compliance insurance (Q: *Is a system of compliance in use to ensure that organisations are correctly implementing nationally or internationally endorsed standards?*)

		Answers	Ratio
Relevant technology and data providers are using international testing and certification standards.		11	33.33%
Relevant technology and data providers are using national testing and certification standards.		13	39.39%
Approved standards are required for all organisational procurements/tenders including relevant technology and data.		13	39.39%
A policy exists to regularly assess and validate organisational compliance.		11	33.33%
None		1	3.03%
No Answer		0	0%

A significant proportion of respondents indicate that both international and national testing and certification standards are actively used by technology and data providers, reflecting a blend of global integration and local customisation. **Similarly, many organisations report that approved standards are mandated in all organisational procurements and tenders, ensuring that compliance is embedded within economic and contractual frameworks. Regular policies for assessing and validating organisational compliance are also prevalent, highlighting a proactive approach to maintaining standards over time**. Despite these robust measures, a small minority report no compliance systems at all, suggesting potential areas for improvement. Overall, the high level of engagement with compliance systems demonstrates a comprehensive approach to standardisation, with ongoing efforts to ensure consistent adherence through a variety of regulatory mechanisms.

The participants were further asked if there is a coordination of standardization at the governmental level (Table 17).

Table 17: FELA Pathway – Standards: standards coordination (Q: *Are the standards coordinated amongst other governmental organisations?* [single choice])

		Answers	Ratio
Yes, through a standard governance board at national level.		20	60.61%
Yes, through organisation lateral meetings.		9	27.27%
No, every organisation deals with its own standards.		4	12.12%
No Answer		0	0%

The survey results reveal that a significant majority of governmental organisations coordinate their standards through centralised or collaborative approaches. 60.61% percent report that a national standard governance board manages this coordination, ensuring consistency and interoperability across various government entities. This centralised control suggests a structured, uniform approach to standard management, which is crucial for effective and efficient governmental operations. Additionally, over a quarter of respondents utilise inter-organisational meetings for standard coordination, indicating a more flexible, though less formal, approach to ensuring compatibility and coherence among different agencies. However, a small minority of organisations manage their standards independently, which can lead to inconsistencies and hinder effective inter-agency collaboration. **All answers in the survey underscore the relevance of standard coordination in government operations, highlighting that while many are well-integrated, there remains room for some to improve their coordination practices to enhance overall governmental functionality**.

The last question referred to the participation in standardization organization. The survey results reveal a strong commitment among organisations to engage in various global and regional standardisation bodies, highlighting the crucial role these entities play in aligning practices with international standards (Table 18).

Table 18: FELA Pathway – Standards: participation in standardisation organisation (Q: *In which normative/standardisation organisation is your organisation actively participating?*)

		Answers	Ratio
INSPIRE		22	66.67%
ISO		21	63.64%
OGC		20	60.61%
IHO		3	9.09%
Others		7	21.21%
None		1	3.03%
No Answer		0	0%

Participation is particularly high in the INSPIRE initiative, with about 66.67% of respondents involved, emphasising its significance in facilitating public access to environmental spatial information across Europe which is further reenforced by its legally binding nature. The International Organisation for Standardisation (ISO) sees close participation levels, with 63.64% of respondents actively involved, demonstrating a broad commitment to upholding high-quality, internationally recognised standards. The Open Geospatial Consortium (OGC) also records substantial engagement at 60.61%, indicating a focus on geospatial and location-based standards.

Conversely, the International Hydrographic Organisation (IHO) experiences much lower involvement at only 9.09%, suggesting its more specialised focus on hydrography might be less relevant to those not directly dealing with marine or hydrographic data, which is surprising given that around 65% of countries in Europe have sea access. About 21.21% of respondents are involved in other, potentially niche standardisation bodies, reflecting a variety of interests in specific areas of standardisation. Notably, only a minimal number, 3.03%, report no participation in any standardisation organisation, underlining the widespread recognition of the importance of these bodies in influencing and adhering to industry standards, which is crucial for enhancing interoperability and facilitating data exchange across borders and sectors.

4 DISCUSSION AND CONCLUSION

4.1 Trends and Outliers

The survey results from the FELA Pathways on Data, Innovation, and Standards provide detailed insights into current practices and areas for improvement across Europe.

Within the Data pathway, the data themes of parcels, buildings, and addresses emerge as the most managed data elements, reflecting their critical role in land administration systems. This prioritisation indicates a widespread acknowledgement of their importance and is in line with general observations within the European region. The survey further reveals that most organisations assess their data needs through structured government and community requests, highlighting a comprehensive approach to data management. However, themes such as regional land use and those under the 'Others' category, which includes niche areas like cable and pipeline services, are less commonly addressed, suggesting these could benefit from increased attention and integration.

The focus on data security is strong, with most organisations managing this at the organisational level and ensuring continuous monitoring and updates. However, the absence of dataset-specific security measures points to a potential area of vulnerability that could be addressed to enhance overall data protection. Furthermore, automation in data processes is identified as an area with significant room for improvement, particularly where current practices involve substantial manual intervention.

In the Innovation pathway, the influence of government requests on driving innovation is evident, signifying a top-down approach in many regions. Nevertheless, the engagement of citizens and the private sector also plays a crucial role, indicating a balanced input into the innovation processes within Europe. The survey highlights that while some organisations have formalised innovation processes through structures like Innovation Boards, others operate in a more ad-hoc manner or lack a defined process altogether, suggesting a need for more systematic innovation management. There is a substantial presence of state-of-the-art scalable infrastructures for managing land information, yet some regions require further enhancements to achieve full operational efficiency. Governmental engagement with academic and private sectors in innovation is varied, with some regions showing robust collaboration through structured programs, while others engage in informal or ad-hoc partnerships. This indicates an opportunity to formalise these collaborations to achieve more consistent and impactful innovation outcomes. Additionally, the development of comprehensive innovation strategies could enable more targeted investments and foster sustainable innovation within land administration.

The Standards pathway shows strong engagement with international standardisation bodies such as ISO, OGC, and the European Union through the INSPIRE initiative, underscoring a commitment to maintaining high standards for interoperability and data sharing. However, the survey also reveals that

some organisations handle standards independently, which can lead to inconsistencies and hinder effective collaboration. The varying levels of standard adoption and implementation indicate that while many regions within Europe have made significant progress, others are still in the early stages of developing and applying these standards. Ensuring compliance through regular assessments and embedding standards in procurement processes are identified as effective measures to improve adherence and operational efficiency. The coordination of standards among governmental organisations is generally well-managed, with many regions employing centralised governance boards or inter-organisational meetings to ensure consistency. However, a minority of organisations still manage their standards independently, as mentioned above, pointing to areas where improved coordination could enhance overall functionality and interoperability.

Overall, the survey findings highlight that while there are robust frameworks in place for managing land data, innovation, and standards, there remains a need for continuous improvement. Enhancing automation in data processes, formalising innovation management, and strengthening standard adherence and coordination are crucial steps for advancing land administration practices. These improvements will help better meet the needs of global and local stakeholders, ensuring more efficient, effective, and secure land administration systems in Europe.

4.2 Limitations and Further Work

The survey, while providing valuable insights into the practices and challenges related to data, innovation, and standards within European land administration systems, has several limitations that should be considered. Firstly, the survey's scope is confined to a European perspective, which means that the findings may not accurately reflect the situation in other parts of the world.

Additionally, the survey results are based on responses from only a portion of the target population. This partial participation may result in a limited representation, as not all relevant stakeholders are represented, potentially introducing bias into the findings. The questions posed in the survey were designed as indicators for the operationalisation of the FELA objectives rather than as definitive measures.

Furthermore, the survey does not provide complete coverage of each FELA pathway. While it certainly sheds light on key aspects, there are areas within data management, innovation, and standard adoption that remain unexplored, leaving gaps in the overall understanding. To address these gaps and gain a more thorough understanding, more in-depth studies are necessary.

In addition to further research, the survey results would benefit from more detailed discussions, which could be facilitated through follow-up workshops. These workshops would enable stakeholders to collaboratively analyse the findings, leading to a better understanding of the implications and more informed strategies for implementing the FELA objectives. Overall, while the survey serves as a valuable starting point, these limitations highlight the need for careful interpretation and further exploration to fully realise the FELA.

In conclusion, the survey results are evaluated for their alignment with the FELA Goals and Requirements.

FELA Goals	FELA Requirements	FELA Pathways
Transparency and accountability increased	Accountable and transparent governance	Governance, Institutions and Accountability*
Gender-responsive and inclusive of vulnerable groups	Inclusive and recognizes all forms of tenure	Policy and Legal
Affordable investments and economic return assured	Affordable with sustainable business models	Financial
Reliable data and service quality attained	Data maintained, secure and not duplicated	Data
Responsible and innovation oriented	Upgradable systems and approaches	Innovation
Interoperability and integration supported	Considers internationally agreed standards	Standards
Cooperation, partnerships, and participation leveraged	Strengthens partnerships and supports collaboration	Partnerships
Capacity, capability, knowledge transfer and exchange attained	Facilitates capacity development and knowledge transfer and exchange	Capacity and Education
National engagement and communication enhanced	Advocates for effective land administration	Advocacy and Awareness*

Figure 2: FELA Goals and Requirements

The survey results from the FELA Pathways on Data, Innovation, and Standards show varying degrees of conformity with the FELA objectives and requirements as outlined:

Data Pathway
FELA Goal: Reliable data and service quality attained
FELA Requirement: Data maintained, secure, and not duplicated
The survey reveals that the prioritisation of critical data themes like parcels, buildings, and addresses is well-aligned with the goal of reliable data and service quality. These elements are central to land administration systems, and their focus suggests a concerted effort to maintain reliable, authoritative, and high-quality data. The strong focus on data security at the organisational level conforms to the requirement for maintaining secure data. However, the absence of dataset-specific security measures indicates a gap that could affect the overall reliability of data security. This suggests partial conformity with the FELA requirement, as there is room for improvement in ensuring that all data elements are adequately secured and not duplicated.

Innovation Pathway
FELA Goal: Responsible and innovation-oriented
FELA Requirement: Upgradable system and approaches
The survey results show that innovation is significantly driven by government requests and supported by citizen and private sector engagement. This balanced approach indicates a responsible orientation towards innovation, aligning well with the FELA goal. However, the inconsistency in formalised

innovation processes across the region suggests that while the intent is there, the execution varies, indicating partial conformity. The presence of scalable infrastructures for managing land information aligns with the requirement for upgradable systems. However, the need for further enhancements in some regions points to areas where the systems are not yet fully upgradable or efficient. The varied levels of collaboration between governmental, academic, and private sectors also indicate that some approaches might not be fully upgradable or innovative, suggesting only partial conformity with the FELA requirement.

Standards Pathway
FELA Goal: Interoperability and integration supported
FELA Requirement: Considers internationally agreed standards
The survey indicates that many regions have made significant progress in adopting internationally agreed standards, which is in direct conformity with the FELA requirement. The strong engagement with international standardisation bodies like ISO, OGC, and the EU INSPIRE shows a high level of commitment to interoperability and integration, in line with the FELA goal. However, the independent handling of standards by some organisations could hinder effective collaboration, suggesting that while there is strong conformity, it is not yet universal in a country. Hence, the inconsistent adoption and independent management of standards in some areas highlight that not all organizations fully meet this requirement, indicating partial conformity.

Overall, the survey findings suggest that there is a strong alignment with FELA objectives and requirements in many areas, particularly in the prioritisation of critical data themes, the focus on innovation driven by multiple sectors, and the engagement with international standards. However, the areas of partial conformity—such as the need for more dataset-specific security measures, formalisation of innovation processes, and consistent adoption of standards—highlight opportunities for improvement. Addressing these gaps will be crucial for fully realising the FELA in Europe.

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Appendix: List of respondents' origin countries/regions

- Albania
- Armenia
- Austria
- Bosnia and Herzegovina
- Croatia
- Cyprus
- Estonia
- France
- Germany
- Ireland
- Luxemburg
- Denmark (North Jutland)
- Norway
- Poland
- Republic of Slovenia
- Scotland (United Kingdom)
- Slovenia
- Spain
- Sweden
- Switzerland
- The Netherlands
- Ukraine
- United Kingdom