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a Swedish national infrastructure to support research in digital and experimental Humanities

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1 Huminfra – a Swedish national infrastructure to support research in digital and experimental humanities

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1 Introduction

Huminfra is a Swedish national infrastructure supporting research in digital and experimental humanities. Research in the humanities is increasingly interdisciplinary, quantitative, and multi-methodological, drawing on digital resources, tools, and technology. Huminfra's establishment and development is timely given the current emergent focus on research infrastructures within the Swedish research landscape, and especially on digital and experimental infrastructures (cf. the research and innovation bill *Forskning och innovation för framtid, nyfikenhet och nytta*, Prop 2024/25:60 2024).

Huminfra (<https://www.huminfra.se/>), a distributed national infrastructure, brings together 12 nodes in the domains of digital and experimental humanities. Its scope includes digital materials, tools, and critical interpretative perspectives, as well as experimental, quantitative approaches (sensor-based data, real-time analyses). Huminfra coordinates and provides a single entry-point to available Swedish materials, research tools, and

expertise via huminfra.se to facilitate discovery of and access to existing Swedish resources. It also hosts national training events in methods related to the resources. As of 2024 it hosts DARIAH-SE, the Swedish national node in the pan-European research infrastructure consortium Digital Research Infrastructure for the Arts and Humanities (DARIAH ERIC). DARIAH-SE provides Swedish and international scholars with mutual access to resources, tools, and training. From 2025 onwards, Huminfra will also develop a small set of national tools based on user needs. Huminfra strengthens research in areas of specific interest to Sweden (cultural heritage, languages spoken in Sweden, national archives) to promote Swedish humanities and ensure its international competitive edge.

In the following, we describe Huminfra and outline the background for its establishment. The chapter serves as a backdrop to the other contributions in this volume which exemplify resources and expertise found in Huminfra and give practical guidelines to a range of infrastructural components in the humanities.

2 *What is Huminfra and why?*

Some of the biggest challenges in the future for academic research and society in general include issues of social equality, diversity, health, migration, climate change, consciousness, and effects of artificial intelligence (AI). Many of these topics revolve around the impact on or change of human behaviours, communication, culture, education, cognition, and art (cf. [United Nations 2015](#)). Research challenges include: What effect will open AI tools have on society and knowledge production? How do social media affect the way individuals and groups think, produce, perceive, and process information? How do environmental factors interact with individual cognition and socio-economic conditions to affect decision-making and changes in behaviours (e.g., becoming a vegetarian to minimise climate change)? How do we access, interpret, preserve and present cultural heritage data? How and when are linguistic, communicative, and cultural skills learned and transmitted in an age of migration? These challenges are both scientific and societal.

The humanities have traditionally tackled such questions qualitatively, but research in the humanities (including the arts, and social sciences) has become more quantitative, interdisciplinary, and multi-methodological. It is increasingly based on complex data sets, both born digital and newly digitised. An increasing number of researchers in the humanities are no longer strangers to statistics, algorithms and programming. They now use state-of-the-art digital and experimental methods that enable rapid and

collaborative analyses of complex data sets. With enriched and expanded tool kits and interdisciplinary linkages, researchers in the humanities now play a key role in contributing human-centred perspectives on the big scientific and societal challenges and furthering and deepening our understanding of the human condition.

However, although methodological resources are widely available, many researchers in the humanities struggle to find and access the research infrastructures they need (cf., [Riksbankens Jubileumsfond 2019](#); [Vetenskapsrådet 2019](#)). Research infrastructures can be defined as organised facilities designed to support research by providing access to equipment, data sets and materials, databases, digital platforms, and networks. They should also provide computational resources and e-scientific/digital tools to process and analyse data and materials. Equally vital is access to the appropriate expertise (e.g., programming skills and methodological know-how) and to training in the relevant techniques including developing collaborative modes of working ([Brodén et al. 2024](#), [Foka et al. 2018](#), [Golub et al. 2020](#), [Niehorster et al. 2024](#)). Hitherto, the infrastructural landscape in Sweden has been fragmented, making it difficult for researchers to identify, select, and gain access to the most appropriate and useful resources. The recent rise of many new (national) infrastructures has made the research landscape even richer, but also more difficult to navigate. This state of affairs may lead to missed research opportunities and a risk that Swedish scholarship loses international ground.

To remedy the fragmentation of the landscape, and to support and help internationalise Swedish research in the humanities, Huminfra was established in 2022 as a distributed consortium, funded by the Swedish Research Council (SRC) and by the 12 participating universities and organisations, labelled nodes. The Huminfra nodes have complementary resources and expertise. This includes digital humanities, defined as work focusing on e-scientific/digital materials, tools and critical interpretative skills and perspectives, but also experimental humanities, characterised by experimental and quantitative approaches, the use of sensor-based data, and sophisticated real-time data analyses. Finally, Huminfra supports research in knowledge areas of specific interest to Sweden such as aspects of Swedish cultural heritage, research on languages spoken in Sweden, and national archives and data sets.

During the establishment phase 2022-2024 Huminfra had three aims:

1. to coordinate and provide a single entry-point to available Swedish materials, research tools, and expertise at the consortium nodes via a web-based information platform, <https://www.huminfra.se> (Figure 1).

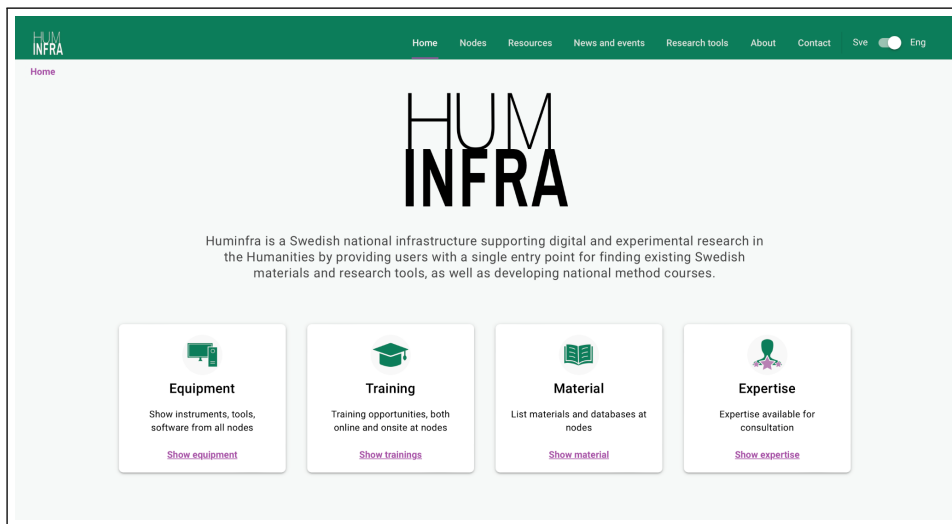


Figure 1: The web-based information platform Huminfra.se

Huminfra.se enables the rapid matching of needs to resources and facilitates access to local resources in accordance with local guidelines and conditions. Furthermore, Huminfra.se also links to other relevant local, national, and international infrastructures (e.g., *Litteraturbanken*, the Swedish National Data Service (SND), etc.).

2. to provide training in methods related to the resources at hand via jointly developed national Huminfra-courses, tutorials, workshops, etc. These training activities along with methodological advice at the local nodes constitute Huminfra's user support. They also serve as a forum for monitoring new needs for tools and training not yet available.
3. to establish and host Swedish membership in the Digital Research Infrastructure for the Arts and Humanities (<https://www.dariah.eu/>), the European Research Infrastructure Consortium (ERIC) that connects Swedish research to European resources, enhancing collaboration options, tool development and training within the domain of cultural heritage to match the existing networks available in the language domain via the European infrastructure Common Language Resources and Technology Infrastructure (<https://www.clarin.eu/>) and its Swedish node Språkbanken CLARIN. In this way Huminfra.se points Swedish researchers to European resources, and guides European researchers towards Swedish ones.

In the consolidation phase 2025-2028, Huminfra adds a fourth aim:

4. to jointly develop a small set of national tools arising from a survey of needs led by DARIAH-SE and from the specific needs and critical issues expressed and identified during the national training events. These will be freely available and wherever possible conform to standards and principles of interoperability as well as the implementation of FAIR data principles (findability, accessibility, interoperability, and reuse of digital assets), including those of DARIAH for cultural heritage data and CLARIN for language data. The tool development transforms Huminfra from the meta-infrastructure it was in the establishment phase to a more explicit methods and resource infrastructure in the consolidation phase.

3 *Huminfra for whom?*

Huminfra's user base is potentially all researchers in the humanities and professionals at cultural heritage institutions in Sweden, as well as international humanities scholars looking specifically for Swedish materials and resources. Other areas also draw on Huminfra's resources. Computer science and associated disciplines are finding new applications in the development of technical solutions, e.g., developing interfaces and tools, for research in these domains, not least through the recent emphasis on the use of AI in the humanities and social sciences (e.g., Wallenberg AI, Autonomous Systems and Software Program – Humanity and Society, <https://wasp-hs.org/>). Requests for expertise on text mining, topic modelling, automated transcription of recordings, making handwritten manuscripts machine readable, automatic dialect identifiers, etc., has increased dramatically and continues to grow. Large Language Models exploded onto the scene in 2022, and the KBLab node at the National Library of Sweden and the Swedish National Archives have both drawn international attention to their work in this area, again attracting new potential users of the technology and the materials housed at these nodes. The user base spans all disciplines and areas of science, as well as other societal stakeholders in the public and private sectors such as health, education, law enforcement, and government agencies. Cultural heritage professionals are another major user base for DARIAH ERIC/SE. The recent national emphasis on digitisation of cultural heritage data means that 3D scanning, visualisation, and corpus related activities will increase considerably in volume. Moreover, the creative industries are expected to grow as a significant new user base over the coming years. Finally, an important outcome of the Huminfra consortium is the Swedish

National Research School in digital humanities: Data, Culture, and Society – Critical Perspectives (DASH). This is the first national Swedish graduate school in digital humanities, which also feeds back into Huminfra's user base by introducing early career researchers to Huminfra as a valuable resource.

4 *What does Huminfra (and DARIAH-SE) add?*

Swedish researchers in the humanities have long worked in a landscape where infrastructural needs at local universities are only partially met, and where the knowledge about the location of resources and how to use them often exists in so-called silos. Knowledge about resources is often shared *within* disciplines, whereas cross-disciplinary knowledge of methods and tools is less widespread.

The added value of Huminfra as a national infrastructure is thus fourfold. First, it meets the growing needs for long-term-provision and maintenance of technology and digital/e-scientific resources for the humanities, including tool development, expertise on management of (especially human) e-data according to the FAIR principles, and adherence to common principles and standards for open science (cf. work by the European Open Science Cloud (EOSC) and the European Strategy Forum on Research Infrastructures (ES-FRI)). In the language domain, the consortium CLARIN ERIC, of which Sweden is a member state, develops language resources and tools according to general principles. In other areas of the humanities and the arts and in the domain of cultural heritage data, DARIAH ERIC offers platforms for training materials, tools and data thereby increasing exchange with the international arena. DARIAH-SE provides Swedish researchers in this domain with an entry point for digital content, tools, services, facilities, and expertise.

Second, Huminfra also helps to make the most of human resources within the experimental and digital humanities, in particular through its dedicated research competent staff by developing general tools and methods, providing training and guidance, maintaining and upgrading hard- and software, and acting as liaison officers between users across disciplines in the humanities and beyond, and with stakeholders in education, industry, cultural and creative institutions, and with other data providers.

Third, Huminfra safeguards a sustainable future for this work by pooling resources and coordinating training, thus securing recruitment and reducing vulnerability.

Fourth, it is vital to coordinate this work at a national level in order to optimise resource exploitation and avoid duplication.

In sum, Huminfra makes Swedish humanities more visible and inter-

nationally competitive. For all four added values, Swedish membership in DARIAH ERIC is an important component. Through DARIAH-SE Swedish researchers in digital arts and humanities gain access to digital content, tools, services, facilities, and expertise in Sweden, in Europe, and beyond. In turn, European and international researchers are able to develop new research, tools and services on the basis of uniquely Swedish resources and integrate them with other data sets. This ensures the visibility of Swedish resources and enhances research related to areas of study in Sweden. Through Huminfra, DARIAH-SE has direct access to data, tools, and content providers via the nodes in the infrastructure.

5 *Huminfra and other infrastructures*

Huminfra has drawn inspiration from international models, for instance DIGHUMLAB Denmark (<https://dighumlab.org>), a national, distributed research infrastructure that integrated and promoted tools, digital resources, communities, and opportunities to Danish researchers. At the international level, Huminfra is linked to and participates in CLARIN ERIC, and as of July 2024 Huminfra hosts DARIAH-SE, the Swedish node of DARIAH ERIC. Moreover, a Scientific Advisory Board composed of international distinguished scholars with long experience in infrastructure development contributes to profiling and strengthening Huminfra's relevance in an international context.

Nationally, Huminfra works closely with a number of existing infrastructures. Traditional key structures for the humanities, such as university libraries, the National Library of Sweden, and the Swedish National Archives, aim to facilitate preservation and access to high-quality research data. The libraries are also important digital data providers and curators, and, to an extent, experts on data management and archiving. The KBLab at the National Library of Sweden, the Swedish National Archives, and the Swedish School of Library and Information Science are members of the Huminfra consortium and they have all made considerable headway towards meeting new research needs (cf. [Kungliga Biblioteket 2020](#)). Moreover, although not part of the consortium, the Swedish National Data Service (SND), custodian and curator of digital research data and the national resource for the accessibility, preservation, and reuse of data, is an important conversational partner to Huminfra.

Another relevant structure is the national infrastructure *Språkbanken* which hosts and develops language technology and resources (e.g., [Borin et al. 2022](#); [Edlund et al. 2022](#)). It comprises *Språkbanken Text*, *Språkbanken*

Tal, *Språkbanken Sam*, and *Språkbanken CLARIN* (the Swedish membership organisation in CLARIN ERIC), coordinated by the University of Gothenburg. *Språkbanken Tal* and *Språkbanken Text* are members of the Huminfra consortium to ensure smooth communication and interaction between the infrastructures. Their inclusion in Huminfra importantly makes access to expertise on language and texts available to non-language disciplines, for example through joint events. Such complementarity is an important gain of the interdisciplinary composition of Huminfra's nodes.

Huminfra also collaborates with the National Research Infrastructure for Data Visualization (InfraVis) and the Swedish National Infrastructure for Digital Archaeology (SweDigArch). InfraVis provides resources connected to scientific visualisation, covering needs from a wide range of disciplines including the humanities. Several nodes in Huminfra are part of both InfraVis and SweDigArch. The connections between the infrastructures enhance interdisciplinary collaborations and knowledge sharing.

The National Academic Infrastructure for Supercomputing in Sweden (NAISS), based at Linköping University, provides computing resources for large-scale computation operations and storage in all disciplines, including user support from 2023. Its predecessor, Swedish National Infrastructure for Computing (SNIC) hosted only a dozen projects from the humanities, but the potential for growth is obvious and Huminfra will promote such growth through its user base.

In sum, existing infrastructures support very specific facets of the infrastructural needs in the relevant disciplines, and Huminfra helps coordinate and strengthen links between them to facilitate knowledge transfer and access to Swedish scholarship.

6 *The societal relevance of Huminfra*

Huminfra.se, which provides information on resources and research output, heightens the visibility and impact of humanities research both within and outside of Academia. The platform acts as an interface to external stakeholders such as cultural institutions, education, health, industry, and public and creative sectors. Researchers using Huminfra resources have the potential to fundamentally change research on how human activities (communication, culture, education, and cognition) evolve as a result of factors such as migration, diversity, climate change, social equality or health, highlighted in the UN's global sustainability goals. This, in turn, could pave the way for new Swedish innovations in many arenas, such as AI applications for (inclusive) communication in written or spoken form (cf. KBLab's develop-

ment of Swedish Large Language Models), new strategies on how to nudge individuals to act in more environmentally sound ways, tools for learning languages, new ways to execute and distribute performing arts to wider audiences, etc.

Huminfra has a dedicated programme of activities targeting non-academic stakeholders. Several nodes organise joint MA theses with industry (KTH Royal Institute of Technology, Linnaeus University, Lund University), invite external stakeholders as speakers at workshops (University of Gothenburg, KTH Royal Institute of Technology, Linnaeus University, Lund University), initiate collaborations with the arts (University of Gothenburg, Lund University, Umeå University), etc. Commissioned education is another route for interacting with non-academic users (e.g., Lund University). Huminfra also has a programme for outreach proper, for example via outreach webinars targeting non-academic potential users. Huminfra outreach also includes activities in social media with the aim of initiating new collaborations.

7 *The long-term impact of Huminfra*

Huminfra aims to contribute to the long-term accumulation of national competence in digital and experimental humanities in at least four ways.

1. huminfra.se contributes to visibility and dissemination of information on existing resources, training activities, and provides examples of research output (for academic and popular science purposes). One such effort was Huminfra's first national research conference, HiC 2024, which gathered researchers, developers, and users of research infrastructures in digital and experimental humanities (cf. [Volodina et al. 2024](#)). Through such knowledge-sharing activities Huminfra contributes to enhanced opportunities for Swedish researchers to find appropriate tools, data sets, training opportunities, and potential collaborators. The Swedish membership in DARIAH further guarantees greater international contacts and international impact of Swedish scholarship and resources, which feeds back to accumulated national competence.
2. Through the national coordination of training activities, Huminfra empowers Swedish scholarship by contributing to the growth of a new generation of humanities scholars, well trained in the techniques needed to tackle new research questions, with skills to make them independent agents in designing and conducting their own studies and not dependent on 'hired help'.

3. National coordination and development of joint tools also means that knowledge, expertise, and resources will become more distributed and are likely to accumulate not only in a few locations, but be disseminated across the entire national arena.
4. Huminfra is a long-term commitment. Huminfra is likely to generate new collaborative research in many domains through the increased visibility and facilitated access to resources, through the training initiatives, and through collaborative method and tool development. As with all infrastructures, sustained maintenance (and funding) is vital to competitive research to avoid resource destruction, jeopardising research initiatives.

8 *Conclusion*

Huminfra.se gives Swedish researchers in the humanities a single entry-point to highlight and advertise Swedish research in relevant fields. It also points to resources and actors outside the nodes participating in Huminfra, which strengthens the visibility and competitive edge of Swedish research and research resources more generally. Moreover, considering the key role of digital tools and modes of communication in research communication today, and Huminfra's ambition to equip researchers with necessary skills in order to handle those, we foresee that Huminfra will contribute to increase the sharing and dissemination of humanities' research results in society.

Further, the establishment of DARIAH-SE and its connections to the DARIAH ERIC will also ensure maximal international visibility of Swedish humanities research. Importantly, Huminfra's sustained dedication to outreach with activities in social media, outreach conferences, and popular science will highlight research to popular audiences, which will generate further potential for new collaborations with non-academic stakeholders, and innovations.

Huminfra is a first major national effort towards equipping Swedish humanities with the skills and tools needed to meet the future research challenges in a research landscape that is increasingly interdisciplinary. The chapters in this volume provide good examples of the kind of expertise and tools scholars now need. They provide valuable practical guidelines but also more general insights on interdisciplinary humanities research and infrastructures. To ensure the sustained momentum of Huminfra, its long-term impact, and continued growth requires foresight, vision, and perseverance. The Huminfra consortium looks forward to the work ahead.

References

- Borin, Lars, Rickard Domeij, Jens Edlund & Markus Forsberg. 2022. *European language equality: D1. 33: Report on the Swedish language*. https://european-language-equality.eu/wp-content/uploads/2022/05/ELE_Deliverable_D1_33_Language_Report_Swedish_.pdf.
- Brodén, Daniel, Mats Fridlund, Leif-Jöran Olsson, Magnus P. Ängsal & Patrik Öhberg. 2024. Samförfattande som datadriven tvärvetenskap: Pragmatiska lärdomar från SweTerror-projektet. *Proceedings of the Huminfra Conference (HiC 2024)* 205. 148–153. DOI: [10.3384/ecp205020](https://doi.org/10.3384/ecp205020).
- Edlund, Jens, Daniel Brodén, Mats Fridlund, Cecilia Lindhé, Leif-Jöran Olsson, Magnus P. Ängsal & Patrik Öhberg. 2022. A multimodal digital humanities study of terrorism in Swedish politics: An interdisciplinary mixed methods project on the configuration of terrorism in parliamentary debates, legislation, and policy networks 1968–2018. In Kohei Arai (ed.), *Proceedings of the 2021 intelligent systems conference (IntelliSys)*, vol. 2, 435–449. Springer. DOI: [10.1007/978-3-030-82196-8_32](https://doi.org/10.1007/978-3-030-82196-8_32).
- Foka, Anna, Anna Misharina, Viktor Arvidsson & Stefan Gelfgren. 2018. Beyond humanities qua digital: Spatial and material development for digital research infrastructures in HumlabX. *Digital Scholarship in the Humanities* 33(2). 264–278. DOI: [10.1093/llc/fqx008](https://doi.org/10.1093/llc/fqx008).
- Forskning och innovation för framtid, nyfikenhet och nytta, Prop 2024/25:60.* 2024. <https://data.riksdagen.se/fil/956CAAE7-7DC5-48E5-B7EA-08BA38553A77>.
- Golub, Koraljka, Elisabet Göransson, Anna Foka & Isto Huvila. 2020. Digital humanities in Sweden and its infrastructure: Status quo and the sine qua non. *Digital Scholarship in the Humanities* 35(3). 547–556. DOI: [10.1093/llc/fqz042](https://doi.org/10.1093/llc/fqz042).
- Kungliga Biblioteket. 2020. *Kungliga biblioteket och forskningsbiblioteken i forskningens infrastruktur: Underlag till utredningen Organisation, styrning och finansiering av forskningsinfrastruktur, Dir. 2020:52*. <https://www.kb.se/download/18.6057ac19175f71f980c14e9/1609144338873/KB-och-forskningsbiblioteken-i-forskningens%20infrastruktur.pdf>.
- Niehorster, Diederick C., Marianne Gullberg & Marcus Nyström. 2024. Behavioral science labs: How to solve the multi-user problem. *Behavior Research Methods* 56(8). 8238–8258. DOI: [10.3758/s13428-024-02467-4](https://doi.org/10.3758/s13428-024-02467-4).
- Riksbankens Jubileumsfond. 2019. *RJ rapporterar 2019:1. Humanistisk infrastruktur*. https://rj.se/globalassets/rapporter/rj%5C_wrapport%5C_2019-1%5C_190508.pdf.

- United Nations. 2015. *Transforming our world: The 2030 agenda for sustainable development*. A/RES/70/1. <https://sustainabledevelopment.un.org/post2015/transformingourworld>.
- Vetenskapsrådet. 2019. *Research overview 2019: Humanities and social sciences*. <https://www.vr.se/english/analysis/reports/our-reports/2019-05-10-research-overview-2019-humanities-and-social-sciences.html>.
- Volodina, Elena, Gerlof Bouma, Markus Forsberg, Dimitrios Kokkinakis, David Alfter, Mats Fridlund, Christian Horn, Lars Ahrenberg & Anna Blåder (eds.). 2024. *Proceedings of the Huminfra Conference (HiC 2024)* (Linköping Electronic Conference Proceedings 205). Linköping University: Linköping University Electronic Press. DOI: [10.3384/ecp205](https://doi.org/10.3384/ecp205).

List of abbreviations

CLARIN	Common Language Resources and Technology Infrastructure
DARIAH	Digital Research Infrastructure for the Arts and Humanities
DASH	Swedish national research school in digital humanities: Data, culture, and society – critical perspectives
EOSC	European Open Science Cloud
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategy Forum on Research Infrastructures
FAIR	principles Findability, Accessibility, Interoperability, and Reuse of digital assets
InfraVis	National Research Infrastructure for Data Visualization
NAISS	National Academic Infrastructure for Supercomputing in Sweden
SND	Swedish National Data Service
SNIC	Swedish National Infrastructure for Computing
SRC	Swedish Research Council
SweDigArch	Swedish National Infrastructure for Digital Archaeology
WASP-HS	Wallenberg AI, Autonomous Systems and Software Program – Humanity and Society

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