Accessible EU Report
Study on AI to support accessibility

Working together to build a more accessible European Union for persons with disabilities.

Consortium composed by:

Subcontracting:

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1. Executive summary

This study has been carried out as part of the Accessible EU project with the objective to provide an overview of the state of art and trends of AI and accessibility, based on desk research, stakeholder involvement activities and an analysis of policy and legislation.

The report begins with objectives and background, as well as the methodology used for the study. Then the results of the desk research and stakeholder consultations are presented. After that follows an overview of trending topics, areas of potential and areas of concern. An overview of the results from stakeholder consultations leads to a section on forward-looking solutions and gaps. The final parts of the report contain a policy analysis, conclusions and recommendations, as well as references.

The methodological approach combines several research tools, to ensure a thorough investigation of the topic. The methodology encompasses desk research, a survey, interviews, and workshops with experts to provide a holistic understanding of the subject matter.

Results

The desk research and stakeholder consultations of this study show similar tendencies as AI discussions in general: there is a broad consensus of AI offering tremendous potential, as well as significant inherent risks.

In connection to accessibility, many AI-solutions have been introduced to the market and are already widely used, such as speech-to-text, voice assistants, auto captioning and image recognition just to mention a few.

The main areas where AI solutions are being developed or refined specifically focusing on accessibility can be categorised in three levels:

- At the **individual level**, AI solutions can directly assist users with disabilities, improving their daily interactions and access to digital content through client-based assistive technology and built-in accessibility features.
- At the **professional level**, AI solutions can support web developers, designers, and content creators to make digital content accessible from the start, as well as improve accessibility testing tools.

- On a **societal scale**, AI solutions can facilitate the development, provision, and distribution of assistive technology, thereby supporting systemic changes.

Risks and concerns

If training datasets are **biased** or **unrepresentative**, which they currently are, AI models will fail to understand or serve people with disabilities. There is also **algorithmic discrimination**, as AI systems build on the statistical average, which reinforces existing inequalities and risks excluding certain groups.

AI-driven solutions often collect personal data which may include **sensitive personal information** and contribute to **surveillance**. Relying on AI to replace human support make end users **vulnerable**.

There is a lack of **transparency** in AI decision-making processes, which are also difficult to understand. This calls for **human oversight**, and a need for training, as results must be handled with caution.

The great potential of AI may lead to **overconfidence** and the presumption that it can “solve accessibility”, leading to re-allocation of funding and less focus on current issues.

Because of the enormous data sets needed, the **power over AI development** is centred in a handful of corporations, making the area difficult to regulate.

Conclusions

AI solutions for accessibility are emerging and maturing across individual, professional, and societal levels, with a potential to greatly enhance accessibility.

However, these solutions must be developed with care to avoid new or reinforce already existing forms of discrimination, data privacy issues, and other barriers.

Including people with disabilities in the design and development process, enforcing clear ethical and regulatory standards, and focusing on transparency and personalisation are essential to minimise these risks. Addressing these concerns proactively can help AI fulfil its promise as a powerful tool for greater accessibility and inclusion.

If handled correctly, AI may push toward a more inclusive, accessible world by embedding accessibility into everyday technologies and services, ensuring that all individuals can participate fully in society.

2. Introduction

2.1 Objective

The objective of this study is to explore the current state of the art in research and policy on AI and accessibility. By examining existing literature and policy documents, this study aims to identify key trends, advancements, and gaps in the field. Accessibility in this context refers to the design of products, devices, services, or environments to be usable by people with disabilities. Despite significant technological advancements, individuals with disabilities often face barriers that limit their full participation in society. AI has the potential to address these challenges by providing tailored support and enhancing the inclusivity of digital and physical environments. At the same time, there are a number of considerations and potential risks to take into account in the development and implementation of AI- driven solutions for accessibility. When studying the potential of AI, it is crucial to consider the interdisciplinary nature of the field, which intersects with computer science, human-computer interaction, disability studies, and public policy.

Understanding the interplay between these domains will provide a comprehensive view of how AI can be harnessed to create more accessible and inclusive technologies.

The core objectives of this study are to find out and discuss:

1. What are the latest research advancements in AI technologies aimed at improving accessibility for persons with disabilities?
2. How are current legal and policy frameworks affecting the development and implementation of accessible and disability inclusive AI solutions?
3. What are the most promising applications of AI in enhancing the lives of individuals with various disabilities?
4. What challenges and ethical considerations arise in the development and deployment of AI-driven accessibility solutions?

By answering these questions, the study aims to provide an overview of the state of the art and highlight areas where initiatives are needed in terms of research and policy in order to fulfil the potential of using AI fostering accessibility.

Ultimately, the objective is to contribute to the ongoing discussion on what practical measures can be taken to ensure that AI is used not only in a transparent and ethical way, but also in a way that promotes equality, participation and empowerment of persons with disabilities to achieve greater independence and integration within society. Through a comprehensive analysis of current trends and future possibilities, this study aspires to **provide valuable insights for researchers, policymakers, developers, and advocates working towards a more inclusive future**.

2.2 Policy background

European approach and legislation connecting Artificial Intelligence and accessibility

The EU's policy on Artificial Intelligence has a wide scope, including investing in research and innovation in artificial intelligence (AI) to promote trustworthy and ethical AI systems, providing a legal framework and guidelines to develop the European AI industry, to harness the full potential and the benefits of AI, and to provide safeguards. As an example, the High-level Expert Group on AI set up by the European Commission emphasise the importance of inclusivity and accessibility in AI development, highlighting that AI systems should be designed to be accessible to all people, including those with disabilities. (AI HLEG 2019)

In later years, the EU has progressed to provide more detailed guidance and regulations with a focus on fostering innovation while protecting fundamental rights. The recently adopted EU AI Act categorizes AI systems by risk level and high-risk systems, including those used in recruitment or financial assessment, must meet accessibility standards in line with the European Accessibility Act (EAA) and Web Accessibility Directive, ensuring equitable access for people with disabilities.

The European Accessibility Act does not make specific reference to AI; however, it requires that certain products and services which AI-integrated components are accessible from the start. This proactive approach helps prevent digital barriers and ensures that AI innovations enhance, rather than hinder, inclusion. Additionally, other EU policies, like the Digital Single Market and Data Strategy, support an inclusive digital environment by prioritizing seamless digital services and data flows, which reinforce AI accessibility in sectors like healthcare and education.

A more detailed analysis of EU policies and legislation on AI can be found in chapter 11.

3. Methodology

3.1 Research questions

To structure the research and ensure that it responds to all of the key objectives, the following research questions have been defined:

1. What are the latest advances in research on Artificial Intelligence in relation to accessibility?
2. What are the main topics discussed in policy and research when it comes to AI and accessibility?
3. What are the main areas of potential for AI to enhance accessibility?
4. What are the main concerns with the use of AI in terms of accessibility?
5. What are the main trends in industry and applied research in terms of AI-driven solutions to enhance accessibility?
6. What gaps can be identified in research and policies regarding AI-driven solutions and accessibility?

3.2 Overview of the study methodology

This study is applying a methodological approach that combines several research tools, to ensure a thorough investigation of the topic. The methodology encompasses **desk research**, **a survey**, **interviews**, and **a workshop** to provide a holistic understanding of the subject matter.

The diverse nature of the research problem necessitates the integration of various methods to collect rich and multifaceted data. Each research tool brings unique strengths and advantages, contributing to a comprehensive analysis and insightful findings.

3.2.1 Desk research

The desk research served as the foundation of this study. It involved gathering existing data and information from a wide range of written or electronic sources, including academic journals, research papers, reports, books, articles, websites, government publications, databases, and other accessible materials related to digital AI and accessibility. Through desk research, we have been able to identify existing knowledge, assess prior studies, and uncover key trends and insights to inform our research questions.

The study employed a scoping review as the most appropriate approach for conducting literature reviews in a diverse and varied context, encompassing academic literature, reports from public authorities at national, EU, and international levels, as well as policy and market studies from stakeholders in different sectors.

In Stage 1, we identified the research questions, defined inclusion and exclusion criteria, including time period, geographic area, and basic criteria for source selection.

Stage 2 involved pilot testing of search terms and inclusion/exclusion criteria, followed by the development of the initial pool of literature.

Stage 3 focused on the selection of relevant sources by reviewing titles and abstracts against the inclusion/exclusion criteria. A snowballing approach was employed by reviewing bibliographies of identified literature to discover additional sources.

Stage 4 involved data extraction, where literature is reviewed, relevant content identified, and feasibility criteria assessed. The relevant evidence and associated contextual information are extracted and documented.

In Stage 5, the results were analysed to understand themes and trends, informing the selection of stakeholders or experts to be involved.

Since AI research and policy involve fast-moving developments, the study is focused on sources published in the past five years, since 2019. The initial focus was on literature from Europe, but as many of the published good practices and research studies come from the researchers based outside Europe, the initial scope has been refined and extended. English-language literature has been prioritised, and key literature has been selected based on the analysis of topics tackled and relevance of the publication, including its impact factor, if any.

To be able to cover all relevant aspects of the complex development and deployment of AI, the desk research has included different types of sources.

As a basis, the desk research has included scientific, peer-reviewed research papers, academic journals, conference proceedings, and books published by reputable publishers and scholarly institutions.

It has also investigated grey literature like industry reports, working papers, technical reports, policy publications, papers from organisations representing persons with disabilities, and other materials that are not traditionally published through scientific and commercial channels. Presenting the point of view of view of disability organisations is essential to highlight the need for safeguards necessary to avoid infringing on fundamental rights of persons with disabilities, like the right to autonomy and decision making; and also, to harvest the benefits of AI. Policy publications and reports from the EU institutions or government agencies, industry associations, international organisations have been included wherever they provide valuable data and information.

The desk research has employed web searches, snowballing from identified literature, and web sweeps to identify relevant works and reports. By integrating different types of sources, we have aimed to provide a comprehensive and well-informed understanding of the topic.

3.2.2 Survey

To collect quantitative data from a diverse group of stakeholders from various sectors, a structured online questionnaire was designed to elicit specific information related to artificial intelligence in support of accessibility. Survey results allow for statistical analysis and provide valuable insights into prevailing trends, opinions, and attitudes.

The survey has been designed to investigate:

- Current use and categorisation of AI to support accessibility (like for example voice recognition, image recognition, natural language processing etc).
- Extent to which AI is integrated into existing accessibility solutions related to policies, research or production (e.g., pilot projects, specific services or mainstreamed in deployed systems).
- Effectiveness and impact including user feedback.
- Challenges and barriers including appropriate policy frameworks, legal restrictions, privacy issues, potential for bias and other ethical considerations.
- Involvement of persons with disabilities in the development of AI-driven solutions and related policy frameworks.

- Best practices and success stories, which can be further examined.
- Emerging trends and new opportunities and threats regarding future use of AI to support accessibility and disability inclusiveness.

Insights generated from the survey have been helpful to understand the current landscape, identify challenges, and identify organisations, sectors and individuals suitable for interviews.

3.2.3 Interviews

To gain a comprehensive understanding of the nuanced experiences, motivations, and perspectives of those directly involved in or impacted by the use of AI to support accessibility, in-depth interviews have been conducted.

Interviewees were selected based on the result of desk research and survey, with the aim to cover various sectors who have a significant influence on or interest in AI and accessibility initiatives.

The desk research has strived to highlight researchers who have contributed to relevant publications, projects, or have been cited in industry reports.

Interviews have followed a semi-structured format, allowing for both guided questions and open-ended discussions to explore specific areas of interest in detail.

Key topics for the interviews covered:

- Participants' experiences in implementing AI for accessibility, including successes, challenges, and lessons learned.
- Participants' motivations behind adopting AI for accessibility and the goals they aim to achieve.
- Insights into how AI technologies have impacted users, including both positive outcomes and any unintended consequences.
- Discussions on ethical considerations, data privacy, and compliance with accessibility regulations.
- Participants' views on the future of AI in accessibility, including emerging trends and anticipated advancements.

Interviews were recorded (with consent) and transcribed to ensure accurate capture of information. The results have been analysed to identify key themes, patterns, and insights across interviews. Findings from the interviews were then integrated into the final report to provide a holistic view of the AI and accessibility landscape.

3.2.4 Workshop

To validate the findings and insights gathered from desk research and in-depth interviews, and to refine the proposed recommendations and solutions for using AI to support accessibility, a workshop was carried out. The purpose of the workshop was to ensure that the conclusions are accurate, relevant, and actionable by engaging key stakeholders and experts.

The workshop invitees included decision-makers from technology companies, policymakers, researchers, accessibility experts and representatives from Organisations supporting Persons with Disabilities.

On October 10, 2024, DIGITALEUROPE hosted a workshop dedicated to exploring the role of Artificial Intelligence (AI) in supporting accessibility. The workshop served the purpose of presenting the preliminary results from desk research, and survey and discussing them with relevant stakeholders.

The event, held both in-person and online, aimed to bring together industry experts, policymakers, technologists, and representatives of disabled communities to discuss how AI technologies can help bridge accessibility gaps and provide solutions for people with disabilities. Through keynotes, interactive breakout sessions, and plenary discussions, the workshop addressed current trends, challenges, and future directions for AI-driven accessibility solutions.

The workshop had participants from different fields as industry (18%), policymakers (22%), researchers and academia (16%), accessibility experts and representatives from Organisations supporting Persons with Disabilities (44%). The workshop registered around 40 participants joining online and 10 in presence at

DIGITALEUROPE's premises. Those participating in the hybrid event, contributed with valuable insights through discussions and real-time feedback provision. The following sections provide a comprehensive overview of the key presentations, findings, and recommendations that emerged from the event.

3.2.5 Data integration and analysis

In the process of analysing the data and drafting the final report, the data was triangulated to ensure comprehensive coverage and to mitigate biases inherent in using a single method. Data from the sources used in the study, including desk research, surveys, interviews and workshops, has been compared to cover all perspectives.

The information gathered from each of the research instrument was combined, guaranteeing a thorough examination of the research issue. To find trends and themes, qualitative data from the workshop and interviews were examined thematically. To identify patterns and correlations, statistical analysis was performed on the survey's quantitative data. The integration of diverse research instruments is a way to bolster the validity and trustworthiness of the results, guaranteeing a comprehensive investigation of the topic.

During the drafting of the final report, a gap analysis was conducted to identify areas for further research. The analysis highlights research and accessibility gaps, presenting findings from both desk research and stakeholder input, aligned with EU policy initiatives.

4. Research advances in AI

Research question 1: What are the latest advances in research on Artificial Intelligence in relation to accessibility?

The first research question of the study concerned finding and exploring the latest advances in research on AI in relation to accessibility.

In order to get an overview of the research, the study started with a literature review, which was later enhanced through complementary workshops and interviews. The methodology for the literature review is provided in chapter 3 of the report. Since research in AI is fast-moving it can be difficult to discern which findings constitute advances, and which are unconfirmed hunches. To ensure that the research included in the study is qualitative, the research focused on finding trends and advances that have been confirmed by more than one source.

The findings from the desk research related to AI and accessibility include advances ranging from technical studies on specific and personalised accessibility solutions to broader discussions on how AI affects society in general and what this means for persons with disabilities.

At a societal level, there is an increasing body of literature in ethics research, for example concerning how to address fairness, bias, and transparency in AI development, ensuring that accessibility considerations are part of ethical AI frameworks. In parallel, AI is being rolled out within both the public and private sector to increase efficiency and expedience. This has led to advances in research examining how AI-driven decisions in hiring, healthcare, and financial services impact people, particularly in terms of potential discrimination against marginalised groups, including persons with disabilities.

A key focus of current technological research on AI focusing on accessibility is different methods to train AI models to avoid bias and ensure accessibility for persons with disabilities. Within this strand of research there are emerging discussions on how AI-driven tools can improve digital accessibility by enabling automated testing, real-time adaptations, and better usability for people with disabilities.

A third key theme that emerges from the literature concerns specific solutions to improve the lives of persons with disabilities, for example testing and examining AI-driven innovations such as speech-to-text, smart mobility aids, and enhanced screen readers.

The next chapter (chapter 5) presents an overview of the emerging research topics and the advances they represent, focusing mainly on the societal and technological frameworks. The following chapter (chapter 6) focuses on advances that represent different areas of potential for accessibility improvements that have a direct impact on the lives of persons with disabilities at a personal level.

5. Overview of trending topics

Research question 2: What are the main topics discussed in policy and research when it comes to AI and accessibility?

This research question seeks to explore the key topics being discussed in both research and policy spheres when it comes to AI and accessibility. The results mainly build on findings from the desk research, complemented with additional insights gathered in the survey, interviews and workshop. The aim of this overview is to create an overall understanding of the multifaceted research and policy discussions in this area, to be able to gain insights into the prevailing trends, concerns, and potential directions for future research and policy development in AI for accessibility.

5.1 AI and the future of web accessibility

The most established strand of research regarding web accessibility and AI concerns how machine learning can be applied to improve automated audits for accessibility and also for fixing accessibility issues. Multiple studies have been conducted in this area over the past five years. Examples in the literature include:

- A case study on the development of a system that uses AI services to double-check and improve results of automatic web accessibility audit tools (Morillo, P. et al 2020)
- Using AI functions such as image recognition and natural language processing to 1) assess multimedia content and address criteria that have previously been difficult to evaluate with automated systems. 2) Reduce the numbers of false negatives and false positives in the testing (Draffan et al 2020)

Lately, another type of discussion has emerged, focusing on AI-driven alternatives to the way web accessibility is conceived of and achieved. One study proposes that instead of ensuring all products and services are accessible, an AI functionality would be developed that can operate any user interface and communicate with an individual user interface generator that would generate an interface that is adapted to the needs of each individual and their abilities. The authors acknowledge that there are a number of issues that requires further study, including a need to research strategies for ensuring accessibility to persons with multiple disabilities, as well as ethical and regulatory issues to address. (Vanderheiden G and Crystal YM 2024)

Another aspect of how web accessibility interrelates with artificial intelligence concerns how developers, designers and auditors can assess AI features that are meant to support accessibility but are not always complying with web accessibility requirements. Some AI features to pay attention to include:

- Auto generated AltText: could lead to inadequate, inaccurate or misleading texts that are inacceptable in some settings (medical, legal and financial).
- Speech recognition: it can support many users but be inaccessible to others. Therefore, it cannot be the only way to operate key functions (login, user authentication).
- Facial recognition: if there is a lack of representation in the training data, facial recognition as authentication method may not work for everyone.
- Image recognition as input (QR codes, scanning id / bank card): manipulating devices related to image recognition can be difficult for some users.

(TPGI 2021)

5.2 AI and ethics in relation to accessibility

The ethical considerations of artificial intelligence (AI) are closely linked to accessibility, as both involve questions of fairness, inclusion, and equal access to technology and services. AI systems can either help reduce barriers or unintentionally reinforce existing inequalities, particularly for persons with disabilities. Discussions on ethical AI design often address issues such as bias, transparency, and accountability, which can influence how accessible and equitable AI-driven services are. Accessibility can in this context be seen as not only a technical aspect but also a consideration to be taken into account in broader legal and human rights frameworks. As AI continues to play a larger role in decision- making processes, discussions increasingly focus on how to balance innovation with fairness, inclusivity, and compliance with accessibility standards.

Discussion and debate on the ethical dimensions of artificial intelligence spans from concrete concerns regarding specific technological methods and components to larger issues regarding the place of AI in society. The below table provides an overview of issues that are frequently occurring in the literature found in the desk research.

Design and development	Deployment and use	Policy, legal and Societal aspects
Algorithmic bias from training data	Use of AI vs personal autonomy	Ensuring human oversight
Lack of representation in data	Respect for individual decision-making	Compliance with fundamental right and accessibility legislation
Privacy concerns	Fair and equal access to AI	Inclusion on employment market
Consent	Responsibility and accountability in use	Coordination with inclusion and accessibility policy programmes
Inclusive design	Transparency and explainability of AI system	Social inclusion, preventing stigmatisation

Until recently, much of the discussion focused on issues associated with the design and development phases of AI, such as algorithmic bias and concerns around security and privacy. A 2022 report by the EU Fundamental Rights Agency argues that a rights-based approach to AI and big data is necessary to provide protection against the risk of bias that can lead to disadvantages to for example people with a disability. (FRA 2022)

With the increased autonomy of AI systems, coupled with their trending deployment in decision-making processes, the discussion around ethics is turning towards aspects of governance and oversight as well as issues of transparency and responsibility.

This has also been underlined by the UN Special Rapporteur on the rights of persons with disabilities in his 2021 report on artificial intelligence and the rights of persons with disabilities. With AI based automated decision-making systems becoming the primary gatekeepers in access to employment, services and social benefits, bias and intransparency in them can lead to systematic and widespread discrimination, that is hard to detect or prove, making persons with disabilities them even more vulnerable to poverty and marginalisation. (UN 2021)

The EU AI Act that came into force in 2024 represents an attempt to tackle risks and potential threats through political oversight and regulation. The World Economic Forum further notes that governance and accountability of AI go beyond AI-specific laws into frameworks such as the EU Digital Market and Services Acts and the Convention on Rights of Persons with Disabilities. (WEF 2024)

When it comes to AI and accessibility, the state of the ethics discussion is mainly focused on transparency (informing the user that they interact with AI or consume AI generated content) and privacy (AI inferring personal details that were not intentionally shared). (AI HLEG 2019, European Commission 2020, EDF 2018)

Transparency is closely linked to accessibility elements such as understandability and operability. To be able to effectively use and interact with AI-based support, it is essential for the user to understand the origin and context of the content. When it comes to privacy, EDF mentions an example in healthcare: even if AI can help personalise healthcare, monitor patients' health and help doctors make better decisions, there are concerns about data privacy and the way AI makes decisions, that can lead to being excluded from appropriate care due to poor data, insufficient research and inadequate planning. (EDF 2024)

5.3 Training of models for AI in the service of accessibility

When a hiring system is trained based on historical data, the result will repeat the previous, discriminative patterns and practices (EDF 2023). Or if a speech recognition model is trained only with typical speech, it will likely not be useful for persons with atypical speech.

A far-leading example was mentioned on EDF's 2024 "Access to services" workshop, about facial recognition failing people with Down's Syndrome: inaccuracies in age prediction (men were estimated to be much older and women much younger than their actual age) may lead to the denial of access to services can if the system categorises them as underage. (EDF 2024)

There are various efforts to fight this inherent bias of AI systems, resulting from people with disabilities being underrepresented in the material used to train AI systems.

Improving, for example, speech-to-text systems results in better quality captions or voice control in many cases, and better accessibility for many persons. But if the algorithm has been trained only for typical speech, it does not ensure full inclusiveness. If AI algorithms are not trained on inclusive data, the system will not work well for those that are excluded from the dataset. It might even be harmful if the system actively discriminates against them. Microsoft's AI for Accessibility program aims to address the situation both by increasing the amount of inclusive data and by improving the access to available inclusive data. An approach to speeding up the creation of inclusive data is to improve the technology, so it does not rely on datasets with an enormous number of high-quality, labelled examples. As an example, the ORBIT dataset uses the "few-shot learning" approach, training models with only a few, high variation examples. (Microsoft 2021)

Google's research project, Euphonia, has been creating inclusive data by gathering speech samples from volunteers with non-standard speech to refine speech recognition. (Google 2024)

Personalised training AI to improve accessibility is not limited by the availability of inclusive data but requires direct training by the user. For example, training an application to recognise typical sounds in the environment of the user or to recognise images/objects in the visual surroundings. (Bennet C., Trewin S. 2023)

The emerging trend of federated learning takes the personalised training to new levels, presenting an important shift in how AI models are trained. Instead of collecting large quantities of data from multiple different sources with traditional machine learning techniques, in federated learning AI models learn directly from individual users' data on their own devices without centralising sensitive information. In addition to preserving privacy, federated learning also has the advantage of increasing data diversity since the training is performed by a variety of users on their own devices. This method therefore has the potential to decrease data bias while enhancing the ability to adapt to various user needs. (Yurdem B et al 2024)

5.4 AI and decision-making

AI is increasingly applied to support decision-making processes across various sectors, including those that enhance accessibility for persons with disabilities. However, there is often a lack of transparency when it comes to how the decisions are made. Algorithms are complex and the underlying data may be biased. This does not only raise a series of ethical questions concerning the use of AI in decision-making, it also involves practical implications on a societal level (Osasana F et al 2024). In the context of ensuring equal access to services, some barriers to fair treatment have been found in the application of AI-based decision making in for example the employment and social security sectors.

In the field of employment, AI-based decision-making support is making its way into the working methods of national employment agencies. There has so far not been enough research on the results to be able to draw any substantive conclusions on the impact of this usage in terms of providing support to persons with disabilities, but initial findings indicate that there are issues related to both the design, development and implementation that can result in unintended impacts at both an individual and a system level. A recent review of an AI-based system used by the Swedish Public Employment Service shows that the implementation of the system has flaws when it comes to transparency of the decisions, how to interpret the AI-based recommendations as well as in the engagement of stakeholders (Berman A et al 2024). For example, the system did not make decisions consistently, thus hampering free and equal treatment and human decision-makers were not able to oversee the operation of the AI and make independent decisions based on output from the AI. (ibid)

In other cases, attempts to introduce independent AI-based assessments have been stopped in reaction to public concerns about the fairness of the system. For example, a proposal was made on using algorithmic decision-making in Australia's National Disability Insurance Scheme (NDIS) to assess whether or not a person was eligible for disability insurance support. The system scored answers to a generic questionnaire and made an assessment on whether or not the threshold regarding the severity of the person's disability was met. To accomplish the task the (NDIS) selected AI-based tools that were not originally developed for this purpose and without consulting end-users. A study investigating the public concerns around the system found that disabled persons and disability sector professionals were concerned that the automatic assessment systems do not take into account individual lived realities and that it also reduces disability to a score of bodily function without considering social or contextual factors. (van Toorn G, Leach Scully J, 2023)

On a more positive note, there are examples where AI is put specifically to use to improve the quality of services provided to persons with disabilities. Provision of assistive technology is an area that has generally been described as underperforming on a global level. While there is a clear need for assistive technology in the population there is a lack of markets, functioning according to the rules of supply and demand, that can provide the AT to the persons who need it (de Witte et al 2018). One of the causes of this problem has been traced to issues with information management. Matching the right AT to each individual requires making an analysis and judgement based on an assessment of the needs of each person and an evaluation of the available AT. This is a complex process that may be hampered by lack of consistency in assessment and evaluation procedures as well as fragmented information (M Ran et al 2022). In this context, AI-based recommendation systems could support both the provider and the end-user in the decision-making process by helping to find and structure possible alternatives based on a personal profile of the user. Research applications in this area includes the Atvisor.ai, an AI-based digital platform that supports assistive technology assessments and the decision-making process. (ibid)

5.5 AI and Assistive Technology

There is a growing body of research on the potential of AI to make big improvements to assistive technology for persons with disabilities. AI-driven assistive technologies make it possible to develop and implement more personalised solutions. Machine learning algorithms can also be used to analyse usage patterns and preferences to continually refine assistive devices, ensuring they meet the evolving needs of users.

The research found on AI and assistive technology addresses areas such as:

- Using an AI platform to help make decisions to improve access to AT (see example in section 5.4 above)
- How AI can be used in education to provide support to students in addition to or in combination with other AT used
- Case studies on the use of AI in applications to support specific groups of persons with disabilities.

In terms of case studies looking at specific AI applications, a large proportion of the literature concern applications for people with visual impairments. For example, one of the sources found involves a systematic literature review to identify the machine-learning models used across different research on Artificial Intelligence of Things applied to Assistive Technology. 50% of the research found and analysed concerned models for applications supporting people with visual impairments (de Freitas, M.P et al 2022). AI components are also making their way into AT for other user needs for example cognitive support. A review of assistive technology in autism care notes that there are several promising solutions under development that can provide support with for example challenges related to communication and social interaction. (Iannone A, Giansanti D, 2024)

5.6 AI addressing accessibility in different sectors

5.6.1 Education

There is a rapidly increasing body of academic literature focusing on how to use AI to create more inclusive and accessible educational environments. Topics covered include for example applications focused on providing personalised support and adapting to individual learning styles and needs, as well as applications developed to support specific needs of students with disabilities; and even further improvements in transcription, translation, and language understanding capabilities will contribute to more inclusive learning. In one study AI-generated content was used in combination with methods of Universal Design for Learning to further enhance support and accessibility for students with learning disabilities. (Hyatt, S. E., & Owenz, M. B. 2024)

There is also an increased use in education of software that can also be used for purposes of work or leisure to support users with specific tasks. Examples of these applications include screen readers, text to speech software, and memory aids.

Increasingly, the most used learning management systems (LMS) integrate components of speech to text, speech synthesis or voice recognition (Zdravkova K, 2022). Recently, discussions have emerged on the potential use of generic AI-assistants such as ChatGPT to provide personalised support to students.

Participants in a 2023 survey at an American university mentioned that AI assistants could help students with disabilities with tasks related to communication (receptive and expressive), idea generation and comprehension of complex ideas. However, several challenges were also identified including lacking accessibility, issues with accuracy and potential overreliance of the tools. The article also notes that there is a lack of empirical evidence on this issue, which makes it difficult to draw any conclusions thus far. (Choi E, 2023)

5.6.2 Employment

In contrast to the sector of education for example, where most articles focus on the opportunities rather than the threats of using AI, the discussion on AI and accessibility is more nuanced in relation to the sector of employment.

On the positive side, there is growing recognition, and also expectations concerning the potential of using AI in both mainstream software and Assistive Technology to support persons with disabilities at work.

An OECD report building on interviews with stakeholders in accessibility identifies four types of solutions that are either in development or being deployed in work settings:

- Disability-centred solutions: Examples include work arounds that support persons with disabilities to perform certain actions, for example image recognition solutions and speech to text. Other solutions address a disability directly, for example AI-powered interview coaching systems for neurodiverse persons.
- Environment adaptation solutions: This group includes solutions that make the environment or content accessible without expecting the individual to adapt. Examples include generators of plain language, live captioning or AI-powered indoor positioning systems for persons with low vision.
- Solutions improving accessibility at a meta-level. These are solutions that supports accessibility indirectly. The group for example includes AI-driven systems providing recommendations for workplace accommodation.
- Solutions unlocking new work opportunities for people with disabilities. A smaller sample of the solutions identified in the report concern AI-driven technologies that are specifically aimed at providing new jobs or adapting existing roles to suit persons with specific disabilities.

According to the interviewees in the report, 77% of the solutions mentioned in the report could not have been developed in their current form without the use of AI. (OECD 2023)

On the other hand, the increasing use of AI in recruitment processes has been seen to involve risks of exclusive and discriminatory practices. Bias in the data used to train the algorithms mean that people who do not have profiles that are typical to people that have previously been hired can be discarded in the selection process. (EDF 2023)

5.6.3 Health

AI-driven solutions are making their way into the health sector, supporting both patients and medical staff.

AI is increasingly being used in diagnostics to improve accuracy and speed of delivery and AI-driven monitoring systems give patients better control of their own health status. When it comes to academic literature on AI in relation to accessibility and inclusion of persons with disabilities, one key focus area for new innovations is rehabilitation. For example, AI and machine learning technology show potential in motor recovery through facilitating personalised treatment planning, using predictive modelling to estimate trajectories of motor recovery, sensor-based movement analysis and robotic-assisted rehabilitation. (Swarnakar, Yadav 2023)

Another study looking at AI-powered solutions for cognitive rehabilitation notes that attention needs to be paid on the choice of application in each case as some AI programs provide standardised training that may not be suitable for all cognitive profiles (Khalid et al 2024). This raises a point about the need for management and human judgement in the development and use of AI-driven tools.

A study on human-centred design to address bias in artificial intelligence notes that AI has both the potential to reduce or to amplify inequalities in health care. On the one hand, improved diagnostics and predictive modelling can help improving the individual care of patients. On the other hand, inequalities in training data can create inaccurate results with unintended negative outcomes for patients. The study authors therefore argue that human-centred design processes are necessary in every stage of the development and deployment of AI in order to identify and mitigate potential bias. (Chen Y. et al 2023)

6. Areas of potential

Research question 3: What are the main areas of potential for AI to enhance accessibility?

This chapter provides examples of main areas of potential for AI to support accessibility. The chapter focuses on innovations that supports persons with disabilities by addressing specific user needs. The systems and devices listed in the table are illustrations of the possibilities provided by the application of AI methods and components in the development of accessibility and assistive systems supporting persons with disabilities. They represent cutting edge technological developments but are not exhaustive or exclusive in relation to utilising the respective AI tools they are associated with.

AI Tool	User Group(s) in the example	Example
Natural language processing	Cognition	Dialogue agents for artificial intelligence-based conversational systems for persons with cognitive disabilities
Natural language processing	Cognition	First steps in the development of a support application for easy-to-read adaptation.
Computer vision, pattern recognition	Hearing	Sign language recognition system for communicating to people with disabilities.
Computer vision	Vision	Find My Things: Personalized Accessibility through Teachable AI for People who are Blind or Low Vision.
Computer vision	Vision	AIris: An AI-powered Wearable Assistive Device for the Visually Impaired.
Robotics	Motor	Independence in the Home: A Wearable Interface for a Person with Quadriplegia to Teleoperate a Mobile Manipulator.

6.1 Natural language processing examples

Natural language processing involves the ability of AI to interpret human language and interact with humans. It enables the development of example voice assistants and speech-to-text applications that facilitate communication and device interaction for persons with visual or motor impairments, and it can support simplification of text for persons with cognitive impairments. (Chemnad, Othman, 2024)

Dialogue agents for artificial intelligence-based conversational systems for persons with cognitive disabilities

A review of AI-based conversational systems shows that there are a number of systems that show promising potential to support persons with cognitive disabilities in a number of areas including communication, organising and managing daily routines, emotional and social support and access to information. In addition to performing tasks on behalf of the user, the systems can also support increased independence by providing feedback and possibilities to practice for example social interaction in a safe environment (Huq et al 2022). The review does however mention a number of challenges regarding the deployment and use of the systems. In addition to issues regarding data privacy there are also concerns regarding the accuracy of the responses given by the dialogue agents, as well as questions regarding user-friendliness such as how to ensure users remain motivated and engaged with the technology. (ibid)

Easy-to-read adaptations

One of the areas of AI in everyday software applications that has had the most rapid development in the past few years is natural language processing, and AI-based text generators. Several tools providing simplified texts and summaries are already available on the market. In this context there is a great potential to use AI to facilitate the production of texts according to the Easy-to-read methodology.

The definition and methodology of Easy-to-read texts varies in different linguistic and national contexts, however at its core it involves the simplification of words and sentences, following a set of predefined rules. Often the text includes a combination of text and images.

The production of Easy-to-Read can be time-consuming when performed by experts, which means it is often expensive. AI-based support has the potential to cut costs and time in the process. Spanish researchers have recently developed an application that can semi-automatically perform an analysis of documents using the rules of an E2R method and provide recommendations on the transformations of the original documents to ensure compliance with E2R guidelines. The objective of the support is not to substitute the work of E2R experts, but rather to support them by performing simpler transformations automatically and leave more time to the experts for the more complex decisions. The tool has so far been developed for and tested in the Spanish language, but there are plans to develop versions for use in English as well. (Suárez-Figueroa M.C et al 2024)

6.2 Computer vision examples

Computer vision refers to the ability of computers to identify information in images, videos and similar input. It can be used to enhance accessibility by powering systems for object recognition, and navigation aids, which support people with visual challenges in safely navigating their surroundings. (Chemnad, Othman, 2024)

Sign language recognition system for communicating to people with disabilities

Since few people outside the deaf and hard of hearing community are able to understand sign language, communication can be difficult for people with auditory disabilities in situations where no translator is available. Written communication is not always an option, it is not a primary choice of a person who is deaf and has sign language as their native language.

To facilitate communication between persons who are deaf and persons who are hearing, research has been made into the use of AI to provide text translation of live signing in the American Sign Language. An experimental system was developed using Computer Vision and Pattern Recognition technology to detect hand movements in real-time using a webcam/live camera, and then use American Sign Language datasets to recognize the signs. The research has been limited to identifying and classifying the letters of the alphabet. The final accuracy rate was reported to 96,3%, however this requires the letters to be signed slowly to allow for the processing to be made correctly. (Obi Y et al 2023)

Find My Things: Personalized Accessibility through Teachable AI for People who are Blind or Low Vision

One of the advantages with assistive AI are the possibilities for personalisation of support for example by the use of AI assistants where the user participates in training the system according to their own needs and preferences. “Find my things” is an example of a teachable machine learning system that helps visually impaired users locate their items using voice commands. The AI is trained to recognize objects within a user's environment through computer vision and auditory feedback. Users can teach the AI about new objects by taking photos and labelling them through a voice interface. Once trained, the AI can guide the user to the objects using audio cues, making daily navigation and object retrieval more accessible. The system was developed and tested by the Teachable AI Experiences Team at Microsoft, together with citizen designers. (Yilin Wen L et al 2024)

AIris: An AI-powered Wearable Assistive Device for the Visually Impaired

Wearable devices have mostly been associated with monitoring of health and behaviour. New research is extending the application field into monitoring the environment to provide navigational aid and descriptions of objects and persons in the surroundings to assist people with visual impairments. One such example is the AIris prototype that was developed and tested by a team of researchers at the National Technical University of Athens. The system is built on a combination of an eyewear with a camera and a natural language processing interface which can provide real-time auditory descriptions of the surroundings.

The system can be used for multiple tasks including face recognition, scene description, text reading, object recognition, money counting, note-taking and barcode scanning. A prototype of the system has been tested with users with positive results. Challenges that remain in refining the system include issues with delay in response between user-command and system-feedback as well as design issues related to, for example, comfort during long-term use of the wearable device. (Danai Brilli et al 2024)

6.3 Robotics

Robotics integrates AI capabilities into physical devices—such as smart prosthetics, automated wheelchairs, and assistive robots—that can perform everyday tasks and adapt to the unique needs of persons with disabilities, thereby improving autonomy and quality of life.

Independence in the Home: A Wearable Interface for a Person with Quadriplegia to Teleoperate a Mobile Manipulator

Robotic systems such as mobile manipulators can support persons with motor impairments to conduct tasks related to household chores and daily activities. A challenge when developing such systems is how to ensure that the interface for controlling the manipulators is easy to use. Both web interfaces with screens and devices such as joysticks may require that the user have sufficient hand motor skills to be able to operate the devices independently. To address this challenge, a recent research project has developed a head-worn assistive teleoperation interface that can be used by persons with head motion (Padmanabha A, Gupta J et al 2024). The interface can be embedded in hats or caps or other head-worn pieces of clothing. The system has been tested with promising results, albeit in a limited scale. More tests are needed to be able to generalise the finds, but the results so far indicate that the system has a potential to provide an interface that is efficient and accurate as well as easy for the user to learn and operate. (ibid)

7. Areas of concern regarding the use of AI in relation to accessibility

Research question 4: What are the main concerns with the use of AI in terms of accessibility?

Concerns around AI and accessibility spans from development-related issues such as the existence of bias in the data used to train the models, to application-related issues where potentially unethical use of AI can lead to exclusion. This chapter provides an overview of the main areas of concern identified.

7.1 Reinforcing existing patterns of exclusion

One area of concern that has been mentioned in the literature is the increasing use of AI-driven tools in recruitment and hiring without properly considering how to counter existing prejudice and mechanisms that exclude persons with disabilities. Due to the way the models used in recruitment tools have been set up and trained, there is a risk that automated hiring systems inadvertently perpetuate bias and preconceptions against persons with disabilities. Researchers point to the need to include the perspectives and needs of persons with disabilities in AI ethics discussion and policymaking around application and use of AI-driven tools in this context. There is also a need for more interdisciplinary collaboration among ethicists, lawmakers, advocates and AI practitioners. (M Buyl et al 2022, Nugent S et al 2022)

The report of the Special Rapporteur on the rights of persons with disabilities (UN 2021) provides a list of areas where using AI can restrict persons with disabilities from employment or benefits, violate their privacy, limits their well-being or result in other discrimination, other due to biased data sets, discriminatory algorithms or the lack of accessibility including:

- decision on social protection benefits,
- decision on health insurance (higher fees or denial of service),
- job recruitment (e.g. preselection of CVs, video interview analysed by AI, inaccessible chat-bot),
- checking performance at the workplace,

- decision on access to education,
- inaccessible AI biometric tools,
- making choices and decisions instead of the person, without their knowledge.

7.2 Data privacy and consent

EDF and other advocacy groups underline the importance of privacy, due to AI applications often needing and getting access to personal information, including sensitive information. It is crucial to protect data privacy and to inform users about it, as they might not understand the implications, and because the increased capacity of data processing and surveillance, as well as the unsupervised use of personal data in automated decision making can lead to the human rights infringements, with heightened negative effects for persons with disabilities.

Privacy International, in their submission to the OHCHR highlighted the importance of the principles of legality, necessity of data collection and the need to ensure safeguards that uphold data protection principles and preserve the rights of persons with disabilities. (Privacy International 2023)

7.2.1 Lack of transparency and risks in decision-making

The Special Rapporteur of the UN on the rights of persons with disabilities mentions a range of issues related to the use of AI in decision-making in sectors such as employment, access to social services, access to health-care services or insurance benefits. The report underlines the inherent lack of transparency of AI decisions, due to either concealing the inner workings of an AI system or the complexity of the decision making and the machine learning in its background. This can be exacerbated by deleting the underlying data, making it nearly impossible to find out whether the decision was discriminatory.

7.3 Overreliance on AI

While AI has been promoted as a way to increase independence and empowerment through personalised support, there are also concerns about people becoming too reliant on the technology. In education research, there have been warnings about students becoming too reliant on AI-based support in their completion of study tasks and that this may hamper the development of their own cognitive abilities such as creativity and critical thinking (Zhai et al 2024). These concerns have also been expressed in relation to persons with disabilities. In a 2024

Special Olympics survey, showed that while a majority of parents (84%) and teachers (79%) believed it was important for young people with IDD to develop AI skills for their future, 73% of teachers and 62% of parents expressed a concern that students with intellectual and developmental disabilities may become too reliant on AI. There were also concerns that AI may “rob” students with intellectual and developmental disabilities of their unique voice. (Special Olympics 2024)

On a system level, overreliance on AI in decision-making processes such as recruitment procedures, social security provisions or even diagnostics can lead to negative consequences for persons with disabilities if biases that are embedded in the models are not detected and countered. A study by Microsoft describes a number of different ways users can over-rely on AI, including automation bias (favouring recommendations from AI over human-generated recommendations), confirmation bias (favouring AI recommendations when they align with their own beliefs), overestimating explanations (lengthy explanations make AI recommendations seem more solid whether or not they are correct) (Microsoft Aether group 2022). Mitigation strategies to counter the overreliance include increasing transparency of the systems and adding features that make users adopt a process that is slower and more deliberate to avoid mechanically accepting AI recommendations. (ibid)

8. Stakeholder consultation

To supplement and validate the data gathered during the desk research, and ensure the involvement of stakeholders, an online survey, a workshop and in-depth interviews have been carried out.

The **survey** aimed at collecting mainly quantitative but also some qualitative responses to the research questions. The survey has been distributed using the networks of DIGITALEUROPE and the partners of the AccessibleEU Centre. Analysis of survey data has also helped to identify respondents with significant insights or unique perspectives on AI and accessibility who were later interviewed.

To validate the findings and insights gathered from desk research and survey, and to refine the proposed recommendations and solutions for using AI to support accessibility, a **workshop** was carried out. The purpose of the workshop was to ensure that the conclusions are accurate, relevant, and actionable by engaging key stakeholders and experts. The workshop invitees included decision-makers from technology companies, policymakers, researchers, accessibility experts and representatives from Organisations supporting Persons with Disabilities.

In order to further collate in-depth knowledge on AI to support accessibility, semi-structured **interviews** have been carried out with representatives from the industry, assistive technology providers, academy, organisations representing persons with disabilities and public sector.

The respondents for these interviews have been selected based on the results of the desk research and survey, with the aim to cover various sectors who have a significant influence on or interest in AI and accessibility initiatives. The online interviews covered questions about areas of potential when it comes to AI for accessibility, in general as well as in relation to the EAA, concerns or possible threats, interfaces specifically designed to facilitate access to information for persons with disabilities and main trends.

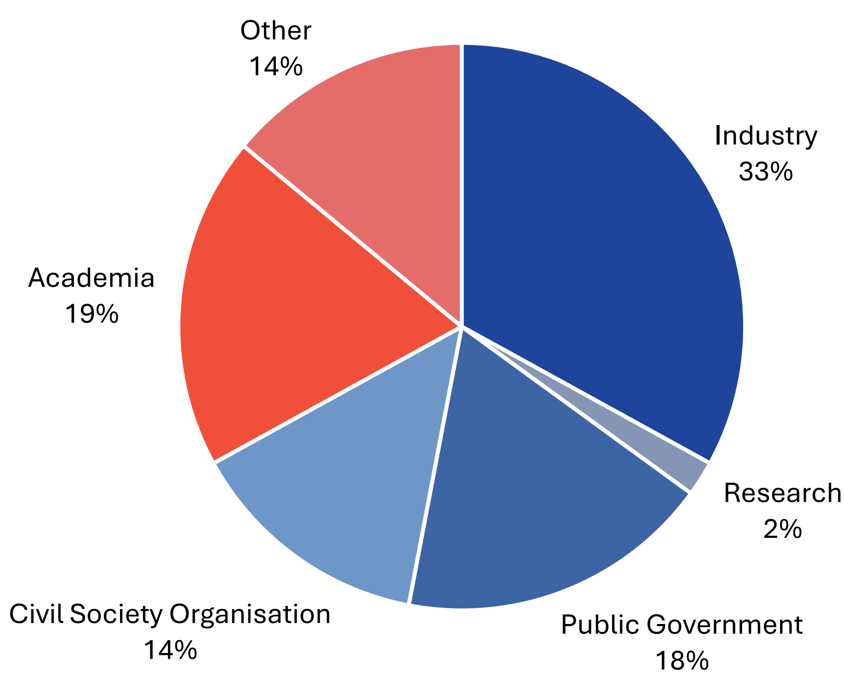
Interviews were recorded (with consent) and transcribed to ensure accurate capture of information. The results have been analysed to identify key themes, patterns, and insights across interviews. Findings from the interviews have been utilized to validate and further expand on the findings of the study and are **integrated into the report**, mainly in chapters 9 and 10.

In addition to the results of the survey, in-depth interviews and a workshop have been carried out with targeted stakeholders, to increase the focus on qualitative data and bridge any gaps in data collection not covered in the previous steps.

8.1 Survey results

The stakeholder survey received 51 individual responses. It is important to note that the survey was distributed to a well-defined group of stakeholders who most likely have a special interest in the topic, which must be considered when analysing the result.

The respondents represent diverse sectors with the largest being the industry (33%), followed by the public sector (18%), academia (19%), civil society (14%), research (2%) and others (14%).



The survey results highlight a **growing interest** in AI-driven accessibility solutions across sectors, driven by their potential for **personalisation, efficiency, and scalability**. However, adoption is tempered by technical, ethical, and regulatory challenges, particularly around competence gaps, data management, and bias.

There's also a clear call for increased **training, guidelines, and collaboration frameworks** to support AI accessibility efforts.

Lack of competence and experience in AI use and development seem to be a recurring issue across organisations. Both when it comes to how employees us AI in their daily tasks and how AI is used in development of the products and services the business provides. Training is needed for foundational technical competencies and domain-specific knowledge, to enable employees to understand and address industry-specific challenges. Training could potentially cultivate a workforce that not only understands AI technology but also possesses the critical thinking skills needed to use AI tools responsibly and effectively, not least when it comes to the risks and challenges connected to persons with disabilities. In a perfect world, training would be dynamic, adapting to the rapidly evolving nature of AI technologies and emerging ethical considerations. There is clearly demand for more in-depth and wide-spread knowledge, but outside of the scope of this study to analyse if this is offered on the market.

More than half of the respondents (53%) claim to **involve persons with disabilities** in design and development. This is a significantly higher percentage than what would be expected from "average" organisations, but surprisingly low considering the profile of informants.

With 85% of respondents planning to expand AI usage, it is clear that AI is seen as a critical tool for advancing digital inclusion. Nonetheless, meaningful impact will require more inclusive development practices, ethical safeguards, and structured support from policy and industry standards.

8.2 Workshop results

The workshop received more than 100 registrations, with 50 participants, 10 participants onsite in Brussels and 40 participants online, representing various industries, policymakers, accessibility experts, individuals with disabilities and organisations representing persons with disabilities. Preliminary study results were presented and discussed in semi-structured break-out sessions, followed by a plenary session where results from smaller groups were reported and discussed.

The workshop was opened with a presentation of research findings, carried out by Susanna Laurin. Following research finding's presentation, participants were divided into **three breakout groups** – 2 online and 1 in person – to explore specific aspects of AI for accessibility in greater depth. Each group was assigned a facilitator, guiding the discussion and moderating the debate, and a note taker, collecting the feedback from participants. The groups used also an online interactive tool to collect inputs. Each group provided real-time feedback and input on a series of key questions related to the development, implementation, and regulation of AI technologies.

After the breakout sessions, all participants (online and in person) were convened in a plenary session.

During the **plenary session**, participants reconvened to discuss the insights gathered from each breakout group. The session focused on the need for greater collaboration between technologists, policymakers, and people with disabilities. Key recommendations included:

Collaborative development

Participants agreed that AI solutions must be developed collaboratively, with input from a diverse range of stakeholders, including individuals with disabilities, developers, and policymakers. Participants called for more comprehensive and representative datasets that include input from users with a wide range of disabilities. AI solutions should be developed in close collaboration with the people they are intended to help. Co-creation models that involve end users at every stage of development were highlighted as a best practice. AI systems need to be transparent in their decision-making processes. Users should have access to clear explanations of how AI-driven decisions are made, particularly in critical areas like healthcare and employment.

Regulatory support

There was consensus that stronger regulatory frameworks are needed to ensure that AI systems are accessible by default. These regulations should prioritize inclusivity and transparency, ensuring that AI-driven tools are designed with the needs of all users in mind. Standards should be established to prevent the creation of inaccessible systems, and governments should provide support for testing infrastructure that validates the accessibility of AI-driven tools. One way could be to monitor and audit AI systems. Regular audits could help identify and address potential biases, while also providing an opportunity to improve the fairness and inclusivity of AI systems.

Capacity Building and Training

It was also recommended to invest in capacity building and training programs. These initiatives should target both technologists and end-users, particularly people with disabilities, to foster greater understanding of the capabilities and limitations of AI and promote responsible use of technology. Courses on inclusive design should be integrated into engineering curricula. This would help to create a new generation of developers who are more attuned to the needs of individuals with disabilities.

Automation and human oversight

AI-driven systems must be designed with mechanisms to collect ongoing user feedback. This feedback is crucial for improving the accessibility of AI tools over time. While AI has the potential to improve web accessibility, participants cautioned against relying too heavily on automated solutions. Human oversight is essential to ensure that AI tools do not create new barriers or exacerbate existing ones.

The DIGITALEUROPE workshop on AI for accessibility successfully highlighted the current limitations and challenges presented by AI-driven solutions. The discussions underscored the importance of inclusive design, collaboration, and transparency in the development of AI technologies. As AI continues to evolve, it is essential that all stakeholders work together to ensure that these technologies serve the needs of everyone, including individuals with disabilities.

9. Forward-looking solutions and insights from new trends and developments

Research question 5: What are the main trends in industry and applied research in terms of AI-driven solutions to enhance accessibility?

Stakeholder involvement also provided insights on recent developments, early ideas and trends that may not yet be on the market or documented. Informants have high hopes for innovation in achieving accessibility goals, fostering a future where technology is truly inclusive, adaptable, and accessible for everyone. The most notable forward-looking solutions discussed are:

9.1 Specialised Models

The development of specialised AI models marks a shift from the reliance on large, general-purpose language models toward models tailored to specific tasks or domains. Unlike general models, which aim to be versatile across a wide range of applications, specialised models are optimised for narrow functions, allowing for enhanced precision and relevance. This trend has significant implications: specialised models can minimise biases by reducing unnecessary or irrelevant data processing, focusing solely on contextually appropriate information. Such an approach is particularly important when it comes to persons with disabilities, where even small errors can have profound consequences. Additionally, specialised models often require fewer computational resources, which can lead to reduced costs.

9.2 On-Device AI

The emergence of small, specialist AI models capable of running directly on personal devices brings transformative advantages in terms of privacy, security, and accessibility. Running AI locally—rather than relying on cloud-based processing—significantly reduces the risk of data interception or fraud, as personal data does not need to leave the device. This "edge computing" model empowers users by giving them more control over their data, an increasingly critical factor not only from a disability-perspective, especially in light of rising concerns about data privacy and security breaches. On-device AI also offers the flexibility of offline functionality, enabling the use of AI applications in environments without stable internet connectivity, which is particularly beneficial for rural or remote areas and for users in resource-limited settings.

Furthermore, on-device AI has the potential to reduce latency, as data does not have to travel to external servers, allowing for near-instantaneous response times and a more seamless user experience.

9.3 Wearables and AI

The integration of wearables and AI offers a promising convergence of real-time data collection and intelligent analysis, leading to personalised, context-aware insights for users with sensory disabilities. Devices such as smartwatches, fitness trackers, and augmented reality (AR) glasses can continuously monitor environmental data and user behaviours, generating information that AI can process to deliver a personalised user experience. The use of AI in wearables also supports autonomous decision-making, allowing devices to adapt in real time to changing conditions. It may also bridge the gap between groups of users, for example by translating verbal communication into sign language in the AR-glasses.

9.4 Personalisation

AI-driven personalisation leverages machine learning to adapt applications and services to individual user preferences and behaviours. When users trust AI technology enough to consent to the collection and analysis of personal data, AI systems can offer a tailored experience that evolves over time, responding to changes in preferences, habits, and needs. This personalisation extends beyond mere content recommendation to encompass adaptive interfaces, user-specific notifications, and context-aware interactions that enhance the relevance and usability of AI applications. Personalized AI thus has the potential to transform user experience, shifting from a one-size-fits-all model to a more nuanced, user-centred approach. However, personalisation must be approached with strong safeguards for privacy and data protection, as well as transparent mechanisms that ensure users understand how their data is being utilized.

9.5 Accessibility by default

The concept of “accessibility by default” proposes a paradigm shift where AI assists developers, designers, and content creators in ensuring that digital content and services are accessible to everyone from the outset. Instead of relying on assistive technology to address accessibility barriers retroactively, AI tools could proactively identify and correct potential accessibility issues in real time during the design, development or content creation phases. This could not only support the user experience but also alignment with legal requirements.

The above trends highlight how AI can be leveraged to address specific user needs and societal challenges. Through specialisation, on-device deployment, wearable integration, personalisation, and built-in accessibility, AI has the potential to deliver more meaningful, secure, and inclusive experiences. These trends underscore a shift toward more context-aware, user-centred, and responsible AI development, with far-reaching implications for the future of technology and society.

9.6 Accessibility trends in literature

A trend to improve existing AI-driven applications to better consider the needs of persons with disabilities is also seen in literature, for example:

- A study on how the AI models used in mainstream speech recognition software can be tuned to work better for people who stutter. (Lea C et al 2023)
- Applications improving communication for persons with disabilities by adding to or enhancing existing techniques. Some examples of this includes using AI to support the production of easy-to-read texts (Suárez-Figueroa et al 2024), and the development of an AI-based system for recognising American Sign Language (Obi Y et al, 2022).

10. Gaps in research and policies regarding AI-driven solutions and accessibility

Research question 6: What gaps can be identified in research and policies regarding AI-driven solutions and accessibility?

Key gaps that have been found in the literature concern accessibility mainstreaming and participation:

Integrating accessibility and disability specific aspects into the development of AI models.
For example, more research is needed on how AI can capture and support the heterogenous nature of disabilities. There is a big potential of AI to support persons with disabilities based on personalised approaches, but the classification methods used in big data are often not capable of capturing the diversity of needs and considerations to be made. (Wald M 2021)

Methods and practice to ensure involvement of persons with disabilities
Several studies call for practical methods and measures to involve persons with disabilities in processes of designing AI-driven solutions as well as in decision-making and drafting of ethics guidance and regulations on the use of AI, to ensure representation and that the concerns and needs of persons with disabilities are addressed.

The survey, interviews and workshop highlight the following gaps:

Built-in technology risks
Given the statistical reasoning that machine learning is built upon, full proportional representation will not solve the problem of the needs of people with disabilities being overlooked or decided against. A solution to this problem remains to be developed.

Insufficient regulation
Regulatory frameworks in EU and elsewhere focus on protections only on high risk or high impact. For persons with disabilities, there is a risk of cumulative harm even in areas deemed as low risk or low impact. This could potentially create an aggregated and significant harm to marginalised minorities such as persons with disabilities and needs to be addressed in EU policy and legislation.

Business logic

A very small number of commercial organisations have resources not available anywhere else in the world, thereby controlling data, language used etc. Their models will always be the best, and therefore used in accessibility solutions. Regulation may potentially stop misuse, but may be a risk in itself, as it may stifle innovation and hinder competition.

"Eliminating disabilities"

There is a belief that AI-solutions will not only accommodate persons with disabilities but somehow overcome the impairments, which may lead to the conclusion that accessibility measures are no longer needed. This is seen as a high risk that needs to be addressed.

11. Policy analysis

11.1 EU AI Act

The recently adopted EU AI Act (European Union 2024) aims to ensure that AI in the EU is trustworthy, and that people's fundamental rights are safeguarded. The goal of the Regulation is to create a harmonised internal market for AI and to provide a safe and supporting environment for innovation and investment. Inspired by product safety legislation, the AI Act follows a risk-based approach, dividing AI systems in four categories:

- Minimal risk: most AI systems are in this category, as they do not create significant risk to the rights and safety of the people. E.g. AI-enabled recommenders, spam filters.
- Specific transparency risk: AI systems where users need to be informed that they are directly interacting with an algorithm or consume content generated or manipulated by AI. E.g. deep fakes, biometric categorisation or emotion recognition systems.
- High risk: risk of harm to the health and safety or the fundamental rights of persons. Many Automated Decision-Making systems belong here, like for example the ones used in recruitment, or to assess a loan or social benefit request.
- Unacceptable risk: AI systems posing a threat to the fundamental rights of people; for example, systems that manipulate human behaviour to persuade persons to engage in unwanted behaviour, systems that allow ‘social scoring', and certain applications of predictive policing.

The AI Act directly addresses accessibility, for example:

- High-risk AI systems must comply with accessibility requirements in accordance with the Web Accessibility Directive and the European Accessibility Act.
- Certain types of information provided to the persons concerned, must conform to the accessibility requirements, such as:
  - notification that the person is interacting with an AI system.
  - notification that the outputs of the AI system are artificially generated or manipulated.

  - o notification that emotion recognition or biometric categorisation is used.
  - o notification about deep fakes.
- The EU database for high-risk AI systems must comply with the accessibility requirements.
- Voluntary codes of conducts may be drawn to facilitate an inclusive and diverse design of AI systems as well as assess and prevent the negative impact of AI systems on vulnerable persons, including as regards accessibility, among others.
- To ensure that AI leads to socially and environmentally beneficial outcomes, Member States are encouraged to support and promote research and development of AI solutions to increase accessibility (among others).

In addition to the specific provisions outlined above, the AI Act seeks to establish a broader framework for AI literacy across Europe. This inclusive approach is designed to ensure that across the AI value chain, from providers, to deployers, to individuals impacted by AI, are equipped with an understanding of the technology, as well as their rights and obligations in relation to it.

11.1.1 Limitations of AI-supported accessibility with regards to the AI Act

The AI Act directly deals with many of the concerns regarding AI that have been identified in the study. For example, the AI Act stipulates that high-risk AI needs to be continuously monitored to ensure that it is compliant with regulations and that it does not cause any harm. Several examples of applications mentioned in the study, relates to the need to step in and supervise the implementation and use of AI solutions so as to avoid negative consequences or bias in the way AI is used to guide decision-making. The classification of high-risk AI corresponds to several of the sectors pointed out in the study as particularly relevant for continuous human oversight and governance, such as health care (see section 5.6.3) and employment and insurance decision-making (see section 5.4).

In addition to serving as a safety guard to avoid direct harm, the stipulations on governance in the AI Act can also serve as a way to incentivise a more deliberate and reflective way to use AI. A key area of concern highlighted in the study is the potential for overreliance on AI technology, which for example can lead to decreased transparency in decision-making processes (see section 7.3).

A potential limitation in the AI Act concerns solutions that are considered general purpose or low risk. There is a potential that some of the AI-driven solutions under this category relies on features that are sensitive to issues of accessibility, transparency, bias even though the context of use is private or general purpose.

For example, AI-driven solutions for accessibility at home, such as wearable assistive devices for persons with visual impairments, rely on training data that comes from a person or a personal setting (see chapter 6). In these cases, it is important that the solution is not only accessible but that the collection and use of training data is transparent.

11.2 European Accessibility Act (EAA)

The European Accessibility Act (EAA) does not directly make reference to artificial intelligence technologies. However, the requirements of the EAA do have a bearing on AI-driven products and services.

Interrelations between the EAA and AI include:

- **Applicability of requirements for AI-driven products**

  In cases where AI technologies are integrated into the products and services covered by the EAA, the application of the technologies must comply with the accessibility requirements set out by the EAA.

- **Design and development**

  A key provision of the EAA is to ensure that products and services are designed to be accessible from the start. This means that all components, including AI algorithms and interfaces must be designed to be accessible. For example, this could involve ensuring that AI-driven interfaces are compatible with Assistive Technology. A challenge that the study has identified with regards to this issue is how to ensure that accessibility is considered for all relevant user groups, which requires involvement of users of various abilities. For example, the research cited in section 5.3 shows that there are still gaps in knowledge and practice relating to making speech-based systems inclusive for persons with speech disorders, due to underrepresentation of this group in training data for the AI models.

- **Non-discrimination**

  The EAA aims to ensure that key products and services in the EU, such as e-commerce, banking, transportation, and digital communications, are accessible to persons with disabilities, thereby promoting equal participation in society and the internal market. requires equal access to products and services for people with disabilities. Therefore, products and services with AI capabilities must be designed in a way that avoids potential discrimination and/or biases.

- **Market surveillance and compliance**

  The mechanisms for market surveillance and compliance that the EAA provides will also be applicable to AI-driven products. The purposes of the compliance checks are to ensure that the products and services meet the accessibility requirements.

11.2.1 Limitations of AI-supported accessibility with regards to the EAA

The provisions of the EAA places indirect accessibility requirements on AI, since it ensures that the end-product that integrates AI technologies are accessible. This is useful in cases where AI is implemented for services and products covered by the EAA. Examples relating to the findings of the study include computers and operating systems and smartphones that can be used together with assistive technology and AI to increase the independence of persons with disabilities, at school or at home. However, a key limitation is that the EAA only covers certain services and products. AI solutions that can be applied in other settings or in multiple settings risk being overlooked. For example, one of the solutions with potential mentioned in chapter 6 of the study concerns dialogue agents for AI-based conversational systems. If these systems are developed to be put in place in the context of products and services based on the EAA, there are clear requirements regarding the accessibility of the solutions. However, the same dialogue agent could be developed for original use in another sector, in which case it would not be subject to the same requirements, even though the user case and user needs for accessibility are similar in the two cases.

A second aspect to consider in relation to the EAA is the question of how AI tools could help to ensure compliance with EU legislation on digital accessibility. The study has found several sources that present AI-driven solutions for evaluating web accessibility. Keeping in mind the vast number of interfaces that are subject to the Web Accessibility Directive and the EAA, it could be attractive to use an automated AI-based solution to support evaluation of accessibility. However, the findings mentioned in section 5.1 underline that it is important to consider the context and the intended output when using AI-driven solutions to avoid misinterpretations.

Automated systems need to not only be trained properly but also be supervised to avoid false or misleading results.

11.3 AI, Accessibility and EU's digital strategy AI

11.3.1 Digital Single Market

The Digital Single Market initiative aims to create a unified digital space within the EU, facilitating seamless digital services and cross-border data flows. A key aspect of this effort is ensuring that AI-driven products and services are accessible to persons with disabilities, particularly in sectors like healthcare, e-commerce, and e-learning. The Digital Services Act (DSA) complements this by introducing new obligations for online platforms, including transparency measures that can help identify and mitigate AI-driven accessibility barriers.

11.3.2 Data Strategy

The European Data Strategy emphasizes a people-first approach to technology, aiming to create a single market for data while ensuring that AI solutions are inclusive and accessible. Since AI systems are heavily data-driven, equitable access to data and safeguards against biases are essential to prevent discrimination against persons with disabilities and ensure that AI technologies meet accessibility standards.

11.3.3 Digital Skills

The EU's focus on Digital Skills development is also crucial for AI accessibility. As AI-powered tools become more integrated into daily life, persons with disabilities must be equipped with the skills to effectively use, navigate, and benefit from AI-based services. This also extends to developers and designers, who need to be trained in accessible AI practices to create inclusive solutions.

11.3.4 Policy on trust and security

Trust and security are at the core of the EU’s digital policies. AI systems must be transparent, privacy-preserving, and secure to foster trust among all users, including those with disabilities. Addressing AI bias, ensuring compliance with accessibility regulations, and protecting user data are fundamental to making AI-driven digital services truly inclusive. The AI Act and the Digital Services Act together provide a regulatory foundation to promote responsible AI use while safeguarding accessibility and fundamental rights across the EU’s digital landscape.

12. Conclusions

The findings from the study emphasise the necessity of a holistic approach to developing and implementing AI systems that prioritise inclusivity, accessibility, and transparency. These insights illustrate that AI solutions must be developed collaboratively, with input from diverse stakeholders, including individuals with disabilities. Such collaboration is essential not only for designing inclusive systems but also for ensuring that AI-driven applications genuinely meet the needs of the people they are intended to serve. Co-creation models, which involve end-users at every stage of development may foster a user-centred approach and ensure that accessibility considerations are embedded in the design process from the outset.

The need for robust regulatory support emerged as a central theme. Comprehensive regulatory frameworks are critical for ensuring that AI systems are accessible by default and do not inadvertently exclude or disadvantage marginalised groups. The AI Act's categorisation of AI risk, ranging from minimal to unacceptable is a risk in itself, as AI solutions deemed "low risk" may still pose significant cumulative risks for vulnerable groups, such as persons with disabilities, and thus should not be overlooked in legislation.

Moreover, the findings underscore the importance of investing in capacity-building and training programs to enhance understanding and responsible use of AI among both technologists and end-users. These programs could be instrumental in fostering digital literacy and awareness about AI's capabilities and limitations, particularly for individuals with disabilities. Integrating inclusive design principles into STEM education is especially critical to cultivating a new generation of designers and developers who are attuned to accessibility needs and the potential impact of AI on diverse user groups.

While automation can streamline processes and enhance accessibility, reliance on AI alone can introduce new barriers if systems are not designed with sufficient feedback mechanisms and human intervention. Therefore, incorporating user feedback into the ongoing development of AI systems is crucial for adapting these technologies to evolving accessibility requirements and mitigating unintended consequences.

Forward-looking trends in AI present promising avenues for enhancing accessibility. These potential advancements may enable AI to address specific user needs more effectively by reducing biases, safeguarding privacy, and adapting dynamically to individual preferences. Specialised models, for instance, allow for precision in task-specific contexts, which is especially relevant when working with vulnerable populations. On-device AI brings the additional benefits of increased data security and offline functionality, making AI applications more practical and inclusive, particularly in remote or resource-limited settings. The concept of "accessibility by default" envisions AI as a proactive tool that helps developers, designers, and content creators prevent accessibility barriers from being built into systems, aligning with legal requirements and improving user experiences.

Despite these advancements, there remain notable gaps in research and policy. Integrating accessibility and disability-specific needs into AI model development remains a significant challenge, as does ensuring that persons with disabilities are involved in decision-making processes related to AI ethics and regulation and trained to use them. While regulatory frameworks like the EU AI Act and the European Accessibility Act provide valuable guidelines, they are overlooking broader applications of AI that may affect accessibility notably.

In conclusion, this study underscores the critical need for inclusive, transparent, and collaborative approaches to AI development and implementation. By integrating accessibility considerations into the design and policy frameworks governing AI, and by fostering ongoing user involvement and oversight, the potential of AI to serve as a transformative tool for inclusivity can be fully realised. Future research should address the above-mentioned gaps and risks connected to AI when it comes to accessibility and persons with disabilities. Likewise, policymakers need to recognise that AI is a tool, not a silver bullet, and that continuous attention is needed to ensure equitable and inclusive access for all. The potential evolution of AI technology, combined with thoughtful regulation and inclusive practices, holds the promise of a future where AI not only enhances accessibility but becomes an intrinsic part of inclusive digital environments.

13. Recommendations

The recommendations provided in this chapter emphasize a proactive, inclusive approach to AI development, governance, and regulation, aiming to make the EU a global leader in accessible and ethical AI innovation.

1. Policy, legislation and standards

- Create a framework for data governance specific to accessibility, which mandates transparency, security, and ethical standards for the collection and use of data in high-risk AI applications.
- Expand monitoring requirements to include AI systems categorised as low risk or general purpose when they impact accessibility.
- Mandate that all high-risk AI systems undergo an accessibility impact assessment before deployment. This should include evaluating accessibility requirements and involving users with disabilities in testing.
- Broaden the EAA's market surveillance to actively monitor new AI-driven accessibility solutions, possibly ensuring they meet accessibility standards even if they operate in sectors outside the traditional scope of the EAA.
- Mandate the European Standardisations Organisations to develop accessibility standards covering specific AI issues.

2. Research

- Encourage and fund research on creation of diverse, representative datasets to reduce bias in AI systems.
- Facilitate collaboration and resource-sharing across EU Member States to foster innovation in AI for accessibility.
- Stimulate development of AI-driven tools to ensure accessibility is built-in by default.
- Incentivise partnerships between the public sector, academic institutions, and private companies to fund research in AI-driven accessibility solutions, especially for areas like healthcare, education, and assistive technologies.

3. Training

- Expand AI literacy initiatives to include targeted training on accessibility standards, design, and use for developers, policymakers, and end-users.

14. Sources

The desk research included literature and documents in the following two main categories:

- academic literature,
- grey literature including material from research projects outside reports.

The sources consulted thus far for the literature review are listed below.

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15. Interview respondents

The study team would like to thank the interviewees for their time and invaluable contribution:

Sector/perspective	Name	Organisation
Industry	Klaus-Peter Wegge	Siemens
	Peter Lanigan	TP Vision
	Christopher Patnoe	Google
	Shadi Abou-Zahra	Amazon
	Ben Loewenstain	Waymo
Assistive technology	Christian Erfurt	Be My Eyes
	David Sloan	Vispero
	David Banes	DATEurope
Academy/research	Gregg Vanderheiden	University of Maryland, USA
	Jutta Treviranus	Ontario College of Art & Design University, Canada
	Magnus Sahlgren	RISE/AI Sweden
	Klaus Miesenberger	Johannes Keppler University, Austria
	Mari Carmen Suárez-Figueroa	Universidad Politécnica de Madrid, Spain
	Daina Podzina	University of Architecture and Urbanism Romania
Organisation representing persons with disabilities	Nicola Gencarelli	Fondazione ASPHI Onlus, Italy

Sector/perspective	Name	Organisation
Public sector	Frida Karlsson	Swedish Agency for Special Needs Education and Schools
	Lisa Stenman	Swedish Agency for Special Needs Education and Schools
	Ing-Marie Svensson	Swedish Agency for Special Needs Education and Schools

16. DIGITALEUROPE Project team

The project team involved on the ACCESSIBLEEU study on AI to support accessibility features 2 experts on the topics of digital accessibility and a project coordinator. The team is enriched by the coordinator of the Working Group on eInclusion of DIGITALEUROPE.

16.1 Research Team:

José Martinez Usero

Jose is Director of Projects at DIGITALEUROPE. José has more than 15 years of work experience as project coordinator of EU projects and several major European Studies on the fields of eGovernment, eInclusion and AHA (Active and Healthy Ageing).

In his professional career, Jose has combined managerial work for ICT consultancies (ONCE Foundation ICT company and Funka) and teaching at several universities, such as, Leeds Metropolitan University, Carlos III University of Madrid, Complutense University of Madrid and Universidade Portucalense. He has also been the Academic Director of the UOC-ONCE Foundation Master on Accessible Technologies. For many years Jose has been participating as expert in ICT standardisation processes, such as the UNE Head of Interoperability Working Group, CEN CENELEC Project Team Leader in the context of Mandate 376.

Jose is a renowned speaker in international conferences and scientific events. He has written several books and a wide range of scientific articles in ICT related fields (some of them with impact factor).

José holds a Computer Science degree and a Master in Telecommunications, both degrees from Polytechnic University of Valencia. Moreover, he holds a PhD in Business Administration from Carlos III University of Madrid. In more recent times, he has also received training on Organisational Strategy by the London School of Economics.

Susanna Laurin

Susanna Laurin is Senior Project Expert at DIGITALEUROPE mainly for the topics related to digital inclusion and ICT accessibility. She is also the Chair of the Funka Foundation, a practical Research and Innovation Centre of excellence focusing on end user involvement, disabilities, empowerment and accessibility. She has been a thought leader in the field of digitalisation, inclusion and e-government for more than 20 years and she is a frequent international lecturer and debater. Susanna is the Chair of the ETSI/CEN/CENELEC Joint Technical Body on eAccessibility, responsible for the development and update of the EN301549, to reflect presumed conformance of the Web Accessibility Directive and the upcoming European Accessibility Act. As one of the leading experts in EU policy and legislation on accessibility, Susanna is leading strategic assignments and research projects on EU level, nationally and across the world.

Recent assignments for the European Commission include the formal review of the Web Accessibility Directive and a study on cognitive accessibility. Susanna is a co-founder, Representative to the EU and Past Honorary Chair of IAAP, the International Association of Accessibility Professionals, as well as the Representative to the EU for the UN-initiative G3ict.

16.2 Project Coordinator

Chiara Longobardi

Chiara Longobardi is Senior Project Manager at DIGITALEUROPE.

She has a solid background in European-funded projects, coordinating consortia and liaising with a wide variety of stakeholders. Her experience is mainly related to topics such as diversity and inclusion, education, digital skills.

Chiara holds a MA in Cooperation and Development, with a focus on European funding and policy. Furthermore, she holds a Master’s degree in International Law as well as Bachelor’s degree in Law from University Luigi Bocconi in Milan.

16.3 Coordinator of the DIGITALEUROPE Working Group eInclusion

Martina Piazza

Martina is Manager for Investments & Innovation at DIGITALEUROPE. She is responsible for managing the Research & Innovation, Audiovisual and e-Inclusion working groups, as well as assisting overall with the DTI PG work.

Martina comes from INATBA, a trade association for blockchain applications, where she worked on many digital policy files. She previously did an internship at the Commission (CINEA, the climate executive agency), the German UnternehmerTUM and PubAffairs.

Martina holds a degree in European politics from KU Leuven, as well as in international relations at the university of Venice and a bachelor’s degree in Linguistics.