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Geographical Names****2025 session**

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Item 5 (a) of the provisional agenda ***Technical expertise: Names collection, office treatment, features
beyond a single sovereignty and international cooperation****Role of Artificial Intelligence in Evidence-Based Geographical
Names Management**

Submitted by Norway**

Summary:

Artificial intelligence presents transformative opportunities for addressing long-standing challenges in geographical names standardization. Artificial intelligence technologies demonstrate value in processing vast quantities of historical documentation, managing multilingual considerations and implementing consistent romanization of non-roman scripts.

Practical applications have shown promising results in several areas. Test cases using untrained artificial intelligence (Claude 3.5 Sonnet) successfully performed complex tasks, including Bulgarian Cyrillic romanization, multilayer romanization of Sorani geographical names with academic, International Phonetic Alphabet and English gazetteer variants, and extraction and alignment of medieval Norwegian proper nouns with modern forms. Only standardization based solely on phonemic transcriptions turned out to be less successful.

However, preventing artificial intelligence-related issues such as hallucination and misattribution requires robust quality control measures. The implementation of human-in-the-loop and expert-in-the-Loop methodologies provides essential oversight. The former ensures regular operational review by human operators, while the latter incorporates subject matter experts for complex cases involving Indigenous names, culturally sensitive locations, or deep historical expertise.

Recommendations include encouraging Member States to develop artificial intelligence-enhanced standardization frameworks, establishing guidelines for evidence evaluation and quality control, and promoting knowledge-sharing across jurisdictions. Success requires careful integration of automated processing with human judgment and expert knowledge, thereby creating systems that enhance standardization efficiency while maintaining cultural sensitivity and accuracy.

The capabilities demonstrated suggest artificial intelligence will play an increasingly important role in geographical names standardization, in particular when combined with appropriate human oversight and cultural expertise.

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Introduction

The standardization of geographical names represents a critical component in global spatial data infrastructure and international communication. As technological capabilities advance, Artificial Intelligence (AI) emerges as a transformative tool in addressing long-standing challenges in toponymic standardization. This paper examines the potential applications and implications of AI technologies in geographical names standardization, with particular emphasis on evidence-based methodologies, offering insights into how member states can leverage these advances to enhance their standardization processes.

Traditional approaches to geographical names standardization face numerous challenges, including the processing of vast quantities of data, managing multilingual considerations, implementing consistent romanization of non-roman scripts, and ensuring consistency across various administrative levels. These challenges are compounded by the increasing complexity of global communication and the need for rapid, accurate geographical information in both public and private sectors. The need for robust, evidence-based approaches has become increasingly apparent as standardization authorities seek to make defensible, transparent decisions.

Evidence-Based AI Applications in Standardization Processes:

The integration of AI technologies offers promising solutions across multiple domains of evidence-based geographical names standardization. In historical documentation analysis, AI systems can now process vast archives of historical maps, documents, and records, extracting valuable information about name usage and evolution over time (Zhang, 2023). Advanced machine learning algorithms can analyze handwriting, recognize patterns in historical maps, and construct comprehensive timelines of toponymic changes, providing a solid foundation for standardization decisions (Ren et al., 2020).

Linguistic evidence processing represents another crucial area where AI demonstrates substantial value. Through computational linguistics applications, AI systems can trace etymological patterns, transform non-roman scripts into roman script, analyze phonetic similarities across dialects (Alex et al., 2015), and decompose complex geographical names into their constituent elements. These capabilities are particularly valuable in regions with multiple language families or complex linguistic landscapes.

AI systems excel in processing geographical feature analysis (Emami, 2023), correlating names with topographic features and detecting patterns in naming conventions. By integrating with GIS databases and processing satellite imagery, these systems can validate the relationship between geographical features and their names, ensuring consistency with physical reality (Ivić 2019). Furthermore, AI can analyze cultural context through natural language processing of cultural documentation, recognition of traditional naming practices, and processing of oral history transcriptions, ensuring that standardization decisions respect and preserve cultural heritage.

Modern AI applications can process community usage evidence through social media analysis, local publication processing, and community feedback aggregation, providing insights into contemporary name usage patterns and preferences (Hu & Li, 2017). In the administrative domain (cf. Ivić 2019), AI systems can analyze government records, cross-reference multiple administrative sources, and track changes in administrative boundaries, ensuring that standardization decisions align with official documentation while maintaining historical continuity.

One of the most significant contributions of AI to evidence-based standardization lies in its ability to perform multi-source validation. AI systems can automatically cross-check multiple evidence types, generate confidence scores based on evidence consistency, and detect conflicts between different sources. This capability ensures that standardization decisions are based on comprehensive analysis of all available evidence, with clear documentation of the decision-making process.

A Few Examples of Use of AI in Geographical Names Management

The following tables are examples of *untrained* AI test results. This means that the prompts were made directly in the query interface on the general Claude 3.5 Sonnet LLM (Large Language Model) from Anthropic. For large-scale AI generation and complex processing, a trained dataset, combined with a bespoke code script will most probably create even more precise results.

Example 1: Romanization of Geographical Names in Bulgarian Cyrillic Script > Roman Script (Obshtnost)

ID	Cyrillic script	Roman script
1	Годеч	Godech
2	Своге	Svoге
3	Поляново	Polyanovo
4	Горски Извор	Gorski Izvor
5	Динево	Dinevo
6	Поликраище	Polikraishte
7	Бобов дол	Bobov dol
8	Станке Димитрово	Stanke Dimitrovo
9	Гоце Делчев	Gotse Delchev
10	Вихрен	Vihren
11	Добринище	Dobrinishte
12	Исперих	Ispcrih
13	Ихтиман	Ihtiman
14	Ахтопол	Ahtopol
15	Добрич	Dobrich
16	Толбухин	Tolbuhin
17	Михайловград	Mihaylovgrad
18	Златоград	Zlatograd
19	Ивайловград	Ivaylovgrad
20	Харманли	Harmanli
21	Разлог	Razlog
22	Сандански	Sandanski
23	Петрич	Petricн
24	Марикостиново	Marikostinovo
25	Горна Оряховица	Gorna Oryahovitsa
26	Лясковец	Lyaskovets
27	Търговище	Targovishte
28	Поповица	Popovitsa

Table 1: Simple Romanization operation: AI-generation of a table, containing columns with Bulgarian cyrillic script and Obshtnost romanization (official Bulgarian Romanization system from 2006 (a variation of the 1995 UN system) in an AI prompt: “romanize this list of Bulgarian geographical names according to the Obshtnost standard. Make a table where column 1 is the ID; column 2 the Bulgarian

name forms; column 3 the Obshtnost romanization form.”

Example 2: Transformation of Sorani¹ Script into Romanized Scripts and IPA phonetic script

ID	Sorani	Academic/Scholarly	IPA	English language gazetteer
1	قه‌لای هه‌ولێر	Qelāy Hewlêr	[qæləj hæwle:r]	Qala Hawler (Erbil Citadel)
2	چییای هه‌لگورد	Çiyay Helgurd	[tʃijaj hælgurd]	Helgurd Mountain
3	ئه‌شکه‌وتی شانه‌ده‌ر	Eşkewtî Şaneder	[æʃkæwti: ʃanædær]	Shanidar Cave
4	شه‌لالی بیخاڵ	Şelalî Bîxał	[ʃælali: bi:xał]	Bekhal Waterfall
5	شه‌لالی گه‌لی عه‌لی به‌گ	Şelalî Gelî ‘Elî Beg	[ʃælali: gæli: ʕæli: bæg]	Ali Beg Gorge Waterfall
6	چه‌می ده‌ر به‌ندێخان	Çemî Derbendîxan	[tʃæmi: dærbændi:xan]	Darbandikhan River
7	چیاکانی ئامیدی	Çiyakanî Amêdî	[tʃijja:kani: a:me:di:]	Amadiya Mountains
8	چیاکانی گاره	Çiyakanî Gare	[tʃijja:kani: ga:ræ]	Gara Mountains
9	دۆلی رانیه	Doñî Ranye	[dohi: ra:njæ]	Rania Valley
10	چیاکانی زاگروس	Çiyakanî Zagros	[tʃijja:kani: za:gro:s]	Zagros Mountains
11	رووباری سیروان	Rûbarî Sîrwan	[ru:ba:ri: si:rwan]	Sirwan River
12	پردی ده‌لال له زاخۆ	Pirdî Delal le Zaxo	[pirdi: dæla:l læ za:xo]	Delal Bridge at Zakho
13	چیاکانی کۆره‌ک	Çiyakanî Korek	[tʃijja:kani: ko:ræk]	Korek Mountains
14	مه‌خمور	Mexmûr	[mæxmu:r]	Makhmur
15	ده‌ریای سماقۆلی	Deryay Smaqulî	[dærja:j sma:quli:]	Lake Smaquli
16	ئامیدی	Amêdî	[a:me:di:]	Amadiya
17	ده‌ریای دۆکان	Deryay Dokan	[dærja:j do:kan]	Lake Dokan
18	به‌شماخ	Beşmax	[bæʃmax]	Bashmakh
19	کانی ماسی	Kanî Masî	[ka:ni: ma:si:]	Kani Masi
20	سۆران	Soran	[so:ra:n]	Soran
21	شه‌قلاوه	Şeqławe	[ʃæqła:wæ]	Shaqława
22	به‌رگه‌لوو	Bergelû	[bærgælu:]	Bargalu
23	رانیه	Ranye	[ra:njæ]	Rania
24	چۆمان	Çoman	[tʃo:ma:n]	Choman
25	ئاكری	Akrê	[a:kre:]	Akre
26	بارزان	Barzan	[ba:rza:n]	Barzan

Table 2: Complex Romanization operation: AI-generation of a table, containing columns with academic/scholarly romanization of Sorani, (simplified) IPA rendering and an English language gazetteer entries in one AI prompt: “romanize this list of Sorani geographical names according to the academic/scholarly standard. Make a table where column 1 is the ID; column 2 the Sorani names; column 3 the academic/scholarly romanization form; column 4 an IPA phonetic transcription; column 5 modified Sorani romanized geographical names for use in an English language gazetteer.”

Example 3: Proper Noun Extraction from Digitized Medieval Documents and Alignment to Modern Proper Noun Forms

¹Sorani is a Kurdish dialect spoken in Iraq and parts of Western Iran. Also known as Central Kurish

DN ID	Proper Noun	Type	RN ID	RN Register
DN 1:6	Honorius	person	2041	Honorius III, pave
DN 1:6	S[culoni]	person	6269	Skule Bårdsson, jarl/hertug
DN 1:6	Norwegie	place		-
DN 1:6	Romanam	place		-
DN 1:6	Petri	person	6423	St Peter
DN 1:6	Laterani	place	3155	Lateranet
DN 1:7	N[ikulas]	person	4668	Nikolas Arneson, biskop av Oslo
DN 1:7	Oslo	place	4945	Oslo
DN 1:7	Judarðe	person		-
DN 1:7	Vælli	place	7085	Voll [Grue 22]
DN 1:7	Gravar	place	1437	Grue [sogn]
DN 1:7	Skæphæimum	place		-
DN 1:7	Jolund	place	2825	Jeløya
DN 1:7	Vddarðr	person	6915	Uddard [= Odardus]
DN 1:7	Mariu	person	3577	Maria, jomfru
DN 1:7	Eðmundi	person	6403	St Edmund
DN 1:7	Howðey	place	2110	Hovedøya kloster
DN 1:7	Vddarðar	person	6915	Uddard [= Odardus]
DN 1:7	Gregores	person		-
DN 1:7	Geslengr	person	2812	J. geslengr, geistlig
DN 1:7	Jon	person	2926	Jon bataðr
DN 1:7	Jon	person	2948	Jon naso, mester
DN 1:7	Bataðr	person	2926	Jon bataðr
DN 1:7	Guðleikr	person	1449	Gudleik, prest
DN 1:7	Jon	person	2955	Jon, skolemester
DN 1:7	Hughleikr	person		-

DN 1:7	Asbiorn	person	241	Asbjørn kopr
DN 1:7	Hallkæl	person	1550	Hallkjell merr
DN 1:7	Olafir	person	4801	Olav gjaldker

Table 3: Two-step scholarly extraction and alignment of Medieval proper nouns from a volume of digitized Medieval Norwegian charters and documents to modern proper nouns.

Step 1 (red colour colums): “Extract all proper nouns from the documents 6 and 7 in their exact order of occurence. Retain original spelling. Make a table where column 1 is the Diplomatarium Norvegicum Code; column 2 the extracted proper noun; column 3 the type of proper noun.”

Step 2 (green colour columns): “Take the names of persons and places from the Regesta Norvegia by joining on the Diplomatarium code and the ‘Proper Noun’ column with the ‘RN Register’ column. Add to the table two columns: column 4, the Regesta Norvegia code for the corresponding name entry; column 5, the Regesta Norvegia name form. Where no match, indicate with ‘-’ in column 5.”

Example 4: Standardization of Western Norwegian Geographical Names on the Basis of Phonemic Pronunciation Renderings

ID	Phonemic Form	AI Standardized Nynorsk Form	Human generated Standardized Form
1	skompane:se	Skompaneset	Skumpaneset
2	tvai:tehamar*n	Tveitehamaren	Tveitehamaren
3	lå:ned*n	Lånerda	Lånene
4	åkseda:*l	Åksedalen	Okseldalen
5	åksedalsti:en	Åksedalsstien	Okseldalsstigen
6	jai:tå:s*n	Geitåsen	Geitåsen
7	tvai:t(e)å:no	Tveiteåna	Tveit(e)åna
8	gamla tvai:t	Gamle Tveit	Gamla Tveit
9	bjørkene:se	Bjørkeneset	Bjørkeneset
10	(kålbai:ns)tvai:t	Kolbeinstveit	Tveit, Kolbeinstveit
11	kal(h)a:jen	Kalhagen	Kalvhagen
12	sone	Sona	Sundet
13	lau:vhidler	Lauvhidleren	Lauvheller
14	asketo:no	Asketona	Asketona
15	lå9hau:	Låghaugen	Langhaug
16	he:so	Hesa	Hesa
17	tau:shau:	Tausaugen	Tausaug
18	nestastø:d*1	Nestastølen	Nedstastølen
19	mitstø:d*1	Midtstølen	Midtstølen
20	vastø:d*1	Veststølen	Vasstølen

21	vastølvatne	Veststølvatnet	Vasstølvatnet
22	vat*n,da:*l	Vatnedalen	Vatndalen
23	vat*n,da(:)lsnu:t*n	Vatnedalsnuten	Vatndalsnuten
24	vastølska:re	Veststølskaret	Vasstølskaret
25	sto:rafjed*l	Storøfjellet	Storafjell
26	plomrai:nu:tad*n	Plomreinuten	Plomreinutane
27	sto:re"kvelven	Store Kvelven	Store Kvelven
28	nestastølhαι:o	Nestastølheia	Nedstastølheia
29	barganu:t*n	Bargenuten	Berganuten
30	hålmali(:)vatne	Holmalivatnet	Holmalivatnet

Table 4: Standardization based on phonemic transcriptions. AI-generation of a table, containing the original phonemic transcription in one column and the AI standardized form in another. The AI prompt was: “Make a table of standardized geographical names in Norwegian Nynorsk (nno) from this list of phonemic transcriptions from Suldal in Rogaland, Norway. Make a table, where column 1 is the ID; column 2 the phonemic transcription; column 3 the standardized Norwegian nynorsk form.”

To compare the AI generation, the human generated standardizations (yellow column) have been added to view the correctness of the AI standardization. In this case, the AI generation is not very successful. There are many discrepancies between the AI generation and the human-generated list. Some mistakes result from a misinterpretation of the phonemic transcription, such as vas- for ‘Vest-‘ instead of ‘Vass-‘ and the application of a definite form where the transcription has an indefinite one, others seem to be the result of a standardization adhering strictly to the transcription without taking sound changes into account. In this case, training the LLM is necessary to be able to achieve results good enough.

Quality Control Through Human and Expert Integration

A critical consideration in the implementation of AI systems for geographical names standardization is the prevention of common AI-related issues, particularly hallucination (the generation of false or unsupported information) and misattribution (incorrect source attribution or reference). In working with the above examples, it was clear that prompt-tweaking played a central part in generating the wanted results. In addition, human interaction, especially in result verification was necessary in order to verify the quality of the prompt results. To address such challenges, this paper proposes a comprehensive framework incorporating Human-in-the-Loop (HITL) and Expert-in-the-Loop (XITL) methodologies.

Understanding HITL and XITL Approaches

- **Human-in-the-Loop (HITL):** refers to a systematic approach where human operators are integrated into AI processing cycles at critical decision points. In the context of geographical names standardization, HITL involves regular users, data specialists, and process supervisors who review and validate AI outputs before they are accepted into official records. This approach ensures that automated processes remain under human supervision and benefit from human judgment and contextual understanding.
- **Expert-in-the-Loop (XITL):** extends this concept by incorporating subject matter experts at crucial decision points, particularly for complex or sensitive cases. These experts include cultural knowledge holders, linguistic specialists, historical experts, and authorized naming authorities. XITL provides an additional layer of specialized oversight, ensuring that standardization decisions reflect deep domain expertise and cultural sensitivity.

Implementation Framework

The integration of HITL and XITL approaches in geographical names standard-ization requires a structured framework operating at multiple levels:

- First, at the base level, AI systems perform initial data processing, pattern recognition, and preliminary quality checks. These systems must be designed to maintain clear audit trails and confidence scores for all suggestions and decisions.
- Second, the HITL layer provides regular operational oversight. Human operators review AI outputs, validate source materials, and monitor process effectiveness. This layer is particularly crucial for maintaining day-to-day quality control and identifying potential systematic issues.
- Third, the XITL layer provides specialized oversight for complex cases. Expert review becomes mandatory for situations involving indigenous names, culturally sensitive locations, disputed territories, or cases requiring deep historical or linguistic expertise.

Quality Assurance and Risk Management

To ensure the effectiveness of these control mechanisms, organizations must implement comprehensive quality assurance protocols. These include systematic review processes, regular quality audits, and continuous performance monitoring. The framework establishes clear risk assessment matrices, identifying high-risk areas that require expert review and medium-risk areas requiring human validation.

Proactive controls include regular system audits, performance monitoring, and training data validation. Reactive measures encompass error correction protocols, stakeholder communication procedures, and system adjustment mechanisms. All decisions and changes must be thoroughly documented, maintaining clear audit trails and decision rationale.

Continuous Improvement and Knowledge Management

The effectiveness of HITL and XITL integration depends on robust feedback mechanisms and continuous learning processes. Organizations must establish clear protocols for error logging and analysis, success pattern documentation, and performance metrics tracking. Regular training programs ensure that both human operators and expert reviewers maintain current knowledge and skills.

Knowledge management becomes particularly crucial in this context. Organizations must maintain comprehensive documentation of decision rationales, process changes, and expert input. Regular workshops and knowledge-sharing sessions facilitate the dissemination of best practices and lessons learned.

Performance Evaluation

Regular evaluation of system performance must include both quantitative and qualitative metrics. Organizations should track error rates, correction frequencies, processing times, and user satisfaction levels. Monthly reviews should analyze performance metrics and error patterns, while annual assessments provide comprehensive system evaluations and strategic planning opportunities.

Conclusion

The continued development of AI technologies presents opportunities for enhanced evidence-based standardization capabilities. Future applications may include more sophisticated pattern recognition algorithms, improved integration with cultural heritage databases, and advanced analytics for predicting naming trend changes based on historical patterns.

The successful implementation of AI in geographical names standardization requires careful integration of human and expert oversight through HITL and XITL frameworks. These approaches, when

properly implemented, provide robust protection against common AI issues while maintaining high standards of accuracy and cultural sensitivity. The combination of automated processing with human judgment and expert knowledge creates a robust system capable of handling the complexities of geographical names standardization while ensuring reliability and cultural appropriateness.

Artificial Intelligence represents a powerful tool for advancing evidence-based geographical names standardization efforts. By carefully implementing AI technologies while maintaining appropriate human oversight and cultural sensitivity, national names authorities can significantly enhance their standardization processes while ensuring decisions are well-documented and defensible.

Recommendations

1. Encourage member states to develop evidence-based standardization frameworks incorporating AI technologies, and:
 - i. Establish guidelines for evaluating and documenting evidence in AI-assisted standardization processes;
 - ii. Develop standardized protocols for quality control and risk management in AI-assisted naming processes;
 - iii. Support the development of AI tools specifically designed for toponymic evidence analysis;
 - iv. Foster collaboration between technical experts and cultural knowledge holders in developing AI-assisted standardization processes.
2. Establish guidelines for implementing HITL and XITL frameworks in geographical names standardization processes, and:
 - i. Create training programs for human operators and expert reviewers involved in AI-assisted standardization;
 - ii. Support the development of performance metrics and evaluation frameworks for AI-assisted naming processes.
3. Promote the sharing of best practices in evidence-based standardization methodologies and in HITL and XITL implementation across member states.

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Points for discussion

The Group of Experts is invited to:

- (1) Express its views on implementation of AI technologies in geographical names standardization processes, particularly in areas of complex script conversion and historical document analysis.
- (2) Consider the proposed Human-in-the-Loop (HITL) and Expert-in-the-Loop (XITL) methodologies as frameworks for ensuring quality control in AI-assisted geographical names standardization.
- (3) Express its views on developing international guidelines for implementing AI-assisted geographical names standardization while maintaining cultural sensitivity and accuracy.
- (4) Encourage Member States to share experiences and best practices in the application of AI technologies for geographical names standardization, with particular emphasis on evidence-based methodologies and quality control measures.