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How public money is shaping the future direction of AI: An analysis of the EU's investment in AI development

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Executive Summary

The European Union (EU) has an ambition to become the world's "home of trustworthy Artificial Intelligence". Alongside a package of regulation that aims to direct technologies according to European values, it is committing billions of euros of investment into the development and implementation of Artificial Intelligence (AI) over the coming decade.

This research commissioned by the European AI & Society Fund and undertaken by Eticas explores that commitment. It examines whether the EU has the capacity to deliver on its promise to "promote the development of human-centric, sustainable, secure, inclusive and trustworthy Artificial Intelligence".

Between 2014-2020, the EU invested €10bn in AI through its vast research structure known as the Framework Programmes (or abbreviated to FP) – over 13% of the total budget. It has now promised a further €20bn by 2030 to invest in a "digital decade", funded via the Framework Programmes and other mechanisms. This is a unique opportunity to position the European innovation ecosystem in ways that are structurally different from the current dominant models of China and the US. There is potential to create a publicly led, rights-based R&D sector, underpinned by an increasingly developed regulatory system addressing AI and data harms. In this research we look at the record of previous EU research programmes to understand how funding flows in practice and whether the goals set out by the EU can be delivered.

Our efforts, though, have been hampered by one of the main challenges of the EU's funding system, namely the lack of accessible data on its funding flows and lack of comprehensive reporting available on the FP's results and impact. Through an arduous process involving the scraping of data from numerous sources, we have now collected a dataset that allows for analysis of past programmes. We have made this publicly available and invite other researchers to interrogate it further.

Unfortunately, we find this opacity is characteristic throughout the funding ecosystem, from the design of programmes, to the allocation of funds, to the evaluation of outcomes. This both hinders the capacity of the EU to realise its stated objectives and undermines the credibility of its commitments as they cannot be effectively scrutinised.

These shortcomings are true across the FP system. But there are additional gaps specific to AI that must be addressed to meet the EU's ambitions to foster trustworthy innovation. We find a persistent tendency towards techno-solutionism – the development of technology for technology's sake without consideration of the societal application and benefits. We find issues of trustworthiness and responsibility are not integrated into the calls for proposals, but are siloed as separate areas of study. And we find there is no effort to involve civil society in either the design or receipt of funding in order to represent the public interest in the development of AI.

Before investing further public funds, we recommend some practical remedies: publicly accessible data, effective evaluation of the real-world impacts of funding, and mechanisms for civil society participation in funding. Unless the EU addresses these failings, the laudable aims of its strategy to be the epicentre of trustworthy AI will be fundamentally undermined.

Findings

- From 2014-2020, the EU invested €10bn into AI via its Framework Programmes. This represents 13.4% of all funding available.
- EU investments are developed in a top-down process with few opportunities for input by researchers, feedback from previous grantees or external scrutiny from civil society organisations (CSOs).
- Research organisations and higher and secondary education establishments secured 73% of the total FP funding for AI between 2007 and 2020, despite an EU objective to move funding into market focused innovation.
- Germany, France and the UK receive the most funding for AI-related projects. Between 2007-2020 they received 37.4% of the total EU budget for host countries.
- Despite a commitment to AI that works for people and is good for society, over one fifth of calls for proposals involving AI from 2007-2020 were allocated to programmes focused purely on technological development without a clear area of application. In spite of a pledge to use technology to address the climate crisis, only 1.1% of the total calls related to the environment involved AI.
- Although FP involves a rigorous ethics review and specific guidelines exist around ethical AI, only 30.3% of funding calls related to AI make any mention of issues of trustworthiness, privacy or ethics.
- CSOs are not involved in the design of funding programmes, nor are they incentivised in any way to participate in funding applications, nor even recognised as a category in data collection.
- The EU does not conduct any evaluation of the impact of its funding. Evaluation is limited to monitoring the fulfilment of research proposals but not on the economic or societal impact of the work that has been funded. This limits the EU's ability to understand the value of its investments and the fulfilment of its commitment to promote trustworthy AI.
- The sectors that ultimately receive the most money do not correspond to those highlighted as political priorities. Transport was the most funded sector in AI despite not being a strategic focus of the EU, while programmes to promote SME and societal participation in scientific innovation have been dropped. There is a need to align political priorities with funding outcomes in specific, measurable ways.

Recommendations

1.

The EU institutions need to make public all data on public funding mechanisms and outcomes in ways that allow for systematic analysis and research.

2.

The European Commission (EC) needs to develop and implement impact assessments that address the economic and societal impacts of the research they are funding.

3.

The EU institutions and Member States need to create mechanisms to incentivise the participation of civil society in funding, to ensure that the public interest is represented in the development of AI.

1. Introduction

Since 1984, the innovation budget of the European Commission (EC) under the European Union (EU) Framework Programmes for Research and Technological Development (also called Framework Programmes or abbreviated to FPs) has increased by 2,500%, from €3.8bn to €95.5bn, making it the "largest research and innovation ecosystem" in the world.[1] In recent years, the role of technology in such funding efforts has also increased significantly, and the EU began the 2020s with a commitment to a "digital decade".[2] This seeks to mobilise €20bn to bring digital technology to businesses, citizens and public administration, under the Digital Europe Programme, part of the Recovery and Resilience Facility, also known as Next Gen funding. This aims to "mitigate the economic and social impact of the coronavirus pandemic and make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions". Establishing global leadership in "trustworthy" AI is an important element of this ambition. With such significant (public) funding going into innovation (often technological), the need to understand the interaction between innovation trends and funding priorities is key to mapping the AI[3] space in Europe.

The EC asserts that the "(w)ell-coordinated use of AI can bring about significant improvements to society" including reaching climate and sustainability goals as well as bringing high-impact innovations in healthcare, education, transport, industry and many other sectors.[4] However, the EC recognises that AI also comes with risks and can produce a wide range of negative impacts on society. The mass collection and processing of personal data for commercial, medical, educational or security purposes poses challenges to privacy, fundamental rights and democratic societies.

1 See: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en. The AI-related investment in the OECD increased by 17 times between 2001-2019, according to Yamashita et al. 2019.

2 See: https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence

3 This study uses the definition of AI from the European AI Act as "software that is developed with one or more techniques and Machine Learning approaches, including supervised, unsupervised and reinforcement learning, using a wide variety of methods including deep learning; Logic- and knowledge-based approaches, including knowledge representation, inductive (logic) programming, knowledge bases, inference and deductive engines, (symbolic) reasoning and expert systems; and Statistical approaches, Bayesian estimation, search and optimization methods that can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with." Further details can be found in Annexe 1 on methodology.

4 See: https://ec.europa.eu/info/research-and-innovation/research-area/industrial-research-and-innovation/key-enabling-technologies/artificial-intelligence-ai_en

The use of data profiling opens the door to algorithmic bias and discrimination at scale. The deployment of such systems among the most vulnerable contributes to exacerbating power imbalances and information asymmetries under the guise of "neutral" data-based decision-making systems.

Europe has not been at the centre of the AI "revolution". AI systems initially proliferated in new US-led data-intensive, disruptive business models that promised personalisation and speed in accessing new services, from rides to social networks. The process of AI mainstreaming brings with it many of the characteristics and dynamics that characterised the emergence of the Silicon Valley model, namely disregard for legal frameworks and societal impact issues, techno-solutionism, and reliance on private venture capital (VC) funding. Current market incentives have given rise to an innovation model that is removed from any notion of social responsibility, where those who "move fast and break things" enjoy the favour of funders and the media. These incentives hinder the emergence of different innovation models. For AI that serves the needs of people and society, respects human rights and promotes the existence of fair, inclusive and sustainable democracies, new incentives need to be promoted.

Europe has entered the AI competition late but with the ambition to be a global leader in "trustworthy AI" and a distinctive commitment to "human-centric, sustainable, secure, inclusive and trustworthy Artificial Intelligence". This commitment is underpinned by the General Data Protection Regulation (GDPR) that has become a gold standard around the world, and a forthcoming "digital package" of legislation including new regulations for AI as well as digital services, the platform economy and data management. This regulatory effort is accompanied by a series of investment initiatives to support development and innovation in the field of AI, which is resource-intensive and requires strong financial support.[5] Although the numbers aren't always clear, and the "20 billion for the digital decade" includes not-yet-specified private funding, at least €1bn will be invested specifically in European AI solutions every year between 2021-2027.

In this context, it is relevant to explore whether the leadership shown by the region in the regulation of AI and data-intensive technologies is being reflected in its funding and market dynamics. This study, undertaken by the Eticas Tech team on behalf of the European AI & Society Fund aims to achieve just this.[6] It is designed to understand the availability of AI-related funding in Europe, how these funds are allocated and for what purposes they are used. Due to their size and both qualitative and quantitative impact on the European research and innovation (R&I) scene, the

5 The OECD report on Measuring the AI content of government-funded R&D projects notes that research funding agencies across the world have given a significant boost to AI-related R&D projects, with funding increasing from $207m in 2001, to nearly $3.6bn in 2019. For more information on the OECD report: https://www.oecd-ilibrary.org/science-and-technology/measuring-the-ai-content-of-government-funded-r-d-projects_7b43b038-en;jsessionid=bxm4gpLlGa1wRAqiXLclnqxTSrV-WCJ7Bn0-YKGp.ip-10-240-5-167

6 For more information about Eticas: https://www.eticas.tech; For more information about the European AI Fund see: https://europeanaifund.org/

study focuses mainly on the funds allocated by the largest R&I ecosystem in the world: the European Commission's Framework Programmes.

The report goes over the specific AI funding structures that will carry out the mission to mainstream trustworthy AI, exploring what and who is being funded, and for what purposes. An exploration of how funding incentivises technological development also opens the door for imagining how funding could promote alternative digital futures and AI realities. Our research process is both inductive and deductive: we explore the EU's political priorities to make sense of its funding mechanisms, but also look at funding outcomes as proxies into the EU's political priorities. Looking into the EU agenda through its funding plans and allocation results is a way to "reverse engineer" political priorities and power relations and provides a unique entry point into the role of AI in society.

The report starts by providing an overview of the AI funding space in the EU, both public and private, then moves on to a gap analysis that structures the research findings around six main areas, followed by a brief conclusion. The three Annexes provide the background work conducted to build the gap analysis, go into detail on the methodology used to conduct the quantitative and qualitative work, and provide an exhaustive analysis of the data scraped from the supply and demand perspective.

2. Research approach

This report seeks to understand the EU agenda through its funding plans and allocation. It focuses on the EC's Framework Programmes because historical data exists to analyse the extent to which political priorities have translated into funding strategies and impact goals. The research draws on interviews, official documents and scientific publications, and "reverse engineers" these programmes, dynamics and priorities by scraping data from websites and repositories holding information on who gets funded, when and for what. This has allowed us to not only describe but also test how intentions and plans translate into funding dynamics. The results are two unprecedented datasets that others can use to continue to inquire into and follow the dynamics of AI funding in the EU as well as providing a complex, bottom-up understanding of the gaps and opportunities in the AI space.

The reader will find a thorough description of how the EU funding schemes are designed, structured, consolidated and evaluated in an analysis of the "supply side" of the funding processes. This quantifies what funds are available for AI research and development (R&D) in Europe by focusing on the EC Framework Programmes and other AI funding actors in Europe. We have created a sample dataset of EC calls between 2007-2020 (the years corresponding to FP7 and FP Horizon 2020) by scraping data from EC Framework Programmes publications and the Cordis website,[7] where funding calls and awarded projects are gathered. We have analysed which domains of AI are funded at the EU level, how funding distribution has changed over time and across different FPs, and how the relative ratio of AI research and their allocated budget has changed in these calls. In order to provide a political context to the gathered data, we also analysed how the EC funding schemes are created, consolidated and reviewed and what role civil society organisations (CSOs) play in shaping the AI funding schemes in Europe. This has allowed us to quantitatively and qualitatively analyse trends, actors (with a specific focus on civil society) and funding available for AI-related projects across time and domains, and explore the role of responsible AI in the definition of what to fund.

In Annex 3, we compile the research undertaken to complete the analysis and quantification of the "demand side" to focus on who is being funded, how much and for what. If funding sources determine market dynamics, then surely an analysis of the demand will allow us to better understand how recipients have adapted to the incentives created by the available funding. In a context dominated by public funding, this analysis is ever more relevant, as it is a unique characteristic of the EU innovation space. By scraping website data from Cordis, we provide original

7 See Cordis website: https://cordis.europa.eu/en

and evidence-based answers to the key questions of what type of institutions (by activity type) get funded, in which countries, the role CSOs play as recipients of these funds, and which domains of application get most of the EU AI funding. This kind of analysis constitutes a big portion of the core of this report.

The methodological description in Annex 1 provides more information into how this has been achieved. In summary, we have followed a mixed-method research design. The quantitative data analysis has been conducted using two original datasets created by Eticas and available on GitHub.[8] These datasets have enabled us to get a unique insight into the actual investment and funding practices of the EC, and hence into the trends and approaches that drive the innovation ecosystem in seeking to obtain these funds. We have thus been able to go beyond the EC declarations and intentions to actually "follow the money". On the supply side, a dataset of EC calls has been manually created, using publicly available PDFs detailing the content of EC funding calls, to identify AI-related research by domain, their relative presence and budget distribution over time. On the demand side, the Cordis AI-funded projects database was created to study which AI-related projects are funded, in which countries, who the host and partner institutions receiving funding are, and what the observable trends are over time. The qualitative analysis included semi-structured interviews with key stakeholders as well as analysis of the relevant documents.

8 See EU AI Fund project profile on Eticas Tech Github https://github.com/eticas-tech/EU-AI-Fund-project/tree/main

3. The AI investment space in Europe

Many countries have increased investment into tech development generally and AI specifically in recent years. OECD countries doubled their AI R&D funding between 2017-2019,[9] with Europe being one of the regions leading such efforts, though it still lags far behind the US and China. Although exact comparisons of investments across geographies are difficult due to different data collection, it is nonetheless clear that the European AI R&D investment landscape is distinct. It is the only region in the world where public funds are invested with the explicit goal of developing AI according to democratic principles and values, and with a specific commitment to be the world's home of responsible AI.

Although private investment in tech in Europe is substantial (€38bn in 2020), it is scattered among many investors with a variety of goals. Public investment is, however, concentrated in centralised funding programmes. Nationally this is situated in government R&D programmes,[10] and at a European level within the EC, through its Framework Programmes for Research and Technological Development. Our research has found that these programmes alone invested €10bn of public funding into AI from 2014-2020. The FPs as a whole cover a wide range of research areas, not just AI, and constitute the world's largest research and innovation (R&I) ecosystem,[11] with a total budget across all areas of €97bn for the period 2021-2027.

Additionally, the Next Generation EU (NGEU)[12] plan exists to support the Member States hit hardest by the Covid-19 crisis. This €750bn funding package is financed by EU debt and aims at enabling collaboration and a joint commitment between Member States to revitalise EU economies and lay the foundations for a more digital-friendly, greener and inclusive Europe by providing the necessary EU business funding. The plan is to allocate a significant portion of funding to sustain a digitally-focused growth strategy with the objective of enhancing digitalisation and innovation in Europe, including a promise that "artificial intelligence will help us to fight climate change and improve healthcare, transport and education". The budget

9 See Yamashita et al. 2019.

10 We have unfortunately been unable to find reliable data from Member States. The best attempt at quantifying national investment in AI R&D has been performed by Yamashita et al. 2019. Their work is a good example of the data gaps that exist in understanding and monitoring AI funding globally.

11 See Nepelski, D., & Van Roy, V. 2020.

12 For more information on NextGenerationEU: https://europa.eu/next-generation-eu/index_en

allocated from NGEU for "Single market, innovation and digital" is €11.5bn,[13] and the EC has promised to mobilise additional private and Member State funds to reach €20bn in investment during the upcoming "digital decade" with a prominent focus on "human-centric values", trust and building AI that "works for people and is a force for good in society".[14]

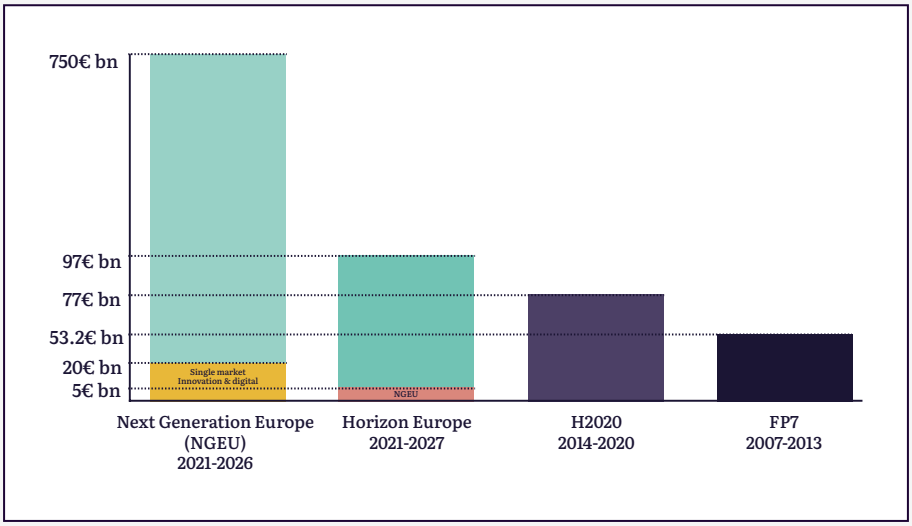


Chart 1. European Commission Tech & Innovation Funding (€ bn)

Alongside these major initiatives are other relevant funding programmes, such as the Single Market Programme,[15] Erasmus+,[16] and the International Thermonuclear Experimental Reactor programme (ITER)[17] to mention a few. ITER is a massive experiment created to advance fusion energy to the point of commercial use and to demonstrate the scientific and technical viability of fusion as a new energy source. The Euratom Research and Training Programme (2021-2025)[18] is a funding programme which complements Horizon Europe, which itself covers nuclear research and innovation, where AI plays an increasingly important role. These types of programmes have relatively small budgets compared to FPs (in 2022, ITER is a €5.61bn fund, Euratom is €1.98bn) but they add to the EU's efforts to invest public resources into the local AI innovation ecosystem.

13 For more information on NextGenerationEU figures: https://ec.europa.eu/info/strategy/recovery-plan-europe_en

14 For more details on this strategy see: EUR-Lex - 52021DC0205 - EN - EUR-Lex (europa.eu)

15 For more information on the Single Market Programme: https://ec.europa.eu/info/funding-tenders/find-funding/eu-funding-programmes/single-market-programme_en

16 For more information on the Erasmus+ programme: https://ec.europa.eu/info/funding-tenders/find-funding/eu-funding-programmes/erasmus_en

17 For more information on the ITER programme: https://ec.europa.eu/info/funding-tenders/find-funding/eu-funding-programmes/iter_en

18 For more information on the EURATOM programme: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/euratom-research-and-training-programme_en

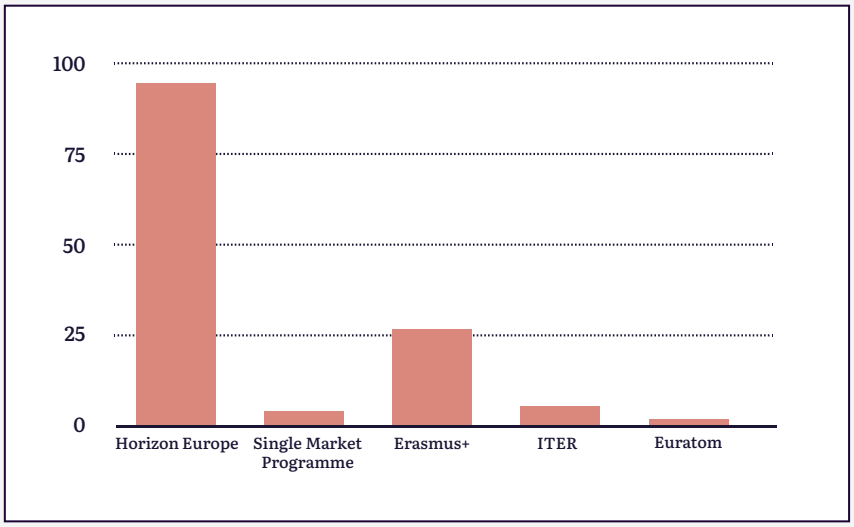


Chart 2. Total budget 2021-2027 of different NGEU programmes.

The EU is also stimulating private sector investment into technological development. The AI Co-Investment Facility,[19] for instance, is a €150m joint equity instrument for companies in the field of AI. It was launched in December 2020 for a period of four years as part of a larger initiative of the European Investment Bank Group and the EC to support the development of Europe's digital future and a leading European tech sector. In the same vein, the EU AI/Blockchain Investment Fund, funded by the EC, is a €700m European investment programme to support AI and blockchain technologies.[20] It mainly provides technical assistance and advisory services to EU Member States and innovative companies to support the development of technically and financially viable investment programmes. Furthermore, as reported by the EC, it supports the development of digital innovation ecosystems through an Investment Support Programme that better connects investors with AI/blockchain innovators and supports the portfolio development of investment projects.

The sheer number of these different programmes which have overlapping remits and budgets leads to a very complex landscape within EU-funded research and development. While headline commitments like the "€20bn digital decade" sound catchy, it is hard in practice to identify exactly where the money for such promises will come from and through which channels it will be disbursed. Despite significant time and effort on our part, it has not been possible to be confident that we have comprehensively mapped the amount and nature of EU investment available for AI. This is a problem not only for researchers and innovators who might benefit from this funding, but also for the credibility of EU commitments around investment, as it is hard to track whether promises are translated into action.

19 For more information on the AI Co-Investment Facility: https://www.eif.org/what_we_do/equity/ai-co-investment-facility/index.htm

20 For more information on the EU AI Blockchain Investment Fund: https://digital-strategy.ec.europa.eu/en/policies/blockchain-funding

While these represent very large amounts, they do not yet compare to private investment, VC and private equity (PE) investment in EU tech companies, which amounted to €16bn in 2016 and up to €38bn in 2020,[21] and are far from US figures, which are approximately five times greater. Still, they are clearly relevant. The European Capital Report 2022,[22] which includes data on about 817 European investors, states that AI & Big Data was one of the most relevant areas for EU investors in 2022. By looking at the industry focus on Europe's Top 50 most active funds, it finds that 69% focused on investments in five or more different industries, with the Top 5 industries in this cohort being FinTech & InsureTech, AI & Big Data, Manufacturing, Construction & Proptech, Life Science & HealthTech as well as IT, Media & Telco. The relevance of tech and AI in the VC space is clearly significant. It is also worth noting that many of the priorities mentioned by VC investors and captured above do not feature prominently in the EU's Framework Programmes, where transport and health capture the greatest amount of public AI-related funds. It is, however, important to highlight that private funding is not strategic as a sector, and while it creates incentives among industry, these are based on revenue and not on a broader strategy to promote specific types of tech development nor specific kinds of social impacts.

Looking at the numbers, EC funding in this space is significant and sets a unique precedent globally. It is important to ask what role EC funding seeks to play, and what is the added value of a public-funding approach to shaping sector that the EU considers crucial to its competitiveness and presence in the global economy. If public funding and initiatives is one of the defining characteristics of the AI funding space in the EU, this needs to be explored strategically, and new paradigms, approaches and technologies need to be explored too. Moving away from Silicon Valley's "move fast and break things" paradigm will require new design and tech development processes. The technologies that emerge from design processes that really incorporate impact and human rights may look very different to those we have now, and so impact and rights may not be seen as an afterthought to mainstream technologies but a fundamental shift in how technologies are conceptualised and developed. Europe can lead the way for multi-disciplinary teams and an AI industry that is truly inclusive, innovative and incentivised to optimise for positive social impact and not just profit. This will require rethinking not just technology processes but also ways of funding and agreeing on strategic priorities and accountability mechanisms, to escape the ills of an overly rigid and non-consultative funding system.

21 See The State of European Tech by Atomico

22 See: European Capital Report 2022: https://www.europeancapitalmap.com/

4. Findings

The research highlights six areas that characterise the potential and shortcomings of the AI funding space in the EU. Overall, we find that current funding commitments run the risk of not achieving the EU's ambitions unless these gaps are addressed by both institutional actors and civil society at large in the EU as outlined below.

A top-down system

The dominance of the EC funding programmes in the AI investment landscape means that money is directed into research and development from the top down rather than the bottom up, creating a supply-led innovation system.

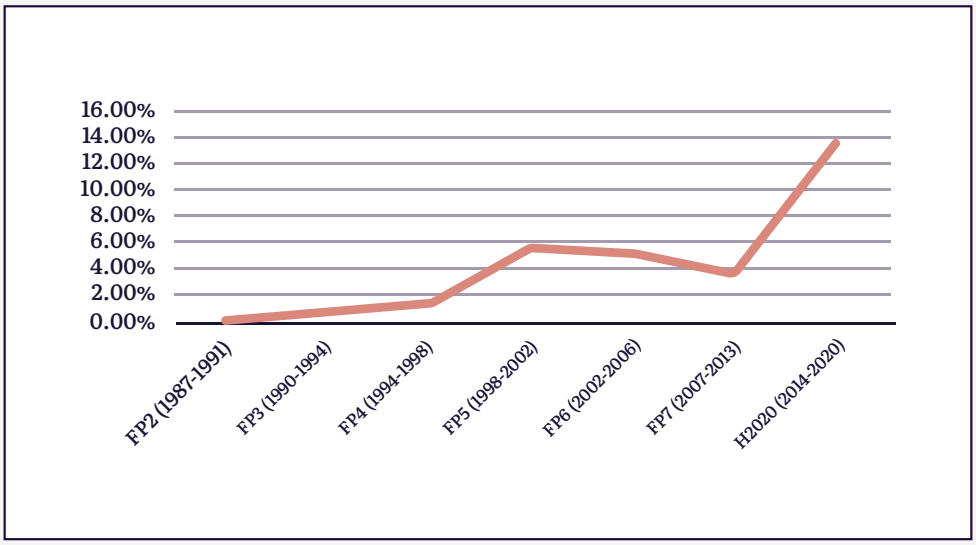


Chart 3. Framework Programmes budget allocated to AI-related projects over time

Our data shows a clear and constant increase in EU AI funding between 1987 (FP2 first year, when the percentage of funding for AI-related projects[23] was 0.06% of the total budget of €5.4bn) and 2002 (FP5 final year, when the percentage of funding for AI-related projects was 5.5% of €15bn), followed by a decrease in budget in FP6 (5.3%) and FP7 (3.7%). This decline is remarkable because during this same period, the funding for

23 To conduct this statistical analysis, we scraped data from the Cordis website. The search syntax included "artificial intelligence" OR "automated decision" OR "biometrics" OR "machine learning" OR "algorithm". We filtered the search results by Collection>Projects. We completed the scraping exercise on June 22nd, 2022. Information on 9,325 projects was scraped. For more detailed information see paragraph 2.2 of our Methodology section (Annex 1).

Framework Programmes increased significantly. This decline in funding for AI-related projects was corrected in H2020 (2014-2020), when funding for AI-related projects increased again to represent 13.4% of the total of €77bn.

The bump in funding between 2002-2013 is worth highlighting. While going through a phase of significant hype around everything AI, it is often easy to forget that AI has been on the agenda for a long time, and that its progress has been anything but linear. Indeed, some voices have pointed to the possibility of a coming "AI winter'' as a consequence of disillusionment over the unfulfilled promises of technology, from autonomous cars to General Artificial Intelligence. Current efforts to paint the Metaverse and Web3 as the inevitable future, and the uncritical celebration of this fact, can obscure alternative futures and narratives. Nevertheless, the EU's commitment to AI funding is currently on the rise.

Documents for Horizon Europe, the Framework Programme running 2021-2027, point to a clear prioritisation of AI-related funding in the EU, to "reinforce research efforts that address critical AI research topics [...] support foundational and application-oriented research on next-generation AI, aiming to keep Europe at the cutting edge in AI [...] advance the state of the art in various areas of AI research, including, research towards the next level of intelligence and autonomy of AI-based systems, transparency in AI, greener AI, AI for complex systems, advances in edge AI networks, unbiased AI systems, empowering humans with advanced AI support [...] and also demonstrate how AI helps transform major economic sectors in production and services [...] and address major societal challenges in areas such as healthcare, civil security, climate change, energy, mobility, media (e.g. addressing disinformation) and agri-food".[24]

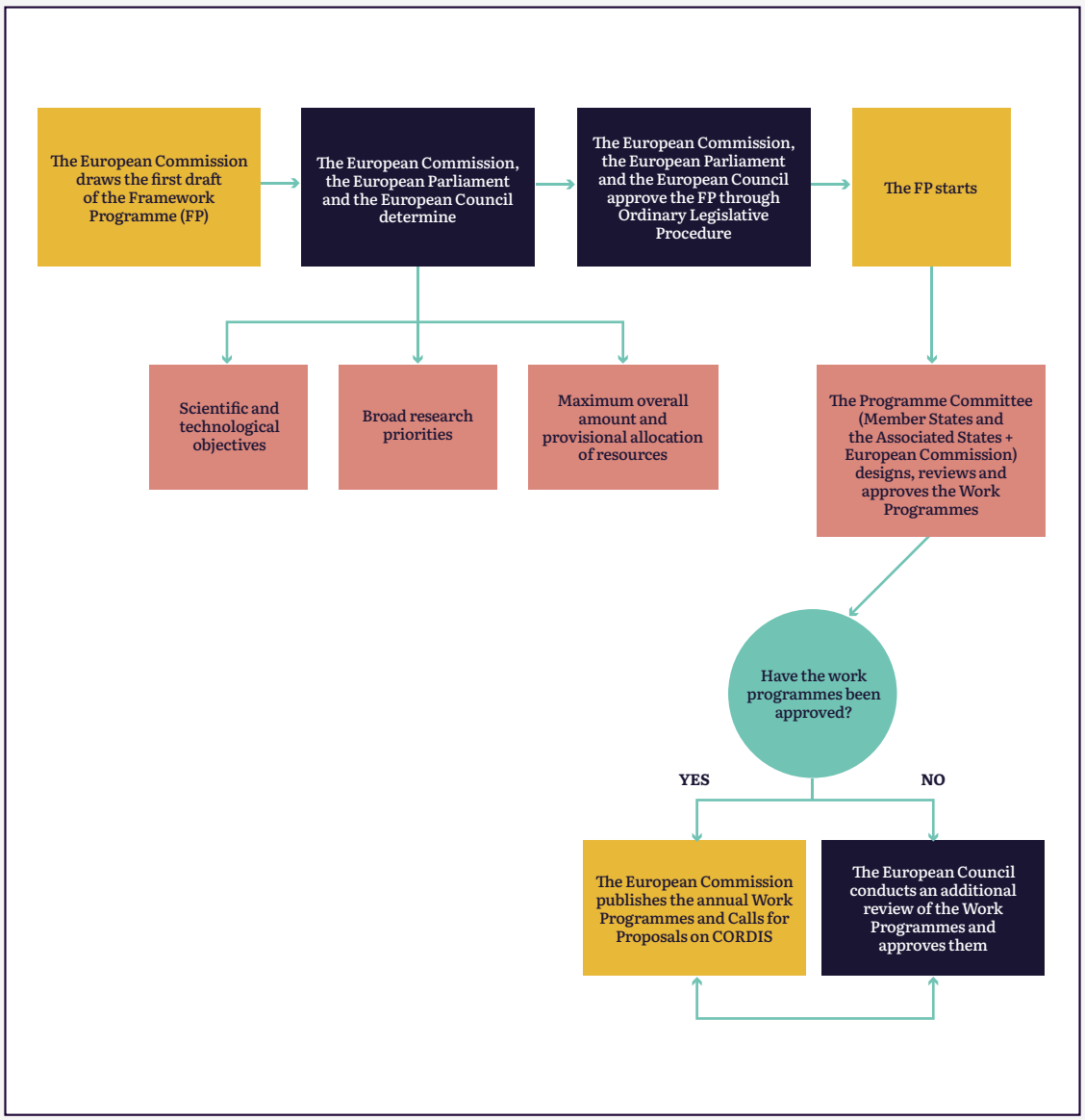
Specifically, the EC has made commitments to the AI lighthouse for Europe programme, to continue work laid out during Horizon 2020 (2014-2020) when €50m was invested in four AI Excellence Centres, comprising networks of researchers working on AI. Additionally, one of the pillars in Horizon Europe is dedicated to "Digital, Industry and Space", and focused on the "research, development and uptake of next-generation computing and data technologies and infrastructures, with a view to enabling the creation of a European single market for data with the corresponding data spaces and a trustworthy and secure AI ecosystem".[25]

The *a priori* due diligence that characterises public funding has led to the development of a supply-led innovation ecosystem where the supplier lays out very specific terms and priorities which grantees compete for and execute. However, grantees' views and contributions are not fed back into the process and there are very few mechanisms to follow up on project execution beyond financial and administrative compliance. In this scenario, control resides on one side of the scale (the funder/funders) and little space is left to the funded (the programmes' participants) for paving the way and shaping research.

24 See the Coordinated plan on artificial intelligence 2021 review, European Commission (2021).

25 See the Coordinated plan on artificial intelligence 2021 review, European Commission (2021).

This is true also in the development of the Framework Programmes which are set for seven-year periods. The process is long, complex and multi-level.



Graph 1. EU Framework Programmes' design and definition process.

While in theory some spaces for external participation exist, most of them are not public (and when they are, the actual input is unclear). For instance, surveys are sent to organisations that register to apply for funds but the results are not shared with Member States, the data is not made public and it is unclear whether survey results have ever been taken into account when making decisions about the Framework Programme content or process. In practice however it is common for well-connected and established research institutions to informally influence Member States or EU institutions by lobbying for their priorities.

As the funder defines not only broad research priorities and scientific and technological objectives but also work programmes, the system is heavily supply-led in that European researchers and other actors (such as public administration, industry actors, CSOs and small and medium-sized businesses (SMEs) among others) seeking funding under the EC's Framework Programmes need to adhere to the specific domains defined in each programme and team up with others in transnational consortia to achieve the stated goals. With strategic priorities being set every five to seven years, this results in a very rigid framework where the European researchers and other actors do not have a space to present their priorities, ideas and needs. Moreover, the obligation to collaborate to secure funding may drive away innovative actors that do not need or seek to work with others, or those whose innovation is linked to proprietary systems.

This supply-led dynamic sits in stark contrast with the procedure of the main non-public actor shaping the AI-funding space: VC funds. These usually follow a demand-led process by which anyone can pitch solutions as long as they are in line with broad areas of interest, and where those seeking funding are encouraged to act alone and not in collaboration with others.

The value of public funding is, however, that it can support initiatives where the market is not willing to engage. And it is perhaps unsurprising that public funding for research into technology that exists to achieve specific goals should be prescriptive to at least some extent. However, it is important to ask whether the way in which EU funding programmes are developed is effective in achieving its stated objectives. The rigidity of the Framework Programmes and the lack of consultation in developing them is at odds with the ambition to develop AI that benefits society.

Research and educational institutions at the forefront

Our data shows that most EU AI funding is awarded to research and educational institutions. While the data shows that this tendency has been changing in the most recent Framework Programmes, it is still notable how most AI funding continues to go to projects involving research-intensive institutions.

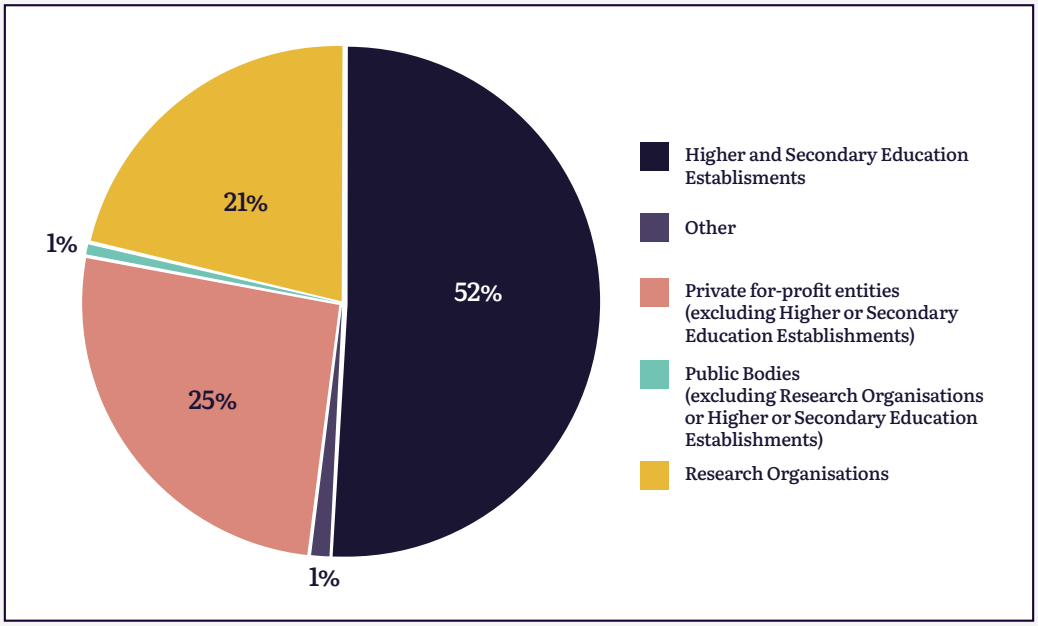


Chart 4. Funded host institutions' activity types: percentage for FP7 and H2020 (2007-2020) for AI-related projects.

Between 2007-2020, higher and secondary education establishments received more than half the FP funding for AI-related projects. If we add "research organisations" to "higher education establishments", their share of funding for AI-related projects is 73% of the total. This is very significant and points to a funding space characterised by a pre-competitive AI research ecosystem, despite the desire from the EU to shift priorities towards market-focused innovation.

This shows how slowly EU priorities are translated into funding dynamics in the Framework Programmes system. The objective of the early FPs was to "promote a European identity through activities such as supporting collaboration between scientists across national borders and encouraging movements of researchers between universities in different countries". But since 2007, and coinciding with budget increases, research "has been put on the forefront of the European agenda" (Stamm 2013) with "the ambition to create a single, borderless market for research, innovation and technology across the EU" (EC 2022),[26] moving research closer to innovation, "in a way that reduces the distance between basic research, applications, and products" (Wigzell 2002).

26 For more information on the European Research Area: https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/era_en

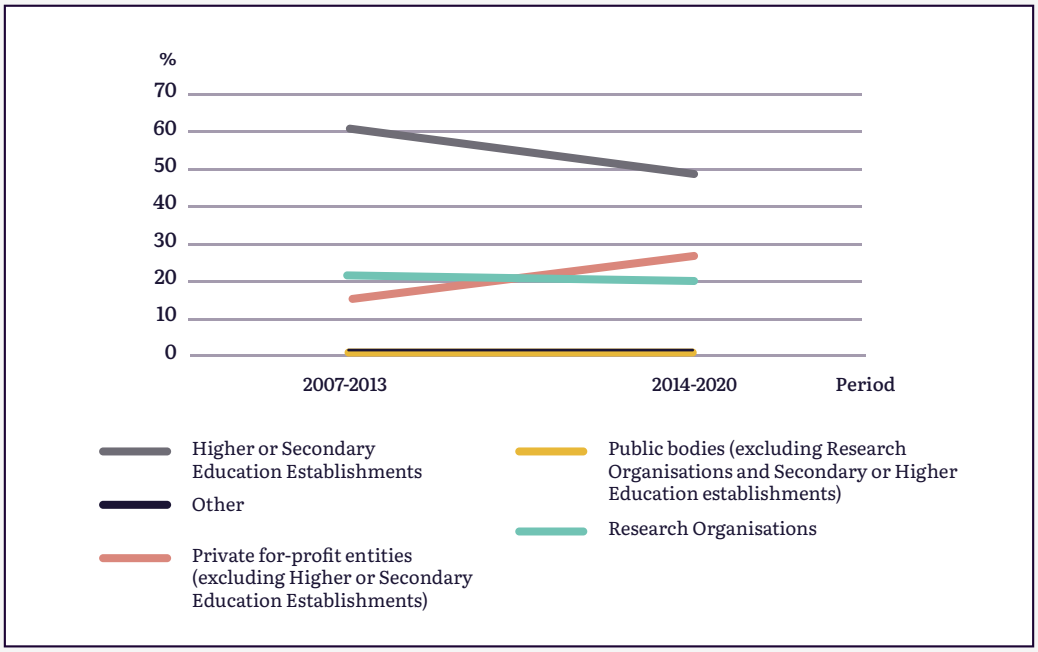


Chart 5. Distribution of host institutions by activity type across all AI-related projects funded under EU FP7 and H2020 (2007-2020) by percentage

The continued dominance of research institutions among the most funded entities tells a story of deep-seated inertia. Between FP7 (2007-2013) and H2020 (2014-2020), though our data shows a decrease of 17.6% (from 66.9% to 55.1% in university leadership and participation and an increase of 58% (from 10.7% to 16.9% of the total budget) in funding going to private for-profit entities, higher education institutions continue to be over-represented as funding recipients.

This may also be a consequence of the EU's supply-side approach. Private AI development entities, or non-academic institutions may not have the time or the resources to wait for the Framework Programmes to publish a topic that is relevant to their field of work. Even if they do, they may not be willing to invest the amount of time needed to apply for these funds: for most topics and programmes, each funding proposal consists of 80 narrative pages describing the excellence, impact and workplan of each proposal, with a level of detail that goes down to individual deliverables for multi-actor pluri-annual projects – a pace and dynamic that may suit research institutions but is clearly removed from SME, start-up and even civil-society ways of working. In addition, once a funding proposal is submitted, applicants wait around four months for an answer.

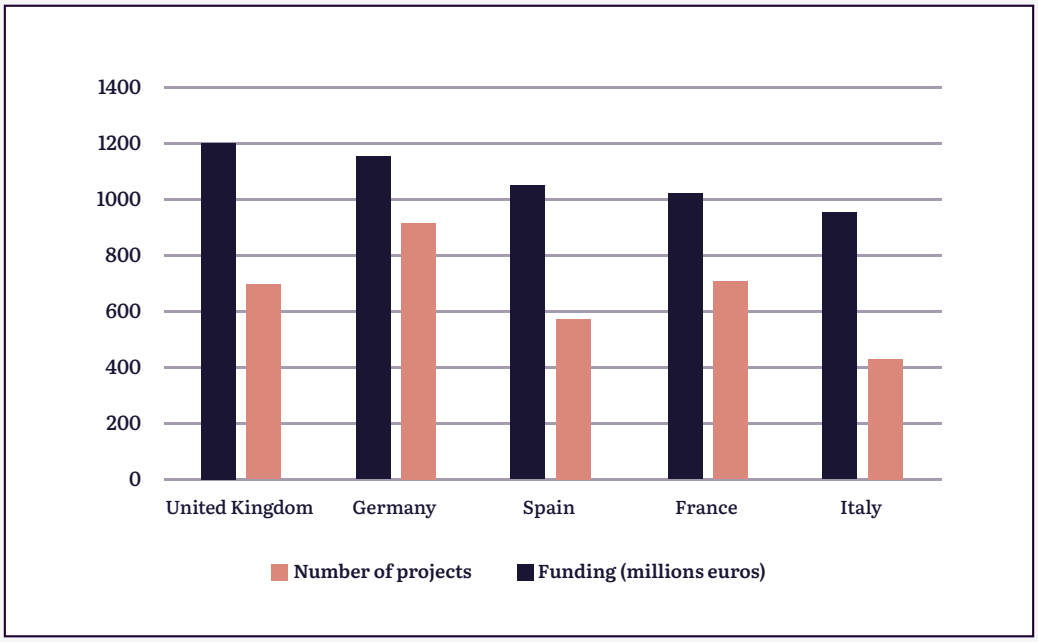


Chart 6. Distribution of AI-related number of projects and EU contribution by country across all AI-related projects funded under EU FP7 and H2020 (2007-2020)

Funding is also concentrated in a few countries, dominated by an axis of the UK, Germany and France which absorbed 37.4% of the total EU budget received by host countries between 2007-2020. Only when looking not at funded actors but at funding amounts per country do other countries like Italy and Spain enter the top five. In the 2007-2020 Framework Programmes, Germany was the country that received the most AI-related funding in the whole of Europe,

There is a notable discrepancy between the countries that receive most funding and the countries that dominate innovation in the market and are highly rated in public readiness[27] (ability for governments to deploy AI), where northern and eastern Europe are prominent.[28] It is unclear if this is part of a strategy to promote regions and industries currently overlooked by private funders, or an unintended consequence consolidated by lack of meaningful oversight and alignment mechanisms.

Both the concentration of funding in research centres and in specific geographies raises the question of whether EU investment reflects or moulds the innovation landscape. Do universities receive more funding because that is where the most innovative work in AI is taking place? Or is it just that they are better at navigating the EU's systems? Does funding flow away from the "usual suspect" countries where AI is already developing in the market on purpose? Or as a side effect of an overly rigid and complex system? It seems that before pouring additional billions onto the R&D and AI table, the EU should seek to answer these questions.

27 See Top 20 Western European AI-ready countries 2020 | Statista

28 See Top 20 Western European AI-ready countries 2020 | Statista

A techno-solutionist approach

EU policy stresses the need to put humans at the centre of technological development and invest in "trustworthy AI". Our data shows however that, despite some recent shifts, funding continues to demonstrate a reliance on techno-solutionism, a lack of multi-disciplinarity in funding dynamics and a non-existent strategy to promote trustworthy AI.

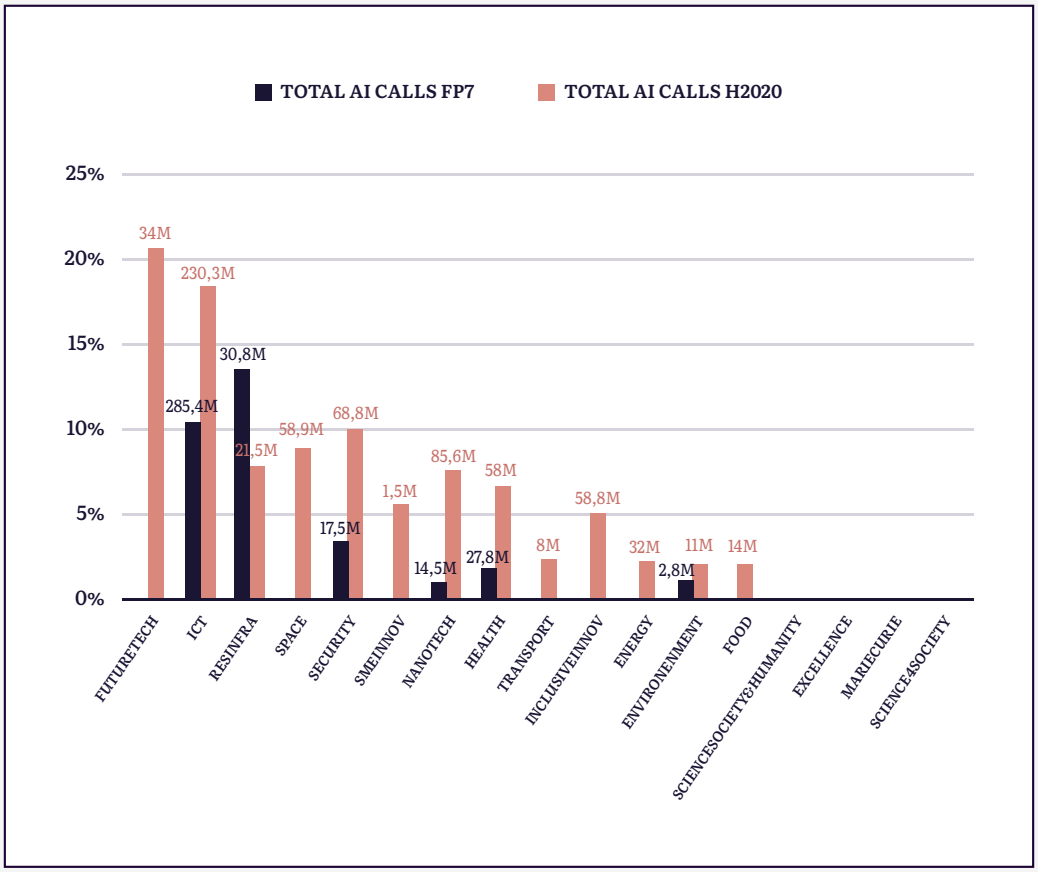


Chart 7. Percentage of total AI-related calls across domains under EU FP7 and H2020 (2007-2020).

In FP7 (2007-2013) we found a significant concentration of AI-related terms appeared in the calls for the technical domains of ICT, Space, Security, while domains related to "food" or "Inclusive Innovation" received no funding for AI-related projects.

These dynamics point to a tendency in the Framework Programmes to lean towards techno-solutionism, which is defined as an over-reliance on technology to tackle and solve complex problems. This leads to an innovation drive where technological solutions are decoupled from actual problems, and the development of new technologies is promoted regardless of their usefulness or social impact. The belief underlying techno-solutionism is that all technological development is good and that technological solutions can and will eventually solve problems.

In Horizon 2020 (2014-20) our data shows a double dynamic. On the one hand, there is a doubling-down on techno-solutionism by continuing to define a significant portion of AI-related topics under the ICT domain and a new FUTURETECH domain, designed to support paths towards "radically new technological possibilities" and "novel and visionary thinking"[29] which accounts for over 20% of the funded domains mentioning AI. On the other hand, there is an increased push for looking at AI technologies in context, as we see AI topics emerge in the context of domains devoted to health, transport and energy.

Also, while we do observe a mainstreaming of AI mentions across areas, most mentions continue to be in the most technical domains, while the domains "Social Sciences and Humanities'' and "Science 4 Society" see no incorporation of AI-related terms. This points to a concerning lack of multi-disciplinarity, where AI issues are only explored in the context of technological innovation, and not in relation to broader societal concerns or non-technical disciplines. This is notable as it contradicts the discourse of the EU institutions, which often insist on the need for multi-disciplinary approaches and a human-centric approach to technology. Specifically, the EU's digital strategy mentions how the region will "make the EU the place where AI thrives from the lab to the market" ensuring "that AI works for people and is a force for good in society".[30] In this case, we see that the practice of the EC is not in line with its stated political goals.

It is also surprising to see a low occurrence of AI-related terms in topics pertaining to the "environment" domain (only 1.1% of the total calls allocated to this domain included AI-related terms), as this is a space where innovation has picked up recently and where AI could play a role in meeting an urgent societal challenge. Looking at the strategy documents produced by the EC to shape ongoing and future AI funding commitments, it seems that the absence of the environment in the past and existing priorities of the FPs has been noted. Specifically, the EC is from now on committed to "accelerate research and development focusing on AI's contribution to sustainable production and major application sectors through the Horizon Europe programme" (EC 2021). It may be worth exploring how the EC missed this as a research, development and funding priority before 2021, and what tool it will develop to ensure that this shift in focus translates into actual funding for new topics and positive societal and environmental impact resulting from such efforts.

Additionally, we find that the EU's commitment to the "development of human-centric, sustainable, secure, inclusive and trustworthy artificial intelligence" does not translate into funding practices as only a tiny fraction of the funding calls (30.3% of the total AI-related funding calls) make reference to these issues.

29 See: https://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-fet_en.pdf

30 See: https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence

This is not to say that efforts have not been made: the Framework Programmes project evaluation process includes a pioneering ethics review of all proposals (described in detail in Annex 2). In Horizon Europe, the ethics review process incorporated a specific section on AI, guidelines on ethical AI exist and a guide to algorithmic auditing is under development. However, we have found that ethics issues and notions of trust, responsibility and privacy are not prioritised in topic descriptions and objectives.

Specifically, none of the topics under the domains devoted to nanotechnologies, future technologies, resilience in infrastructures and SME innovation include terms or requirements related to privacy, ethics or trustworthiness. When these terms emerge, they do so in the context of projects linked to ICT, security and health, and most references are related to privacy, and not broader issues of trustworthiness. This means that in most of the domains where AI-related terms are most prevalent, responsible AI is not a concern or priority.

Significantly, in the security domain, some calls are focused on ethical aspects. While this is good news, it also means that responsibility-related keywords (for example "privacy", "ethics" and "trustworthy") are absent from most of the AI-related calls in this domain, and so ethical and responsibility issues are not tackled transversally but in specific topics. For example, the keyword "privacy" can be found in the following calls' topics: "Human factors, and ethical, societal, legal and organisational aspects of using Artificial Intelligence in support of Law Enforcement" and "Intelligent security and privacy management". The reason why some AI-focused topics may not have responsibility precautions mentioned in the topic description is unclear, but it is concerning that the practice of the FPs seems to contradict again the programme's stated political principles and priorities, as well as developments in the legislative space around AI in the EU. In extreme cases, topic descriptions seek to fund projects that cannot be developed under the current regulatory constraints, for instance "seamless biometrics" which is contrary to requirements for consent, or web scraping and profiling in commercial or high-risk domains. In fact, several FP-funded projects have raised doubts among journalists and MEPs, and some projects have been exposed as not complying with EU's data protection regulations even though they did go through the ethics review process.[31]

Our data shows that when it comes to trustworthy AI, the EU is not putting their money where their mouth is.

31 Examples of EU projects that have been exposed as not complying with EU's data protection regulations even though they did go through the ethics review process are the iBorderCtrl project (for more information on this project: https://www.iborderctrl.eu/) and the InSecTT project (for more information on this project: https://www.insectt.eu/). For a good overview on the iBorderCtrl case and the EU history of funding illegal and unethical technology see: https://www.patrick-breyer.de/en/posts/iborderctrl/.

The role of civil society

Examining the role of civil society in the definition of R&I priorities can also shed light on the dynamics of the EU funding programmes. Research impact rests on the assumption that "the inclusion and active involvement of different stakeholders in research processes can create more useful research outcomes" (van de Klippe, 2021). As the third-sector of society, CSOs are distinct from government and business organisations, defined by non-governmental and non-profit characteristics, and are one of these key stakeholders. Specifically, when trying to understand what factors shape incentives for innovation, the participation and role of civil society is a good indicator of how a particular funder may understand innovation and, most importantly, its impacts. If those who are subject to AI decisions don't have a say in tech development decisions, the chances that these do not "work for people" nor are "a force for good in society" is high.

As described above, there is little opportunity for external input, including from civil society, into the design of funding programmes. We are disappointed to report we have also not found any evidence of involving civil society in the funding itself. In fact, data on CSO participation in funding calls is not even collected as a specific category. The inclusion of CSOs was only briefly relevant in Horizon 2020, when a programme called "Science with and for Society" (SwafS) was created, but then discontinued in Horizon Europe. Data obtained from EC-funded projects looking specifically at the role of civil society in FPs confirm that civil society participation is low and that CSOs are invisible (see Annex 3).

EU institutions do not see civil society as a relevant driving factor, nor do they promote the participation of civil society actors as end users or implementors of innovation in the FPs' main areas. This points to an important gap of political significance and impact in the EU innovation ecosystem. If the EU wants to promote a human-centric strategy around AI, the humans impacted by AI developments will need to be involved in defining priorities and designing solutions, but the current reality of the FPs is that civil society has no way of being involved, and there is no evidence that current and future EU funding plans have identified this as a significant gap worth addressing.

Evaluation

For a public programme that has been shaping the R&D ecosystem in the EU for the last 20 years and which is set to invest almost €100bn into the innovation fabric of the EU in the next five, having clear and transparent impact indicators is crucial. Understanding the successes and failures of previous funding rounds would provide vital information to ensure that this massive public effort to promote R&D in general, and AI in particular, at the EU level is working in the ways it was intended and producing concrete results on the ground in line with the stated priorities.

Measuring the ways in which these goals are achieved is crucial to the credibility and effectiveness of the distinctly European, human-centric tech future the EU is promising, but evidence from previous programmes shows that while that is the theory, in practice it does not happen.

One of the main responsibilities of the EC in the Framework Programmes is to assess their impact and effectiveness. The better regulation guidelines[32] provide a set of common requirements: impact assessments are supposed to identify the main research and innovation challenges in Europe and define specific impact objectives for each call, and evaluations then assess the progress made towards achieving the programme's objectives and build an evidence base to improve implementation (Horizon Europe, 2022).[33] The EC website states that "monitoring is a systematic process of data collection, addressing in particular how the programme is implemented", which provides regular insights regarding the effects and benefits of the programme, and is also instrumental for the analysis conducted in the evaluations." But our findings point to a concerning lack of meaningful impact indicators and evaluation.

The lack of emphasis on evaluation is evident in our own methodology: we have had to scrape the data we needed from the EC websites, as it had never been gathered in a structured way, and we have faced many difficulties because the indicators collected by the EC's Cordis system are not useful in terms of making sense of how FP funding is distributed, to whom or for what. A strategic approach to indicators and making minimal changes to how this data is gathered and presented would go a long way in providing policymakers with a real-life picture of where €100bn of tax-payers' money is going. But these do not exist today.

What we have found is that while significant time and effort is devoted to evaluation, all the measures we have been able to analyse have clear methodological flaws. For instance, the EU's impact assessment methodology assesses impact solely in relation to the call topic and domain.[34] The data sources used in the interim evaluation of Horizon 2020 projects never leverage data from the field nor anything beyond the information provided by the grantees, and oversight mechanisms focus on the evaluation of the fulfilment of contractual obligations and not on the actual results and overall impact of the investment. Overall, issues of broad societal or economic impact are not assessed, "Horizon 2020 indicators focus on input/outputs but not on results and impact, in particular the indicators to track progress on the societal challenges are not challenge-specific, i.e. they relate to classical outputs from Research and Innovation projects – publications, patents, prototypes – but

32 For more information on guidelines for Evaluation and Monitoring: https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how_en

33 For more information on impact assessments, evaluation and monitoring of EU research and innovation programmes: https://ec.europa.eu/info/research-and-innovation/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/evaluation-impact-assessment-and-monitoring_en

34 See: Evaluation, impact assessment and monitoring (europa.eu)

not to their impacts on, for example, reducing CO2 emissions, or improving the health of citizens, or their security, often in the longer term".[35] It is unclear how these concerns highlighted in 2017 have been taken into account in the subsequent Framework Programme, Horizon Europe, as the funding and oversight process seems to be the same as before. Also, as far as we know, the impact of the EU's funding efforts in actually promoting trustworthy AI has never been assessed.

Some societal issues are reviewed at the ethics review stage of funding allocations, but with important limitations (see Annex 2). As for economic impact, we have not been able to identify any assessment of the economic value produced through the EU's funding programmes. Moreover, the European Innovation Council,[36] which is responsible for identifying, developing and scaling up breakthrough technologies and game changing innovations in Europe, has itself been criticised by Horizon Europe's rapporteur for the Industry, Research and Energy committee of the European Parliament (ITRE) due to funding delays and bureaucratic hurdles.[37]

Finally, it is not clear what the budget for evaluation and impact is, although experts have reported frustration at the time and budget limitations imposed on evaluation panels, and an organisational pressure to focus on formal and not substantive issues. It would be healthy for the EC to make this information public and assess whether there is sufficient resource for such crucial activities. If evaluation and impact are not a priority, the FPs risk becoming a hollow process of devolution of funds to the Member States, without any strategic direction or regional positioning.

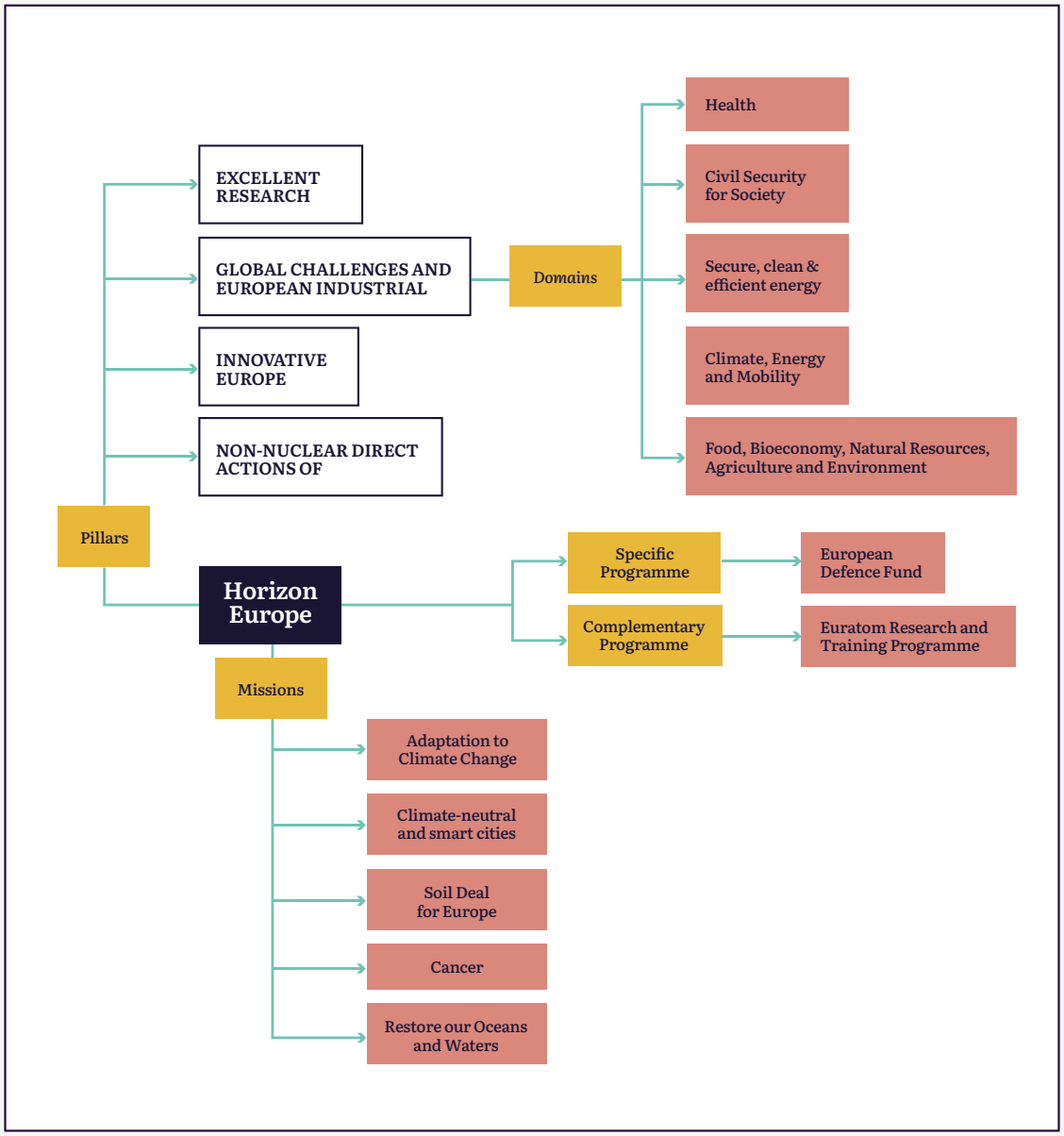
Directing the funding

Despite all the effort devoted to defining each Framework Programme, what emerges is not a clear strategy and direction for EU innovation, but a picture composed of a thousand pieces. Every five to seven years, the EU makes substantial changes to the pillars and domains of the FP. However, it is often unclear how these changes translate into the specific topics, which are ultimately what define what is funded.

35 See Interim evaluation of Horizon 2020, European Commission (2017): https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/interim-evaluation-horizon-2020-key-documents_en#documents

36 For more information on the European Innovation Council: https://eic.ec.europa.eu/index_en

37 See Killeen, M. 2022.



Graph 2. Organisational structure of Horizon Europe (2021-2027 Framework Programme)

Indeed, there is a sense of stability at the domain level, where established actors can more or less trust that similar domains will continue across funding cycles and programmes. These actors can also trust that the EU funding efforts will continue to privilege research actors, albeit at a decreasing rate.

Moreover, while sector-specific funding figures for Horizon Europe are not yet clear, our data shows that we come from a scenario in H2020 when the most-funded AI sector in the EU was transport, alongside an increasing emphasis on the environment and health. In the meantime, the private sector seems to be prioritising FinTech & InsureTech, AI & Big Data, Manufacturing, Construction & Proptech, Life Science & HealthTech and IT, Media & Telco. As the EU has not clearly stated a specific interest or strategic priority around the use of AI in transport, it may be the case that what ends up receiving EU funding is not the result of a political or policy process, but results from other dynamics such as funding legacies or Member State competition. That being said, there may be merit in the EU exploring and funding areas that are not covered by private investment funds. If that is the case, the political reasoning behind such choices should be explicit and the impact measurable and measured, which is not the case at the moment.

Our data also points to an urgent need to align political strategic priorities with funding outcomes in specific, measurable ways. Commitments to a human-centric AI model need to be translated into specific data governance and engineering requirements, and the ethics review process needs to be put at the forefront of evaluation efforts to ensure that impact priorities are implemented. If "human-centric, sustainable, secure, inclusive and trustworthy artificial intelligence" is a strategic priority in Horizon Europe, it is unclear why the "Science with and for Society" programme has been discontinued. If SMEs are at the heart of a "sustainable and digital Europe" it is unclear why the "Innovation in SMEs" programme and the emphasis on SME participation that was promoted during H2020 is not highlighted in Horizon Europe.

5. Conclusions

Framework Programmes are long-established, organisationally consolidated, multi-level instruments with a huge quantitative potential to create and drive incentives for the development of a competitive, robust and value-aligned research, development and innovation ecosystem in the EU. However, we have found that issues of opacity, lack of participation and lack of evaluation of impacts in the planning and funding stages are seriously hindering the capacity of FPs, and of the EC, EU institutions and Member States to make the most of the available resources.

Our work points to three issues that need urgent attention:

1. The EU institutions need to make public all data on public funding mechanisms and outcomes in ways that allow for systematic analysis and research.
2. The EC needs to develop and implement impact assessments that address the economic and societal impacts of the research they are funding.
3. The EU institutions and Member States need to create mechanisms to incentivise the participation of civil society in its funding, to ensure that the public interest is represented in the development of AI.

We recognise that CSOs can only capitalise on these recommendations if they have the strength and capacity to participate. Enabling diverse communities to engage in the challenges posed by new data systems will require efforts from multiple actors.

While these recommendations are focused on practical improvements to the funding programmes as they exist, we would encourage policymakers to think beyond these current structures. Could notions of the commons or public-interest technologies find a space in the European AI ecosystem – as we have started to see with initiatives such as Germany's Sovereign Tech Fund?[38] If so, how should innovation be defined in those spaces? As the interaction between humans and machines increases, could this third space promote socio-technical engagements with innovation that can reconcile, from its inception, engineering possibilities with social values and expectations? Could such spaces escape techno-solutionism? This longer-term shift would require a more active and tech-savvy civil society, able to design tech solutions and approaches but also ensure that individual and collective impacts, and the voices of those affected by the automation of everything are heard and taken into account. It would also require a public administration and funding space that is willing to lose some control over funding priorities and execution dynamics, and define success not in terms of financial compliance and execution but actual outcomes. The first step towards this scenario would be to build a shared

38 See: https://sovereigntechfund.de/en

agreement on what data and technological futures are desirable, why and by whom, something that some civil society actors, and specifically the European AI & Society Fund, are already working on.

By putting values and rights at the centre of the AI discourse, and mobilising public funding to generate incentives towards achieving the goal of trustworthy AI, the EU has created a space for thinking about technology in ways that escape what some have called surveillance capitalism. The current shortcomings of the mechanisms designed to fulfil the promise of an alternative, rights-based technological future and incentive structure should not scupper the entire enterprise. Underpinning and consolidating the space carved out by the EU, and taking specific steps towards trustworthy AI will require a concerted effort and the ability to both hold those officials to account and contribute to shaping the future of AI in ways that serve people and society, uphold human rights, and promote democratic practices.

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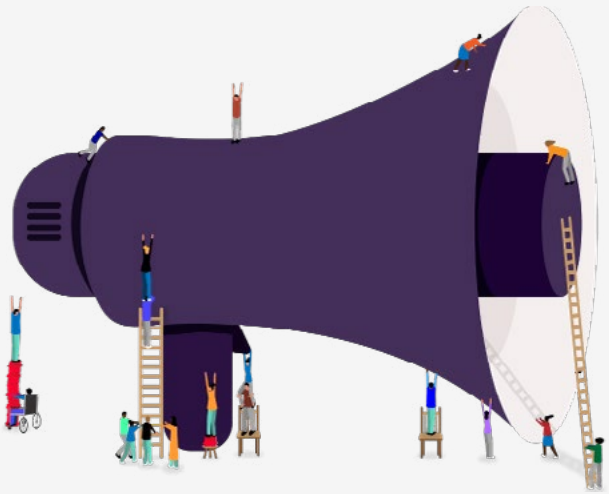
Annex 1: Methodology

The methodological framework for this project is based on mixed methods that combine quantitative and qualitative approaches. Below, we will briefly summarise our data collection and analysis in each approach.



1. Defining AI

For the purposes of this study, we have taken the EU AI Act's definition as a starting point, as it is wide enough to incorporate many of the technical developments that are referred to as AI. The AI Act defines AI as: "software that is developed with one or more techniques and Machine Learning approaches, including supervised, unsupervised and reinforcement learning, using a wide variety of methods including deep learning; Logic- and knowledge-based approaches, including knowledge representation, inductive (logic) programming, knowledge bases, inference and deductive engines, (symbolic) reasoning and expert systems; and Statistical approaches, Bayesian estimation, search and optimization methods that can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with."[39]

We like this definition because its focus is not on complexity but on processes and outcomes. Therefore, it includes any machine-assisted project, regardless of its complexity. As we have seen many low-tech AI solutions having important social impacts, we believe this broad approach is the most suited for this report

39 See AI Act art. 3(1)

2. Quantitative analysis

For the quantitative analysis, we built two original datasets that provide the empirical data for supply and demand-side analyses.

2.1. Supply-side analysis

To analyse the supply side (EC funding frameworks in the field of AI), we extracted data from the FPs' PDFs which are publicly available (albeit neither in an organised nor accessible way, thereby requiring effort and connections to collect) and detail each "call" and "topic" put out by the EC to seek proposals from consortia of (mainly) EU innovation institutions. These topics state a title, topic description, objectives, expected impacts and funding range to guide applicants. Our sample includes data from 2007, 2010 and 2013 (belonging to FP7) and 2014-15 and 2018-20 (the initial and final years of FP8, officially called Horizon 2020). These include 3,049 calls and 17 domains. For each call, we extracted the information on the following fields:

1. Framework Programme
2. Period
3. Domain
4. Call code
5. Call title
6. Call description
7. Minimum and maximum budget.

The extraction was conducted manually by the Eticas team and required downloading 55 PDF files from the EC website, going over 6,236 pages and copying the relevant information into an Excel spreadsheet. The analysis included the distribution of AI-related keywords ("artificial intelligence", "automated decision", "algorithm", "biometrics", and "machine learning") across different topics and across FPs over time.

2.2. Demand-side analysis

To conduct the statistical analysis of the demand-side (recipients of the AI-related EC funds), we scraped data from the Cordis website. The search syntax included "artificial intelligence" OR "automated decision" OR "biometrics" OR "machine learning" OR "algorithm". We filtered the search results by Collection>Projects. We completed the scraping exercise on June 22nd, 2022. Information on 9,325 projects was scraped.

We scraped information from the following fields:

1. Project title
2. Project Description
3. Objective
4. Fields of science
5. Programme(s)
6. Topic(s)
7. Call for proposal
8. Funding Scheme
9. Project acronym
10. Grant agreement ID
11. Project website
12. Start date
13. End date
14. Overall budget/total cost
15. EU contribution
16. Coordinator/Host institution name
17. Coordinator/Host institution address (Country information)
18. Coordinator/Host institution activity type
19. Coordinator/Host institution (Net) EU contribution
20. Participant/Beneficiary 1 name
21. Participant/Beneficiary 1 address (Country information)
22. Participant/Beneficiary 1 activity type
23. Participant/Beneficiary 1 Net EU contribution.[40]

After the scraping was completed, we cleaned and organised the dataset and ran some random cross-checks of the fields to make sure that the scraping exercise was conducted properly. The scraping was limited to FP programmes. Data on other EU funding programmes implemented by the EC in parallel to the main EU Framework Programmes (see section 3.6) was excluded.

Since the project fact sheet on the Cordis website did not include the "domain of application" information, we conducted another scraping exercise, which filtered the AI-related projects by "domain of application". Hence, we managed to include the "domain of application" information to the original dataset with more than 9,000 projects. We made this effort because the "domain of application" is valuable information for understanding what definition/s and application/s of AI are being prioritised in FP funding.

The demand side analysis included inquiring into the distribution of host institutions of AI-related projects across activity types, country of origin, and amount of EU funding. We also conducted topic modelling analysis on the

40 Steps 20-23 were repeated for the rest of the participants/beneficiaries.

description of project objectives (of all AI-related projects in our dataset). The results are presented in Table 1 below to facilitate the analysis and make trends evident.

DOMAIN	ALGO	AI	BIOMETRIC	ML	ADS	TOTAL INSTANCES	UNIQUE CALLS
ENERGY	1	2	0	2	0	5	4
ENVIRONMENT	1	2	0	0	0	3	3
FOOD	0	1	0	1	0	2	13
HEALTH	5	8	0	1	0	14	6
SECURITY	8	7	3	1	0	19	33
TRANSPORT	2	4	0	0	0	6	12
INCLUSIVEINNOV	2	1	0	0	0	3	0
SCIENCESOCIETY&HUMANITY	0	0	0	0	0	0	4
EXCELLENCE	0	0	0	0	0	0	2
SCIENCE4SOCIETY	0	0	0	0	0	0	6
MARIECURIE	0	0	0	0	0	0	0
FUTURETECH	5	1	0	0	0	6	14
RESINFRA	3	2	0	0	0	5	0
ICT	16	16	0	5	0	37	2
NANOTECH	5	7	0	1	0	13	0
SMEINNOV	1	0	0	0	0	1	12
SPACE	9	2	0	2	0	13	1
TOTALS	58	53	3	13	0	127	112

Table 1: Frequency of each AI-related keyword across different funding calls' domains for FP7 and H2020

2.3. Merging domains of application for analysis

During the period studied, the EC led two different FPs: FP7 and Horizon 2020. The structures of FP7 and H2020 are a bit different from each other in terms of pillars and specific domains.[41] In order to be able to study these FPs comparatively, we had to align pillars and domains corresponding to similar fields and come up with a transversal categorization, as can be seen in Table 2.

41 H2020 is divided into three pillars ("Excellent Science", "Industrial Leadership", and "Societal Challenges") and two specific objectives ("Spreading Excellence and Participation" and "Science with and for Society" (See: EC Website). On the other hand, FP7 had a different organization that included four programmes, namely "Cooperation", "Ideas", "People" and "Capacities" (See the Cordis Website)

Domains of application FP7	Domains of application H2020	Merged domains of application
CAPACITIES	INDUSTRIAL LEADERSHIP	INDUSTRIAL LEADERSHIP
ENVIRONMENT	CLIMATE ACTION, ENVIRONMENT, RESOURCE EFFICIENCY AND RAW MATERIALS	ENVIRONMENT
ICT (Information and Communication Technology)	INDUSTRIAL LEADERSHIP	INDUSTRIAL LEADERSHIP
IDEAS	EXCELLENT SCIENCE	EXCELLENT SCIENCE
JTI (Joint Technology Initiatives)	EXCELLENT SCIENCE	EXCELLENT SCIENCE
NMP (Nanosciences, Nanotechnologies, Materials and new Production Technologies)	NANOTECH	INDUSTRIAL LEADERSHIP
PEOPLE	SPREADING EXCELLENCE AND WIDENING PARTICIPATION	SPREADING EXCELLENCE
SECURITY	SECURE SOCIETIES	SECURITY
SPACE	SPACE	INDUSTRIAL LEADERSHIP
SSH (Socio-economic Sciences and Humanities)	INCLUSIVE, INNOVATIVE AND REFLECTIVE SOCIETIES	SOCIETIES
TRANSPORT	SMART, GREEN AND INTEGRATED TRANSPORT	TRANSPORT
HEALTH	HEALTH, DEMOGRAPHIC CHANGE AND WELL-BEING	HEALTH
FOOD, AGRICULTURE AND TECHNOLOGY	FOOD SECURITY, SUSTAINABLE AGRICULTURE AND FORESTRY, MARINE, MARITIME AND INLAND WATER RESEARCH AND THE BIOECONOMY	FOOD
ENERGY	SECURE, CLEAN AND EFFICIENT ENERGY	ENERGY
CAPACITIES	SCIENCE WITH AND FOR SOCIETY	SCIENCE WITH AND FOR SOCIETY
COOPERATION	FUTURE TECHNOLOGY	EXCELLENT SCIENCE
CAPACITIES	SME INNOVATION	INDUSTRIAL LEADERSHIP

Table 2. Reference of distribution of original pillars and domains and merged domain of applications.

We are aware that the compiled datasets allow for many more exercises and other insights into the data. As neither the EC nor Cordis provide structured data that would allow others to run experiments and inquiries, we are making our raw data available in GitHub, and encourage others to continue to interrogate trends and dynamics in EU public funding of the research and innovation space. The datasets can be found on Eticas' GitHub profile.[42]

42 See: https://github.com/eticas-tech/EU-AI-Fund-project

3. Qualitative analysis

The qualitative analysis included semi-structured interviews with key stakeholders, in-depth analysis of the relevant official and non-official documents and the study of AI-related calls and projects under different EC Framework Programmes. We had two rounds of video-call interviews as well as email exchanges with experts that included people responsible for EU projects, national contact points and EU project coordinators. Document analysis covered the official reports and other publications released by the EC as well as other written material produced by CSOs, journalists covering EC funding and other actors. The qualitative analysis served exploratory purposes at the beginning of the project to generate further questions and hypotheses. They also enabled us to better interpret quantitative analysis by putting flesh on bare numbers.

Annex 2. Mapping supply: EU AI funding

1. EC Framework Programmes

The Framework Programmes for Research and Technological Development, also called Framework Programmes or abbreviated to FPs, are funding programmes created by the EC to support and foster research in the European Research Area (ERA), a system of scientific research programs integrating the scientific resources of the EU and created to "catalyse coherence and mobilise joint efforts across Europe with the aim of improving Europe's research capacity in global competition" (Banda 2002).

The funding programmes began in 1984 with the creation of the First Framework Programme for Research (FP1). FPs are 5-7 year-long programmes that assign the available funding through different pillars and domains that define what will receive funding, under which conditions and for how long. Innovation actors seeking funding in the EU need to wait for their field or focus of work to be reflected in those domains, and usually team up with other organisations in consortia. This is true for the most research-intensive and pre-competitive domains, but also for the domains that seek to fund innovation SMEs. Cross-border collaboration is a must in order to access EU funds. FP1 received €3.8bn, and after years of incremental increases, a big jump in Framework Programme funding took place in 2007, from €16.1bn to €50.5bn.

While in the early years the FPs had "little impact on the coordination of national activities in the field of science and research," today the reliance of the EU R&D ecosystem on FP funds is undeniable, especially among universities and, most remarkably, since the 2008 financial crisis, when the boost in FP funds coincided with austerity programmes in many countries, resulting in significant decreases in national research funding.

The merge of the pre-existing FPs with the ERA, and the creation in 2007 of the European Research Council (ERC), the EU's public body for funding scientific and technological research, was the result of two main needs: to create a regional R&D agenda, and to move research closer to innovation, "in a way that reduces the distance between basic research, applications, and products" (Wigzell 2002). While the objective of the early FPs was to "promote a European identity through such activities as supporting collaboration between scientists across national borders and encouraging movements of researchers between universities in different countries" (íbid.), since FP7, and as funding has increased exponentially, the emphasis has moved away from basic research and into market applications. Table 3 provides an overview of FP periods, funding and focus.

ID	Framework Programme	Period	Budget (billions of €)	Focus
FP1	First	1984-1987	3,8	Exploratory Research, Mobility of Researchers and Networking of Research Centers
FP2	Second	1987-1991	5,4	Research Infrastructures, Mobility of Researchers, Support for SMEs
FP3	Third	1990-1994	6,6	Competitiveness and New Technologies (ICT, biotechnologies and new materials)
FP4	Fourth	1994-1998	13,2	Selectivity, Integration and New Technologies
FP5	Fifth	1998-2002	15	Society Needs, Competitiveness, Sustainability, Innovation and Participation of SMEs
FP6	Sixth	2002-2006	16,3	Technological Research
FP7	Seventh	2007-2013	50,5 over seven years +2,7 for Euratom over five years	Technological Research
FP8	Horizon 2020 (English)	2014-2020	77	Innovation
FP9	Horizon Europe	2021-2027	95,5	Civil Applications and Innovation

Table 3. EU Framework Programmes: Period, Budget and Focus

Today, and as evidenced by funding increases, research "has been put on the forefront of the European agenda" (Stamm 2013). As a result of this shift, the ERA has been revitalised, with "the ambition to create a single, borderless market for research, innovation and technology across the EU" (EC 2022).[43]

43 For more information on the European Research Area: https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/era_en

1.1. EU Framework Programmes organisational structure

Every Framework Programme has been designed with a typical organisational structure that has seen multiple modifications over the years, but remained unchanged at its core.

The EU Framework Programmes are organised into main columns called "pillars". Each pillar is oriented towards a specific policy objective and includes different "domains" (previously called "thematic areas") which are implemented through "work programmes". An example is given below:

Horizon Europe (the most recent Framework Programme, 2021-2027) is organised into four pillars. One of these pillars is called Global Challenges and European Industrial Competitiveness and includes different domains implemented through related work programmes: health; culture, creativity and inclusive society; civil security for society; digital, industry and space; climate, energy and mobility; food, bioeconomy; natural resources, agriculture and environment.

1.2. EU Framework Programmes ethics review

A relevant step in the funding process of FP projects is the ethics review all projects must go through if they have been initially shortlisted for funding. The existence of an ethics review process is significant in that it aims to ensure that all public R&D funding is allocated to projects that are aligned with EU values and legal frameworks, specifically in what concerns data protection, non-discrimination and responsible research and innovation.

The ethics review process, not unlike the Framework Programs themselves, has undergone several transformations over the past decades, taking a prominent role since FP7 and being a mandatory review step since Horizon 2020. Projects funded under Horizon Europe have to incorporate ethics issues and precautions, with a specific focus on AI, and go through a review process that is unique in its conception and implementation in that it requires all applicants to provide *a priori* guarantees and explanations on how ethics issues have been built into the proposals. If these are not provided, the ethics reviewers at REA may impose additional requirements to grantees and conduct checks of a project's activities to ensure compliance (Fitzgerald, 2007).

The ethics self-assessment covers issues related to human tissues and cells (with embryonic cells treated as a separate ethics category), humans' participation in research activities, personal data, research involving animals, environment, health and safety, participation of third countries (non-EU), misuse of research results (e.g. use for military purposes), as well as a separate section for issues related to AI research where participants are required to assess whether a data protection impact assessment is in order or define precautions of the profiling activities to take place, for instance.

The ethics review process spans from project definition to implementation, in what constitutes a true oversight and due diligence process. We delve deeper into the process as this is truly a pioneering ethics due diligence exercise:

- Application or Proposal Stage: Each consortium needs to clearly showcase that they have a clear understanding of the potential risks arising out of its proposal as far as Data Management, research ethics and impact to society is concerned. This is presented in two ways: a codified Ethics Self-Assessment questionnaire that is completed when the proposal is submitted, and the actual reference to the above elements within the Impact and Excellence parts of the proposal's main body.[44]
- Evaluation Stage: Once a proposal is submitted, ethics experts will review it specifically to determine whether the consortium has taken all ethics aspects into consideration. At this stage the self-assessment will also be reviewed to ensure that it is aligned with the ethics elements that arise by reviewing the proposal.
- Grant Agreement Stage: This is an intermediate stage where the proposal has been approved for funding, but additional ethics requirements may be added after the experts' review. These requirements can be as simple as requiring an independent ethics advisor but can also be significant additions such as multiple new deliverables targeting specific ethics concerns of the ethics reviewers.
- Implementation Phase: This stage spans the entire lifecycle of the project from its official kick-off up to its final evaluation. Beyond reviewing ethics deliverables submitted during the project, as per the grant agreement, the Project Officer and sometimes ethics evaluators will organise formal review meetings (these vary depending on the duration of the project, but they usually happen every 12-18 months) and also may attend demonstrations or other relevant events.

The ethics review process is unique in its scope and implementation. It also points to an awareness of the need to build EU values into innovation processes. However, it must be noted that neither the efficiency of this oversight process in the quality of EU research and innovation, nor its role in building an EU-specific innovation ecosystem, have ever been properly assessed. Also, data on the cost of such efforts has never been made public, so it is unclear if the aims of this process are in line with the effective funding available, and whether oversight needs may be hindered by budget constraints. We are aware of some experts' frustration with the process and pressures to clear ethically sensitive projects.

44 Link to the Ethics Self-Assessment questionnaire: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/how-to-complete-your-ethics-self-assessment_en.pdf

2. AI in the Funding Programmes

In this section, we present background data and information that helped us narrow down our inquiry on the role of AI in the Framework Programmes as reported in our Findings section.

Table 4 shows the distribution of AI-related keywords across different pillars.[45] At this high level, we find that AI has made it into the FPs in a fairly balanced way. "Excellent Science", "Future and Emerging Technologies", "Marie Curie Actions" (MSCA) and "Research Infrastructures" have the highest share of calls (10%) with AI-related keywords, but the frequency of AI-related terms is low (10 out of 99). "Industrial Leadership" and "Societal Challenges" are the pillars with the most frequent calls, including AI-keywords: 58 (out of 646) and 44 (out of 2,216) respectively. These pillars have a higher number of calls in general, but the ratio of AI-related calls is smaller (9% and 2% respectively). This may point to some sort of political guidance in terms of the overall "weight" of AI-related domains per pillar.

45 Note that H2020 is divided into three pillars ("Excellent Science", "Industrial Leadership", and "Societal Challenges") and two specific objectives ("Spreading Excellence and Participation" and "Science with and for Society" (See: EC Website). On the other hand, FP 7 had a different organization that included four programmes, namely "Cooperation", "Ideas", "People" and "Capacities" (See the Cordis Website). In order to be able to study these FPs comparatively, we aligned pillars corresponding to similar fields and came up with a transversal categorization. Please see our methodology section for the organization of FP7 and H2020 pillars and how we (re) categorized them in our analysis.

DOMAIN	CALLS TOTAL			CALLS W/KEYWORDS ONLY			CALLS % TOTAL VS W/ KEYWORDS		
	FP7	H2020	TOTAL	FP7	H2020	TOTAL	FP7	H2020	TOTAL
EXCELLENT SCIENCE	0	99	99	0	10	10	0.0%	10.1%	10.1%
INDUSTRIAL LEADERSHIP	261	385	646	16	42	58	6.1%	10.9%	9.0%
SOCIETAL CHALLENGES	1333	883	2216	10	34	44	0.8%	3.9%	2.0%
SPREADING EXCELLENCE	0	20	20	0	0	0	0.0%	0.0%	0.0%
SCIENCE FOR SOCIETY	0	67	67	0	0	0	0.0%	0.0%	0.0%
TOTALS	1594	1454	3048	26	86	112	1.6%	5.9%	3.7%

Table 4: Distribution of AI-related keywords across EU Framework Programmes pillars in FP7 and H2020.

This broader approach gets more granular if we conduct a domain analysis. Table 5 analyses the occurrence of the AI-related keywords across different domains, finding that the highest share of AI-related mentions is in the Future and Emerging Technologies (FutureTech) domain, aimed at supporting paths towards "radically new technological possibilities" and "novel and visionary thinking".[46] Considering these innovative aspects, it is understandable that it has the highest share of AI-related keywords (6 out of 29). Some examples of the FutureTech calls involving AI include:

- Global Systems Science (GSS) (FETPROACT 1 - 2014): aims to tackle real world problems (e.g., climate change, global financial crises, global pandemics, and growth of cities) by using novel methods such as Big Data and algorithmic game theory.
- Environmental Intelligence (FETPROACT-EIC-08-2020): calls for bringing environmental modelling, advanced sensor research, social sciences and AI to create dynamic models of the environment, including predictive modelling, scenario testing and real-time tracking.

Information and Communication Technologies (ICT) is the domain with the highest number of calls that include one of our AI-related keywords (33 out of 220 calls). Some examples of these calls include "Artificial Intelligence on demand platform" (ICT-49-2020) which aims to "facilitate the integration of AI into applications, making it a compelling solution for users, especially from non-tech sectors"; "Big Data Research" (ICT 16 – 2015); "AI for the smart hospital of the future" (DT-ICT-12-2020); "5G PPP – Smart Connectivity beyond 5G" (ICT-52-2020); "FinTech" (ICT-35-2018); and "Cybersecurity, Trustworthy ICT" (ICT 32 – 2014).

46 See: https://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-fet_en.pdf

AI calls in the field of security also mention the use of AI by Law Enforcement. Some of them include: "Exploring new modalities in biometric based border checks" (BES-6-2015), "Sensor technology for under foliage detection" (SEC-2013.3.2-2); and "Audio and voice analysis, speaker identification for security applications" (SEC-2013.5.1-2).

DOMAIN	CALLS TOTAL			CALLS W/KEYWORDS ONLY			CALLS % TOTAL VS W/ KEYWORDS		
	FP7	H2020	TOTAL	FP7	H2020	TOTAL	FP7	H2020	TOTAL
FUTURETECH	0	29	29	0	6	6	0.0%	20.7%	20.7%
ICT	85	135	220	9	24	33	10.6%	17.8%	15.0%
SPACE	44	81	125	6	6	12	13.6%	7.4%	9.6%
RESINFRA	0	45	45	0	4	4	0.0%	8.9%	8.9%
SECURITY	138	88	226	5	9	14	3.6%	10.2%	6.2%
SMEINNOV	0	18	18	0	1	1	0.0%	5.6%	5.6%
NANOTECH	132	151	283	1	11	12	0.8%	7.3%	4.2%
HEALTH	282	145	427	4	9	13	1.4%	6.2%	3.0%
INCLUSIVEINNOV	0	101	101	0	2	2	0.0%	2.0%	2.0%
TRANSPORT	270	119	389	0	6	6	0.0%	5.0%	1.5%
ENERGY	158	184	342	0	4	4	0.0%	2.2%	1.2%
ENVIRONMENT	170	112	282	1	2	3	0.6%	1.8%	1.1%
FOOD	221	134	355	0	2	2	0.0%	1.5%	0.6%
SCIENCESOCIETY &HUMANITY	94	0	94	0	0	0	0.0%	0.0%	0.0%
EXCELLENCE	0	20	20	0	0	0	0.0%	0.0%	0.0%
SCIENCE4SOCIETY	0	67	67	0	0	0	0.0%	0.0%	0.0%
MARIECURIE	0	25	25	0	0	0	0.0%	0.0%	0.0%
TOTALS	1594	1454	3048	26	86	112	1.6%	5.9%	3.7%

Table 5: Distribution of the AI-related keywords across different topic domains in FP7 and H2020.

3. Funding for trustworthy AI

Another hypothesis that we wanted to test with our dataset is the occurrence of terms related to responsible research and innovation, specifically in the field of AI. Therefore, we have run the keywords "privacy", "ethic-", and "trustworthy" against our dataset.

DOMAIN	PRIVACY	ETHIC	TRUSTWORTHY	TOTAL INSTANCES	UNIQUE CALLS
ENERGY	2	1	0	3	2
ENVIRONMENT	0	0	0	0	0
FOOD	0	0	0	0	0
HEALTH	6	6	0	12	7
SECURITY	6	6	1	13	10
TRANSPORT	0	0	0	0	0
INCLUSIVEINNOV	0	2	0	2	2
SCIENCESOCIETY &HUMANITY	0	0	0	0	0
EXCELLENCE	0	0	0	0	0
SCIENCE4SOCIETY	0	0	0	0	0
MARIECURIE	0	0	0	0	0
FUTURETECH	0	0	0	0	0
RESINFRA	0	0	0	0	0
ICT	13	4	1	18	13
NANOTECH	0	0	0	0	0
SMEINNOV	0	0	0	0	0
SPACE	0	0	0	0	0
TOTALS	27	19	2	48	34

Table 6. Frequency of each ethics-related keyword across topics for FP7 & H2020 AI-related calls

Interestingly, these terms are mentioned in some calls in only five domains: "ICT", "security", "health", "energy" and "inclusiveinnov". This means that in most of the domains where AI-related terms are most prevalent, such as "Futuretech", "Resinfra, "SMEinnov" and "Nanotech", the ERA considers that responsible AI is not a concern or priority. Overall, "privacy" is the most common keyword (27) followed by "ethic-" (19). The total frequency of the studied keywords is 48, and 34 calls had at least one of these keywords.

In the Security domain, for instance, we found that:

- 6 out of 14 AI-related calls include the keyword "privacy". For instance, see: SU-AI03-2020 (Human factors, and ethical, societal, legal and organisational aspects of using Artificial Intelligence in support of Law Enforcement); and SU-DS02-2020 (Intelligent security and privacy management).
- 6 out of 14 AI-related calls include the keyword "ethic". Examples: SU-AI03-2020 (Human factors, and ethical, societal, legal and organisational aspects of using Artificial Intelligence in support of Law Enforcement); BES-6-2015 (Exploring new modalities in biometric based border checks); SEC-2013.3.2-2 (Sensor technology for under foliage detection).
- 1 out of 14 AI-related calls include the keyword "trustworthy": SU-AI02-2020 (Secure and resilient Artificial Intelligence technologies, tools and solutions in support of Law Enforcement and citizen protection, cybersecurity operations and prevention and protection against adversarial Artificial Intelligence).

In Health:

- 6 out of 13 AI-related calls include the keyword "privacy". For instance, see calls: SC1-DTH-04-2020 (International cooperation in smart living environments for ageing people); SU-TDS-02-201 (Toolkit for assessing and reducing cyber risks in hospitals and care centres to protect privacy/data/infrastructures).
- 6 out of 13 AI-related calls include the keyword "ethic". Examples: SC1-BHC-06-2020 (Digital diagnostics – developing tools for supporting clinical decisions by integrating various diagnostic data).
- For InclusiveInnov, 2 out of 2 AI-related calls include the keyword "ethic". These are DT-TRANSFORMATIONS-02-2018-2019-2020 (Transformative impact of disruptive technologies in public services) and DT-GOVERNANCE-05-2018-2019-2020 (New forms of delivering public goods and inclusive public services).

Annex 3. Mapping demand: who receives EU AI funding

This section reports additional data that helped us identify WHO (which organisations) receives the most funding, WHAT (which pillars and domains) gets funded under the EC Framework Programmes, and HOW the available funds are distributed.

1. Who gets funded

One of the key questions that we used our data to answer is about the type of institutions which receive funding under EU Framework Programmes. The Cordis dataset classifies host and participating institutions into five broad categories:

- Research organisations
- Higher or secondary education establishments
- Private for-profit entities
- Public bodies
- Other

Such a broad categorisation limits the analysis; for instance, we cannot see the role of less institutional actors such as CSOs. But the categorisation that is currently available provides enough granularity to allow us to share some tendencies and insights. Moreover, the absence of a category for CSOs already indicates that CSO participation in research and innovation is not seen as a political priority in the EU. In fact, CSOs fall under the activity type "Other", which is a truly mixed bag of everything that does not belong in the other categories. Still, only 1% of the projects funded to address AI-related issues in the period 2007-2020 were "Other". These include Fédération Européenne Des Géologues (Belgium) leading the Energy project CROWDTHERMAL "Community-based development schemes for geothermal energy", and Stichting European Urological Foundation (Netherlands) leading the Health project "Optimal treatment for patients with solid tumors in Europe through Artificial intelligence." In both cases, these are professional organisations not representing those who may be impacted by AI-related processes or digital rights CSOs.

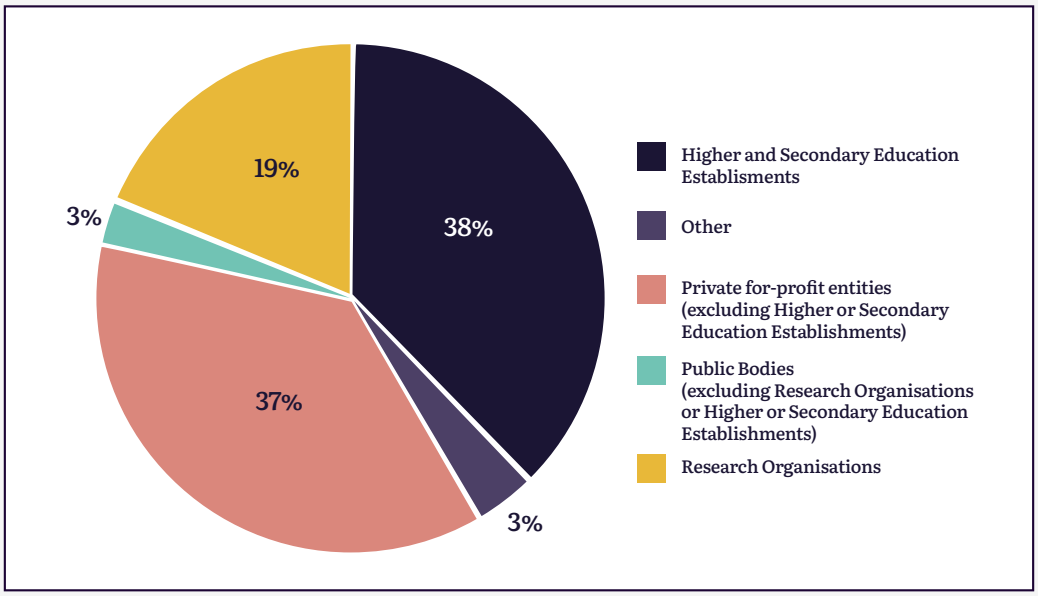


Chart 8. Participants' activity types by percentage. For FP7 and H2020 AI related projects

Over time, the participant approach confirms the main trend observed when looking at host institutions (see Findings section): a decrease in university leadership and a (less sharp) increase in funding going to private for-profit entities. The tendency is even more acute if we look at actual funding received by activity type: here, all activity types see their funding increase at the expense of the funds going to universities.

Charts 9 and 10. Distribution of participants and funding by activity type across all AI-related projects funded under EU FP7 and H2020 (2007-2020) by percentage

2. What gets funded

AI has a very wide range of applications. This section reports additional data that helped us unpack the AI-related research and study exactly which AI topics received the most EU funding.

Table 7 shows the distribution of AI-related projects funded between 2007-2020. We find that most funded projects fall under the pillars Excellent Science (which includes the ERC, Future & Emerging Technologies, Marie Curie actions and Research Infrastructures) (52.3%), with Industrial Leadership falling into second place (23.6%).

Domains	Percentage (Frequency)
EXCELLENT SCIENCE	52.3% (2508)
INDUSTRIAL LEADERSHIP	23.6% (1129)
SOCIETAL CHALLENGES	16.4% (785)
SPREADING EXCELLENCE	7.6% (362)
SCIENCE WITH AND FOR SOCIETY	0.2% (8)

Table 7. AI-related project distribution across pillars (percentages): high level analysis (projects under FP7 and H2020 are 4,792)

While relevant, this distribution does not provide insight into what is being funded. Therefore, we run the analysis from a different, more granular perspective, moving from pillars to domains to analyse recurrence and salience. Using this approach, we can confirm that the demand data corroborates the findings identified in the supply side analysis. Namely, the fields where AI-related terms are mentioned the most are Marie Curie, the ERC and ICT (Table 8).

Domains	Percentage (Frequency)
MARIE CURIE	26.5% (1271)
ERC	26.3% (1260)
ICT	16.7% (799)
HEALTH	4.5% (217)
FUTURETECH	4.5% (215)
TRANSPORT	4.4% (213)
SME	3.9% (189)
ENERGY	2.6% (126)
SECURITY	2.5% (120)
JTI	2.4% (113)
NANOTECH	1.5% (71)
SPREADING EXCELLENCE	1.5% (70)
SPACE	1.4% (68)
INFRASTRUCTURES	1.3% (60)
ECSEL	1.1% (53)
ENVIRONMENT	0.8% (39)
SOCIETIES	0.8% (37)
FOOD	0.7% (33)
EURATOM	0.3% (16)
SCIENCE FOR SOCIETY	0.2% (11)

Table 8. AI-related projects distribution across pillars (percentages)

Table 8 also confirms that after pre-competitive and technology-focused domains (ICT and FUTURETECH), Health and Transport are the most funded domains. Indeed, when looking at the ten most funded projects (see Table 12) across all AI-related projects funded under EU Framework Programmes, from FP1 to Horizon 2020 (1984-2020), and their domains of application, the data shows that Transport and Health are the areas receiving the most FP funding.

AI-related projects	FP	Domain of application	EU contribution (€ million)	Host Institution
Implementation of activities described in the Roadmap to Fusion during Horizon 2020 through a Joint programme of the members of the EUROfusion consortium	H2020	EURATOM	678.8	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV
Engine ITD - GAM 2018	H2020	TRANSPORT	171.9	MTU AERO ENGINES AG
Large Passenger Aircraft Innovative Aircraft Demonstrator Platform	H2020	TRANSPORT	170.6	AIRBUS
AIRFRAME ITD	H2020	TRANSPORT	160.9	DASSAULT AVIATION
Systems ITD	H2020	TRANSPORT	113.2	THALES AVS FRANCE SAS
Academia and Industry United Innovation and Treatment For Tuberculosis	H2020	HEALTH	92.5	STICHTING RADBOUD UNIVERSITAIR MEDISCH CENTRUM
Research training in artificial intelligence for industrial applications	FP6	MARIE CURIE	90.5	SKF B.V.
European Regimen Accelerator For Tuberculosis	H2020	HEALTH	89.8	UNIVERSIDAD CARLOS III DE MADRID
Airframe ITD	H2020	TRANSPORT	75.3	DASSAULT AVIATION
Second funding line in Work Programme 2018-2020 for the further development of a European SST Service provision function	H2020	SPACE	73.6	CENTRO PARA EL DESARROLLO TECNOLOGICO INDUSTRIAL

Table 9. Top 10 funded projects across all FPs for AI-related projects

To complement the analysis, we conducted a Structural Topic Model analysis of the projects' objectives. After tagging and cleaning the Cordis data, we sought to identify the 20 most frequently occurring words in AI-related projects.

	Algorithm	Artific-	Biometr-	Machineri/Machinelearn-	Automat-
FP1 (106 projects)	207	35	0	1	66
FP2 (222 projects)	496	69	2	1	81
FP3 (218 projects)	436	41	3	5	62
FP4 (538 projects)	798	92	31	17	131
FP5 (607 projects)	937	82	121	11	169
FP6 (485 projects)	529	63	57	2	63
FP7 (1.487 projects)	1.851	137	86	34	0
H2020 (5.266 projects)	2.945	4	2	181	554

Table 10. Frequency of AI-related keywords in projects' objectives across all FPs (1984-2020).

What is remarkable from this perspective is that the list does not include any references to ethics, privacy, trustworthiness or social impact, thus corroborating a trend already identified when analysing the demand side – namely that, in practice, the EC is neither promoting nor funding responsible, trustworthy AI.

#	feature	frequency
1	system/systems	17317
2	data	13240
3	algorithms	6683
4	development	6583
5	information	5520
6	develop	5350
7	design	5203
8	methods	4797
9	analysis	4674
10	models	4557
11	technology	4531
12	applications	4499
13	control	4492
14	developed	4468
15	techniques	4291
16	software	4174
17	tools	4050
18	results	4001
19	different	4001
20	network	3792

Table 11. Top 20 most frequent words across AI-related projects' objectives

Chart 11 shows the distribution of AI-related keywords included in projects' objectives across different FPs, allowing us to analyse their evolution over time. It is clear that overall there is an increase in the frequencies of the keywords analysed, which is coherent with the growth of the number of projects included in every FP. Once these words are weighted by number of projects, results show that "algorithm" is by far the most frequent of the selected words across all Framework Programmes and also the one with the greatest increase over time, especially between FP7 and H2020. Overall, frequencies for the words "artific-", "biometr-" and "machineri/machinelearn-" remain more or less steady over time, while "algorithm-" and "automat-" increase in use.

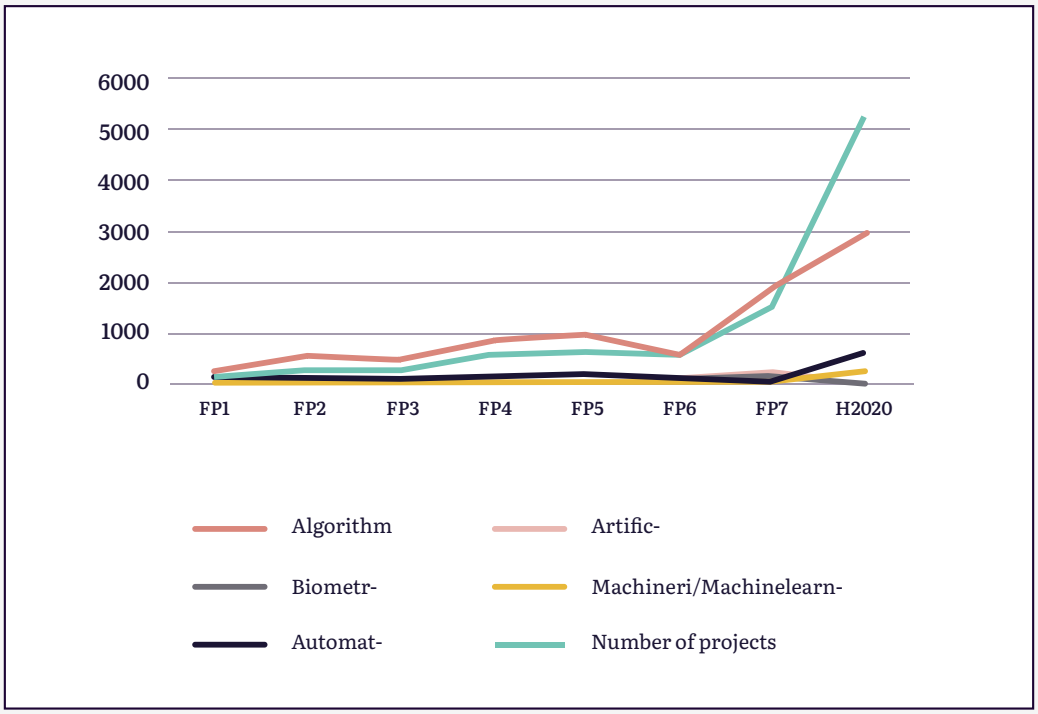


Chart 11. AI-related keywords in projects' topic descriptions over time (frequencies).

In order to understand which topics are the most salient across projects' objectives and what specific words are associated with each topic, we analysed how words cluster together to form latent topics.

Topic	Percentage	Terms
Algorithmic Modelling	7.6%	Problems, algorithms, theory, methods, problem, computer, mathematical
Artificial Intelligence	6.9%	Services, platform, technologies, solutions, industry, business, AI
Machine Learning	6.4%	Learning, machine, human, neural, models, brain, robots
Tech Business	6.3%	Market, business, solution, technology, companies, software, product
Research	6.2%	Training, researchers, scientific, development, systems, tools, developed
Digital Network Systems	6.2%	Systems, applications, computing, network, networks, performance, distributed
Systems Development	5.7%	System, design, software, development, systems, tools, developed
Biology	5.3%	Cancer, cell, clinical, cells, molecular, disease, novel
Systems Processing	5.1%	Process, control, production, system, industrial, materials, development
Quantum Technologies	5%	Quantum, physics, materials, systems, properties, experimental, information
Digital Health	4.7%	Health, patients, clinical, medical, care, treatment, patient
Social Communication	4.4%	Security, social, media, privacy, information, policy, public
Systems Management	4.4%	System, traffic, safety, systems, management, control, information
Environment	4.3%	Energy, power, system, control, systems, grid, efficiency
Digital Image Processing	4.3%	Image, 3d, imaging, processing, images, signal, optical

Table 12. Main topics informing AI-related projects' objectives across all FPS (FP1 to H2020) (1984-2020)

As can be seen, "algorithmic modelling", "artificial intelligence" and "machine learning" are the most common topics, together making up about 20.9% of the objectives. Graph 3 shows the relevance of each term concurring with the formation of the topics:

Graph 3. Main topics and relative terms informing AI-related projects' objectives for all FPS

Among the more technical terms, it is worth mentioning the salience of tech business-related terms. Once again, we find a clear emphasis on Health and Transport domains, but also on quantum technologies and the environment, something we had not yet come across in the analysis.

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