AI as an Interdisciplinary Enabler: Case Studies and Ethical Challenges

Zenon Lamprou *Catalink Limited* zenon.lambrou@catalink.eu
Haris Shekeris *Catalink Limited* haris.shekeris@catalink.eu
Pilar Orero *Universitat Autònoma de Barcelona* Pilar.Orero@uab.cat
Konstantinos Avgerinakis *Catalink Limited* koafgeri@catalink.eu

Abstract

Artificial Intelligence (AI) has evolved into a socio-technical phenomenon, necessitating interdisciplinary collaboration for its effective and ethical deployment across diverse sectors. This paper examines the role of interdisciplinary approaches in AI development, focusing on healthcare and climate science as key case studies, while also touching upon education, industry, and accessibility. We explore how ethical and governance dimensions, particularly within the framework of EU policy such as the AI Act and GDPR, concretely shape these collaborations. In healthcare, AI advancements in diagnostics and drug discovery highlight the need for cooperation between clinicians, data scientists, and ethicists to mitigate risks like bias and unequal access. Similarly, in climate science, AI's contribution to environmental monitoring and policy decisions demands collaboration among scientists, policymakers, and ethicists to ensure accountability and transparency. We analyze how responsibilities are distributed, ethical risks are mitigated, and governance frameworks influence design choices in these domains. The paper concludes that successful AI deployment depends not only on technical innovation but also on robust, interdisciplinary governance structures that embed principles of fairness, accountability, and transparency into every stage of development and implementation, fostering AI as a shared societal project.

Keywords: Artificial Intelligence (AI),Ethical AI,Human-Centered AI,Responsible Innovation

1 Introduction

Artificial Intelligence (AI) has evolved from a technical discipline into a socio-technical phenomenon influencing healthcare, environmental policy, education, and accessibility. Its effective deployment thus becomes an inherently interdisciplinary enterprise requiring cooperation among engineers, clinicians, social scientists, ethicists, and policy-makers.

Beyond healthcare and climate science, AI also reshapes domains such as education, industry, and accessibility, further illustrating its interdisciplinary reach. In education, Intelligent Tutoring Systems (ITSs) adapt to learners' performance and emotions, integrating insights from educators, psychologists, and computer scientists to personalize instruction, though raising concerns over privacy and fairness Singh et al. [2022], Kamalov et al. [2023] . In the industrial sphere, AI underpins the transition toward Industry 5.0, emphasizing human-centric and sustainable production through applications such as logistics robots, renewable energy optimization, and automated defect detection, all requiring collaboration among engineers, data scientists, labor experts, and legal specialists Wang et al. [2025], ec2 [2021]. Similarly, in the field of accessibility, AI contributes to narrowing the digital divide and supporting compliance with the European Accessibility Act by enabling speech-to-text systems, website accessibility checkers, and other inclusive technologies Smith [2025], EU [2025], Tamajka et al. [2025]. Yet persistent challenges—such as bias in speech recognition for minority languages or users with disabilities—underscore the need for interdisciplinary teams that unite technical innovation with social science perspectives and the lived experiences of disability communities.

While earlier work often surveyed AI's breadth across multiple sectors, this paper narrows its scope to two domains: healthcare and climate science,to illustrate in greater depth how ethical and governance dimensions concretely shape collaboration. Drawing on EU policy frameworks and recent case studies, we explore how responsibilities are distributed across stakeholders, how ethical risks are mitigated, and how governance frameworks influence design choices.

The work for this paper has been funded by the EU in the project **ALFIE**[1] **Assessment of Learning technologies and Frameworks for Intelligent and Ethical AI, grant number 101177912**.

2 Case Studies of Interdisciplinary AI

2.1 Healthcare and Biomedical Research.

The healthcare sector exemplifies the most pronounced instance of AI-enabled interdisciplinarity. Advancements in deep learning have led to significant enhancements in medical imaging, diagnostics, and drug discovery, frequently exceeding the capabilities of conventional methods Wang and Liu [2021], Lin et al. [2020]. The development of these systems stems from the collaboration of clinicians who provide domain expertise, and data scientists who construct predictive models, while insights from ethicists inform risk mitigation strategies associated with bias and unequal access. Applications extend from arrhythmia prediction Koulaouzidis et al. [2022] to oncological tumor detection and continuous monitoring through wearable devices. In every instance, the synthesis of medical expertise with technical innovation demonstrates the transformative potential of interdisciplinary teams in healthcare delivery.

These systems present ethical and regulatory difficulties associated with data consent, algorithmic bias, and accountability. Numerous medical AI systems are classified as high-risk under the EU AI Act [2024], necessitating human supervision, comprehensive documentation, and ongoing post-market scrutiny.

[1] https://alfie-project.eu/

Hospitals are increasingly forming interdisciplinary ethics committees, involving patients and data specialists, to ensure fairness and transparency prior to implementation.

Accountability is a significant issue. When AI systems make diagnostic mistakes, accountability is shared among developers for maintaining model accuracy, clinicians for exercising sound judgment, and healthcare organizations for ensuring governance. This model of shared responsibility showcases the ethical collaboration in AI development, where technical innovation and ethical considerations progress together.

Data protection under the GDPR also directly impacts AI development. Due to the sensitive nature of healthcare information, complying with stringent data minimization principles can sometimes clash with AI's need for extensive, representative datasets. Therefore, balancing bias mitigation with privacy considerations presents a combined legal and technical challenge that necessitates ongoing interdisciplinary collaboration.

2.2 Climate Science and Environmental Monitoring.

AI's contribution to climate research extends beyond modeling and prediction—it increasingly informs policy decisions and adaptation strategies. Hybrid models that combine physical simulations with machine learning have improved flood forecasting and disaster response Das et al., Slater et al.. Satellite-based analyses also detect early signs of forest degradation and ecosystem stress Forzieri et al. [2022]. These applications illustrate how AI supports evidence-based policymaking by providing rapid, data-driven insights into complex environmental systems.

However, the interface between AI science and climate policy introduces a distinct set of ethical and governance challenges. AI tools not only assist scientists but also shape how governments and international agencies perceive, prioritize, and act on climate risks. When algorithms determine which regions are most "at risk" or which interventions appear most "efficient," they implicitly encode value judgments about what and who should be protected first. Consequently, the accountability of climate-adaptation programs must remain with policymakers and implementing institutions—not with the algorithms that inform their choices. The EU AI Act reflects this distinction through its separation between the provider (system developer) and the user (e.g., public authority). Responsibility for outcomes ultimately rests with the human actors who interpret and operationalize AI outputs within adaptation strategies.

Moreover, the translation of scientific models into policy decisions requires epistemic transparency—a shared understanding among scientists, policymakers, and affected communities about how AI conclusions are generated and how uncertainty is managed. Without such transparency, algorithmic predictions may acquire unwarranted authority in public discourse, narrowing the space for democratic debate. Establishing participatory governance structures that include domain experts, data ethicists, and civil society actors helps ensure that AI-supported adaptation remains accountable and contestable.

At the same time, the energy consumption of large AI models presents an environmental paradox: technologies designed to address climate change may themselves carry significant carbon footprints. Integrating sustainable computing principles—through energy-efficient architectures, low-emission data centers, and life-cycle impact assessments—has therefore become an ethical imperative.

Interdisciplinary governance mechanisms can mitigate these risks. Climate scientists, AI developers, ethicists, and policymakers must co-design evaluation frameworks that ensure adaptation systems are transparent, explainable, and socially legitimate. This collaborative approach not only strengthens technical robustness but also maintains democratic responsibility—a prerequisite for ensuring that AI remains a trusted partner rather than an unaccountable decision-maker in climate governance.

3 Ethical and Governance Dimensions

Across all domains, ethical and governance challenges shape the success of interdisciplinary collaborations. AI systems risk perpetuating bias, creating opaque decision processes, and enabling intrusive surveillance. The OECD has documented widespread use of AI in state surveillance, raising concerns about civil liberties Feldstein [2022]. At the same time, the European Union's AI Act introduces a risk-based framework that seeks to ensure fairness, accountability, and transparency European Union [2024]. The interplay between the AI Act and existing frameworks such as the GDPR demonstrates that regulation itself is an interdisciplinary project, requiring input from legal scholars, technologists, and social scientists.

The EU Artificial Intelligence Act (2024) and the General Data Protection Regulation (GDPR) together define Europe's emerging governance landscape for AI. Although complementary in their goals of promoting fairness, transparency, and accountability, the two frameworks differ in focus and sometimes generate tension when applied to real-world systems.

The GDPR concentrates on protecting individual rights, establishing principles such as data minimization, purpose limitation, and the right to explanation. On the other hand, the AI Act regulates the behavior of organizations that develop or deploy AI systems, emphasizing risk management, documentation, and human oversight. The first point of conflict lies in data governance. While the GDPR restricts the collection and reuse of personal data, the AI Act often requires large and diverse datasets to mitigate bias and ensure representativeness. Balancing these objectives demands interdisciplinary collaboration: data scientists must design bias-resistant models without breaching data-protection rules, and legal experts must interpret how anonymization and synthetic-data techniques can satisfy both frameworks.

A second area of overlap concerns automated decision-making. Article 22 of the GDPR limits fully automated decisions that have significant effects on individuals, insisting on meaningful human intervention. The AI Act echoes this by classifying such systems as "high-risk" and mandating explicit human oversight.

Yet, what constitutes “meaningful human control” remains open to interpretation, requiring input from ethicists, engineers, and regulators to operationalize in practice.

Finally, both frameworks impose transparency obligations, though from distinct angles. The GDPR grants individuals a right to understand how personal data are processed, whereas the AI Act obliges system providers to ensure algorithmic interpretability for regulators and domain experts. Aligning these notions of explainability—one legal and rights-based, the other technical and operational—represents a continuing challenge.

Overall, the interplay between the GDPR and the AI Act underscores that AI accountability is inherently interdisciplinary. Effective compliance cannot rest solely on law specialists or technologists but requires coordinated governance structures that integrate ethical reasoning, technical documentation, and legal expertise into every stage of AI system design and deployment.

4 Discussion and Future Directions

The case studies across healthcare, and climate science show that interdisciplinary collaboration is both essential to and shaped by AI deployment. Yet these collaborations remain fragile, requiring sustained effort to align technical innovation with ethical and societal priorities. Future work should focus on embedding principles such as fairness, accountability, and transparency directly into system design, rather than treating them as afterthoughts.

Governance will also play a decisive role. Harmonized regulatory frameworks can provide consistency across domains, while allowing space for context-specific adaptations. Beyond regulation, fostering AI literacy among domain experts and interdisciplinary training for technical researchers will be critical to sustaining collaboration.

5 Conclusion

AI has emerged as a powerful enabler of interdisciplinary collaboration, producing advances that no single field could achieve alone. The case studies reviewed here demonstrate that its most impactful applications arise when technical expertise, domain knowledge, and ethical oversight are deliberately integrated. Yet these collaborations succeed only when supported by governance structures that safeguard fairness, accountability, and inclusivity.Looking ahead, the challenge is not simply to refine algorithms but to cultivate practices and institutions that sustain responsible collaboration across domains. In this sense, AI is best understood not only as a technological innovation but also as a shared societal project—one whose success depends on ongoing dialogue and ethical commitment across disciplines.

References

Industry 5.0: Towards a sustainable, human-centric and resilient european industry. Technical report, European Commission, 2021.

P. Das, A. Posch, N. Barber, M. Hicks, K. Duffy, T. Vandal, D. Singh, K. v. Werkhoven, and A. R. Ganguly. Hybrid physics-AI outperforms numerical weather prediction for extreme precipitation nowcasting. 7(1):282. ISSN 2397-3722. doi: 10.1038/s41612-024-00834-8. URL `https://www.nature.com/articles/s41612-024-00834-8`. Publisher: Nature Publishing Group.

EU. European accessibility act - european commission, 2025.

European Union. Artificial intelligence act, 2024. Regulation (EU) 2024/1689, Official Journal of the European Union.

S. Feldstein. The global expansion of ai surveillance. Technical report, Carnegie Endowment for International Peace / OECD, 2022.

G. Forzieri et al. Emerging signals of declining forest resilience from satellite and machine learning data. *Nature Climate Change*, 12:400–406, 2022.

F. Kamalov et al. Ai in education: Opportunities and ethical challenges. *Computers and Education: AI*, 2023.

G. Koulaouzidis et al. Prediction of early coronary revascularisation using ensemble models and spect data. *Cardiovascular Research*, 2022.

X. Lin et al. Drug–drug interaction prediction using graph neural networks. *Bioinformatics*, 36(22):4914–4920, 2020.

R. Singh et al. Seistutor: An intelligent tutoring system using cnn-based emotion recognition. In *International Conference on Intelligent Tutoring Systems*, 2022.

L. J. Slater, L. Arnal, M.-A. Boucher, A. Y.-Y. Chang, S. Moulds, C. Murphy, G. Nearing, G. Shalev, C. Shen, L. Speight, G. Villarini, R. L. Wilby, A. Wood, and M. Zappa. Hybrid forecasting: blending climate predictions with AI models. 27(9):1865–1889. ISSN 1027-5606. doi: 10.5194/hess-27-1865-2023. URL `https://hess.copernicus.org/articles/27/1865/2023/`. Publisher: Copernicus GmbH.

R. F. Smith. Closing the digital divide as we enter the intelligent age, 2025.

M. Tamajka, J. Podroužek, L. Kobzova, S. Kula, A. Gavornik, et al. Modern ai deployments and ethical gaps. Technical report, ALFIE Project Deliverable D2.1, Horizon Europe, 2025. Available at: alfie-project.eu.

J. Wang and J. Liu. Deeplab v3+ for gastric cancer segmentation achieving 95.76% accuracy. *Medical Imaging Review*, 2021.

Y. Wang et al. Ai-enabled optimization of renewable energy systems. *Renewable Energy Advances*, 2025.