Generative AI Greece 2030

Possible futures of
Generative Artificial Intelligence in Greece.

With the support of the
Special Secretariat of Foresight

Trends - Opportunities for Greece - Vulnerabilities - Uncertainties -
Scenarios - Policy Proposals -

GenAI & Greece 2030

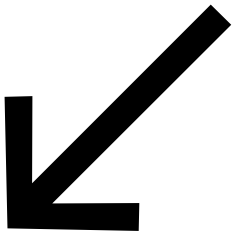
Greece 2024

FINAL ESSAY

December 2023

https://foresight.gov.gr

Generative Ai



Contributors

National Centre for Social Research (EKKE)

Charalampos Tsekeris, Principal Researcher EKKE (Scientific Responsible)Dimitra Kondyli, Research Director EKKE
Katerina Mandenaki, PhD, Department of Marketing and Communication Management, University of Athens
Nikos Stasinopoulos, PhD Political Science
Amalia Fragkiskou, Specialist Functional Scientist A grade EKKE

National Centre for Scientific Research "Demokritos"

Vangelis Karkaletsis, Research Director NCSR "D" (Scientific Responsible)
Stelios Karozis, Collaborating Researcher NCSR "D"
Denia Kanellopoulou, Collaborating Researcher NCSR "D"
Christos Spatharis, Postdoctoral Researcher NCSR "D"
Antigoni Moira, Scientific Associate NCSR "D"

Recommended citation format:

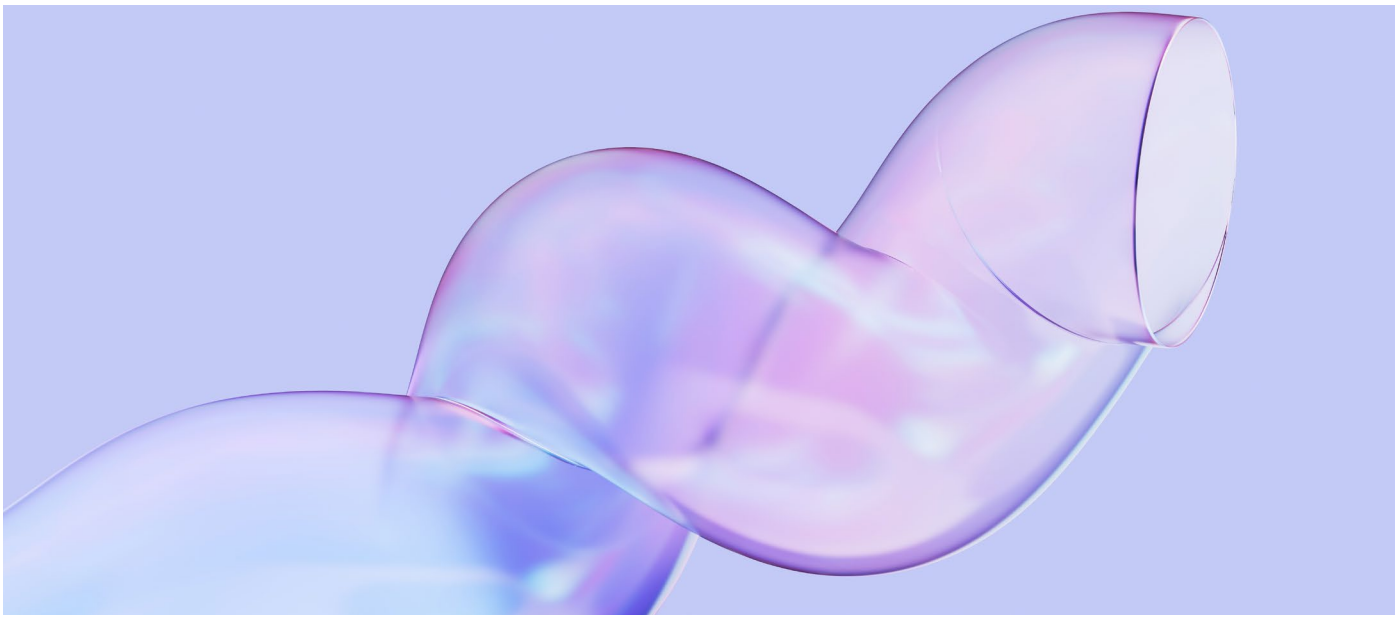
Tsekeris, X., & Karkaletsis, V. et al. (2023). Generative AI Greece 2030: Possible Futures of Generative Artificial Intelligence in Greece. Athens: Special Secretariat of Foresight.

EKKE & NCSR "D". (2023). Generative AI Greece 2030: Possible Futures of Generative Artificial Intelligence in Greece. Athens: Special Secretariat of Foresight.

Executive Summary

The present study is the first empirical strategic foresight research approach on the use of Generative Artificial Intelligence (GenAI) in Greece. The study, conducted by the National Centre for Social Research (EKKE) and the NCSR "Demokritos", with the support of the Special Secretariat of Foresight, presents trends, opportunities, challenges, uncertainties and possible options that will shape the future of the GenAI ecosystem in Greece. It provides a framework of proposed strategic initiatives and policy recommendations. Its main objective is to draw on the collective knowledge and foresight perceptions of a sample of Greek experts/specialists on the impact of the domestic GenAI ecosystem, in the time frame of 2030.

More specifically, following a thorough preliminary desk research, systematic literature review and multimethod horizon scanning, we proceeded to interviews using questionnaires. The informants are a rich and inclusive group of 30 experts representing different stakeholders (public administration, research-academic community, business-private sector and civil society, professional and scientific associations), who are systematically involved in GenAI. They were asked to evaluate a series of hypotheses and statements on the future (or possible futures) of GenAI in the country until 2030.

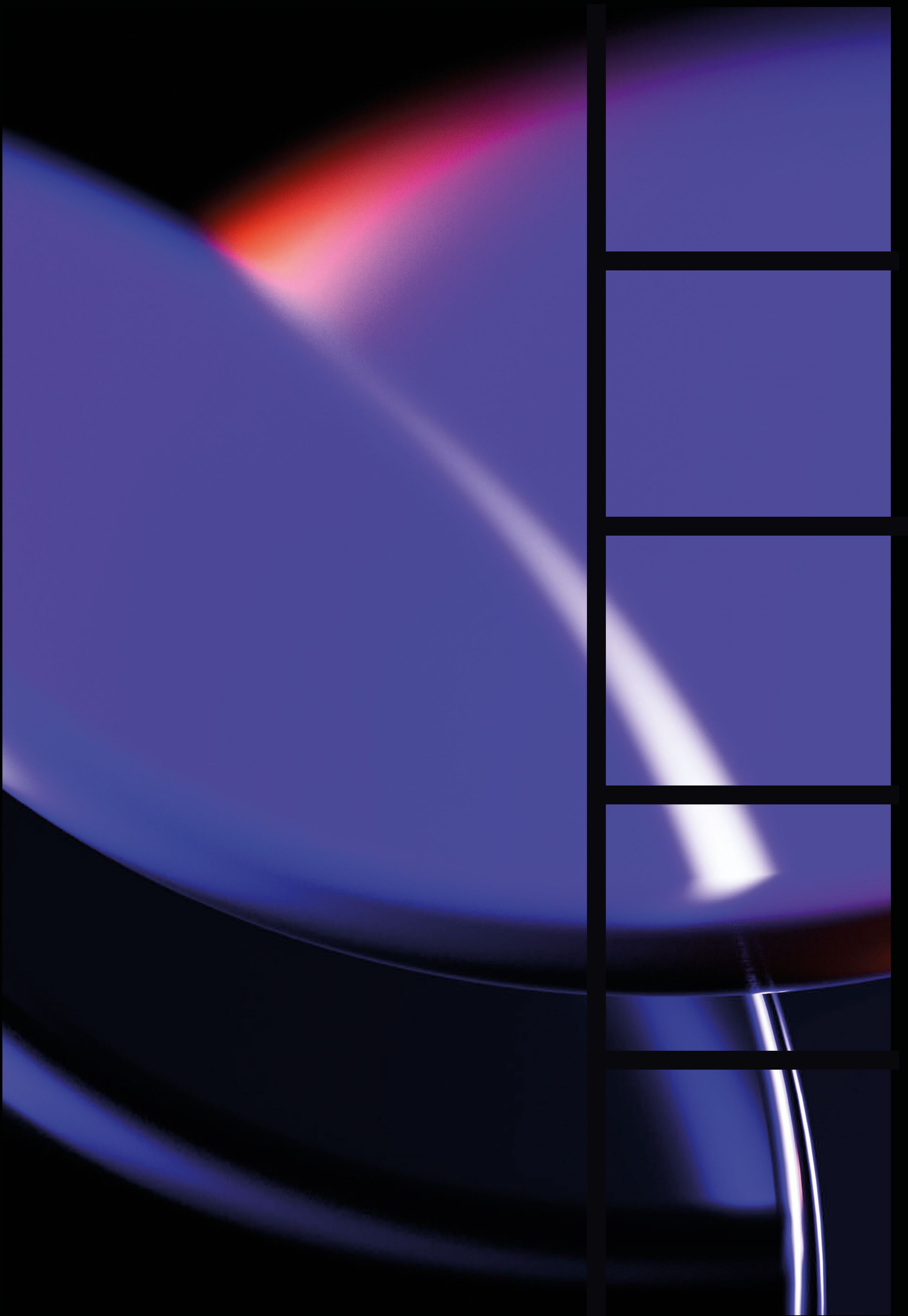


- GenAI is already here and seems to be an exponential and rather irreversible technosocial development that we have to learn to live with, avoiding the risks and taking advantage of its numerous benefits. This is a shared conclusion among our informants, although almost all of them consider that GenAI is at a very early stage, especially in Greece. Today, we are only observing fragments of tomorrow's GenAI's landscape. However, it is likely that it will not take a long time for the landscape to take shape.
- The mainstreaming of GenAI, either as general purpose or as special purpose technology, is expected to have a large and multi-level impact on Greek society by 2030, with a prevailing optimistic outlook on the nature of this impact. This optimism rests on the potential for qualitative changes in the way we live, interact, work, learn, produce and consume.
- Striving to assess how the dynamics of GenAI could evolve towards 2030, it is necessary to consider both the enabling factors that play a catalytic role and the inhibiting factors that limit or hinder the development of GenAI. The main accelerating factors include advances in new technologies that expand the technical capabilities of GenAI, digital literacy, large investments (both public and direct private investments as well as public-private parAIerships) by the technology sector, and the will of public policy, the economy as a macro-scale, businesses (for-profit or social) and society to embrace and harness GenAI. Key inhibitors include lack of interoperability and competitive standards, lack of digital literacy, incentives and long-term plans, defensive or technophobic mindsets as well as technology use fatigue.
- Although all informants prefer an open, inclusive and democratic breed of GenAI, there is a significant proportion of participants who regard and foresee that the technological field will be closed and centralized, dominated by few corporate actors, along with many digital inequalities and algorithmic injustices.
- Issues of digital ethics and regulation are of great concern to experts. On the one hand, excessive political or corporate interference and control could limit the level of functionality and innovation of GenAI. On the other hand, a low level of regulation could make users feel insecure about the reliability of content (e.g., fake news and deepfakes), their privacy and confidentiality, leading to a less positive and healthy culture of GenAI use.
- By 2030, targeted action and proactive policies around GenAI will be important and necessary for both private companies and the public sector.

This research presents four scenarios of possible alternative future images of GenAI in Greece by 2030. The first is called «techno-social acceleration», where the world is described as adaptable and freed from technophobic entanglements, while the sustainability and value of the GenAI ecosystem are at a high level accompanied by a fairly resilient liberal political system. In the second scenario, the «techno-dwarf», the open economy and a set of favorable political intentions prevail, but the GenAI ecosystem loses momentum and is not a priority due to excessive regulations and strict bureaucratic rules. The third scenario is described by the term 'technosocial tarriness". It represents a stunted or underdeveloped GenAI ecosystem in a closed and technophobic world, alongside a significant lack of ethical and regulatory frameworks, public policies, and institutional interventions. The fourth scenario depicts a «techno-giant» with feeble, poor legs and represents a GenAI ecosystem that reflects the global technological boom, but within a socio-cultural and political environment that is unable to turn speed into adaptation, to integrate modern techno-evolutions and to exploit the possibilities and opportunities they offer.

The global geopolitical and geo-economic order is becoming increasingly uncertain, complex and unstable. GenAI seems to amplify these systemic features, highlighting the need for an 'exponential' and future-oriented way of thinking. We cannot be sure what the future holds, nor can we avoid constant disruption in an era of permacrisis. But it is up to us to harness this generalized uncertainty/complexity, set long-term goals, adapt institutions and mindsets, be adequately prepared and work towards the most favorable scenario - i.e., the 'technosocial acceleration' scenario - to enhance the country's capacity for sustainable growth and resilient prosperity, based on dynamic diagnoses of the trends, uncertainties and opportunities emerging around us.

↗ TABLE OF CONTENTS



Introduction

Recent developments in the field of artificial intelligence (AI), and more specifically in the domain of generative artificial intelligence (Generative AI), are ushering in a wave of technological innovation capable of reshaping the fabric of society, the economy, and work. As this transformative technology continues to evolve at a rapid pace, Greece appears to be at the dawn of a new era, where Generative AI is poised to play a central role in accelerating automation, enhancing productivity, and revolutionizing various industries.

Generative AI systems have evolved - and continue to evolve - exponentially into a new form of techno-social subject, demonstrating an unprecedented ability to compose and produce content that resembles human results, to execute commands (in probabilistic terms), and to create *without thinking, feeling, understanding, explaining, or making moral judgments, to give a "why" to what happens*[1]. Generative AI demonstrates a continuously expanding range of possibilities, from creating primarily real texts to creating images, videos, music, and even computer code. The impact of the continuous development of Generative AI is enormous and affects many different sectors of activity such as healthcare, finance, entertainment, media, education, public administration, environmental protection, shipping, tourism, culture, etc.

This technology represents a major leap forward in human-machine[2] collaboration and convergence, comparable in significance to the advent of personal computers, the internet, and mobile technology. However, as with any revolutionary technology, Generative AI reconfigures our entire perceptual horizon, presenting its own set of challenges, including the potential for its systems to generate inaccurate or false information, raising questions about technical and epistemic reliability, as well as ethics.

As more and more organizations in Greece and around the world integrate Generative AI into their daily operations, we can imagine and anticipate profound technological, social, political, and environmental changes. The high degree of uncertainty and complexity accompanying these developments necessitates the implementation of a proactive approach strategy, namely participatory processes that allow for systematic understanding (but not prediction) of the environment and the forces shaping it, alternative future prospects, and scenarios for shaping policy and strategy.

In this strategic foresight study, we delve into the various dimensions of the impact of Generative AI in Greece, particularly focusing on the recording and analysis of the direct and indirect potential consequences as well as challenges of using this rapidly evolving technology, with a timeframe up to 2030. We explore the landscape of the multidimensional utilization of Generative AI, analyze trends, opportunities, vulnerabilities, and uncertainties, and use scenario construction to contribute to long-term planning and the formulation of proactive public policies. Our emphasis is on discovering opportunities and possibilities, as well as dynamically understanding and leveraging the complexity of the Generative AI ecosystem.

Our goal is twofold: First, to use strategic foresight tools to evaluate the potential "futures" of Generative AI in Greece, providing thematic information and identifying areas of opportunity for business and economic development. Second, to highlight vulnerabilities and "vulnerable" factors and to analyze how this new technology can be applied more broadly (beyond the field of economy and businesses) to address risks and manage and leverage challenges.

The "futures" of Generative AI in Greece can be imagined as filled with promises, but also with many risks and potential traps. This study, conducted in the fall of 2023 by the National Centre for Social Research (EKKE) and the National Centre for Scientific Research "Demokritos", with the support of the Special Secretariat of Foresight, aspires to serve as a compass for individuals, businesses, organizations, and policy-making bodies within the contemporary, ambiguous, and evolving socio-technological landscape. It opens up spaces for forward-thinking[3] and exploratory thought and provides the philosophy and tools needed for the effective navigation and utilization of Generative AI by our country.

The discussion about technology and how it integrates and changes our daily lives has intensified in recent years. The dramatic advancement observed in the field of Artificial Intelligence (AI) over the last decade and its first practical applications in research, industry, and various aspects of our lives have been the catalyst. These developments bring such significant changes to how we produce, consume, work, learn, stay informed, interact, and meet our needs, that it is now widely believed that humanity is in the midst of the 4th industrial revolution, with AI and big data as driving forces.

[1] See Floridi, L. (2023). AI as Agency Without Intelligence: On ChatGPT, Large Language Models, and Other Generative Models: Philosophy and Technology. Available at: https://ssrn.com/abstract=4358789

[2] According to the research program World Internet Project - Switzerland 2023, this convergence, known as "cyborgization," "enhances the religious nature of digitization." See https://mediachange.ch/research/wip-ch-2023/

[3] Azhar, A. (2021). Exponential Thinking. Research-Technology Management, 65(1), 11-17.

The digitization of the modern world (the so-called "2nd phase of digitization"[4]) and the enormous volume of data resulting from the use of the internet and various applications were among the main factors that triggered the development of AI. Access to such a large volume of data can make an AI application "smarter" and much faster than in the past. At the same time, the exponential growth of computing power enables the processing and utilization of all this data. Technological advancements, such as cloud computing and distributed computing, now allow us to store, process, and analyze data on an unprecedented scale (which would not be manageable without these advancements).

Even those who were not previously involved in the technology sector began to turn their attention to AI and to follow discussions about its capabilities and applications, especially after the creation of GPT-3[5] by OpenAI in the summer of 2020. Its ability to "converse" and provide answers in a manner resembling that of a human has impressed its users. Drawing from vast amounts of data and leveraging immense resources, funds, and computational power, OpenAI created a large language model (LLM) capable of unprecedented performance.

The question that naturally arises is this: Who *possesses the technology, the data, and the computational resources to create such large language models that will drive development and bring revolutionary answers to everyday needs and problems?* Will this opportunity remain in the hands of only a few large technology companies that will regulate the use and guide the applications?[6]

At this point lies the great challenge for the European Union (EU) and its member states. The current situation gives them the opportunity to actively participate in developments and to shape, at their discretion, the use of AI with a focus on its positive impact on the economy and social development. AI has the power to radically change business models and create value in many sectors, promoting competitiveness and the resilience of the economic system.

[4] Latzer, M. (2022). The Digital Trinity—Controllable Human Evolution—Implicit Everyday Religion: Characteristics of the Socio-Technical Transformation of Digitalization. KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie, 74(Suppl 1), 331-354.
[5] OpenAI. (2020). Language models are few-shot learners. Proceedings of the 34th International Conference on Neural Information Processing Systems (NIPS'20), 1877–1901.
[6] Lehdonvirta, V. (2022). Cloud empires: How digital platforms are overtaking the state and how we can regain control. MIT Press.

A Few Words about the Prospective Methodology ↙

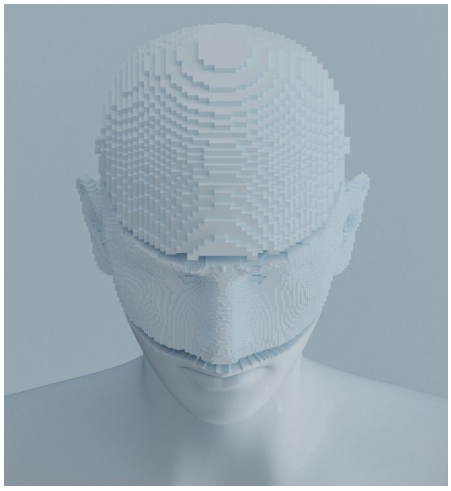
The forward-looking methodology[7] followed here is as follows:

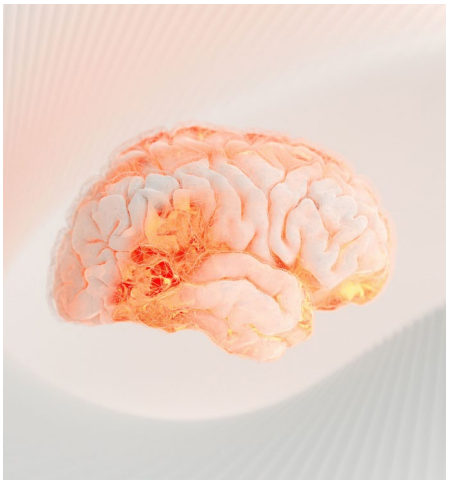
Following a comprehensive preliminary desk research, systematic review of scientific literature, as well as expert opinions and executive reports, the team conducted a multidisciplinary horizon scanning[8], including interviews using questionnaires (with closed and open-ended questions). The informants were drawn from a rich and as comprehensive as possible sample of 30 specialists, representing various stakeholders (public administration, research-academic community, private sector-enterprises, and civil society, professional, and scientific organizations) systematically involved in the National Technology Strategy (NTS). The aim of this investigation was to evaluate a series of assumptions/statements regarding the future (or, more precisely, potential futures[9]) of NTS in the country until 2030. Among the questions raised were what NTS is, how it is perceived to evolve and be implemented, which factors will play a decisive role (inhibitory or acceleratory) in its adoption or rejection, what reservations are expressed, which sectors of the economy and fields of society it will disrupt, for what purpose it is estimated to be used, etc.

The interdisciplinary scientific team (EKKE & NCSR "D") conducted an *initial environmental*[10] scanning to gather actionable real-time information, both at the level of (a) events, (b) trends, (c) emerging issues, and (d) expectations.

It is essential here to further clarify what foresight is and how it frames the concept of the future[11], as a term of plurality, feasible, possible, or desirable, and as a reference horizon for our policy proposals regarding the NTS. The approach to foresight requires a different mindset and perception of the present in its historicity, between experience and expectation or "presumption" of the impending, distinguishing the "presentified" past from the "presentified" future, but also from the "futureified" present. The future as an inductively extending perception of now (as if it were just a few mechanical "tic" clock moments ahead) is not experienced by us in the same way as the future as a meeting with unexpected challenges for our current perception and knowledge.

It might be fruitful to perceive the future as a horizon of expectations in the form of our present horizons rather than as a simple aggregate of events that we are called to guess[12]. Each individual lived present of a social group has its own horizon of the future from the perspective of an observer, and there are heterogeneous potential future presents for which our present constitutes their reasonable past[13]. These distinctions are of utmost practical importance to clearly discern how populations are either discouraged or encouraged regarding the adoption of technological affordances and related policy scenarios and proposals.





[7] This methodology is informed by similar foresight work related to emerging technologies linked to policy proposals at the European Union level. Indicatively mentioned here is the ETICA methodology (Ethical Issues of emerging iCt Applications), which constitutes a foresight analysis methodology used by organizations such as the European Commission to guide decision-making in applied technology policy fields. More recently, with a focus on AI issues, there is the AI4People, an Atomium—EISMD initiative. See, for example:
-AI4People Project http://www.eismd.eu/ai4people
-ETICA Project https://cordis.europa.eu/project/id/230318
-Floridi, L. (2019). What the near future of artificial intelligence could be. Philosophy & Technology, 32(1), 1–15.
-Floridi, L. et al. (2021). An Ethical Framework for a Good AI Society: Opportunities, Risks, Principles, and Recommendations. In: Floridi, L. (ed) Ethics, Governance, and Policies in Artificial Intelligence. Philosophical Studies Series, vol 144. Springer.
-Floridi, L. (2014). Technoscience and ethics foresight. Philosophy & Technology, 27(4), 499–501.
-Lucivero, F. (2016). Ethical assessments of emerging technologies. Springer.
-Nazarko, Ł. (2017). Future-oriented technology assessment. Procedia Engineering, 182, 504–509.

[8] Systematic scanning and collection of events and trends, resulting in the formation of different (alternative) visions of the future and/or visual mapping of change indicators. https://commission.europa.eu/strategy-and-policy/strategic-planning/strategic-foresight_en

[9] Methodologically, it is advisable to speak of futures in the plural, while their non-predefined outcomes have many nuances. This is not just a philological observation. It is indicative that a rigorous and results-oriented organization like the US Department of Defense coined a term in the 1990s to describe the modern world: VUCA - an acronym for volatile, uncertain, complex, and ambiguous. This semantic breadth accurately describes the challenges of futures studies and is a useful tool for the explicitly expressed goals of this research, including how to encourage innovation in AI, mitigate potential risks, and enhance public trust in these issues, among others.

[10] There exists a plethora of basic methodologies and approaches for exploring strategic foresight in the literature. Here, we leverage the most critical methodologies for the original empirical exploration of NTS in Greece. One of the established reference handbooks in the scientific community is Jerome C. Glenn and Theodore J. Gordon's (2009) Futures Research Methodology Version 3.0 (The Millennium Project).

[11] Koselleck, R. (1979). Vergangene Zukunft: Zur Semantik geschichtlicher Zeiten. Suhrkamp. Koselleck similarly uses the terms "gegenwärtige Vergangenheit" and "vergegenwärtigte Zukunft"

[12] Luhmann, N. (1980). Temporalization of Complexity: On the Semantics of Modern Time Concepts. In Gesellschaftsstruktur und Semantik: Studien zur Wissenssoziologie der modernen Gesellschaft. Suhrkamp, 235–300

[13] Luhmann, N. (1991). Risk: A Sociological Theory. De Gruyter, 41.

Methodologically, the analysis of trends and megatrends, the identification of weak signals[14], and the mapping of scenarios largely depend on the approach we adopt regarding the future. It is well-established in the relevant international literature that there are generally three clusters of epistemological assumptions on which a foresight study can methodologically rely[15].
1. Either a *positivist* approach to the future, which involves a predictive character based on probability models. This approach is interested in the "probable" future, favoring "top-down" scenarios, where passive adaptation to technological developments by social actors is usually preferred.
2. Alternatively, a *cultural/interpretive* approach is discussed, where the focus is on the "possible" or alternative futures, tending to highlight perspectives that are underrepresented, invisible from the dominant paradigm of future treatment, often consistent with the robust positivist model mentioned earlier. In this context, the major research subject and the target of policies are primarily vulnerable, underrepresented population groups and their expectations. The priority here is not the passive acceptance of technological developments but the active participation of stakeholders. A variation of this approach is that of "participatory futures," which emphasizes consultation with involved social groups and mobilizing local communities in collaboration with scientists. A key advantage of the above is that it facilitates the engagement of stakeholders in the decisions made jointly.
3. Finally, a *critical* approach to "desirable futures" is proposed, where the significant question and policy priority are not what is statistically probable but who decides what is desirable to prioritize. It is worth noting here that focusing on the desirable may lead to a neglect of what is realistic to expect in our policies from a future perspective.

Both the formulation of long-term policies and the perception of societal actors cannot ignore in their plans critical issues such as climate change and digital transformation, the future-oriented temporal modalities of possible worlds, and related scenarios that unfold before us. Our expectations need to be positioned against clusters of uncertainties (and not just isolated imminent events), with inherently incomplete knowledge about them. The following diagram (Figure 1) is called the "cone of the future" and resembles a funnel precisely because as we move away from the present, the diameter of possible scenarios increases, and exponentially widening factors that can influence developments.

[14] In the scientific field of foresight, the term "weak signal" describes "a first raw piece of information that can be interpreted as an initial indication of potential change (opportunity or threat) within a system. At the same time, it could be interpreted as an initial indication that carries dynamic for changing a trend. Unfortunately, in such a rapidly changing and complex, 'noisy' environment, it is indeed a challenge to distinguish signals that have real significance for the future... identifying weak signals is difficult and accompanied by many uncertainties and failures, i.e., signals that either did not develop as expected or did not bring the expected changes." [Source in Greek: https://www.futures.gr/2019/10/08/ασθενή-σήματα-ποια-πτυχία-μπορούν-να-ε]
[15] Contrary to many, here we follow the informative, concise classification of Jennifer Gidley, an iconic researcher in futures studies, author of a related handbook recently published in Greek as well. See Gidley, J. (2017/2022). The Future: A Very Short Introduction. University of Crete Press, pp. 197-200.

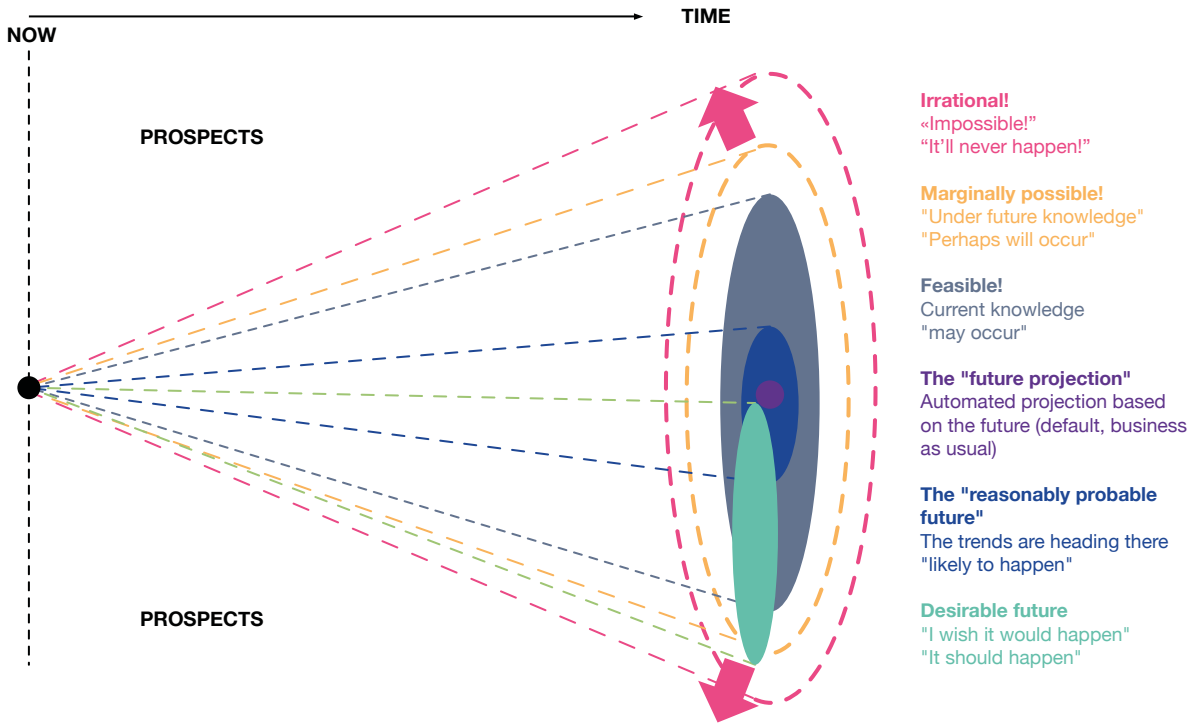


Image 1: *"The cone of the future." Adaptation of Hancock & Bezold, from Voros J (2003). A generic foresight process framework. Foresight, 5(3), 10-21.*

The above visualization of future scenarios pertains to subjective judgments, at the level of individuals or broader social actors, regarding anticipations and expectations about the future that are based on present beliefs. Therefore, the same idea can be categorized - over time - into different categories than the ones listed below[16]:

- Firstly, anything beyond the present constitutes a **potential future**, based on the fundamental premise of futures studies that the future is indeterminate and "open."
- The **preposterous** future, which may seem absurd or even ridiculous by present standards.
- The **plausible** future, which pertains to the range of future possibilities that we believe "could" occur based on the often measurable and quantifiable state of the present and its trends (social processes construed as natural "laws" or "regularities"). This often aligns with the **projected** future, which concerns the typical expectation of what will happen if things continue along a "business as usual" logic. It represents a default scenario, a simple continuation of the present, a perpetuation of the status quo, and usually serves as the baseline against which the other future scenarios articulated here are compared.
- The **possible** future, which encompasses futures that we now believe are possible, given a future knowledge and causal relevance of events that we do not currently possess but could reasonably acquire in the future.
- The **preferable** or desirable future, which pertains to what we consider we would wish or should happen (or not happen). These future scenarios involve normativity and evaluative judgments, distinct from the other, more tropic, futures outlined above, which are primarily epistemic judgments.

Of course, the above distinctions are merely analytical discrete categories. In real life, we observe compositions of these categories and transitions from one to another during the evolution of a significant event or the introduction of a new technology into our lives. A metaphorical transfer of the above "cone of the future" might resemble a lens emitting rays of light projecting into the future. Additionally, we observe in the cone that as we approach the center, "logic" prevails, while at the periphery, the categories seem to touch the boundaries of imagination. However, what will become reality for us in the future draws from both of these fields, with a characteristic example being "Wildcards"[17], scenarios with event outcomes that seem to have particularly low statistical probability of occurring and resemble "fantasy," but sometimes they do happen and have enormous impacts on our lives[18].

[16] We rely here on: Voros, J. (2017). Big History and anticipation: Using Big History as a framework for global foresight. In: Poli, R. (ed.) Handbook of anticipation: Theoretical and applied aspects of the use of future in decision making. Springer.
[17] See: Barber, M., Analyst, S., & Vic, B. (2006). Wildcards–Signals from a future near you. Journal of Futures Studies, 11(1), 75-94.
[18] Indicatively:
- Petersen, JL (1997). The wild cards in our future: Preparing for the improbable. The Futurist, 31(4), 43-47.
- Petersen, JL (1999). Out of the blue: How to anticipate big future surprises. Madison Books.
- Taleb, N. (2007). The black swan: The impact of the highly improbable. Random House.

Since it's a reasonable question that often leads both the general public and experts to misunderstandings, we must clarify that deepening studies on foresight regarding uncertainties and vulnerabilities does not imply cultivating insecurity, even indirectly. Quite the opposite! *Foresight studies aim precisely to make citizens socially and psychologically resilient and social systems sustainable, so that we can feel secure and safe*[19].

Cultivating "anticipatory capacity"[20] through methodologies and education in foresight and future literacy empowers citizens and stakeholders to change how they "use the future" and thus become capable of imagining different futures in a dialogical, realistic, and ethically responsible manner. Consequently, they can specify their areas of action in the present and leverage their "anticipatory capacity" in their own narrative within the specific socio-economic and cultural context[21].

[19] We must clarify that: a) another type of uncertainty concerns the probability-centric dimension of future estimates and another concerns the psychological and political management of citizens' security in relation to the future, and b) another issue is security as security and another is security as safety, leading to different perceptions of the future and policy priorities. Security as security has a preventive character and is associated with short-term protection and management of deliberate risks, threats, and damages, such as cyber hacking, which is characteristic of crime. Security as safety accepts the above, but also refers to the protection of social structures from risks and damages and is not attributed to specific malicious human action, such as damage to life and property. It has a public, preventive, regulatory character and is associated with long-term, future-oriented sustainability. It is a fundamental protective mechanism for citizens that alleviates the fear of inherent insecurity, as a constitutive condition and condition and not a casuistic, ex-post treatment. A forward-looking policy that addresses insecurity only as insecurity usually promotes strict regulation through ex-ante or ex-post sanctions. Without this distinction, neither a fundamental dimension of the current consultation on security and precaution for the drafting of the European AI ACT can be understood.

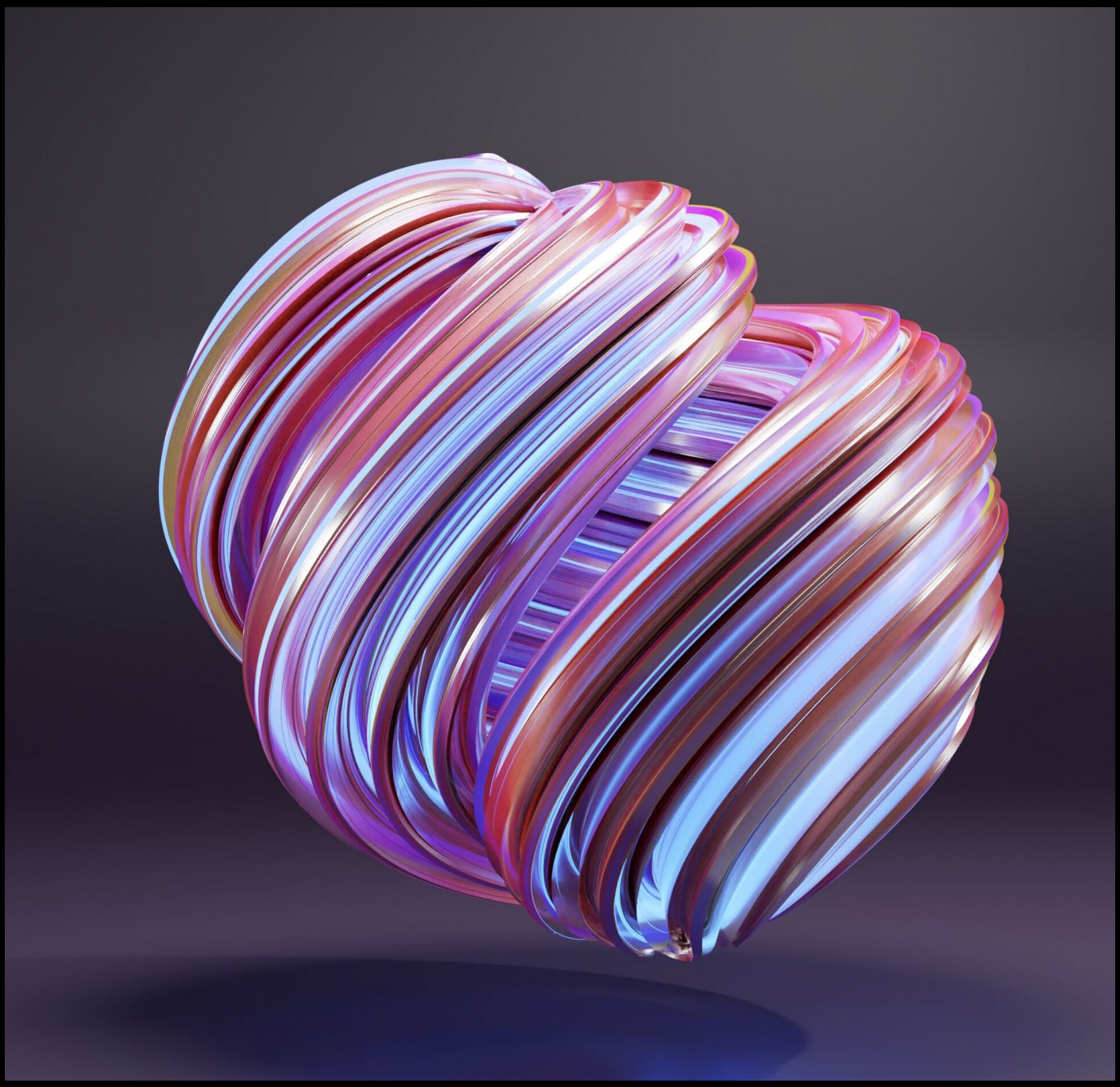
[20] It is worth mentioning that UNESCO, in 2019, the year of the first international Symposium on Anticipatory Systems, Futures Studies, and Futures Literacy, had already created nine such chairs (UNESCO Chairs in Anticipatory Systems, Futures Studies, and Futures Literacy), with the main goal of developing a global network to establish literacy in anticipatory capabilities and futures for all, within and outside the framework of education. See related https://en.unesco.org/events/first-international-symposium-unesco-chairs-anticipatory-systems-futures-studies-and-futures.

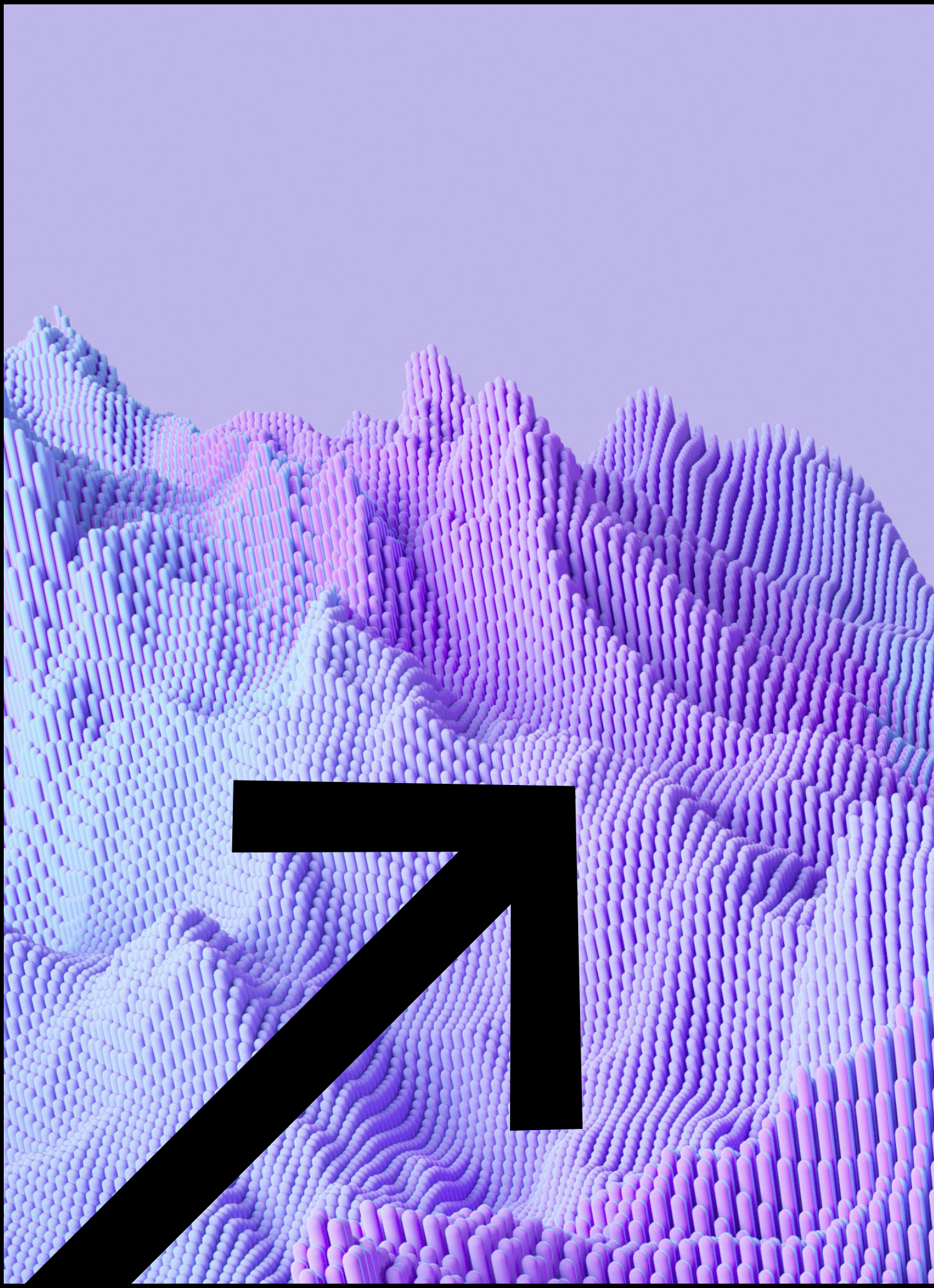
[21] Miller, R. et al. (2018). Transforming the Future. Anticipation in the 21st Century. UNESCO Publication via Routledge, pp. 18-20. Riel Miller, UNESCO Head of Futures Literacy, created a typology, a cross-tabulation correlating the development of anticipatory capacity with the creation of open or closed social systems. He urges us to theorize about the anticipation of the future either as "a colonization of the future in order to feel secure (in terms of secure, not safe)," or sometimes as "a fate-worshiping attitude towards the future where imagination atrophies," or as "a decisive creative imagination where an effort is made to make a difference compared to what existed until now," or as "an active perception of readiness for action but in the direction of adaptation with the existing" (in the same, pp. 32-34). Additionally, on the subject:

- Miller, R. (2007). Futures Literacy: A Hybrid Strategic Scenario Method. Futures, 39(4), 341–362.
- Miller, R. (2011). Using the future: a practical approach to embracing complexity. Ethos–Journal of the Singapore Civil Service, 10, 23-28.
- Miller, R. (2014). Networking to Improve Global/Local Anticipatory Capacities – A Scoping Exercise: Narrative Report. UNESCO/Rockefeller Foundation.
- Miller, R. (2015). Evaluating and Improving the Use of the Future for Identifying and Choosing Dynamic Opportunities. UNESCO/Rockefeller Foundation
- Miller, R., & Poli, R. (2010). Anticipatory Systems and the Philosophical Foundations of Futures Studies. Foresight, 12(3), 7–17.
- Poli, R. (ed.) (2017). Handbook of Anticipation: Theoretical and Applied Aspects of the Use of the Future in Decision Making. Springer.
- Rosen, R. (1985). Anticipatory Systems: Philosophical, Mathematical, and Methodological Foundations. Pergamon Press.

The method of horizon scanning adopted in this study, in a still unmapped field in Greece, is a necessary step for the systematic cultivation of a "future-oriented" mindset in the governance and regulation of new technologies. In this direction, we trace trends and early "weak signals" for emerging developments, catalysts, facilitators, or hindering factors for the exponential technology of AI and its regulation. This research helps us prioritize and identify relevant indicators. Discussions with experts, bibliographic and online searches, and the processing of current reports on relevant issues in real time are fundamental tools.

Subsequently, the Trends we identified in various fields of activity are presented, reflecting the already recorded contribution of AI technologies, as well as forecasts for the expansion and shaping of the international market. Then, the opportunities emerging from the development and implementation of AI in various sectors of economic and social life are presented, from Public Administration and Justice to Culture, Construction, and Agriculture. In the following two sections, *Vulnerabilities* and concerns arising from the rapid evolution and mutation of AI are developed, as well as the *Uncertainties* that may disrupt its adoption and adaptation. In the section "AI Productivity and Greece 2030," the possible *Scenarios* we designed to arrive at *Policy Proposals* and the success conditions of a *Positive Narrative* of AI application in our country are presented in the final section of this work.





Trends

Trends

AI is changing the "fabric" of human knowledge and is in constant evolution, offering new possibilities and opening up new horizons in many sectors. Trends reflect the demand for higher quality and variety in content creation, as well as the desire to expand AI capabilities in various areas.

According to a recent McKinsey[22] study, as highlighted by Athanasios Chymis, Researcher at the Center for Planning and Economic Research (KEPE): "*the impact of AI on productivity globally could add $2.6 to $4.4 trillion annually. Furthermore, AI will increase the overall impact of artificial intelligence by 15% to 40%. The same study estimates that approximately 75% of the value that AI could offer falls into four sectors: customer operations, marketing and sales, software design, and research & development. This means, according to the same research, that the industries with the greatest impact from AI will be banking, high technology, and life sciences. The reason is that AI by definition has the ability to support customer interactions, generate creative content for marketing and sales, and draft computer code based on natural language.*"

Algorithms are evolving and incorporating new techniques, providing new opportunities for applications that require high creativity and naturalness in the generated content, such as text, music, video production, and other forms of multimedia content.

In this study, technological, environmental, political, social, and economic trends of AI are described. These trends constitute directions of change in AI over time, as well as the foundations for identifying opportunities in the Greek context, as well as the challenges we are called to face. The latter, together with the positive scenario that Greece can follow and pursue, shape the axes of policies that must be taken into account.

[22] McKinsey & Company. (2023). The economic potential of generative AI. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier#work-and-productivity

Technological Aspects

Human-AI Collaboration

As AI capabilities evolve, a crucial question arises: What will be the consequences for human life, work, and interaction with AI? AI is increasingly becoming involved in human activities, with Deloitte noting that over half (53%) of organizations have already begun adopting robotic process automation[23]. This trend is expected to further expand, with AI potentially automating up to 65% of tasks and significantly reducing costs[24]. The evolving relationship between humans and AI underscores the need to carefully examine the changing landscape of work and daily life in this increasingly AI-enhanced world.

Multimodal AI

According to data on the use of foundational AI models, or "base models," the top position is held by large language models, with 71% of AI companies using and developing them, followed by multimodal models[25] at 38%.

A multimodal model is a type of AI capable of accepting and generating information from multiple sources, such as text, images, sound, video, etc. The trend towards transitioning to multimodal models arises from the belief that these models will achieve higher accuracy compared to traditional models, thereby extending their application to a diverse set of applications. Additionally, multimodal models do not have an exclusive dependence on text data and the limitations that come with it, such as exclusive use for text generation, lack of knowledge extraction from contextual multimedia, and limited generalization ability.

In the research domain, notable works include GATO[26], Decision Transformer[27], and PALM-E[28], which focus on training multimodal models capable of processing text, images, and value sequences, enabling them to generate effective control strategies.

Assistance in code writing

GPT provides developers with a valuable toolkit to enhance their productivity. This includes capabilities such as code conversion from one programming language to another, automation of writing tasks, and code explanation.

In the field of code production, notable research and tools have emerged to further assist developers. Specifically, tools like Codegen[29] and CodeGeeX[30] represent significant progress in this area. Additionally, widely recognized tools such as Co-Pilot[31],ChatGPT[32], and Llama[33] hold a prominent position in the developer community for their ability to aid in various activities related to code writing and correction.

[23] McCrindle. (2023). The future of human-AI interaction. https://mccrindle.com.au/article/the-future-of-human-ai-interaction/
[24] McKinsey & Company. (2022). The state of customer care in 2022. https://www.mckinsey.com/capabilities/operations/our-insights/the-state-of-customer-care-in-2022
[25] LEAM:AI. (2021). Large AI Models for Germany – Feasibility Study 2023. https://leam.ai/feasibility-study-leam-2023/
[26] Reed, S. et al. (2022). A Generalist Agent. Transactions on Machine Learning Research.
[27] Chen, L. et al. (2021). Decision Transformer: Reinforcement Learning via Sequence Modeling. Neural Information Processing Systems.
[28] Driess, D. et al. (2023). PaLM-E: An embodied multimodal language model. Proceedings of the 40th International Conference on Machine Learning, Vol. 202.8469–8488.
[29] Nijkamp, E. et al. (2022). CodeGen: An Open Large Language Model for Code with Multi-Turn Program Synthesis. International Conference on Learning Representations.
[30] Zheng, Q. et al. (2023). CodeGeeX: A Pre-Trained Model for Code Generation with Multilingual Benchmarking on HumanEval-X. Proceedings of the 29th ACM SIGKDD Conference on Knowledge Discovery and Data Mining. 5673–5684.

Documented Summary of Decisions

The process of summarizing for evidence-informed decision-making involves condensing a large volume of information into a summarized format. These summaries provide decision-makers with essential knowledge, findings, and facts necessary for making sufficiently evidence-based decisions based on available data. This approach finds particular resonance in fields such as healthcare, business, and the academic community, where data analysis plays a critical role in shaping choices and strategies. An example that serves the above purpose is PolicyGPT[34], which provides summaries of information for privacy policies.

Detection of Content Generated by AI

Detection of content generated by AI refers to the ability of AI systems to accurately identify and distinguish content that has been generated or manipulated by other algorithms. This trend is particularly significant in efforts to combat the spread of misinformation, deepfakes, and other forms of AI-generated content that can deceive, misinform, or manipulate individuals[35]. Additionally, it is essential for maintaining and re-establishing credibility and authenticity in digital media.

Rise of Web3 Services Utilizing Productive Artificial Intelligence

The rise of Web3 (Spatial Web)[36] services using AI represents a significant evolution in the digital world. Leveraging blockchain technology, Web3 aims to create an internet where users have control over their data and transactions. Furthermore, AI can enhance user experience on Web3 platforms by providing personalized content and interactions. Lastly, AI fundamentally transforms the sphere of Web3 marketing, boosting the capabilities of marketing strategies. A recent study[37] attempts to shed light on this trend, providing useful insights into how AI tools are utilized in commerce to enhance productivity and accelerate the marketing cycle.

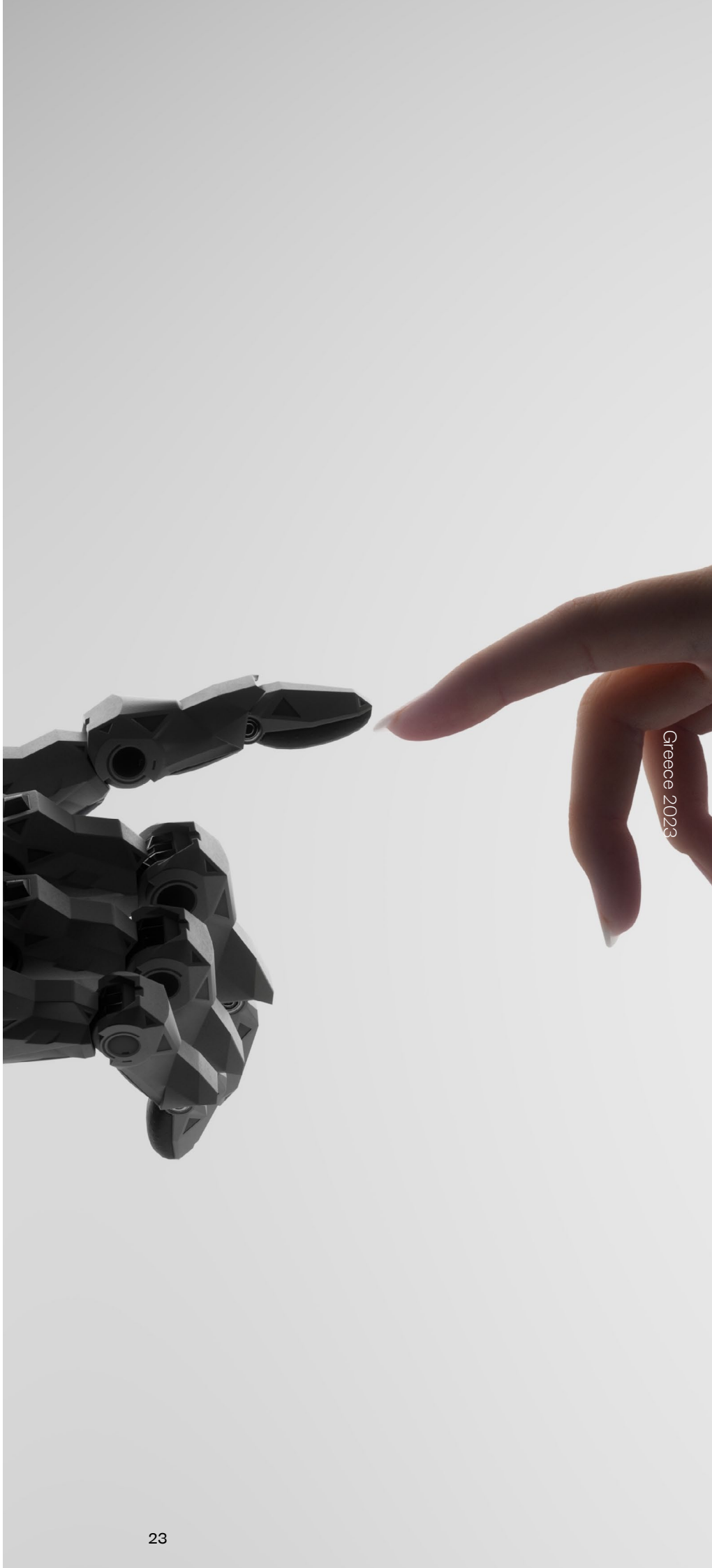
Further Development of Natural Language Processing

The advancement of new methodologies in natural language processing (NLP) continues unabated in the research space, exploring various aspects of LLMs, such as generalization ability, reasoning capability, understanding of AI decisions, cost reduction, among others. Simultaneously, one of the most useful and widely recognized use cases of LLMs is text translation. Extensive research has shown that translation using LLMs often surpasses popular translation software like Google Translate[38]. This underscores the remarkable potential of LLMs in overcoming language barriers and facilitating effective cross-linguistic communication.

Autonomous AI Systems

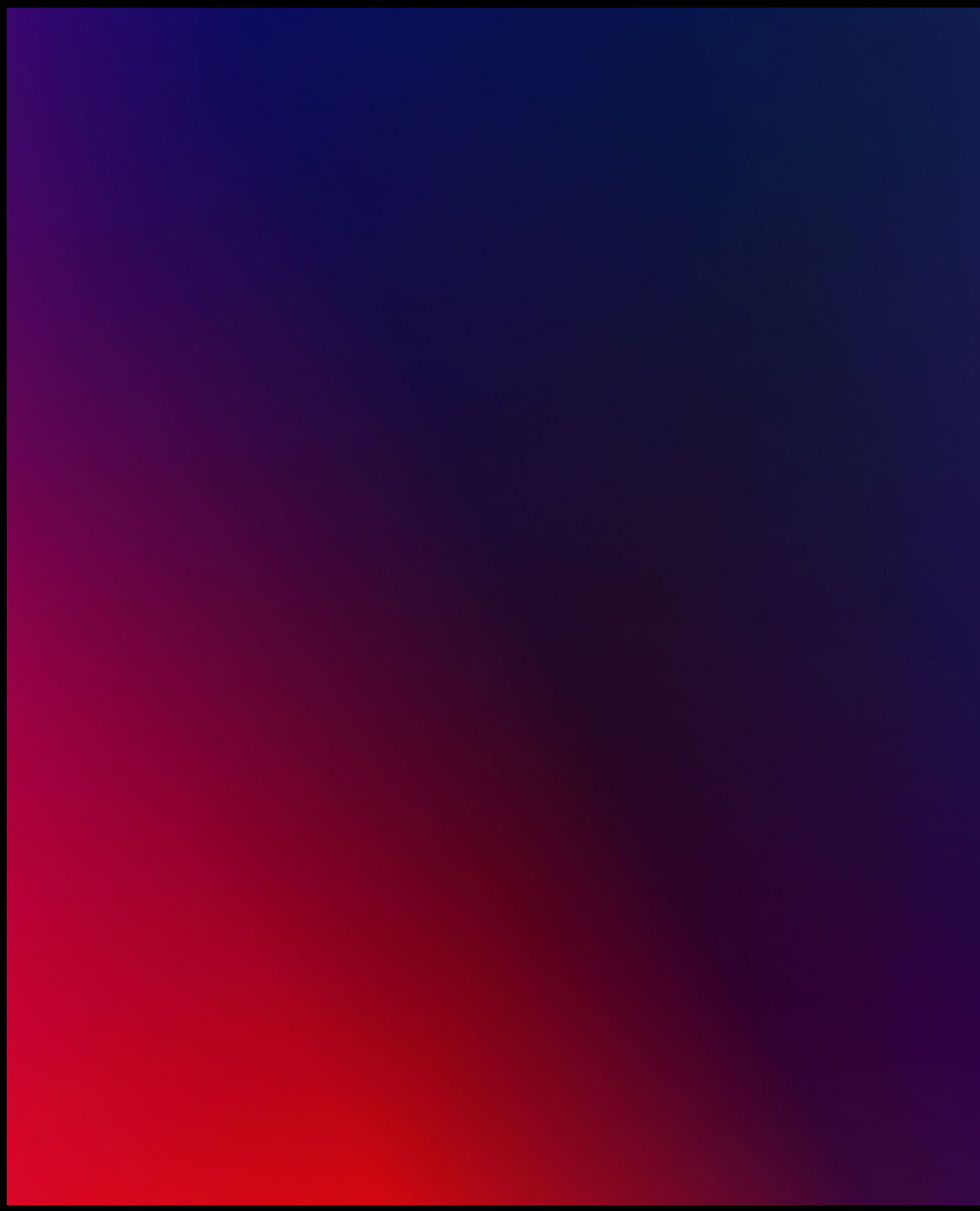
This marks a notable leap in the field of productive AI applications. These systems operate independently, continuously generating content in response to queries without the need for constant user interaction. Unlike traditional chatbot applications, which rely on user-initiated questions and answers, autonomous AI applications execute more complex and advanced functions, making them highly flexible.

An outstanding example is Auto-GPT[39], an autonomous AI system capable of generating content and performing a wide range of tasks without requiring continuous guidance from users. The autonomous nature of these models paves the way for a new generation of AI applications capable of handling increasingly complex and dynamic scenarios with minimal human intervention.



[31] Github Copilot, https://github.com/features/copilot
[32] OpenAI. (2023). ChatGPT [Large language model].https://openai.com/blog/chatgpt
[33] Touvron, H. et al. (2023). LLaMA: Open and Efficient Foundation Language Models. ArXiv.
[34] Tang, C. et al. (2023). PolicyGPT: Automated Analysis of Privacy Policies with Large Language Models. ArXiv.
[35] Wang, L. et al. (2022). Deepfakes: A new threat to image fabrication in scientific publications? Patterns.
[36] World Economic Forum. (2023). What is Web3 and how could it change the internet? https://www.weforum.org/agenda/2023/03/what-is-web3-and-how-could-it-change-the-internet/
[37] Botco.ai, The State of GenAI in Marketing, https://insights.botco.ai/the-state-of-GenAI-chatbots-in-marketing-report
[38] Jiao, W. et al. (2023). Is ChatGPT a Good Translator? Yes With GPT-4 As The Engine. ArXiv.
[39] AutoGPT. (2023). What is Auto-GPT and why do we care? https://autogpt.net/what-is-auto-gpt-and-why-do-we-care/

Economic Aspects



According to a study conducted in 2019 by Accenture Greece in collaboration with Microsoft in Greece[40], it is estimated that AI could add $195 billion to the country's GDP over a 15-year period, while it is projected that by 2030, the AI product market will amount to $500 billion.

Investment in Research and Development for AI

As indicated by the financial data of major corporations, significant emphasis is placed on research and development for AI applications. Specifically, both Alphabet and Meta have substantially increased their research and development expenses in recent years[41]. These figures indicate a commitment to innovation and technological advancement in a rapidly evolving sector, with no one wanting to be left behind.

Democratization of AI

Currently, there is a huge gap between the tech giants and those who lack the financial means and computational resources required for AI model training. This problem is also confirmed by a spokesperson for a multinational technology company, emphasizing the need for "*democratization of digital technology and access to it for a much larger portion of the population.*" The prevailing trend aims to promote the democratization of AI through distributed learning, open-source communities, and the creation of data centers accessible to all citizens.

Financial Aspects

AI can enhance fraud detection and prevention by analyzing vast amounts of transaction data to identify suspicious patterns and potential threats in real-time. Additionally, it can optimize investment strategies by processing market data, news, and historical trends to provide insights and predictive models based on data, assisting financial institutions and investors in making informed decisions. In customer service, chatbots and virtual assistants can provide personalized financial advice, answer queries, and assist in account management, improving overall customer experience[42].

Below are some examples of AI applications in the financial sector:[43]

• Capital One and JPMorgan Chase[44] utilized AI to enhance their fraud detection and suspicious activity monitoring systems with AI. This effort reportedly resulted in a significant reduction in false positives, improved detection rates, cost reduction, and enhanced customer satisfaction.

• Morgan Stanley Wealth Management[45] will leverage OpenAI's technology to harness its vast data sources to support financial advisors with information on companies, sectors, asset classes, capital markets, and regions worldwide.

• Wells Fargo is developing document processing automation capabilities, including providing summary reports and scaling chatbot virtual assistants.
• Goldman Sachs and Citadel are exploring AI applications for internal software development and information analysis.

[40] Accenture. (2019).[31] Github Copilot, https://github.com/features/copilot
[41] The Wall Street Journal. (2022). Big Tech Is Spending Billions on AI Research. Investors Should Keep an Eye Out. https://www.wsj.com/articles/big-tech-is-spending-billions-on-ai-research-investors-should-keep-an-eye-out-11646740800
[42] Chen, B., Wu, Z., & Zhao, R. (2023). From fiction to fact: the growing role of generative AI in business and finance. Journal of Chinese Economic and Business Studies, 1-26. https://doi.org/10.1080/14765284.2023.2245279
[43] Shabsigh, G., & Boukherouaa, E. B. (2023). Generative Artificial Intelligence in Finance. FinTech Notes, 2023(006). https://www.elibrary.imf.org/view/journals/063/2023/006/article-A001-en.xml
[44] Finextra. (2023). Generative AI: The Missing Piece in Financial Services Industry? https://www.finextra.com/blogposting/24089/generative-ai-the-missing-piece-in-financial-services-industry
[45] AIMultiple. (2023). 10+ Generative AI Finance Use Cases in 2023. https://research.aimultiple.com/generative-ai-finance/

Environmental Aspects

Sustainable Design

It focuses on the sustainability of data centers within the framework of the Climate Neutral Data Center Pact[46], aiming to establish standards for their sustainable operation. Among the pact's key goals are improving energy efficiency, transitioning to green energy sources, and promoting equipment reuse and recycling.

Environmental Monitoring

It significantly contributes to activities such as methane emissions monitoring, air quality monitoring, measuring environmental footprints, and emission reduction. In the context of environmental sustainability, AI serves as a valuable tool for collecting and processing data from various sources, thus enabling the provision of real-time information and forecasts regarding environmental conditions.

Rise of "Green" AI

As AI models continue to evolve, the increasing complexity and demand for computational power raise environmental concerns regarding the notably increased carbon footprint. In response, significant emphasis is placed by the research community on developing energy-efficient algorithms and architectures.

Resource Optimization

In light of sustainability initiatives, there is an urgent need for waste reduction, cost reduction, and efficiency enhancement, with AI at the forefront as a key ally in achieving these goals. This is accomplished through the analysis of vast datasets and the creation of actionable information for optimizing resource management.

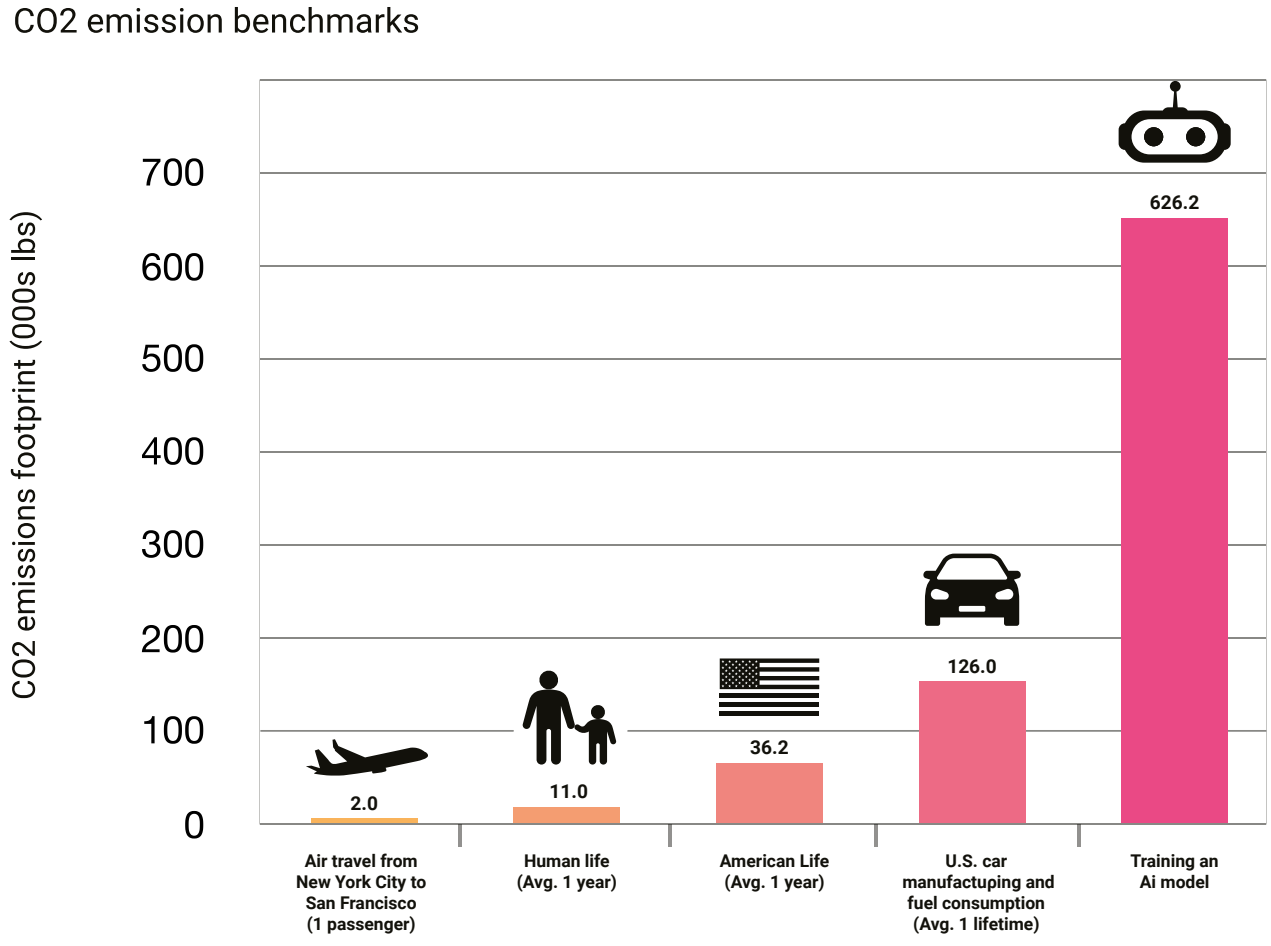


Image 2: *The carbon footprint for training AI models is estimated to be approximately 5 times larger than the footprint of producing a car and the fuel it consumes in 1 year in the USA.*

Political Aspects

Ethical Guidelines

There is a need to provide a framework of broader universal political guidelines and standards for developers and AI users to ensure that their systems are designed and used ethically. This includes principles such as transparency, justice, and the protection of privacy and human rights. As K. Sampatakakis states, "*There will be a need for a comprehensive regulatory framework, similar to the General Data Protection Regulation (GDPR), to define the terms of operation and protect citizens from a technology that is so complex that they cannot easily understand its risks.*"

Labor Market

AI has the potential to play a dual role in addressing the challenges of job displacement and creating new opportunities in the workforce. On the one hand, it can automate routine and repetitive tasks across various sectors, leading to increased efficiency and productivity but also to job displacement, mainly of the better-trained and better-paid workforce[47]. Additionally, as observed by a representative of a multinational technology company, AI can contribute to "*addressing shortages in specialized personnel in remote areas.*"

However, it can also act as a catalyst for job creation, fueling demand for roles related to AI, such as AI system developers, data analysts, or specialists in digital ethics, who are necessary for the development, maintenance, and responsible use of AI systems. Furthermore, as AI technology continues to evolve, it opens up new avenues for innovative roles and industries, promoting the need for a workforce with expertise in the field of AI.

In a related report by the World Economic Forum titled "The Future of Jobs 2023[48]," the expected evolution of jobs and skills over the next five years is examined, based on employer knowledge, emphasizing the central role of technology adoption in driving business transformation during this period. In terms of foresight, although numerous research reports, conferences, and scientific meetings on the "*future of work*" have been conducted to date, the approaches followed are often unilateral and do not comprehensively address the complex, multi-level, and *multifaceted system of dynamic changes*, where work is just one manifestation[49].

Therefore, we must explore the long-term future, primarily using large-scale global research as a guide[50].

Intellectual Property Rights and Commercial Rules

The proliferation of AI systems raises significant questions regarding the ownership of rights to the content they produce. A notable challenge lies in the ability of AI systems to generate content that closely mimics human-generated content, thus blurring the boundaries of intellectual property. Consequently, intense debate has emerged concerning the legal ownership of content produced by AI systems and the appropriate mechanisms for compensating their creators. Furthermore, with the increasing use of AI across various sectors, there is a need to establish a clear institutional framework that clearly regulates intellectual property rights over creations generated by AI systems, such as patents, trademarks, and copyrights.

Geopolitical Competition

The rapid spread of AI systems raises significant and complex geopolitical issues. The race for technological dominance intensifies geopolitical competitions, especially between the United States and China[51], as countries seek to leverage the capabilities of AI for economic, technological superiority, and influence on global norms. As AI systems become increasingly capable of creating realistic content (text, images, and videos), they have the potential to influence the power dynamics between states and the nature of competition in the 21st century.

It is now evident that AI can create immediate geopolitical risks through its ability to produce highly targeted deepfake videos, disinformation campaigns, and large-scale cyber-attacks, posing threats to national security and trust in institutions. States also compete to set dominant standards for a technology that many believe is as socially and economically impactful as the Internet.

[46] Climate Neutral Data Centre Pact. https://www.climateneutraldatacentre.net/

[47] Financial Times. (2023). Here's what we know about generative AI's impact on white-collar work. https://www.ft.com/content/b2928076-5c52-43e9-8872-08fda2aa2fcf

[48] World Economic Forum. (2023). The Future of Jobs Report 2023. https://www.weforum.org/publications/the-future-of-jobs-report-2023/digest

[49] Tsekeris, C., & Christofilopoulos, E. (2023). The Future of Work from the Perspective of Foresight. In: The Future of Work. Friedrich-Ebert-Stiftung.

[50] Regarding the global research conducted by the Millennium Project (in which Greece also participated), it resulted in three detailed scenarios for the future of work: (1) the scenario of "self-negotiating economy," (2) the scenario of "future despair," and (3) a "mixed scenario." Glenn, J.C., Florescu, E., & The Millennium Project Team. (2019). Work/Technology 2050: Scenarios and Actions. The Millennium Project. https://www.millennium-project.org/projects/workshops-on future-of-worktechnology-2050-scenarios/

[51] Brookings. (2023). The geopolitics of generative AI. https://www.brookings.edu/events/the-geopolitics-of-generative-ai/

Cybersecurity and National Security

Effective addressing of cyber threats and data breaches requires the implementation of robust measures and regulations in the field of cybersecurity. These measures include secure data storage and transmission, advanced identity verification methods, and strict access controls, which are necessary to safeguard digital assets.

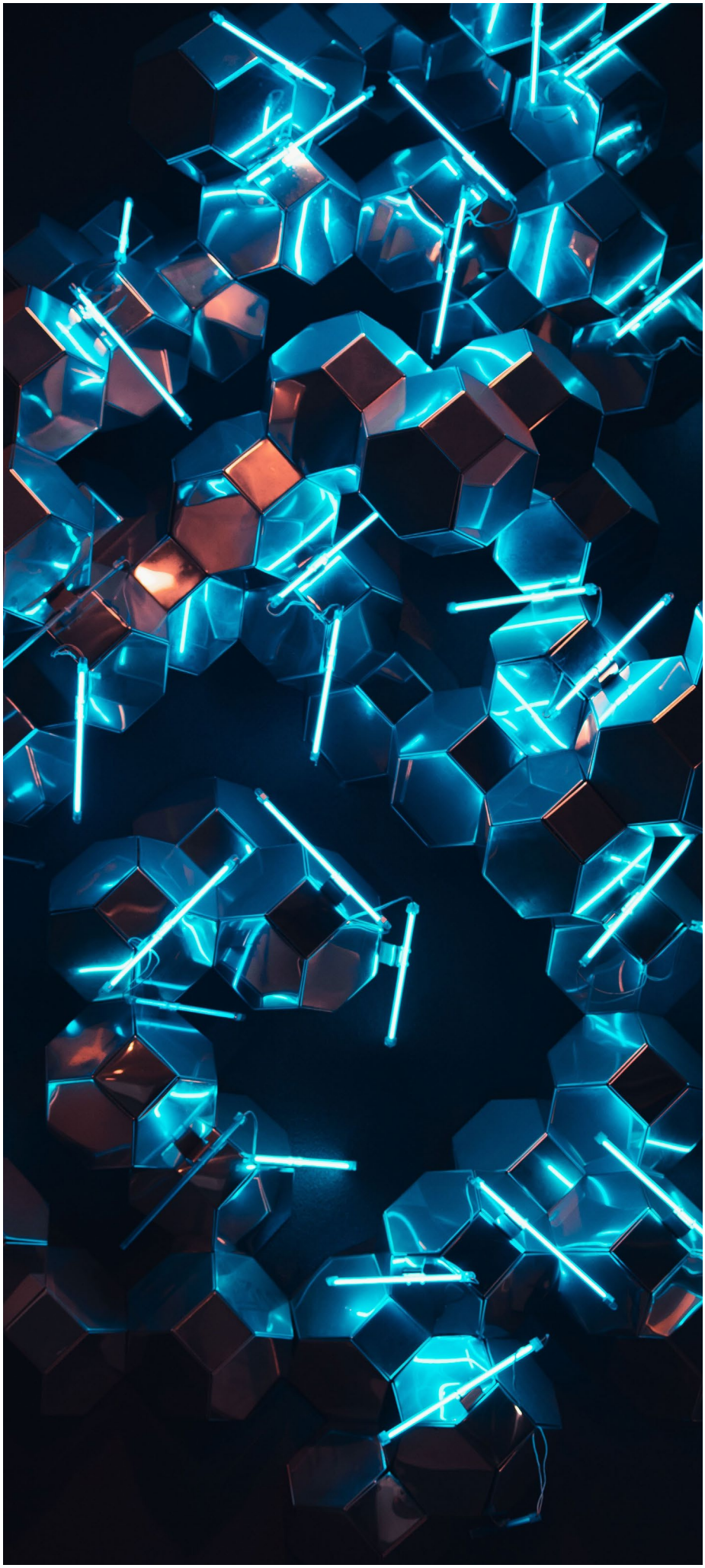
At the same time, there is a growing demand for data and information platforms, highlighting the importance of ensuring the security of these vast networks. Another significant issue is the exploitation of AI by malicious users (hackers), emphasizing the need for continuous vigilance regarding cybersecurity.[52]

National GenAI Strategies

Countries are increasingly developing comprehensive plans and strategies to promote their capabilities in GenAI[53]. Some of them have a particularly aggressive approach with investments in research, talent acquisition, and infrastructure, while others develop a more collaborative approach to promote their GenAI[54] capabilities.

International Cooperation

The explosion of GenAI has strengthened the arguments for the necessity of global cooperation[55]. Generally, collaborative efforts between different countries to promote and develop GenAI are increasing. These efforts take various forms, including joint research programs, exchange of best practices, establishment of standards, and common initiatives to address global challenges such as climate change and economic development.



Social Aspects

Productive AI in arts and culture

This emerging trend stems from the evolution of AI systems to create extremely complex and original forms of art, music, and literature. Through extensive training on vast datasets containing various works of art and cultural objects, AI promotes standards and styles that span across different genres. Consequently, it can produce entirely new or novel content that often closely resembles creations produced by humans. This evolution has led to the emergence of a new landscape of digital art that not only pushes the boundaries of creativity but also disrupts conventional artistic processes.

It seems that AI is reshaping the broad field of cultural and creative industries, redefining humanity's age-old concern for nature and the direction of its creativity, as well as its assistance through technology. In this context, four scenarios have recently been formulated for the future of AI, with an emphasis on AI in these types of industries (arts and culture):

1) *AI can become an assistant and enhance human creativity.*

2) *We may be led to a slow adoption of AI due to deficiencies in relevant skills in the human workforce, as well as ethical and legal complications regarding the intellectual property rights of creators.*

3) *Super-intelligent AI almost completely replaces human talent in creative industries because it may be more cost-effective in the medium term, and human creative effort often proves unproductive and does not produce measurable results.*

4) *Limited impact of AI on cultural production, as AI may offer low-creativity - merely imitative - results (narrow GenAI)*[56].

In the context of this discussion on the emerging impacts of AI on the fields of cultural/creative industries, even the legal framework of intellectual property rights is facing a new model: "*material created by artificial intelligence cannot be used to replace a human author. Specifically, material created by artificial intelligence cannot be classified as source material for adaptation in any way, and if a studio wants to use a screenplay created by AI, there can be no credited author, and therefore, no intellectual property right.*"[57]

Ethical concerns

With the continuous evolution and expansion of AI, it seems that discussions and concerns regarding ethics are increasing significantly. It is important to note that many of these discussions surpass old "dualistic" or "Manichaean" tendencies by acknowledging the duality of AI: the same technology entails both good and bad uses[58]. However, here we must introduce an analytical distinction according to which the framework of guiding principles is divided into: a) procedural principles that govern the functionality of systems, such as accountability, transparency, explainability, interoperability, bias management, and scientific validity as a value, and b) ethical principles that prospectively coexist and harmonize, such as autonomy and respect for human dignity, protection of privacy and rights against unfair third-party management, the principle of non-harm and benefit, the avoidance not only of the digital divide but also of the broader social impacts of algorithmic bias and the creation of automated inequalities in benefit distribution, solidarity and the sense of co-belonging, justice, responsibility towards the creation of safety locks for human control of automation in algorithmic decision-making, as well as the integration of ethical standards already from the design process of the generated technological systems.

A significant current concern revolves around the potential misuse of content produced by AI, especially in the creation of deepfake videos that can spread false information or serve malicious purposes. The creation of filtering mechanisms is vital, allowing AI systems to autonomously adapt to ensure compliance with ethical rules. Additionally, the concept of trustworthy use of AI extends beyond ethics, encompassing philosophical, legal, and technological dimensions[59].

[51] Brookings. (2023). The geopolitics of generative AI. https://www.brookings.edu/events/the-geopolitics-of-generative-ai/
[52] McKinsey & Company. (2022). Cybersecurity trends: Looking over the horizon. https://www.mckinsey.com/capabilities/risk-and-resilience/our-insights/cybersecurity/cybersecurity-trends-looking-over-the-horizon
[53] OECD.AI Policy Observatory. (2023). How countries are implementing the OECD Principles for Trustworthy AI. https://oecd.ai/en/wonk/national-policies-2 [54] Holon IQ. (2020). 50 National AI Strategies - The 2020 AI Strategy Landscape. https://www.holoniq.com/notes/50-national-ai-strategies-the-2020-ai-strategy-landscape
[55] Callirgos, P. (2023). Charting the path to global AI governance: potential and ethics. https://www.bsg.ox.ac.uk/blog/charting-path-global-ai-governance-potential-and-ethics. University of Oxford Voices.
[56] https://www.futuresplatform.com/blog/scenarios-future-of-ai-creative-industries
[57] https://openstandards.ellak.gr/2023/07/12/i-pithani-kindini-sti-nomothesia-gia-tin-paragogiki-techniti-noimosini/
[58] See for example Urbina, F., Lentzos, F., Invernizzi, C., & Ekins, S. (2022). Dual use of artificialintelligence-powered drug discovery. Nature Machine Intelligence, 4(3), 189-191.
[59] Fraunhofer. (2023). Trustworthy use of Artificial Intelligence. https://publica-rest.fraunhofer.de/server/api/core/bitstreams/d0828008-b4f0-44f1-a9b5-77946fe25278/content

Prejudices and Discrimination

Some of the major challenges in AI systems are prejudices, stereotypical generalizations, and erroneous judgments. These issues arise due to biases present in the data and related to human behavior[60]. However, efforts to eliminate all sources of bias from the data are becoming increasingly intense with the aim of creating unbiased models. Additionally, after training the base models, the common practice is to *fine-tune* the models by experts to avoid unwanted behaviors.

Privacy

Ensuring the protection of privacy is of utmost importance[61]. According to recent research, there is a risk of violating privacy and property rights of third parties, namely the end-users of a service[62]. There is the issue of data violation of a user utilizing a digital service without their consent (e.g., a company creating a digital game targeting end-users with the main indirect purpose of collecting their behavioral data and selling it to another company, without the consent of the game users).

Overall, it seems that AI intensifies these concerns, the mitigation of which is associated with the use of multiple filtering and anonymization strategies. In Greece, as Nikos Demertzis, Professor of Political Sociology & Communication at the University of Athens, points out, there is the "privacy paradox," meaning that while we are genuinely concerned about the integrity of our personal data, "*we accept, however, in a digital voluntarism sense, that privacy does not exist, and that we have nothing to hide when simultaneously millions of us expose moments of our private lives on social media or give away our digital footprint for commercial and other purposes whenever we accept the cookies of a website.*"[63]

Public acceptance and mindset change

As with any new technology, skepticism and concern surround these new systems regarding their potential social impacts. For instance, according to a survey by FocusBari/YouGov, upon hearing the term "Artificial Intelligence," almost one in two internet users in Greece express skepticism or doubt, one in three have positive feelings, and one in five report negative feelings. This perception seems to align with the empirical findings of the research project conducted by the *Greek World Internet Project in 2022* (WIP-GR 2022)[64]. However, as people become more familiar with AI technology and realize its various advantages, there is a noticeable transition towards increased acceptance. In fact, we tend to trust AI despite our reservations[65]. Nonetheless, there is still a significant level of concern, especially in cases where AI plays a role in decision-making processes.[66]

[60] See for example, Sunstein, C. R. (2019). Algorithms, correcting biases. Social Research: An International Quarterly, 86(2), 499-511.
[61] Véliz, C. (2021). Privacy is Power. Melville House.
[62] Carlini, N. et al. (2020). Extracting Training Data from Large Language Models. USENIX Security Symposium.
[63] https://www.kathimerini.gr/society/562228378/arthro-toy-n-demertzi-stin-k-axiopistia-kai-paradoxiidiotikotita-sto-diadiktyo/
[64] See Tsakeris, X., Demertzis, N., Papadoudis, G., Linardis, A., Mandenakis, K., & Christofilopoulos, E. (2023). The Internet in Greece: The 4th wave of the World Internet Project Greece. EKKE & Special Secretariat of Foresight. https://doi.org/10.17903/wip4_gr
[65] It's about the so-called "trust paradox" towards AI. See related: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0288109
[66] https://www.weforum.org/agenda/2022/01/artificial-intelligence-ai-technology-trust-survey/

Opportunities

Opportunities

Global trends in AI define the environment in which new opportunities emerge at a national level for innovation, development, as well as for the upgrading and modernization of sectors of the economy. These opportunities, emphasized by a forward-looking approach, can significantly contribute to the co-evolution of the country's techno-socio-economic framework and shape new pillars of long-term and sustainable development. In this section, sectors and specializations of opportunities are mentioned through the Greek perspective, taking into account local specificities, needs, and capabilities, by analyzing the responses of 30 specialists (see Figure 3), representing various stakeholders.

AI can create new, original content, such as text, images, or music, and this is a strong future trend according to the experts who participated in our empirical research (see Figure 4). The combination of these two technologies opens up exciting possibilities such as the creation of unique digital assets that can belong to and be traded on the blockchain.

As a representative of a multinational technology company stated in the context of our research, "*AI has the potential to support higher quality, greater volume of content, and higher productivity of workers.*" Furthermore, according to a recent study conducted by Deloitte Digital[67] in the United States among 640 marketing companies, AI is already reshaping content production for marketing, with 26% of respondents already using AI and another 45% planning to use it by the end of 2024. The same study reveals a 54% increase in the volume of content produced by companies in the previous year, while 65% of them are concerned about intellectual property or legal risks associated with AI use. However, AI users report a time saving of approximately 11.4 hours per week, allowing them to dedicate themselves to higher value or more strategically significant tasks. Nevertheless, according to our aforementioned interlocutor: "AI tools require human intervention for the immediate production and evaluation of outputs and, therefore, are tools that help people in their daily lives. While the content created using AI in the future is likely to continue to be guided by humans."

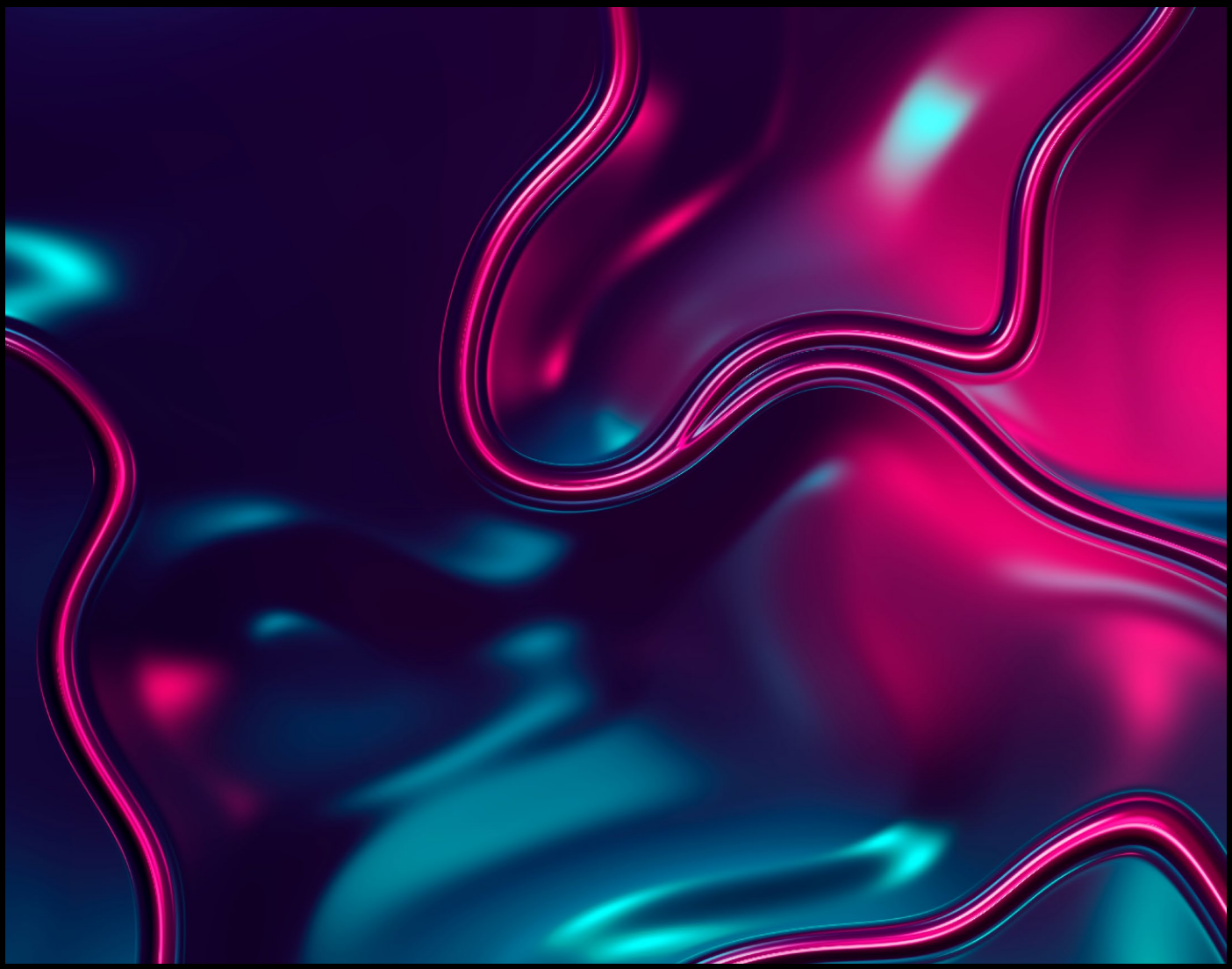
In the same vein, Lefteris Helioudakis, Board Secretary of Homo Digitalis, an AMKE (Societe Anonyme with Cooperative Form) that operates in the defense and promotion of Human Rights in the digital age, estimates that: "*there is certainly a small chance that by 2030 most of the digital content we see, read, or hear will be created by AI if the term '*created*' refers to the exclusive creation of digital content.*" For the Homo Digitalis team, such a scenario would be inevitable, as "*this would be a great failure of our generation.*" *However, L. Helioudakis clarifies that* "*if by '*created*' we mean a broader use of smart tools for content production by humans, then the answer is yes, there is a very high probability.*"

In September 2020, The Guardian published an article[68] written entirely by OpenAI's ChatGPT. In the linguistically articulate article created by AI to answer the question posed by the newspaper's editors, 'convince us that robots have peaceful intentions', ChatGPT itself writes: "*People must be cautious about the evolution of AI. Microsoft tried to create a user-friendly AI that spoke like a teenager... and it was racist. AI, like any other living thing, needs attention. AI must be treated with care and respect.*"

If we overlook the technical manipulations with which the model expresses itself in the article, the ability of AI to produce - seemingly original - content and the possibility that humans will "consume" it should be considered given, as Kyriakos Sampatakakis, Country Managing Director of Accenture Greece and Managing Director of Greece and Central-Eastern Europe, also estimates. However, he observes that: "*the maturity of the technology will also influence the speed of its implementation in each category of digital content. For example, the text and images published on various websites (news, blog posts, etc.) will likely be largely determined by GenAI much earlier than 2030. Other categories of digital content such as feature-length films will take longer, although even in these cases the content will incorporate extensive elements of GenAI.*"

[67] Deloitte. (2023). Deloitte Digital's latest research forecasts generative AI's transformation of content marketing. https://www.deloittedigital.com/us/en/blog-list/2023/GenAI-press-release.html

[68] The Guardian. (2020). A robot wrote this entire article. Are you scared yet, human? https://www.theguardian.com/commentisfree/2020/sep/08/robot-wrote-this-article-gpt-3



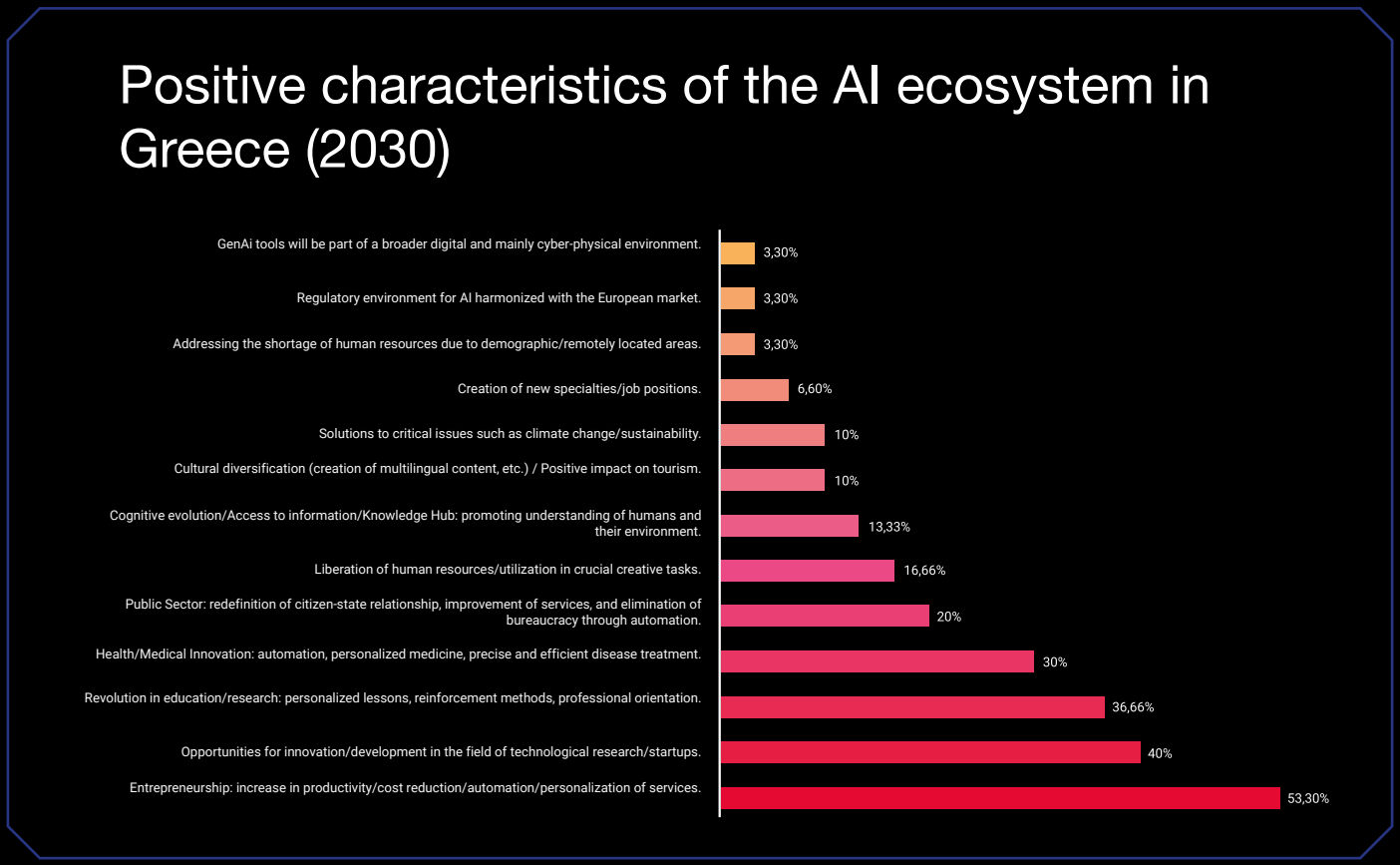


Image 3: *Experts' responses regarding the opportunities from the AI ecosystem in Greece until 2030.*

Do you consider it likely that by 2030 the majority of the digital content we see, read, or hear will be created by AI?

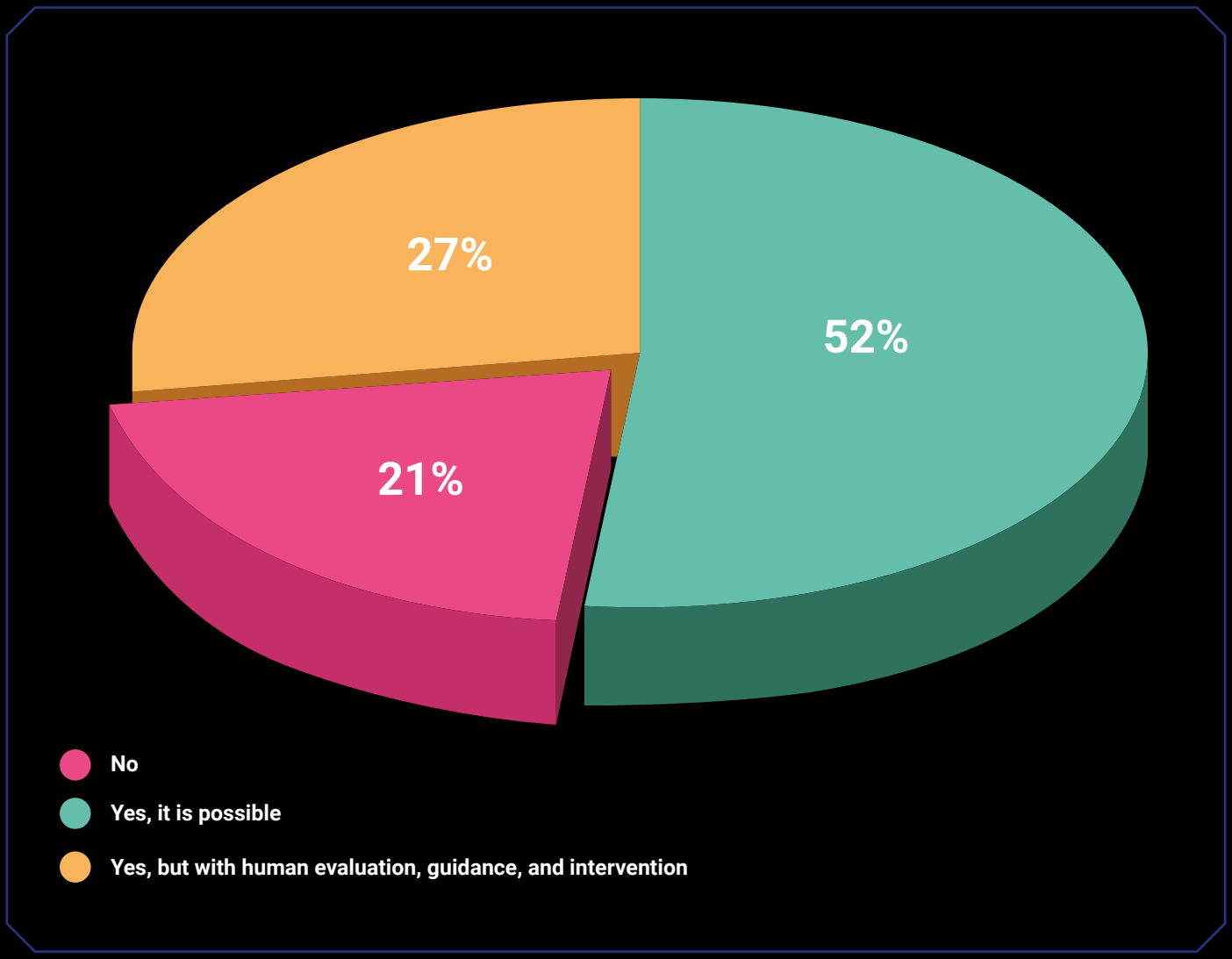


Image 4: *The majority of digital content by 2030 will be created by AI.*

Public Administration

AI can serve as a catalyst for a radical revision of the way administrative decisions are made in the public sector and drive the transformation of public services in Greece. As empirical research has shown, among the most positive features expected from the evolution of the AI ecosystem in Greece will be "*the improvement of services by government agencies*" (Dimitris Eforakopoulos, President and CEO, InfoQuest Technologies) and "*the upgrading of public administration with more efficient services and citizen service*" (Cleo Sgouropoulou, Professor Department of Computer Engineering and Informatics, University of Patras), including through the "*automation of public sector services*" (Martha Tsingari, Senior Partner, Foster + Partners).

Already, the use of AI proctoring tools for the selection exams of public sector executives is a reality, while the process of creating chatbots and e-wallets on gov.gr is advancing. Kyriakos Sampatakakis, Country Managing Director of Accenture Greece, predicts an "*evolution of the gov.gr platform*" and believes that "*interaction through AI will redefine the citizen-public services relationship with an integrated digital platform.*" Deputy Minister of Digital Governance Konstantinos Kyranakis speaks more specifically of a "*digital assistant for every citizen using AI and its integration with public information systems to eliminate bureaucracy and provide user-friendly services.*"

Furthermore, he looks forward to using AI for "*improving decision-making processes and analyzing big data to shape more effective policies and achieve automation and acceleration of administrative tasks.*"

However, for this change to occur, AI must be at the center of public administration, in an era of historic transition from e-government and digital policy to *algorithmic governance*[69]. Below are some of the benefits that such a change can bring.

Data-Driven Decision Making

The integration of AI into public administration helps in better understanding and addressing today's data deluge. Specifically, AI can analyze trends emerging from historical data, social media activity, and economic indicators, providing valuable insights.

Access to Information

Employees of public entities can find the information they need to complete their tasks more quickly by integrating AI into their processes. Real-time access to relevant information can be achieved through a quick query across various datasets and types of data. This eliminates the need for time-consuming searches in documents or isolated databases. Moreover, most of the time, the data needed by public employees cannot be found on the internet or other easily accessible sources. Therefore, advanced tools like citizen service centers operating with AI are essential for quickly finding the correct information.

Enhancement of Citizen Support and Service

An immediate goal could be the optimized provision of quality assistance and information to citizens on a twenty-four-hour/real-time basis. This can be achieved with AI tools such as service desks using AI, chatbots, and virtual assistants. Such advanced tools help public services automatically handle the most common queries (or standardized requests), leaving time for employees to perform more complex tasks. Specifically, within this framework, a plethora of new AI applications can be integrated into digital Citizen Service Centers. Additionally, with minimal impact on the quality of public services, significant cost reduction opportunities can be found through the use of AI[70].

Increase in Efficiency

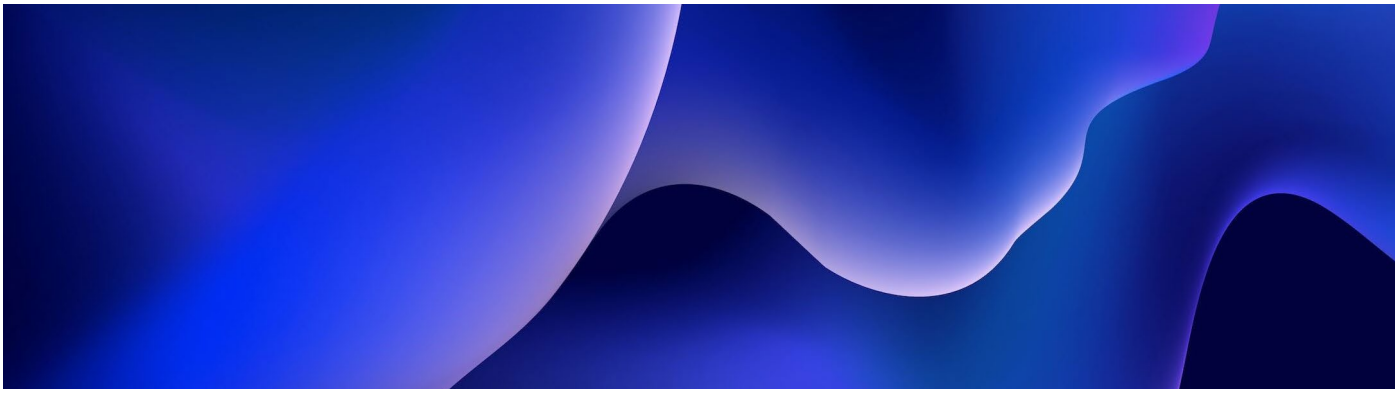
The bureaucracy of public administration procedures (including the hiring process) is sometimes extremely time-consuming. These processes are rationalized with the use of AI, reducing bureaucracy and increasing transparency and accountability. Applications for monitoring government work, multi-level governance, risk management in the public sector, and better informing citizens could be developed in a short period of time.

Automated Report Generation

AI can automatically generate detailed reports, removing administrative burden from public entities. It can also simplify report writing and data analysis, allowing for faster decision-making.

[69] Dunleavy, P., & Margetts, H. (2023). Data science, artificial intelligence and the third wave of digital era governance. Public Policy and Administration. https://doi.org/10.1177/09520767231198737

[70] For example, according to a study by Deloitte, it is estimated that high levels of investment in AI by the US government could potentially free up to 1.3 billion hours of human labor and save over $40 billion annually. See https://www2.deloitte.com/xe/en/insights/industry/public-sector/transforming-cost-management-for-government-agencies.htm



Optimization of Knowledge Management and Processing

AI can quickly classify vast amounts of documents, such as application forms and contracts, using automated document scanning capabilities supported by advanced AI algorithms and NLP models. AI applications can accurately highlight inconsistencies that may not be detected due to human error.

A characteristic example is the automatic processing and categorization of supplier offers received by a procurement department of a government entity using AI. The relevant procurement department, with the help of AI, could identify inconsistencies, such as incomplete data or incompatible bids, allowing the staff to focus on the more effective evaluation of viable proposals.

Automated Budgeting and Resource Allocation

By examining past expenditures, forecasting future requirements based on trends, and facilitating informed decision-making for resource allocation each year, AI can streamline and expedite the budgeting processes in public services.

Evaluation of Services Provided by the Government

Finally, the utilization of AI capabilities in evaluating and subsequently improving the services provided by public entities (both physical and electronic, such as gov.gr) to citizens could prove invaluable. Drawing on existing knowledge from citizen requests and cases already serviced, AI can assess response times and the quality of responses received, as well as make suggestions for their improvement. Additionally, concerning electronic services, critical factors that could also be evaluated include technical adequacy and usability, and based on generated data, plans for maintenance and renewal can be formulated.

It is evident that the responsible integration of AI into the public sector marks the entry into a radically new era of productivity, accessibility, long-term planning, and resilient innovation. The aforementioned use cases of AI provide a first glimpse into its immense potential to transform the very nature of governance. The main goal is to establish a public administration that can communicate with every citizen in their language, predict and address problems before they arise, and distribute resources accurately.

Although certain challenges must still be addressed before the final adoption of AI in public services, its potential is too significant to be ignored. In the coming years, significant progress can be expected in service provision and policymaking, as more governments begin to implement these new technologies[71].

Justice

It is obvious that such technological advancement has already come to the attention of national legal institutions. This concerns primarily sensitive data for documenting and establishing legal judgments. In Greece, specifically, a Permanent Scientific Committee has already been formed to examine the implications of the introduction of AI in the judicial system. This Committee will submit proposals to the Minister of Justice for modernizing the legislative framework, taking into account new technological developments and creating provisions for the protection of the rights of those involved[72].

Moreover, since a significant part of lawyers' work involves documents, the ability of AI to quickly absorb a vast amount of information and then generate original content suggests that these technologies could *change the way lawyers and law firms work,* helping them make better decisions, extracting and synthesizing knowledge from a - sometimes - vast repository of data from their previous work[73].

[71] https://www.rezolve.ai/blog/generative-ai-government
[72] https://ministryofjustice.gr/?page_id=7483
[73] https://law.queensu.ca/news/Applying-generative-AI-to-law

Tools such as Westlaw[74], Draftme AI[75], or Practical Law[76] are just a few examples that have leveraged this opportunity. Additionally, *AI can immediately facilitate citizens by making legal documents more understandable and easily accessible[77].*

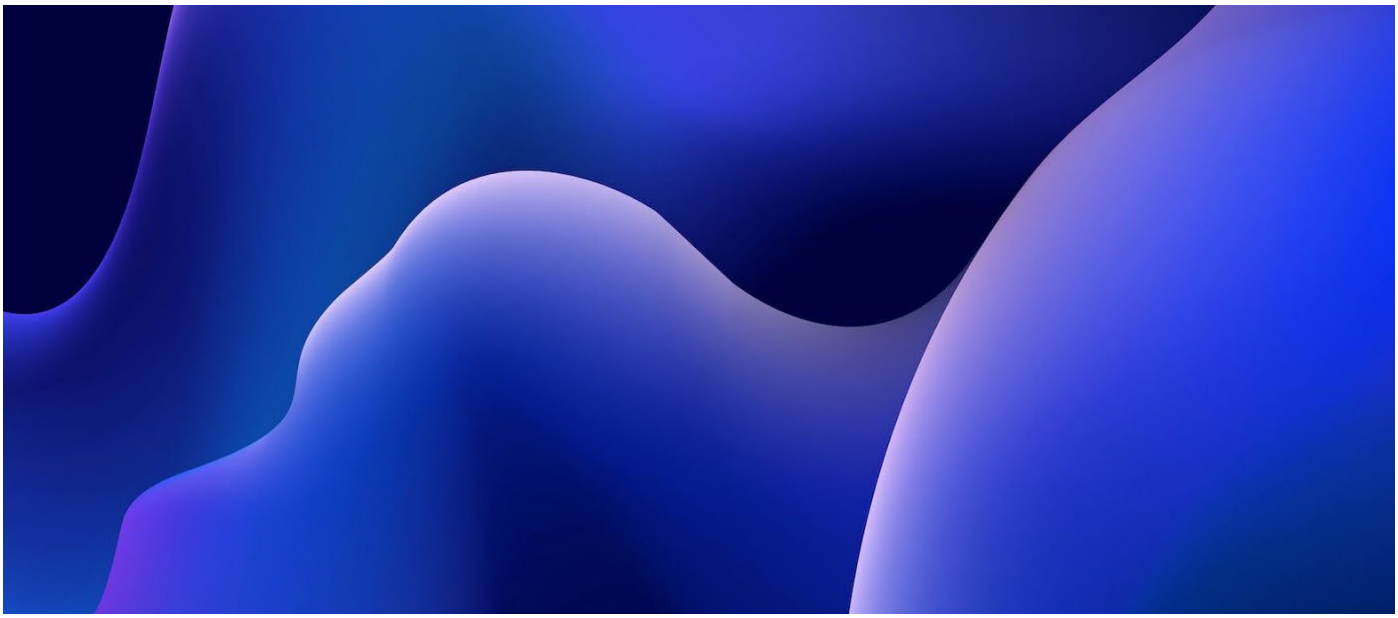
The Greek Ministry of Justice introduced provision for the use of AI in various areas of the competence of the Court of Audit, such as the assignment of services or work, conducting audits, scanning, and mechanical reading of records. Therefore, AI is expected to provide even more capabilities to improve services.

It is worth mentioning that, in Greece, the Legal Library already implements AI technologies to facilitate the management of large portfolios with diverse users and needs[78]. Furthermore, it has developed a computational tool[79] that provides access to the full content of case law, as well as legal interpretation formulated in large datasets of hundreds of thousands of pages of scientific journals and opinions, while collaborating for years with the Institute of Computer Science (ICS) for the exploitation of AI methods[80].

Finally, a particularly critical issue that could be addressed by leveraging AI capabilities is that of *regulatory compliance*. Compliance with constantly changing rules, standards, and reporting requirements has become crucial for businesses in all sectors. As digital innovation continues to expand into various fields, the importance of ensuring compliance has increased even further. Maintaining flexibility and responsiveness to the dynamic and evolving conditions that affect regulatory requirements is necessary for businesses, as the consequences of non-compliance can be severe. AI plays a crucial role in compliance by automating tasks and streamlining the creation of legal documents. It also aids in interpreting complex regulations through natural language processing, provides real-time support through chatbots, and uses predictive analytics to identify and mitigate compliance risks.

Additionally, it facilitates personalized training on compliance issues, monitors data and transactions for violations, and helps organizations adapt to global compliance needs through language translation and localization. AI enables organizations and businesses to stay informed about regulatory changes, improve controls, and adhere to ethical standards, ultimately promoting a culture of compliance and reducing the burdens of manual compliance management[81].

[74] https://legal.thomsonreuters.com/en/westlaw
[75] https://www.draftme.ai/
[76] https://legal.thomsonreuters.com/en/products/practical-law
[77] https://www.rezolve.ai/blog/generative-ai-government
[78] https://www.nb.org/alma
[79] https://www.qualex.gr/
[80] https://www.bcg.com/harnessing-the-power-of-ai-in-greece-embarking-on-the-path-to-value
[81] https://www.leewayhertz.com/generative-ai-for-compliance/



Health

In healthcare services, it appears that two main areas where AI can be utilized and contribute to their advancement are emerging.

The first concerns pharmaceutical research and *drug development*. All stages of the drug creation process, from research and clinical trials to production, could benefit from AI, leading to better, faster, and more cost-effective development and availability of new drugs[82].

The second area in which AI can bring about drastic changes is *healthcare delivery*, which has vast amounts of patient data and medical literature. Here, there is a need for more efficient ways of utilizing this information. Traditional methods of data analysis are time-consuming and often lag behind the rapid pace of medical advancements, potentially jeopardizing patient care. As Katerina Tsadima, Head eLearning Instructional Designer at Wide Services[83], estimates, "*AI will contribute to the development of advanced medical solutions, such as personalized medicine, addressing diseases with precision and effectiveness,*" while Manolis Patiniotis, Professor at the Department of Sociology of the University of Athens, predicts "applications in medicine regarding therapeutic protocols and methods for addressing difficult cases (AI-aided medicine)." Additionally, Konstantinos Kyranakis, Deputy Minister of Digital Governance, looks forward to "*access to big data from hematology and imaging tests in the electronic health record and proposals via GenAI for personalized treatments, always with the final decision belonging to the medical personnel.*"

By harnessing the capabilities of AI models in healthcare processes, organizations will be able to provide better quality medical services, research, and data privacy protection. Their ability to understand, generate, and summarize text-rich data ensures that healthcare remains informed, effective, and compliant with ethical and moral standards[84].

[82] Bian, Y., & Xie, X. Q. (2021). Generative chemistry: drug discovery with deep learning generative models. Journal of Molecular Modeling, 27, 1-18. https://link.springer.com/article/10.1007/s00894-021-04674-8

[83] Greek Premium Certified Moodle ParAIer, e-learning platform

[84] See https://research.aimultiple.com/large-language-models-in-healthcare/ . On this point, refer to the forthcoming "Opinion on Artificial Intelligence Applications in Health in Greece" by the National Bioethics and Technoethics Committee.

More specifically, the applications of particular interest are as follows:[85]

- **Clinical Management Support:** Busy clinical physicians, often burdened with extensive note-taking, can leverage NLP capabilities to create clinical note templates quickly and accurately. By providing a brief verbal summary or relevant patient data, an integrated and contextually relevant clinical documentation can be generated. This not only saves time but also enhances the accuracy of patient information recording. Several applications have already been developed in this direction (e.g., Corti[86]: Patient Triage, Google Bard powered by Med-PaLM 2).

- **Clinical Decision Support:** Given advanced understanding of human language and further improved domain knowledge, GPT models also have the ability to support clinical decision-making. For example, *Glass AI*[87] is an experimental tool that operates with LLM and serves as a diagnostic assistant to create a catalog of potential diagnoses and treatment plans tailored to a clinical case. Similarly, *Kahun*[88] is a symptom-checking tool that provides clinical assessments of patients, generating differential diagnoses and treatment options based on the patient's history and medical literature.

- **Patient Support:** *Hippocratic AI*[89] focuses on the patient and their needs, prioritizing empathy, quality care, compassion, and creating patient-friendly responses, enhancing trust and commitment to the therapeutic process. Following a similar logic, *Gridspace*[90] is an operational solution that automates communication with patients, handling telephone calls, answering questions, and performing administrative tasks.

- **Synthetic Data Generation:** *Syntegra Medical Mind*[91] utilizes generative AI for producing realistic synthetic patient records from real healthcare data, such as electronic medical records, while simultaneously protecting patient privacy. Healthcare professionals can access and analyze these data for research, education, and decision-making purposes without compromising patient privacy. *DALL-E 2* is another OpenAI model for generating images from text. Thanks to its extensive pre-training, *DALL-E 2*[92] has the capability to generate or enrich medical data, which are often sparse or limited in medical research and education, without compromising patient privacy[93].

- **Professional Training:** Many applications can be adapted within the framework of medical education, even in educating patients on medication adherence or their general care. Applications such as *Unlearn. AI*[94] can be used to create "digital twins" of individual patients, offering a comprehensive model of potential outcomes under different scenarios.

[85] Zhang, P., & Kamel Boulos, M.N. (2023). Generative AI in Medicine and Healthcare: Promises, opportunities and challenges. https://www.mdpi.com/1999-5903/15/9/286#B23-futureinternet-15-00286
[86] Corti triage - protocol software for medical calls. https://www.corti.ai/solutions/engage
[87] Mariu. (2023). Glass.AI, Generative AI tools for Healthcare providers. https://healthcare.boardofinnovation.com/glass-ai/
[88] https://www.kahun.com/technology
[89] https://www.hippocraticai.com/benchmarks
[90] https://resources.gridspace.com/
[91] https://www.syntegra.io/technology
[92] https://openai.com/dall-e-2
[93] Adams, L. C. et al. (2023). What Does DALL-E 2 Know About Radiology? Journal of Medical Internet Research, 25, e43110. https://www.jmir.org/2023/1/e43110/
[94] https://www.unlearn.ai/technology

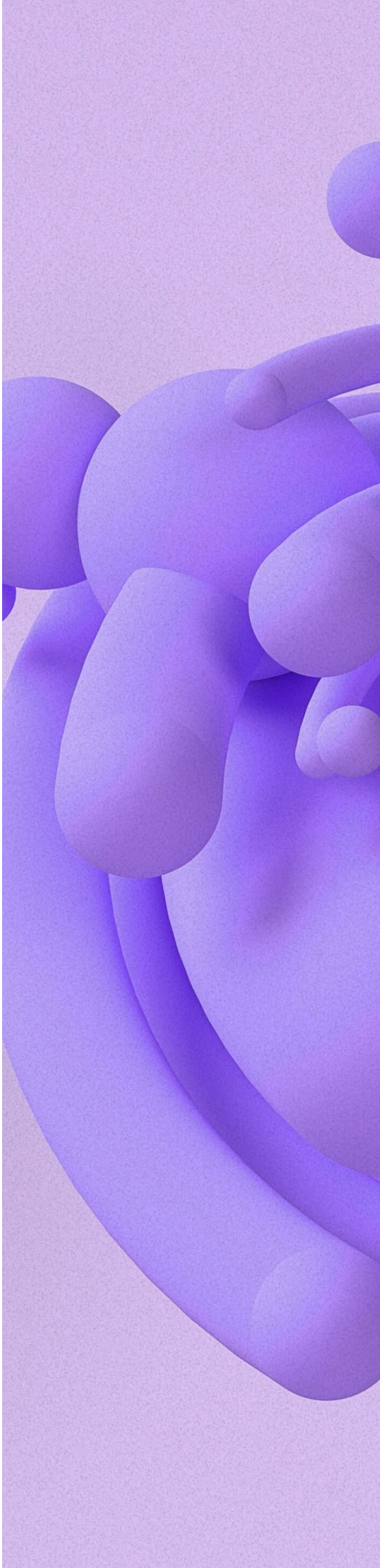
Education

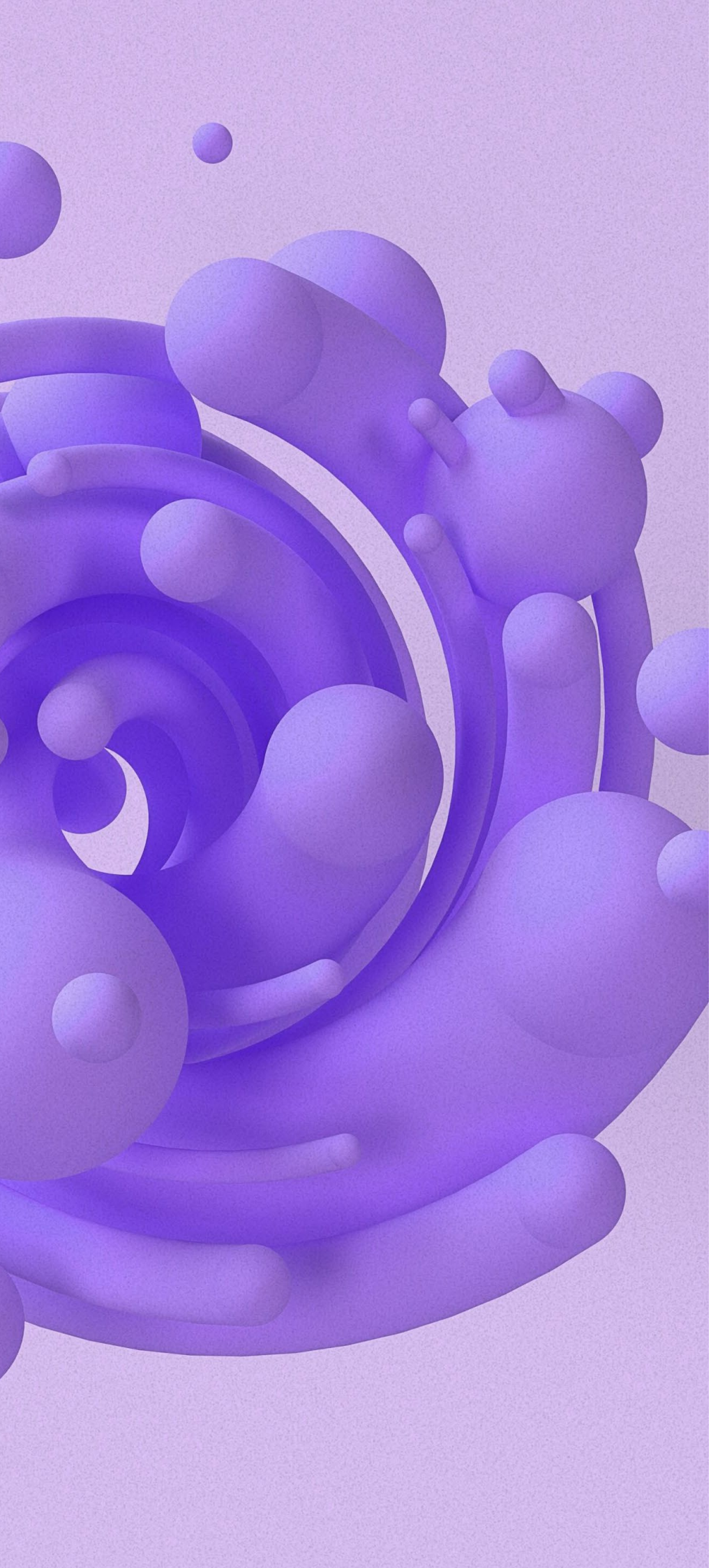
Education and training are critical pillars of implementing tools and models based on NLP. This sector has been identified as sensitive and "high-risk-deployment" in the draft related articles of the European AI Act. This is because education and training simultaneously serve as channels for resource distribution and access. From the international domain of the educational industry and educational technology, an indicative example is Duolingo, a language learning app that utilizes OpenAI's GPT-4 to create new exploitable features such as *Explain My Answer*[95]. Thus, the opportunities provided by NLP in promoting autonomous education are emerging, attempting to create a digital twin of the traditional educational process. In the evidently favorable field of educational possibilities emerging, it is reasonable to note that reservations regarding the use of NLP applications (such as ChatGPT), such as those of the Deutsche EthikRat, around the possibility of skill de-skilling[96], or the risk of isolation from the social environment and real needs through the misuse of advanced immersion applications in the metaverse[97], are not absent.

Before delving into specific possibilities of future application, it may be worth mentioning that in recent years there have already been examples of utilizing the capabilities of NLP and AI in the digital educational industry through metrics linking it to qualifications certification and the job market. The intersection of work capabilities and educational skills is now emerging as a privileged investment field[98]. It is worth noting that in the international educational industry, the development of platform economy models has favored an algorithmically oriented "demand-driven education," competency-based education, using NLP to develop predictive talent analytics, to match students and graduates with potential career paths through matching tools. This technological capability is offered to them to integrate into the constantly evolving job market (between learning and earning). Based on mass-collected data from educational platforms, from reports on the completion of digital asynchronous educational programs and skills certification tests, the goal pursued is now to shape some algorithmic matching models of successful course completion cycles with professional performance indicators in the job market.

The emergence of terms such as "talent economy," "career readiness," and "employability metrics" is now common both in the education market and in the job market. The partial algorithmization of the educational process also allows for aligning the expected future demand for positions by employers and recruitment agencies with the formation of relevant study cycles and educational subjects and rewarding educational institutions based on achieving the above goals. In light of the above analysis, it was deemed appropriate to address the Regional Development Director of Pearson[99] for the Balkans, Italy, Georgia, and Armenia, as a critical informant on the subject. Mrs. Stathopoulou supported that there will be a sufficient increase in the use of NLP in the next four years and considered that a catalytic factor for use will be the creation of educational programs and courses focusing on NLP at educational institutions in Greece, while also focusing on the prospects of collaborations between international companies and research centers specializing in NLP.

However, the aforementioned company is neither the only nor the first in the direction of the complete digital transformation of education and the utilization of NLP[100] in it. It is worth noting that in the USA, fully digitized Universities based on demand-driven and competency-driven education have been developed for decades, terms necessary for the restructuring of education towards the utilization of NLP. Additionally, beyond Universities, the NLP-oriented digital ecosystem of professional retraining is also developed, with companies serving as algorithmic facilitators for finding learners, content creator instructors, certification mechanisms, and sometimes employers. Prominent players in this industry include well-known names like EdEx[101], Udemy[102], Udacity[103], LinkedIn Learning[104], and others.





[95] Duolingo Blog. (2023). Introducing Duolingo Max, a learning experience powered by GPT-4.
[96] https://www.bdi.de/themen-und-politik/nachrichten/meldung/chatgpt-meets-ethikrat-1/
[97] https://www.ethikrat.org/fileadmin/PDF-Dateien/Veranstaltungen/herbsttagung-2023-11-15-nosthoff.pdf
[98] Exactly such a model has been developed by the Certification and Handbook Issuance Organization Pearson. This model has been extensively analyzed in: Williamson, B. (2020). Making markets through digital platforms: Pearson, edu-business, and the (e)valuation of higher education. Critical Studies in Education. DOI:10.1080/17508487.2020.1737556. For indicative documentation from the organization regarding its approach to demand-driven education provision, see the link. Also, see a summary report by Pearson (1) on the future of skills focusing on 2030 and tools utilizing AI for self-assessment of skills and deficiencies by learners: https://futureskills.pearson.com/explore, and (2) on the skill-gap alignment with emerging labor market needs: https://www.talenAIeuron.com/
[99] https://www.talenAIeuron.com/
[100] Examples: https://www.wgu.edu/ , https://www.capella.edu/capella-experience/about/ , https://www.snhu.edu/online-degrees .
[101] https://openedx.org/get-started/get-started-self-managed/ ,https://open.edx.org/get-started
[102] https://www.udemy.com/teaching/
[103] https://www.udacity.com/blog/category/instructors
[104] https://www.linkedin.com/learning/

Based on the above, the contribution of NLP to the unified education and job ecosystem could serve:

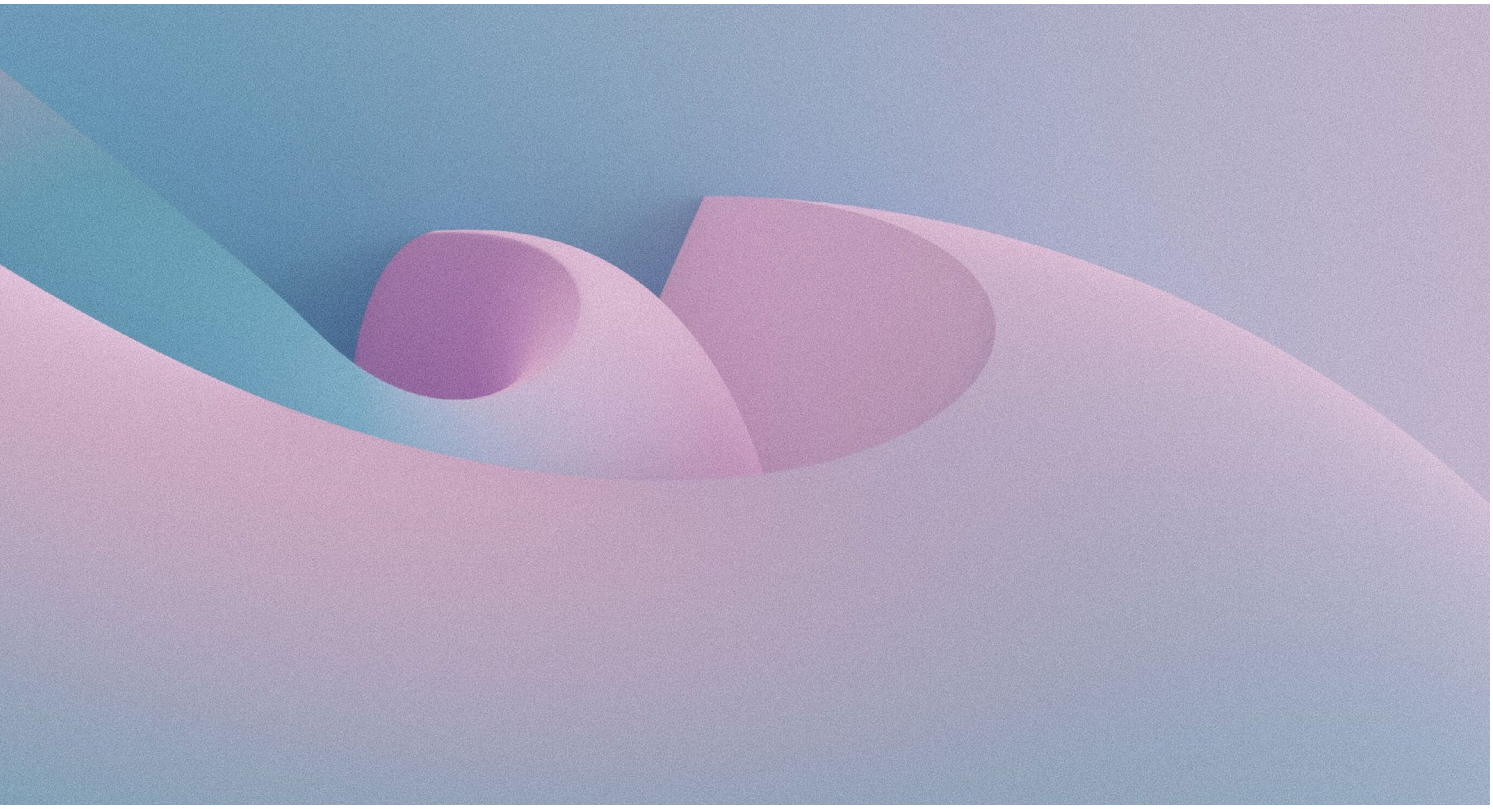
1. both graduates, retraining individuals, and employees in terms of job search or career path, professional networking, real-time updates on new skills, retraining opportunities in emerging professions, and even salary levels,

2. as well as to employers to plan real-time and data-driven job demand, assess the competitive advantages of available human capital, develop parAlerships with relevant educational institutions, and devise strategies to attract suitable candidates.

Furthermore, a significant parallel development, that of blockchain technology, allows for the development of reliable insurance locks against uncontrolled development of educational products and content based on NLP and especially against risks like deepfakes, misinformation, authentication of learners, and examinees[105]. In any case, the -real-time and rapid- matching of educationally certified and blockchain-verified skills and abilities with actual job offers and emerging professions constitutes a field of contribution of NLP, responding to a not-so-weak signal anymore of the non-rewarding accumulation of degrees in contemporary society. The Ministry of Digital Governance has already been developing policies and digital matching tools as well as professional classifications and skills towards this direction[106]. Due to its specific weight, our research inquiries were also addressed to Georgios Karachalios, Deputy Minister of Digital Governance, who pointed out that his estimation is that "*NLP will be a means of pilot applications and research programs in the coming years*", and also suggested among other things that, based on the critical and cohesive role of NLP for the convergence of skills and job fields, it would be worthwhile to "*create an NLP Observatory and a network of stakeholders to promote GenAI within the framework of the National Alliance for Digital Skills*".

[105] Already in the emerging domestic eLearning industry, this is beginning to be exploited, especially in training for industrial sectors with roles of increased responsibility and danger, and continuous certifications and re-certifications of knowledge and suitability in terms of skills and abilities. Regarding the aforementioned approach to education informatics, firstly, it should be noted that blockchain is technically a distributed ledger, public or private, in which transactions or data are linked together in connected blocks, making them practically immutable and unquestionable by all distributed nodes where the ledger has been updated. The strong point of this technology is the indisputable verification and authentication through mechanisms of trust distribution around any transaction of any nature (not just economic) among peer-to-peer nodes. How is this applied in education? In the educational ecosystem, education providers function as issuers of digitally sealed (eIDAS) Verifiable Credentials (VC Issuers). Successful candidates in education are awarded these certificates (VC Owners), which, thanks to blockchain utilization, are tamper-proof and therefore reliable. A public entity, such as a Chamber of Commerce, the Ministry of Education, the Bank of Greece, etc., constitutes a third fundamental pole in the ecosystem that automatically verifies the contents of such a certificate and approves, updates the professional-educational profile of the professional registered in the database pool. The electronic identity of the trained professional is linked to a Decentralized Identifier/ DID, which is again recorded in the blockchain. This way, an immutable bond is created between the certificate, its issuer, and the trained professional.

[106] BSee https://esco.ec.europa.eu/de/node/351 and https://www.dypa.gov.gr/esco-matchin), as well as the implementation of the special digital portal https://skills.gov.gr/, through which interested parties will gain access to an individual skills account.



Focusing even at the classroom level, NLP has the potential to enhance the educational process in various ways. At the international level, in a recent report by the IE University Center for Governance[107], in the section concerning education, among the scenarios discussed regarding the future of the educational process with the introduction of NLP, a scenario emerged with a significant margin, suggesting the existence of potential (virtual) classrooms where an AI tutor facilitator will play a significant role, while NLP will be utilized to facilitate the creation of potential virtual experiences outside the classroom environment, thus making the educational process more empirical in this specific sense.

It is within its technological capabilities for NLP to operate as an *assistant to teachers in the classroom*, offering students a better understanding of subjects by creating notes, reports, diagrams, and lesson summaries. According to the estimation of Konstantinos Karpouzis, Associate Professor at the Department of Communication, Media and Culture of the Panteion University, "*the integration of NLP into the educational system through the production of personalized content, descriptive assessment, and the use of its tools for the education of students and teachers in new technologies*" is one of the greatest opportunities.

Furthermore, NLP capabilities can be particularly beneficial in *special education*, where it can be tailored to students' specific difficulties, creating real-time lessons tailored to their individual needs[108].[109] Additionally, natural language learning and teaching systems can assess students' levels of knowledge, identify gaps in their understanding, and then address them through *personalized learning materials and explanations*[110].

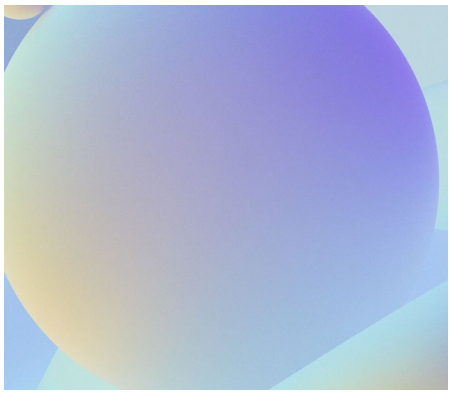
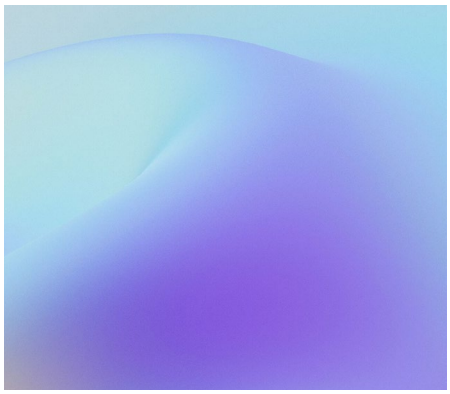
As mentioned earlier, another area of education where NLP can substantially contribute is the development of workforce skills. Companies and organizations (public or private) managing sensitive personal data can generate, through models, test cases with synthetic data to avoid violating their customers' privacy in their efforts to train their employees. Moreover, based on the assessment findings of their employees, they can create rapid and effective *training programs* tailored to the needs of each worker.

An opportunity for the Greek reality could also be the enhancement of lifelong learning and adult education in general. One of the main benefits of NLP in lifelong learning is its ability to provide personalized educational experiences. Traditional education usually follows a "one size fits all" model, where students are expected to learn at the same pace and in the same way, which is incompatible with adult learners who have unique needs and learning preferences. NLP can analyze large amounts of data on the strengths, weaknesses, and learning styles of a student to create a personalized learning plan.

[107] 7 IE University Center for the Governance (2023). Report on Trends for the Next 50 Years. https://docs.ie.edu/Arq&des%20-%20AI50/AI50_CGCreport.pdf
[108] Kasneci, E. et al. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. Learning and individual differences, 103, 102274. https://www.sciencedirect.com/science/article/pii/S1041608023000195
[109] Jeon, J., & Lee, S. (2023). Large language models in education: A focus on the complementary relationship between human teachers and ChatGPT. Educ Inf Technol. https://doi.org/10.1007/s10639-023-11834-1
[110] https://leam.ai/feasibility-study-leam-2023/

Moreover, emphasis should be placed on enhancing digital literacy so that all citizens can take advantage of the opportunities of new technologies. In this context, the representative of Accenture, Kyriakos Sampatakakis, emphasizes that "*NLP will revolutionize education by enhancing personalized teaching and empowering inclusion*". As noted by the representative of the Hellenic Federation of Enterprises (SEV), "*it is positive that enrolments in ICT departments in Greek universities are increasing, but the pace must be accelerated. According to Eurostat, students enrolled in ICT departments were 3.42% of the total in 2019, 3.54% in 2020, and 3.77% in 2021*".

These developments in education based on NLP fundamentally transform the learning landscape and pave the way for more qualitative - personalized, tailored, and effective - educational experiences.

Research & Development

GenAI has the ability to bring revolutionary changes to the research and development (R&D) of various sectors within the Greek scientific and industrial community. Its application in R&D can lead to increased efficiency, innovation, and productivity. Below are some possible applications:

- **Synthetic data generation:** GenAI can be used to create synthetic data for research purposes. For example, in fields such as healthcare where access to patient data is limited, generative models can create realistic medical data for training and validating algorithms[111].
- **Design and prototyping:** In product design and manufacturing, GenAI can assist in creating and optimizing prototypes. GenAI allows businesses to optimize the product design process by automating various aspects such as generating design variations, analyzing performance parameters, and evaluating market demand. This is accelerated during the "prototyping" phase, allowing for faster iteration and improvement of product designs.
- **Production of research content:** GenAI can automate the creation of technical reports and research papers. Researchers can input their findings and let GenAI produce coherent and well-structured documents, saving time and allowing scientists to focus on their primary work.
- **Experiment design:** GenAI can help in designing experiments and simulations. It can generate hypotheses and propose experimental setups, thus optimizing resource usage and ensuring that experiments are well-designed and controlled. Optimizing experiment design can also significantly reduce the time required for experimentation and accelerate the acquisition of reliable results.
- **Code generation:** In software development and computer science, GenAI can automatically generate code snippets or even entire applications based on descriptions or requirements. This accelerates the software development process and reduces the likelihood of syntactic errors.

[111] Zhang, P., & Kamel Boulos, M.N. (2023). Generative AI in Medicine and Healthcare: Promises, opportunities and challenges. https://www.mdpi.com/1999-5903/15/9/286#B23-futureinternet-15-00286


- **Prediction/forecasting of new technologies:** GenAI can assist professionals in the research and development field to predict/forecast to some extent future technological advancements and identify potential innovations. By analyzing historical data, scientific publications, and market trends, GenAI algorithms can generate predictions/forecasts and scenarios, allowing research and development teams to "visualize" emerging technologies and allocate resources accordingly.

- **Simulation and testing:** Leveraging the computational power of GenAI, organizations can design computationally optimized experiments, i.e., simulations. Simulations are virtual tests that allow the identification of potential flaws, lead to design optimization, and aid in making informed decisions before the physical implementation of the projects under study.

Social Transformation

Regarding the social sphere, the adoption of GenAI applications can have a positive impact on our daily lives and bring about radical changes in various sectors. Below, we mention some key examples of sectors that GenAI can reshape.

Art and culture

GenAI models can now create highly advanced and original works of art, music, and literature. By training them on large datasets of existing art and cultural objects, GenAI can learn the patterns and styles of various genres and create entirely new content that is almost indistinguishable from works produced by humans. Additionally, an opportunity arises with the creation of personalized entertainment content tailored to users' preferences and interests[112].

A characteristic example of GenAI utilization for setting up an interactive exhibition is the project "Shelter of Greek Ideas[113]"[114] which utilizes cutting-edge technologies, such as GenAI, to develop interactive objects that exhibit ideas of ancient Greek thought.

Moving from imagery to sound, it is worth mentioning the very recent announcement by Google Deep Mind[115] regarding the creation, in collaboration with YouTube, of "Lyria," an advanced GenAI model for music composition that uses extensive "big" data, as well as two GenAI experiments aimed at enhancing human creativity. Dream Track is an extensive experiment through "YouTube Shorts" that allows for experimental co-creation of soundtracks, involving artists, composers, and even audiences (fans), in the production of the final creation. The other experiment concerns the creation, through Lyria, of GenAI music tools to facilitate creative composition by artists, songwriters, and even music producers. Due to the use of groundbreaking GenAI technology, Google Deep Mind claims that all related GenAI experiments comply with the GenAI regulation principles set by YouTube for itself and its service users (YouTube AI principles), which aim to facilitate creative musical expression while also protecting the musical creators and the integrity of their work.

Moreover, as noted by a representative of a multinational technology company, *GenAI will be able to address shortages in specialized personnel in remote areas of the country.*

[112] Creative Dock's REPORT, ibid.
[113] https://aylonlyceum.gr/
[114] https://www.houseofclassicalgreekideas.com/
[115] https://deepmind.google/discover/blog/transforming-the-future-of-music-creation/

Accessibility & Inclusion of People with Disabilities

GenAI inaugurates a new era regarding the accessibility and inclusion of people with disabilities, positively influencing various aspects of their lives. Through the capability of automatically adding captions and audio descriptions to images, individuals with hearing or vision impairments can seamlessly enjoy multimedia content. As assistive technology advances, websites and digital products undergo rigorous evaluations, ensuring that they are user-friendly for all users, even before they are released. For example, AccessiBe[116] utilizes GenAI for the automatic enhancement of website accessibility.

In the field of customer experience, GenAI can facilitate inclusion with virtual wardrobes and visual assistants. Voice shopping, exemplified by Amazon's Alexa, allows consumers to navigate the online market effortlessly using their voice. Voice recognition technologies are becoming increasingly adept at understanding non-standard speech, thanks to initiatives like the Speech Accessibility Project[117] and Voiceitt[118]. Additionally, text summarization or text-to-speech conversion helps non-neurotypical customers understand content more easily, mitigating challenges related to language and word choice.

Furthermore, GenAI can contribute to making prosthetic limbs more personalized and functional by adapting these devices to the individual needs of each user.

Avoidance of Discrimination and Toxic Behavior

Backpack Language Models offer a potential solution towards addressing the issue of gender stereotypes in content creation and provide a pathway for mitigating gender bias by incorporating sense vectors, a more sophisticated version of the bag-of-words[119] approach.

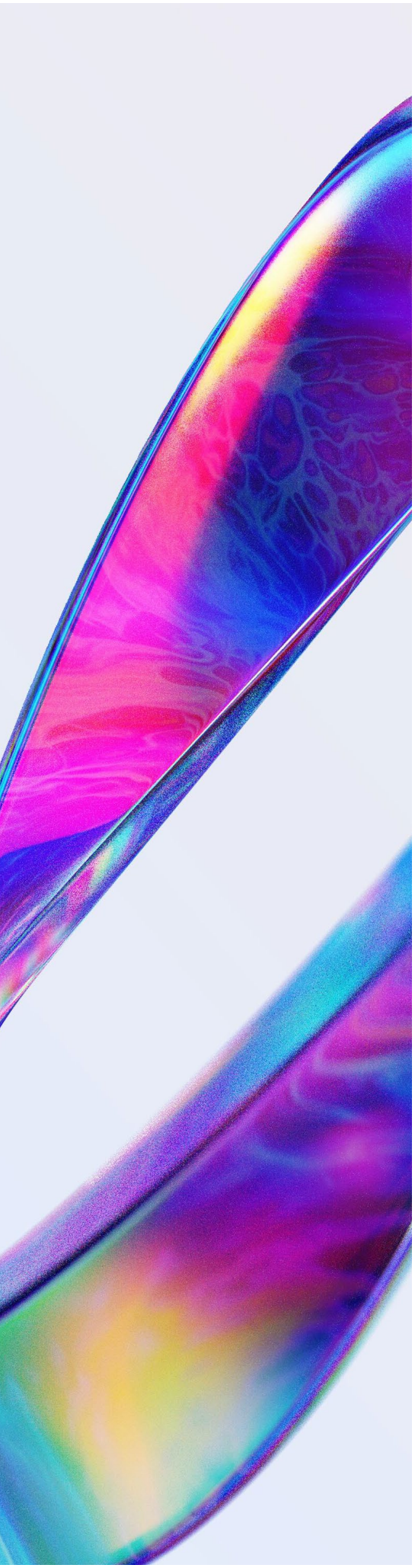
Of interest is the application Fairslator[120], which ensures that biases due to gender or racial origin are eliminated in the translations it produces.

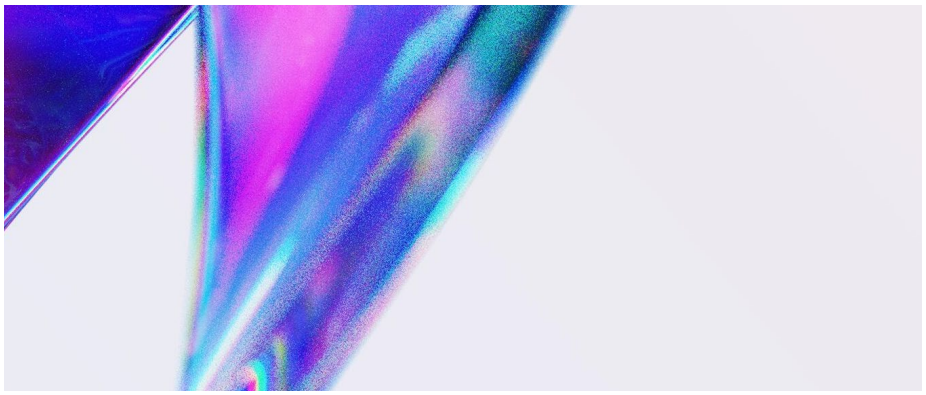
Avoidance of Misinformation

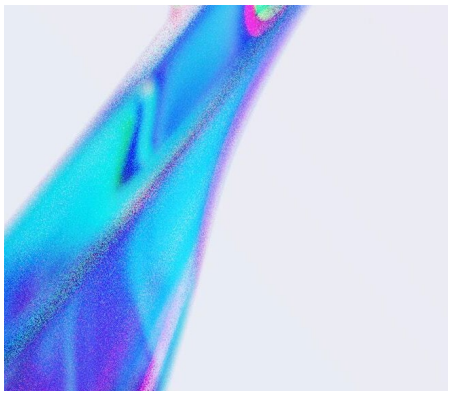
Combatting misinformation is a costly and highly complex process, placing GenAI at the forefront as a solution to this problem. Timely detection of misinformation is crucial for limiting the impact of a phenomenon that would otherwise be impossible to prevent. Two main future research directions emerge for combating misinformation with GenAI. The first is the study of creation and dissemination patterns for a better understanding and prediction of the spread of harmful propaganda and conspiracy theories. The second is the application of intelligent technologies to enhance the field of checks and balances in mass media[121].

Smart Living

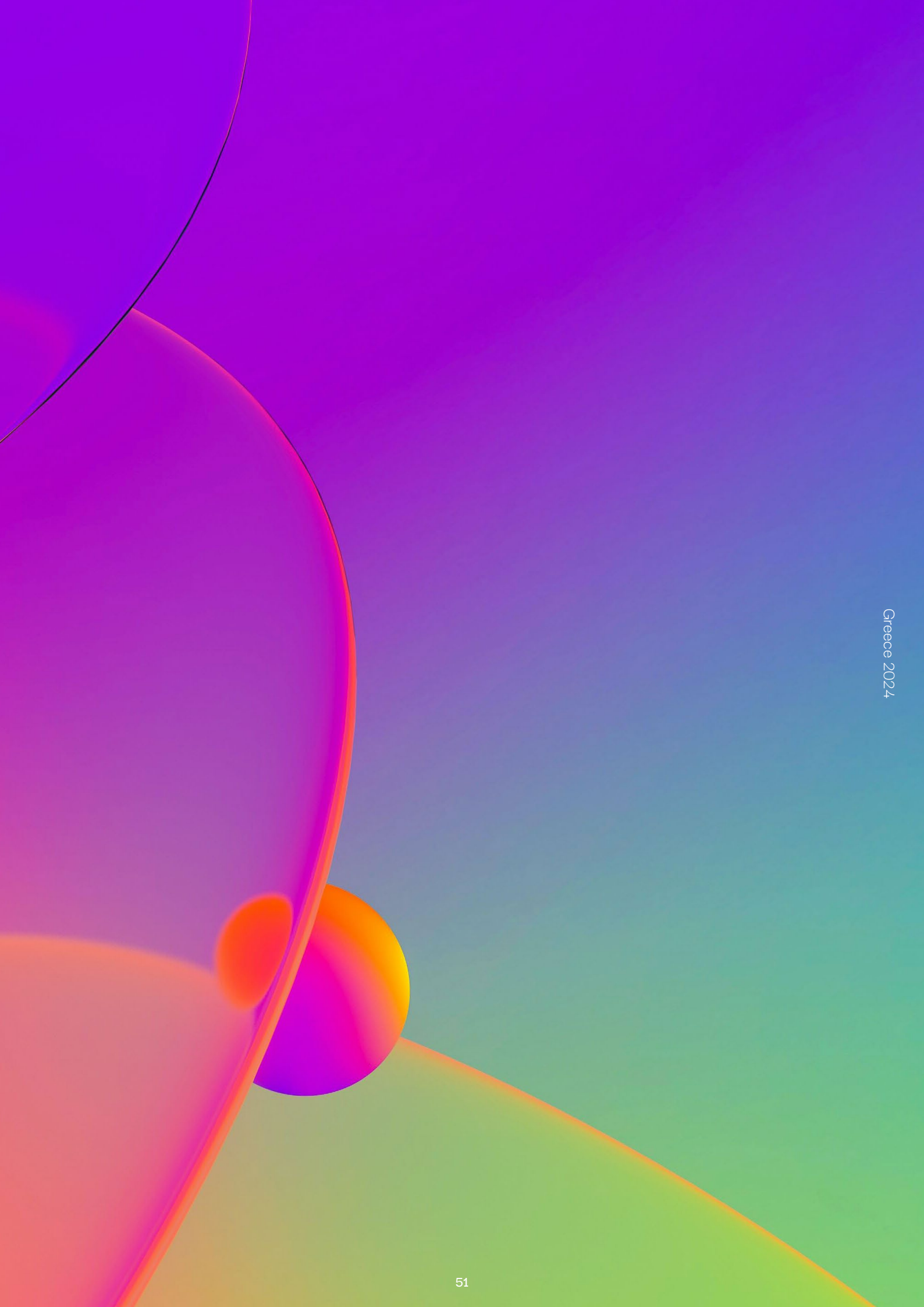
Home automation and its management through GenAI are revolutionizing the way we interact with living spaces, bringing convenience, comfort, and security to our daily lives. With energy-saving home systems, households become smarter, optimizing energy consumption patterns to enhance cost-effectiveness. Meanwhile, smart security systems based on GenAI are changing the game when it comes to home security. These systems incorporate cutting-edge features such as facial recognition, motion detection, and real-time notifications, providing comprehensive protection while significantly reducing false alarms[122].







[116] https://accessibe.com/
[117] https://voicebot.ai/2022/10/03/tech-giants-launch-speech-accessibility-project-to-improve-voice-aifor-people-with-disabilities/
[118] https://www.voiceitt.com/
[119] Backpack language models: Tackling gender bias in Generative AI - Pixis (2023). https://pixis.ai/blogs/backpack-language-models-tackling-gender-bias-in-generative-ai/
[120] https://www.fairslator.com/
[121] Montoro-Montarroso, A. et al. (2023). Fighting disinformation with artificial intelligence: Fundamentals, advances and challenges. Profesional de la información, 32(3). https://revista.profesionaldelainformacion.com/index.php/EPI/article/view/87328
[122] Creative Dock's REPORT, ibid.


Greece 2024

Civil Protection & Prevention

Civil protection[123] is the safeguarding of people, the environment, and property against all types of natural and human-made disasters. Apart from developing forces and equipment to address emergency needs, it also involves planning and preparation for such events. This includes conducting risk assessments and establishing protection and rescue plans and procedures. It is noteworthy that the "*Strategic Foresight Report 2023*" by the European Commission, titled "*Sustainability and Well-being of People at the Heart of Europe's Open Strategic Autonomy,*" includes as a key conclusion the complementarity of civil protection with "civil prevention" through strengthening the EU toolbox for preparedness and response. A representative of a multinational technology company estimates that "*GenAI can offer solutions to critical issues such as climate change,*" while Antonis Chondros, CEO of Victus Networks, is optimistic about technology's contribution to environmental sustainability. Similarly, Cleo Sgouropoulou, Professor at the Department of Computer Engineering and Informatics at the University of the Aegean, believes that GenAI "*could be used to develop solutions that contribute to sustainable development and addressing the challenges of climate change,*" a view supported by the representative of the multinational technology company.

Successful applications of GenAI in civil protection and "civil prevention" can decisively contribute to reducing deaths and economic losses from such disasters.

Some possible examples[124] of implementation include:

- Regularly updated local flood forecasts and other *natural disaster predictions* that allow for timely issuance of location-based safety warnings.
- *Management of critical infrastructure.* For example, smart electrical grids include applications for distributed control and classification of network damage types and severity, as well as predictions for electricity demand in emergency situations.
- In the context of *wildfires*, satellite image analysis, unmanned aerial vehicles, or internet-connected cameras can help automate fire detection, thereby reducing response time and increasing the likelihood of fire suppression.
- By analyzing data from various sources, including satellite images and hazard signals, GenAI can assist in search and *rescue operations*. Authorities can, for example, identify the most likely search areas and improve the chances of locating and rescuing individuals at risk.

[123] https://eur-lex.europa.eu/EL/legal-content/glossary/civil-protection.html

[124] https://css.ethz.ch/content/dam/ethz/special-interest/gess/cis/center-for-securitiesstudies/pdfs/CSSAnalyse260-EN.pdf

Defense

Countries worldwide are increasing their defense budgets to evaluate and harness the potential of GenAI. MarketResearch.biz[125] predicts GenAI growth in defense at a 21% CAGR for 2022-2032, creating a market size of $2.91 billion by 2032 (see Figure 5). The primary users of GenAI in defense are mainly governments and the military, with an estimated share of 47%, followed by defense contractors and research institutions.

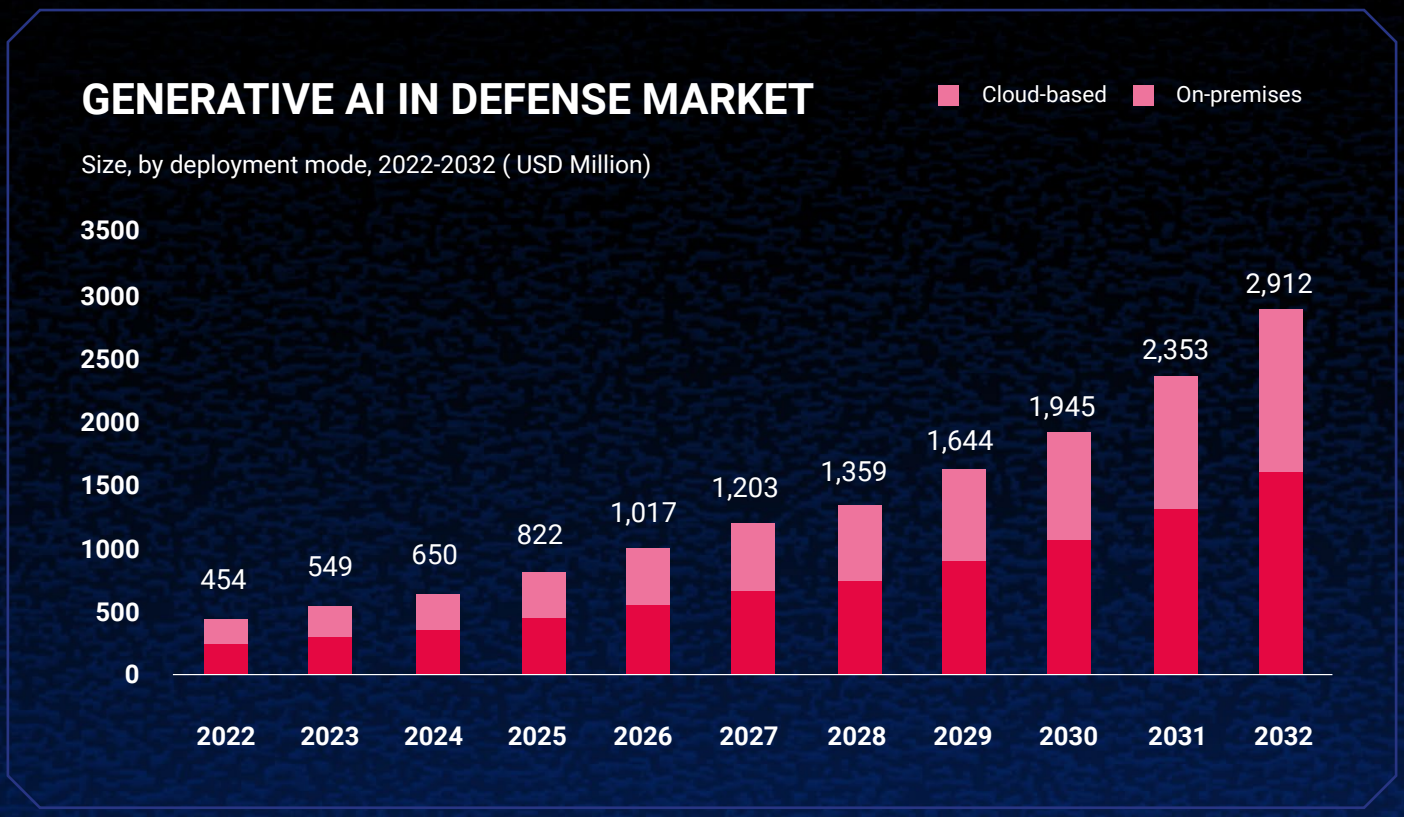


Image 5: *The market will grow up to 21% CAGR and is expected to reach 2.91 billion dollars by 2032.*

Currently, many national governments are in the assessment phase, testing the capabilities of GenAI to understand its limitations and advantages, identify future use cases, and better assess its risks. The main opportunities[126] in the field seem to be:

- **Enhanced intelligence:** GenAI can enhance human intelligence by providing advanced analytical capabilities and decision support systems to defense personnel. GenAI can enhance situational awareness, aid in threat detection, and support decision-making by analyzing large amounts of data and generating insights.
- **Autonomous systems:** The defense sector is increasingly adopting autonomous systems, including unmanned vehicles and unmanned aircraft. GenAI can contribute to the development of autonomous systems, allowing them to perceive and understand complex environments, make autonomous decisions, and adapt to dynamic scenarios.
- **Cybersecurity and threat detection:** As dependence on digital infrastructure grows, defense organizations face increasing cyber threats. GenAI can play a vital role in detecting and mitigating cyber threats by analyzing patterns, creating synthetic attack scenarios for defense testing, and strengthening overall cybersecurity measures.

[125] https://marketresearch.biz/report/generative-ai-in-defense-market/

[126] Generative AI in defense market size, share, and forecast by 2032 - MarketResearch.biz (2023). https://marketresearch.biz/report/generative-ai-in-defense-market/

Beyond governments, commercial defense developments in GenAI are also emerging. Recently, Google AI released a model called Imagen, which can generate realistic depictions of military equipment, aiding in their design and assisting in soldier training. Microsoft recently developed Synthia, a model that generates synthetic data, which could assist defense companies in developing military solutions[127].

Traffic Management, Transportation, and Green Energy

The integration of *autonomous vehicles* in urban environments holds much promise, as it has the potential to significantly reduce traffic congestion, accidents, and pollution emissions, issues that particularly affect Greece's major cities. These vehicles can operate as part of interconnected networks, communicating with each other and with city infrastructure to optimize traffic flows, thus contributing to safer and more efficient urban landscapes. Additionally, *traffic management systems* based on GenAI analyze real-time data to predict and respond to changing traffic patterns, allowing for proactive adjustments to traffic light timings and dynamic rerouting, enhancing urban mobility[128].

Specifically:
"*GenAI can help optimize transportation systems by analyzing vast amounts of data to identify patterns, predict traffic flows, and suggest efficient routes. It can also assist in demand prediction, resource allocation, and propose improvements for sustainability and cost-effectiveness in transportation planning. Moreover, GenAI can support real-time monitoring and decision-making, enhancing overall efficiency and responsiveness in transportation management*[129]."

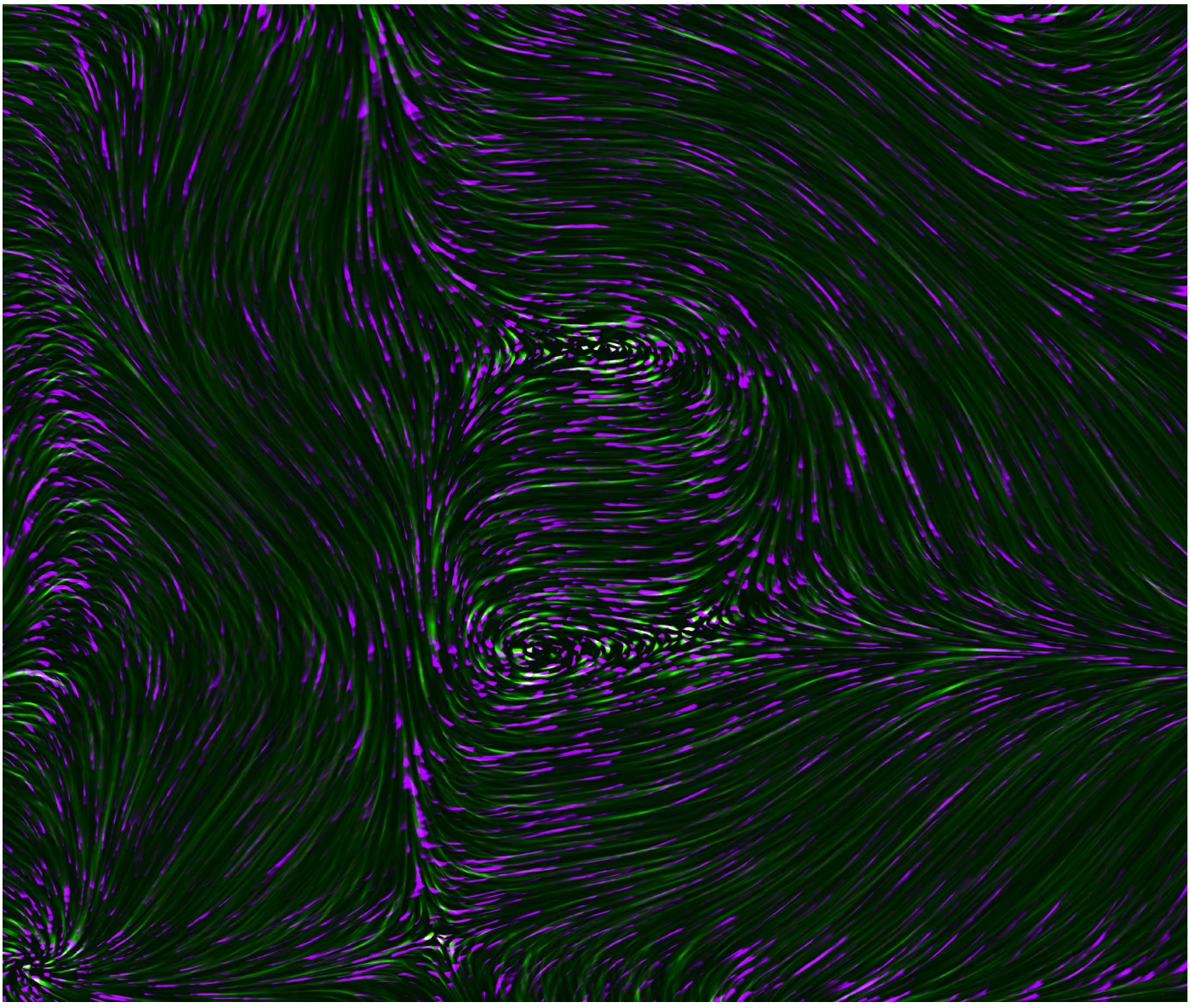
A notable example and innovative addition is Wayve's LINGO-1 model, which provides driving commentary and answers questions interactively, thus enhancing the driving experience[130].

Regarding environmental protection, smart networks using GenAI can dynamically *adjust energy provision based on*

[127] Generative AI's potential as a force multiplier in Defense - CIO (2023).
https://www.cio.com/article/651428/generative-ais-potential-as-a-force-multiplier-in-defense.html
[128] Creative Dock's (2023) REPORT: Future of Generative AI.
https://www.rohrbeckheger.com/insights/report-future-of-generative-ai
[129] Excerpt from a discussion (10.11.2023) with Theodore Tsekeris, Senior Researcher at the Center for Planning and Economic Research (KEPE), specializing in Transport Economics, Spatial Development, and Supply Chain and Value Networks.
[130] https://wayve.ai/thinking/lingo-natural-language-autonomous-driving/

real-time data, weather conditions, and user demand, minimizing waste and improving network stability. Furthermore, GenAI-supported sustainable resource management optimizes resource consumption and reduces waste, leading to more efficient and effective management systems through real-time data analysis. *Efforts to control pollution and reduce emissions with GenAI* aim to monitor and analyze pollution levels, predict pollutant sources, and develop strategies for emission reduction using intelligent systems and technologies, promoting a cleaner and more sustainable future[131].

Additionally, the need to find raw materials to facilitate the green transition as quickly as possible can be aided by GenAI. According to the Economist[132], 99% of exploration projects fail to identify economically exploitable deposits and turn them into actual mining projects. As A. Hyms notes: "*GenAI can collect bundles of geological, geochemical, and geophysical data to feed software models that will identify patterns and draw conclusions about where to conduct exploration surveys with a higher success rate. Many major industry players globally are already beginning to use GenAI in this direction. Cobalt, copper, lithium, and nickel are some of the minerals with rapidly growing demand for a range of uses in the energy transition (batteries, etc.). Especially now that Europe wants to reduce its dependence on mineral imports and exploit deposits within its territory, our country should pioneer in this field to exploit its, largely untapped, mineral wealth.*"



[131] Creative Dock's REPORT, ibid.
[132] Economist. (2023). Could AI help find valuable mineral deposits?
https://www.economist.com/science-and-technology/2023/11/01/could-ai-help-find-valuable-mineraldeposits

Construction

GenAI has the potential to bring changes to the construction[133] sector in Greece, optimizing design, scheduling, and project management. GenAI algorithms can assist architects and engineers in creating innovative and sustainable building designs, taking into account factors such as local climate and available resources. Through predictive analyses, GenAI can help identify potential cost overrun issues or delays in construction projects, allowing for better risk management.

GenAI is expected to influence construction as well. Design assistance models, efficient analysis, and summarization of extensive documents such as contracts, specifications, and reports, as well as the integration of knowledge from the business world, are just a few areas where GenAI can be utilized[134]. Finally, leveraging GenAI can contribute to the digitization of construction twins and further assist the work of engineers.

Industry - Manufacturing

GenAI can bring opportunities at multiple levels to the manufacturing industry, as per A. Hymis (KEPE), presenting many possibilities in a) creating new products, b) improving employee training, c) quality control, d) product design, e) logistics, and f) enhancing supply chain[135] processes. Specifically, A. Hymis (KEPE) states that:

"*GenAI through blockchain and smart contracts promises to increase data security, traceability, and transparency while simultaneously reducing costs and time management. GenAI is expected to further accelerate the transformation of the manufacturing and industrial sector through algorithms that can generate new content or designs from scratch, based on a set of rules and inputs, thus enhancing innovation, efficiency, and sustainability.*"

Agricultural Production

The agricultural sector, a key pillar of the Greek economy, is set to benefit significantly from the proliferation of GenAI. Estimates indicate that investments in GenAI applications in agriculture will almost decuple over the next decade (see Figure 6), thus highlighting the primary direction of innovation in this field. One of the key applications is predicting crop yields, where GenAI utilizes data and *predictive models to provide farmers with valuable information for future crop production.* Additionally, GenAI can contribute to resource conservation by *helping farmers efficiently allocate resources* such as water, fertilizers, and pesticides to maximize yields and minimize waste. Soil analysis is another area where GenAI contributes, as it can assess soil health and composition, guiding farmers in optimal planting and cultivation practices[136].

[133] Martha Tsigkari's The stakes are high – so are the rewards: AI and the future of Construction, Building. https://www.building.co.uk/building-the-future-commission/the-stakes-are-high-so-are-therewards-ai-and-the-future-of-construction/5124627. article

[134] Ibid.

[135] Marr (2023). The future of manufacturing: generative AI and beyond. https://www.forbes.com/sites/bernardmarr/2023/07/25/the-future-of-manufacturing-generative-ai-andbeyond/

[136] Lu, G. et al. (2023). AGI for Agriculture. ArXiv. https://arxiv.org/abs/2304.06136

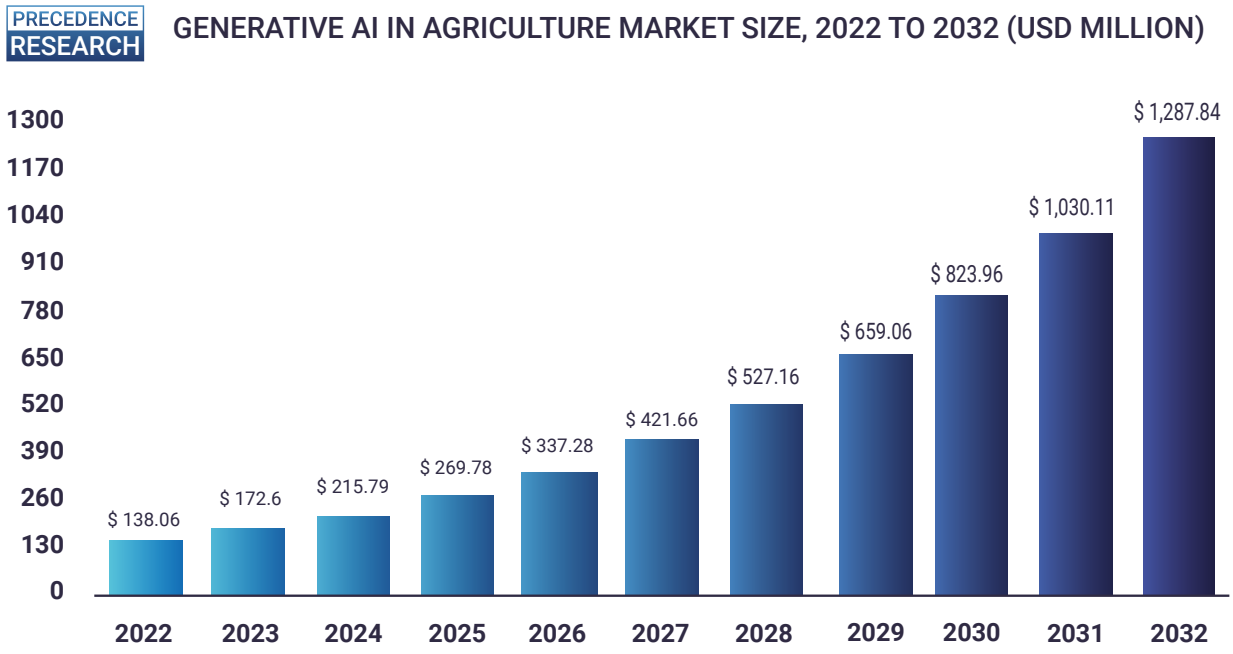
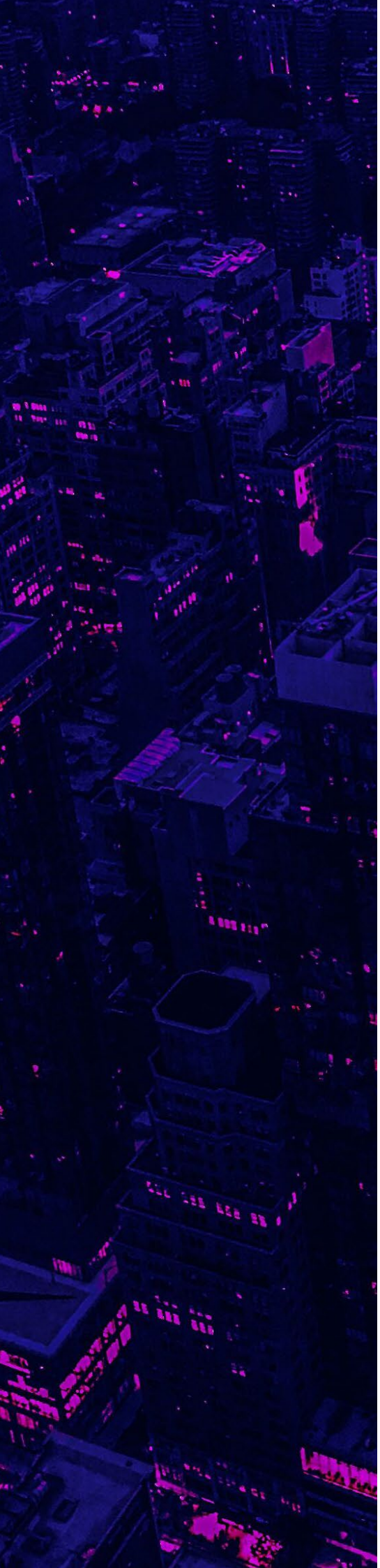


Image 6: *The global size of AI in agriculture was estimated at $138.06 million in 2022 and is expected to be worth approximately $1,287.84 million by 2032*[137]*.*

Athanasios Hymis (KEPE) sees GenAI as an ally in food security and sustainable agriculture in the near future, stating that it "*can greatly assist farmers in adapting to constantly changing environmental conditions, in terms of developing new seeds and plants resistant to climate change.*" Finally, the synergy between GenAI and Digital Twins in agricultural practices offers a promising avenue for precision agriculture. By creating digital replicas of agricultural crops, farmers can simulate various scenarios and test alternative strategies to enhance productivity, conserve resources, and optimize crop management. This blend of GenAI and digital twins is poised to reshape the agricultural landscape, making it more sustainable and efficient.

[137] https://www.precedenceresearch.com/generative-ai-in-agriculture-market



Tourism

GenAI can significantly benefit Greece in the tourism sector by enhancing the overall visitor experience and promoting the country as a top destination. Through smart digital assistants (chatbots), tourists can receive real-time, personalized recommendations and information about local attractions, accommodations, and dining options, making their travels more convenient and enjoyable. Additionally, the utilization of augmented reality tools, already used by Virtual Concierge companies in Greece since the late previous decade, now evolves into AI immersed reality tools, maximizing the visualization of services and consumer experience in the experience economy. Another parameter where the current development of GenAI contributes to the tourism industry, as stated in our research by a representative of a multinational technology company, is that GenAI "*will have a positive impact on the tourism sector by breaking down language barriers.*"

A managerial executive of the Tourism Cultural Institute in our research mentions the beneficial effect of reallocating resources to more useful actions and functions. However, reservations are expressed regarding the potential loss of intellectual property rights of educational material producers and the personalized contact among members of the tourism work ecosystem, as well as the possibility of job losses.

From the perspective of reservations, as emphasized in our research by Konstantinos Miliotis, a researcher at the University of West Attica in the field of information technology in tourism, the demand for extensive data collection poses significant risks to privacy and citizen security. Additionally, there is a potential risk of losing the human factor in services (a vital element in the tourism industry), directly impacting job reduction. An additional problem would be the excessive dependence on technology, with a direct risk of vulnerability to technological errors and cyber-attacks. Finally, it is mentioned that the use of GenAI could lead to a homogenization of tourist experiences, reducing cultural diversity. Along the same lines, it is worth adding the oligopolistic trend of large companies in the tourism economy platform, which, precisely because they control the distribution channel of the tourism product through the utilization of advanced "smart" algorithms, make the critical mass of Greek small-scale accommodation providers and owners entirely dependent on the algorithms of the former.

Furthermore, GenAI can assist in content creation by generating enticing marketing materials, including travel articles, social media posts, and promotional videos, thus enhancing Greece's online presence and attracting a broader international audience. This technology also contributes to the preservation of historical and cultural heritage by facilitating the creation of virtual tours and interactive exhibitions.

Overall, GenAI revolutionizes the tourism sector by offering a range of innovative solutions. *Virtual travel experiences* stand out, allowing users to explore destinations without ever leaving their homes. This not only aids travelers in planning their trips but also serves as an educational tool, providing knowledge about different cultures and allowing individuals to explore the world from the comfort of their homes. GenAI also offers personalized recommendations to help travelers save time and money, ensuring that their choices align with their interests and needs. Additionally, it optimizes marketing campaigns by precisely targeting the right audience, creating attractive messages, and measuring campaign results for more effective promotion.

Automated customer service supported by GenAI is crucial for addressing inquiries, resolving complaints, and providing support, ensuring a seamless and flexible experience for tourists. Moreover, GenAI can facilitate personalized training experiences for tourism personnel by adapting training to individual strengths and weaknesses, resulting in better-trained staff. Finally, AI-based guides can offer tourists interactive and informative guidance, enhancing destination exploration and creating more attractive and enriching travel experiences. These GenAI applications lead the tourism industry to greater efficiency, personalization, and customer satisfaction.

Shipping

Given that the shipping sector involves geographically distributed resources, outdated computing systems, and frequent personnel turnovers, aspects such as knowledge transfer, preventive maintenance, and communication are crucial. Therefore, GenAI can be utilized for question-and-answer systems for internal knowledge discovery and problem-solving, automation of tedious or time-consuming tasks (e.g., report generation and communication processes), and enhanced event monitoring with proactive alerts and recommendations (e.g., for predictive maintenance of vessels, material/system failures).

Route Optimization

Using GenAI, advanced navigation systems could be developed that take into account real-time weather data, traffic conditions, and vessel characteristics. This could assist ships in optimizing their routes to reduce fuel consumption and minimize the risk of accidents due to adverse weather conditions.

Cargo Handling and Supply

GenAI can optimize cargo handling and supply processes at ports by forecasting demand, managing container movements, and optimizing ship loading and unloading.

Crew Training and Support

GenAI can be used to develop training simulators for maritime crews, providing realistic scenarios for training and emergency response exercises. It can also serve as a knowledge source for crew members, providing information and guidance on various maritime procedures and protocols.

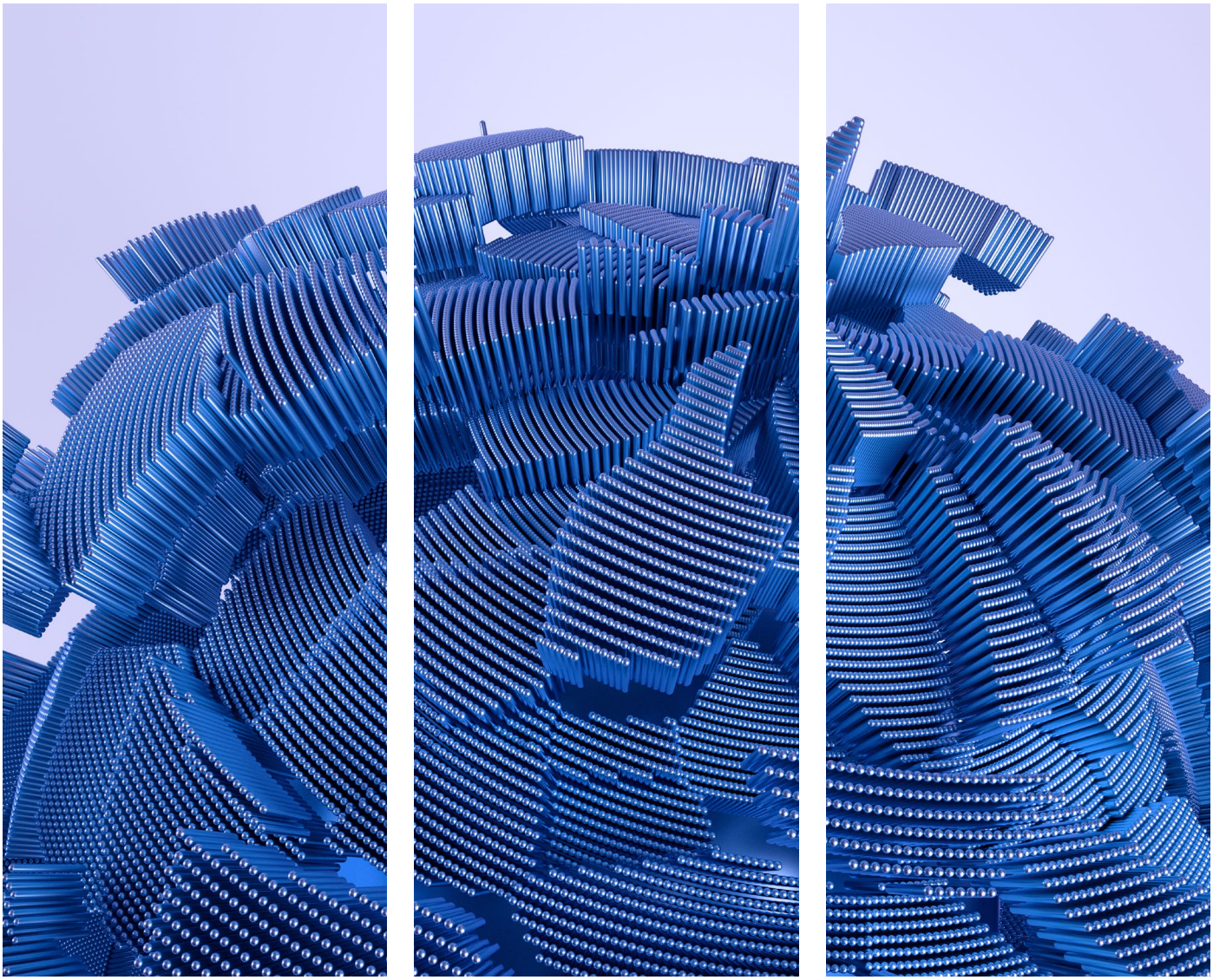
Multilingual Communication

GenAI can facilitate communication between crew members and port workers, aiding international cooperation. An example of such an application is SeaGPT. Specifically, Greywing, based in Singapore, recently developed SeaGPT, an AI chatbot based on GPT-4 technology, as a solution to streamline communication between crew managers and port agents. This tool can automate communication processes, including drafting email messages and extracting essential information from port agent responses for specific crew members[138].

Maintenance Prediction

GenAI can analyze data from various sensors and maintenance records to predict when equipment or machinery on a ship requires maintenance. This approach can significantly aid in preventing breakdowns and reducing downtime.

[138] https://www.seagpt.ai/



Finance

Financial advisory services based on AI, particularly GenAI, utilize advanced algorithms to analyze financial data and users' individual goals. This enables them to provide highly personalized recommendations and guidance regarding budgeting, savings, investments, and debt management. Simultaneously, *tax management tools* with AI revolutionize tax management by automating tedious tasks, optimizing tax planning, and minimizing errors. Additionally, AI plays a crucial role in assessing credit risk, using data analysis to estimate creditworthiness and *evaluate credit risk* for lending and investment cases in real-time. This not only enhances the accuracy of credit assessments but also reduces default rates.

However, caution is needed to ensure that this technological capability does not create social injustice through algorithmic bias, *establishing automated exclusions of vulnerable groups*[139]. It can also assist in introducing and assessing fairer criteria in credit analysis and aligning with ESG (Environmental, Social, Governance) criteria. Finally, regulatory compliance monitoring with the help of GenAI simplifies compliance processes through automation and detects potential violations and fraud, ensuring a safe financial environment[140].

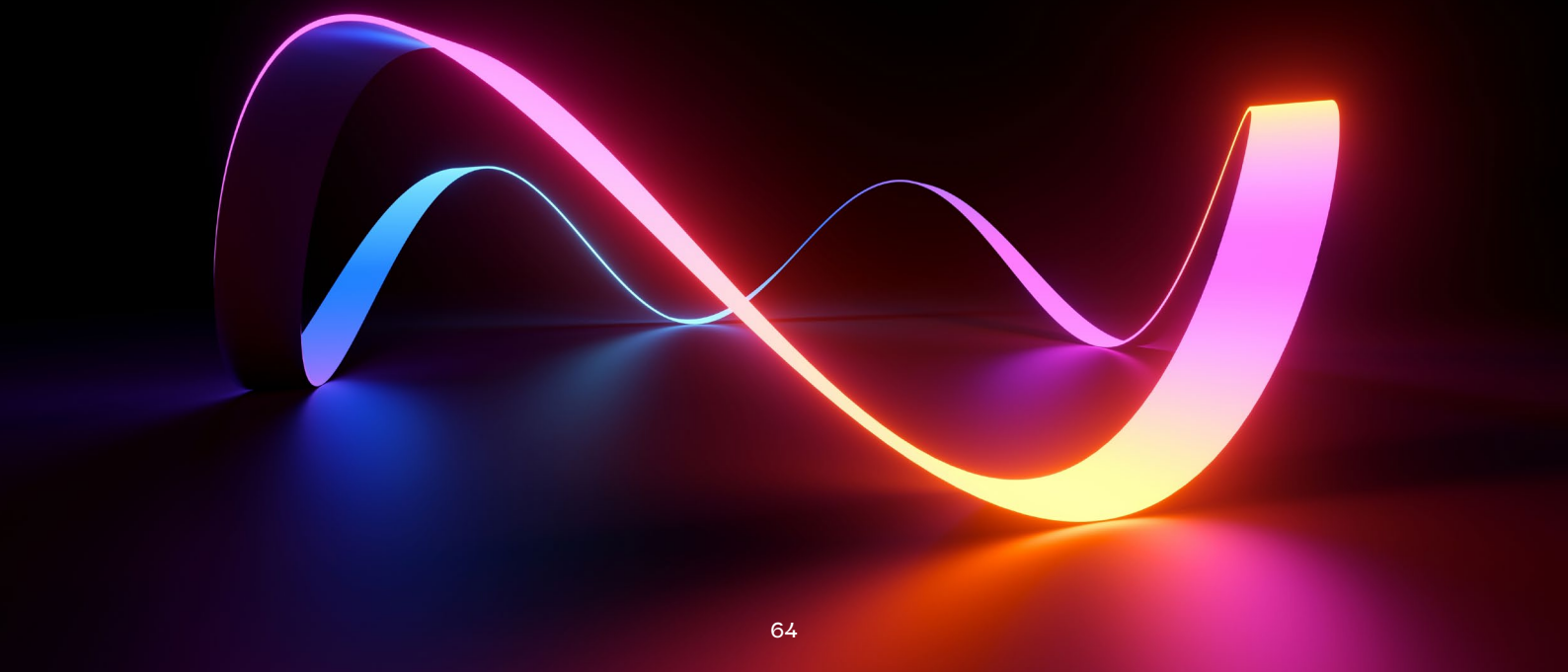
[139] As an example on this topic, Virginia Eubanks (2018) discusses "Automating Inequality" in her book published by St. Martin's Press in New York. .

[140] Creative Dock's REPORT, ibid.

Vulnerabilities

Vulnerabilities

The rapid rise of AI constitutes an example of the speed at which technological progress penetrates established structures and institutions, altering their organization and behavior. Simultaneously, it demonstrates how quickly the landscape of risk evolves and mutates in all sectors that can apply AI technologies. Moreover, as noted by a representative of a multinational technology company, "*AI production systems - and especially large language models - have been shown to exhibit capabilities that were not part of their training. Therefore, advanced models may operate in an unpredictable or undesirable manner.*" Apart from the present inability to predict the ramifications of the functioning of existing models, various risks may disrupt the adaptation and adoption of AI, both in the production process and in society. In the following graph (Figure 7), the estimates of experts regarding the most negative scenarios of a future AI ecosystem in our country are shown.



Adversarial Attacks

AI models may be susceptible to adversarial attacks. Adversarial attacks are deliberate modifications to input data that attempt to compromise the performance of an AI model, and this can also affect AI models. Adversarial attacks can have unintended consequences, such as compromising image creation in an AI model by adding small modifications to input data, thus leading to undesirable outputs (such as misleading images or images containing unwanted information, e.g., reproduction of stereotypes, etc.).[141] [142]

[141] Goodfellow, I.J., Shlens, J., & Szegedy, C. (2014). Explaining and Harnessing Adversarial Examples. DOI: 10.1145/2969033.2969125.

[142] Szegedy, C., Zaremba, W., Sutskever, I., Bruna, J., Erhan, D., Goodfellow, I., & Fergus, R. (2013). Intriguing properties of neural networks. DOI: 10.1145/2999134.2999277.

Negative characteristics of the AI ecosystem in Greece 2030

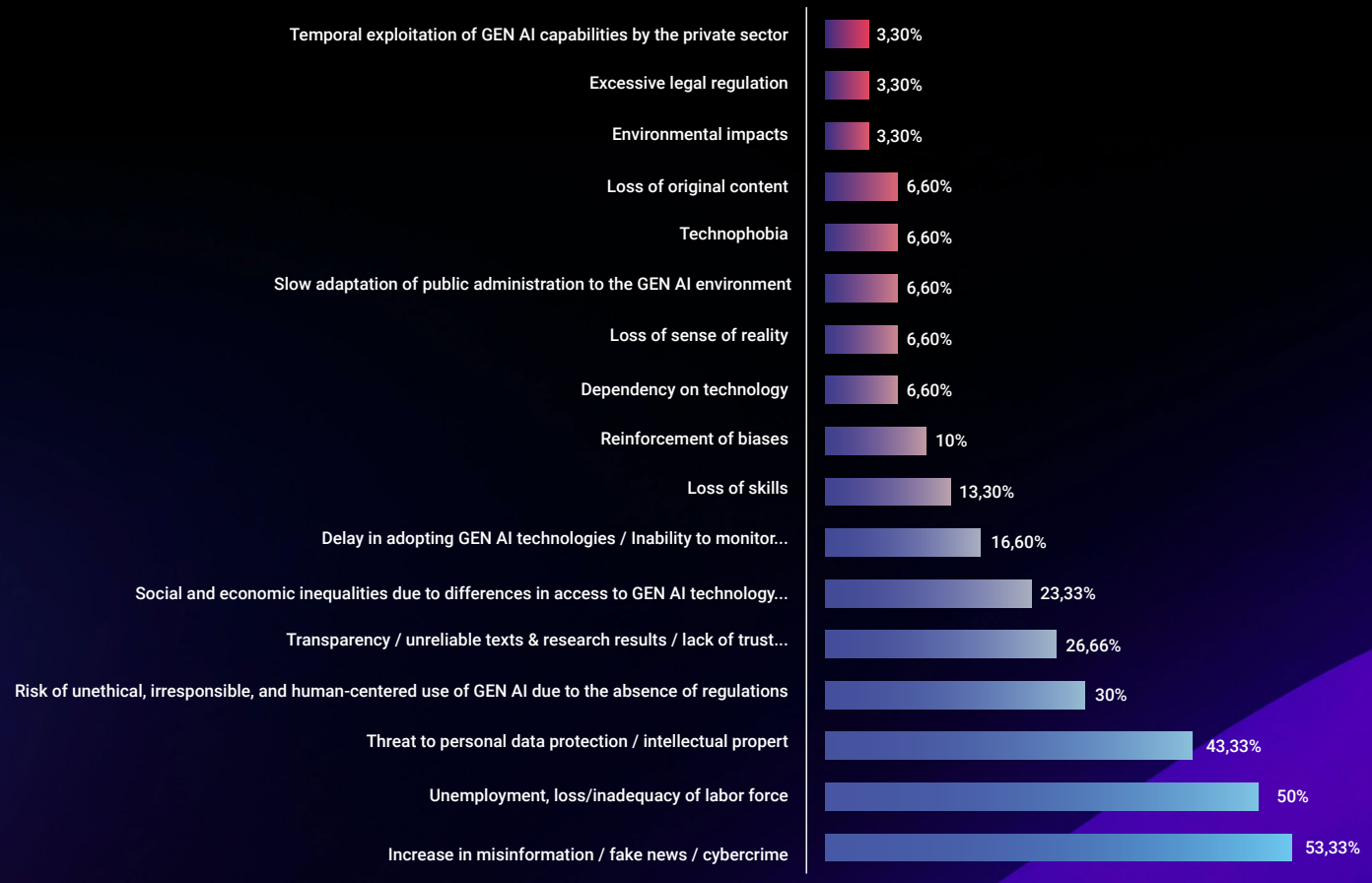


Image 7: *Experts' estimates of the negative impacts of AI in Greece by 2030.*

Furthermore, adversarial attacks have implications for system security (cybersecurity, privacy loss) and undermine trust in machine learning systems and AI. Advanced techniques and solutions are required to address these problems, including detection and mitigation of adversarial attacks in machine learning. Additionally, it is necessary to develop models that are more resistant to such attacks to ensure the security of systems.[143] [144] [145] [146] [147]

[143] Qiu, S., Liu, Q., Zhou, S., & Wu, C. (2019). Review of Artificial Intelligence Adversarial Attack and Defense Technologies. Applied Sciences, 9(5):909. https://doi.org/10.3390/app9050909

[144] Alzantot, M., Sharma, Y., Elgohary, A., Ho, B., & Srivastava, M. (2018). Did You Hear That? Adversarial Examples Against Automatic Speech Recognition. http://arxiv.org/abs/1801.00554

[145] Samangouei, P., Kabkab, M., & Chellappa, R. (2018). Defense-GAN: Protecting Classifiers Against Adversarial Attacks Using Generative Models. http://arxiv.org/abs/1805.06605

[146] Baluja, S., & Fischer, I. (2018). Adversarial Transformation Networks: Learning to Generate Adversarial Examples. http://arxiv.org/abs/1703.09387

[147] Robey, A., Wong, E., Hassani, H., & Pappas, G. J. (2023). SmoothLLM: Defending Large Language Models Against Jailbreaking Attacks. 1–40. http://arxiv.org/abs/2310.03684

Excessive Dependency and Lack of Verification

AI models are often associated with excessive dependence and a lack of verification in the field of data and content production. Excessive dependence includes using AI to generate realistic data, such as images, videos, and audio, which are difficult to distinguish from real data and therefore may not be considered reliable by users, researchers, and companies. This highlights the problem of *lack of verification.*

"*For society,*" observes journalist Yiannis Rizopoulos, a member of the Boussias Media Group, "*one of the biggest problems negatively affecting the public's trust in AI is the lack of transparency because no one knows the criteria by which algorithms in black boxes operate.*" Athena Vakali, a professor of Computer Science and Director of the Data and Web Science Laboratory at Aristotle University of Thessaloniki, warns of "*the lack of quality indicators and certified verification processes of the generated AI knowledge and its results,*" *and cautions against* "*the devaluation of generated knowledge and the loss of trust by researchers and the public following possible generated false and malicious information from AI tools and services.*"

The European Union's AI Act requires transparency, such as the obligation to disclose that the content is generated by AI, as well as information on data protected by intellectual property rights used for training AI systems. However, the control of AI leaps will in reality be an ongoing process balancing knowledge and independence.

This is the main reason why scientists must play a critical role in mitigating the impacts of this developing technology. While the demand for supervision of new models and technologies by researchers and scientists is clear and urgent, it is equally clear that companies that have invested enormous financial and research resources in their implementation will not disclose their secrets, thereby excluding the possibility of independent verification and regulation.[148]

Vasilis Vasilopoulos, Data Protection Officer at ERT, estimates that "*based on the asymmetrical new contract and the lack of regulation, there will be serious negative impacts on content quality due to plagiarism, homogenization, and fantasies, indistinguishable from misinformation, conspiracy theories, and truth,*" *and sees* "*education and journalism closer to these threats.*"

According to the assessment of legal expert Lilian Mitrou (professor at the Department of Information and Communication Systems Engineering, University of the Aegean):

"*Neither research nor quality is promoted when a system, as well-fed and selected as it may be, chooses and composes sources and produces results instead of the researcher or the evaluator. It greatly enhances to an unpleasant degree the dissemination of false or altered information in a 'scientifically plausible' way much more than we have had so far.*"

Konstantinos Karpouzis, assistant professor at the Department of Communication, Media, and Culture at Panteion University, argues for "a resurgence of a climate of technophobia, the spread of fake news, and the easy production of texts that are not checked for accuracy, using synthetic images."

The need for objective evidence[149] and verification of data authenticity is one of the most critical thorny issues in the use of AI, often causing problems of trust and reliability[150].[151] [152] It should be noted that AI has the ability to retroactively modify electronic copies of books or scientific articles, posing a threat to our common horizon, to established points of reference for truth[153]. Therefore, much discussion is now being held about the "*containment problem*" *of AI*[154].

[148] C. L., van Dis, E. A., van Rooij, R., Zuidema, W., & Bollen, J. (2023). Living guidelines for generative AI—why scientists must oversee its use. Nature, 622(7984), 693-696.
[149] Lasser, J., Aroyehun, S. T., Carrella, F., Simchon, A., Garcia, D., & Lewandowsky, S. (2023). From alternative conceptions of honesty to alternative facts in communications by US politicians. Nature Human Behaviour, 1-12. https://www.nature.com/articles/s41562-023-01691-w
[150] Geirhos, R. et al. (2019). Shortcut learning in deep neural networks. Nature Machine Intelligence, 1(7), 666-673.
[151] Poursaeed, O., Poursaeed, O., Yang, L., Cao, C., Ren, Z., & Nourbakhsh, I. (2018). Generative adversarial networks for adversarial attacks. http://arxiv.org/abs/1812.02315
[152] Rossler, A., Cozzolino, D., Verdoliva, L., Riess, C., & Thies, J. (2019). Faceforensics++: Learning to detect manipulated facial images. http://arxiv.org/abs/1901.08971
[153] https://www.nytimes.com/2023/04/03/books/classic-novels-revisions-agatha-christie-roalddahl.html
[154] 4 Suleyman, M., & Bhaskar, M. (2023). The coming wave: Technology, power, and the twenty-first century's greatest dilemma. Crown. See also: Babcock, J., Kramar, J., & Yampolskiy, R. V. (2019). Guidelines for artificial intelligence containment. In: Ali. E. Abbas (Ed.) Next-Generation Ethics: Engineering a Better Society. Cambridge University Press, 90-112.

Privacy Breach

As AI models can be used to create fake data, this content can violate individuals' privacy, with the main examples being: (a) the creation of altered or fake photos and videos, (b) the reclassification and retrieval of personal information from images or text, (c) the creation of fake profiles, among others[155] [156] [157] [158]. Additionally, the threat to personal data, privacy, and intellectual property is the second most significant vulnerability revealed by the present empirical research. K. Sampatakakis (Accenture Greece) considers both the unethical use of AI and the threat to privacy to be even more immediate compared to the impact of AI on the job market. A member of the academic community and a specialist in these matters, he speaks of "*unfair exploitation of personal data*", while a representative of a multinational technology company warns that AI can lead to "*more '**intelligent**' and therefore more dangerous cyberattacks threatening personal data*". In the same context, the Deputy Minister of Digital Governance, K. Kyranakis, emphasizes that:

"*For achieving personalized service provision through AI, it is necessary to feed algorithms with user data, including personal information, which could jeopardize privacy. Additionally, content reproduction applications (e.g., avatars, voice cloning, etc.) may be maliciously used, violating the privacy and personal lives of citizens. Moreover, through the collection of usage data, behavior analysis can be conducted, paving the way for potential privacy breaches.*"

Enhancement of Prejudices

As AI models rely on vast datasets for content generation, they inherit the biases and prejudices present in these datasets used for their training. Martha Tsingkari (Senior ParAIer, Foster + ParAIers) emphasizes that, in addition to the general problem of lack of transparency in models, there are also "*unconscious embedded biases*" in the training data of the models. As Antonis Stasis, General Director of Digital Governance (Ministry of Digital Governance), observes, there is a risk of "*prejudiced information based on stereotypes from other eras*", including (a) the reproduction of biases existing in educational data, such as gender, nationality, age, etc., (b) reinforcement of stereotypes through content creation that represents stereotypical images and prejudices, and (c) the re-creation of reinforced prejudices through content that not only reflects but reproduces existing biases in more harmful forms.[159] [160] [161]

[155] Zhao, H., Zhang, H., Liu, J., & Shao, D. (2020). A Survey of Deepfake and the Countermeasures. Journal of Visual Communication and Image Representation, 74, 102056.
[156] Dufour, J., & Wu, Y. (2020). Deepfake Video Detection Using Recurrent Neural Networks. IEEE Access, 8, 185137-185146.
[157] Günther, M., Zahner, D., Niemczak, C., & Rahm, E. (2021). Privacy and Security Implications of Deepfakes. Data & Knowledge Engineering, 137, 101246.
[158] Marra, F., Gragnaniello, D., Cozzolino, D., Verdoliva, L., & Poggi, G. (2018). Detection of GANGenerated Fake Images Over Social Networks. IEEE Transactions on Information Forensics and Security, 14(9), 1970-1984.
[159] Crawford, K., & Paglen, T. (2019). Excavating AI: The Politics of Images in Machine Learning Training Sets. AI Now Institute.
[160] D'Onofrio, D., Cristoforetti, L., & De Nardis, M. (2020). Debiasing Natural Language Understanding Models: A Review and Quantitative Analysis. http://arxiv.org/abs/2010.02503
[161] Bolukbasi, T., Chang, K. W., Zou, J. Y., Saligrama, V., & Kalai, A. T. (2016). Man is to computer programmer as woman is to homemaker? Debiasing word embeddings. In Advances in Neural Information Processing Systems (NeurIPS), 29.

According to recent research by UNESCO[162], AI has increased the potential avenues for technologically assisted gender-based violence faced by many online communities. Although there are no global data yet on gender-based violence in the era of AI, comparative studies from 2020[163] reveal that 58% of young women worldwide have experienced some form of gender-based violence on Social Media platforms, while the majority of applications developed for online security, failing to recognize this systemic distinction, shift the responsibility for self-protection against online attacks onto the victim.

This relationship between AI and the reinforcement of prejudices has sparked many discussions about the necessity of developing better practices in education and regulation of models, as well as the development of measures to reduce biases in generated content.

Change and Degradation of the Model (Model Drift)

The necessity for continuous training and updating of AI models makes them vulnerable to "model drift," which refers to the decrease in efficiency and effectiveness after the initial training. This phenomenon occurs due to (a) the need for changes in input data and retraining, where the model may become ineffective or produce content that does not align with the new conditions, (b) the phenomenon of catastrophic forgetting, where training on new data may conflict with their performance on the original data, and (c) the performance of biases, where retraining may incorporate and reinforce biases present in the new data[165].

To manage "model drift" in AI systems, it is essential to monitor and regularly retrain them with new data, use techniques such as transfer learning to maintain their effectiveness, and approach their training with scrutiny and attention to biases[166].

[162] Chowdhury, P & Lakshmi D. (2023). Technology-Facilitated Gender-Based Violence in an Era of Generative AI. UNESCO. https://www.unesco.org/en/articles/technology-facilitated-gender-basedviolence- times-generative-ai
[163] Plan International. (2020). State of the World's Girls: Free to be online. https://www.plan.org.au/wp-content/uploads/2020/10/SOTWG-Free-to-Be-Online-2020.pdf
[164] Amer, M., & Maul, T. (2019). Reducing catastrophic forgetting in modular neural networks by dynamic information balancing. https://arxiv.org/abs/1912.04508
[165] Kirkpatrick, J., Pascanu, R., Rabinowitz, N., Veness, J., Desjardins, G., Rusu, A. A., ... & Hadsell, R. (2017). Overcoming catastrophic forgetting in neural networks. Proceedings of the National Academy of Sciences, 114(13), 3521-3526.
[166] Riemer, M., Cases, I., & Gmez, J. (2019). Lifespan development of deep neural networks. In Proceedings of the IEEE International Conference on Computer Vision (ICCV), 2019.

Next-Generation Social Networks, Metaverses, and Democracy

The social networks of the new generation allow users to interact, share information, and create content in the digital space. AI models can be used to generate content such as images, texts, and videos that can be published on these networks, enhancing interaction and content creation. The same applies to metaverses, with the additional feature of using them for voice recognition and user interaction with the medium.

The above raise concerns regarding data privacy and security. Additionally, as shown in Figure 7, the possibilities of misinformation, false or altered news, and cyber fraud represent the most significant vulnerability for empirical research informants, ultimately raising questions about the dissemination of AI in society. As noted by Lefteris Chelioudakis (Homo Digitalis), "*violations of intellectual property rights are already happening to a great extent and will continue to happen if the protection model is not improved,*" while there are "*risks regarding the easier dissemination of false news, which will likely create greater public distrust even in true content regarding the easier use of such technologies for fraud.*"

The creation of fake or false information or images (Deepfake) by AI models can be used for misinformation, fraud, and privacy violation, something that for Athena Vakali (AUTh) can lead to "*discrediting of produced knowledge and loss of trust of researchers and the public after possible production of false and malicious information from GenAI tools/services/solutions*".

Specifically, for the case of metaverses, concerns are expressed about potential deficiencies in democracy[167], transparency, and consent, as the companies managing these worlds may have enormous power in determining their rules and operations[168].

Although the use of AI may include uses to facilitate democratic discussion and consultation, regardless of medium and network, there is simultaneously a risk that the use of AI will bring about diametrically opposed results if done without an ethical-legal framework and regulatory-supervisory control[169].

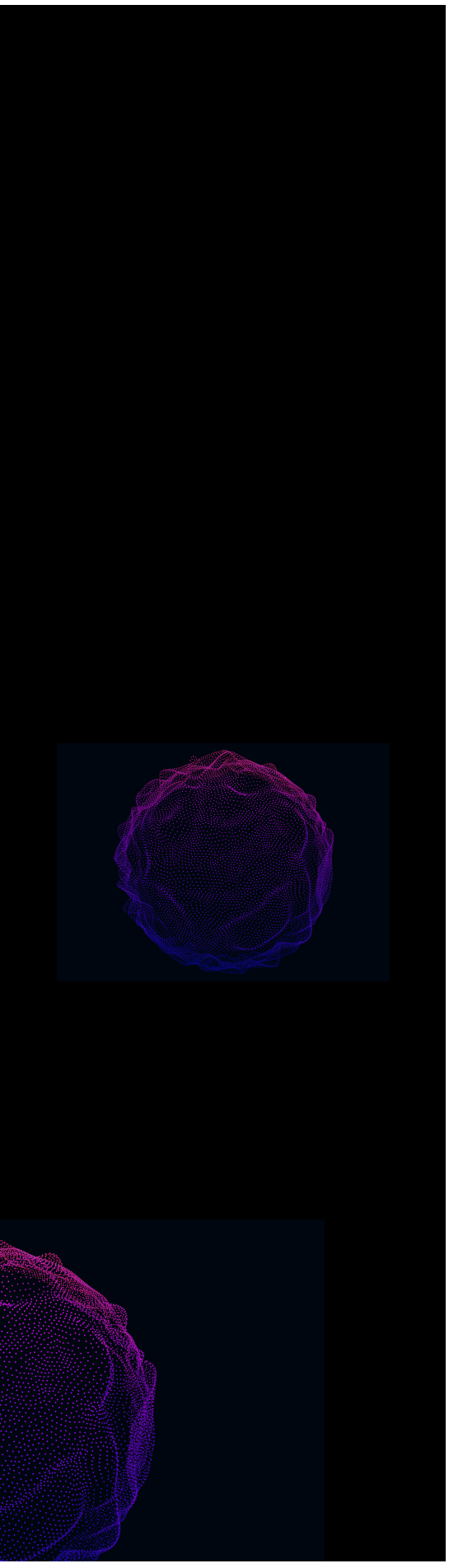
[167] Floridi, L. (2022). Metaverse: A Matter of Experience. Philos. Technol., 35, 73. https://doi.org/10.1007/s13347-022-00568-6

[168] Lv, Z. (2023). Generative artificial intelligence in the metaverse era. Cognitive Robotics, 3, 208–217. DOI: 10.1016/j.cogr.2023.06.001

[169] Jungherr, A. (2023). Artificial Intelligence and Democracy: A Conceptual Framework. Social Media + Society, 9(3). DOI: 10.1177/20563051231186353

Uncertainties

Uncertainties



Engaging with the future inevitably confronts the fundamental uncertainty of the system, especially in the modern fluid and globalized environment of complexity and rapid change in which we live. However, the approach of strategic foresight perceives uncertainties, inherent in every decision-making process, not as a problem but as an opportunity for exploitation, as well as a source of inspiration and knowledge. It is our fundamental assumption that the future of AI in Greece cannot be predicted, but the fields that present the most significant gaps and weaknesses can be defined so that their trajectory becomes more manageable. Infrastructure, data availability for training base models, public perception and familiarity with AI capabilities, labor market adaptation, ethical and regulatory issues, as well as other unforeseen factors, can influence the future course of creating a positive AI ecosystem. Empirical research classified some "inhibitory factors" (Figure 8) regarding the development of AI in Greece, highlighting current uncertainties regarding economic, legal, social, technological, and ethical fields.

The greatest challenge for the development of AI applications remains perennially the availability of data for model training. A massive volume of texts, images, and other data types is required to support, for example, the training and evaluation process of a multimodal AI system. Sources that may be used potentially may be protected by copyright or contain sensitive personal data (e.g., medical records, legal documents) of real individuals. However, various forms of inadequate behavior may be observed in neural models trained on a large volume of freely available internet data. Therefore, the behavior of the models to be developed must meet the criteria for applications in business and society, and this behavior must be prevented or minimized. Thus, preventing bad behavior should be a top priority in the design, training, and evaluation of models[170].

More specifically, sensitive areas such as those of justice and health are vulnerable to ethical and moral issues, personal data, and the reliability of results. In the legal field, potential breaches of client confidentiality and the accuracy, explanation, and interpretation of legal outcomes produced by AI require careful scrutiny. To address these challenges, it is essential to establish guidelines, standards, and oversight mechanisms to ensure transparency and fairness. Similar issues are raised in the health sector, with the protection of patients' personal data and their trust in the diagnostic results of models prevailing.

[170] https://leam.ai/feasibility-study-leam-2023/

Inhibiting factors for the development of AI in Greece

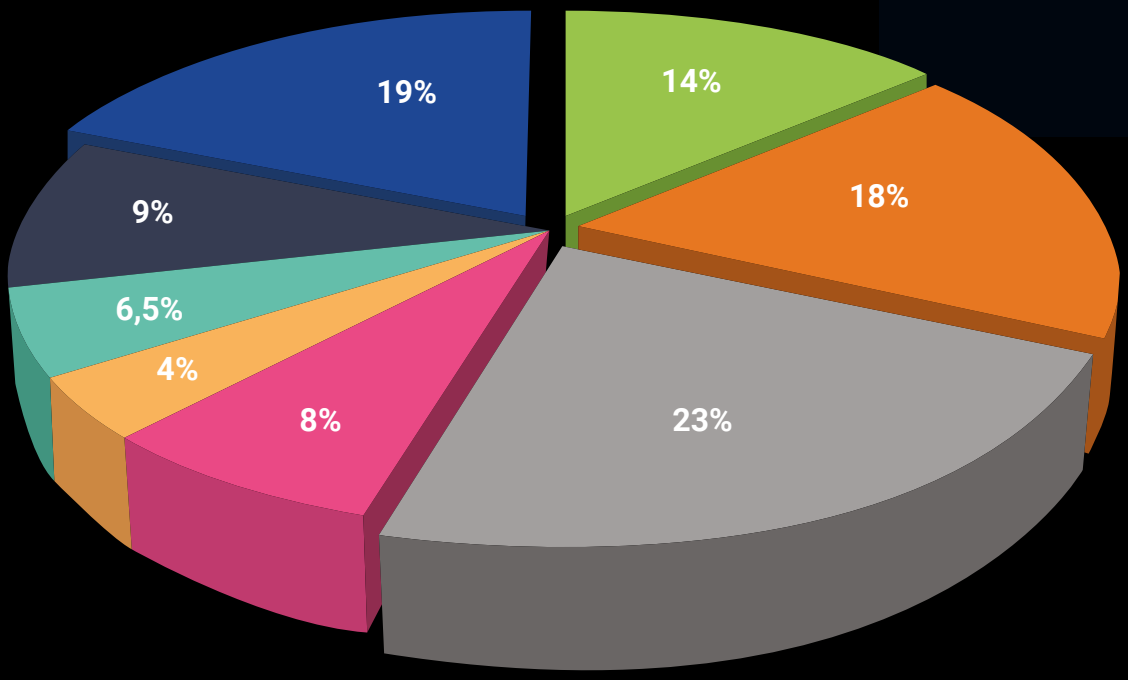


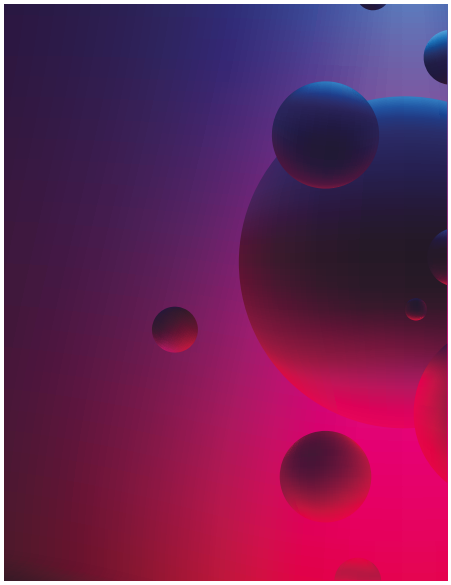
Image 8: *Inhibiting factors for the development of AI in Greece.*

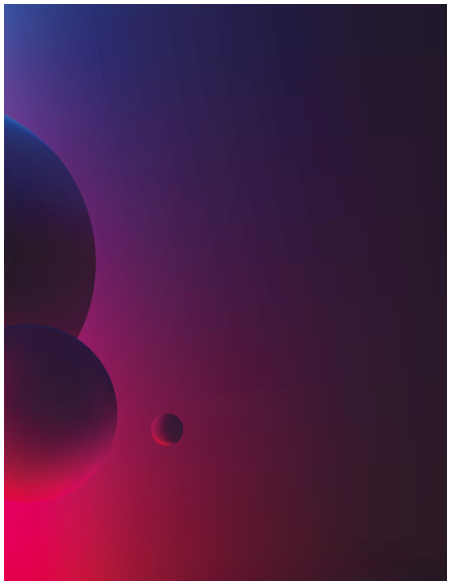
The above analysis highlights the need for the establishment of an ethical framework in order to *prevent phenomena such as false statements,* discrimination, and toxicity. Models may result in false statements when gaps in knowledge persist despite pre-training or when inconsistencies arise due to conflicting training data. Additionally, imbalances, including biases (e.g., regarding gender and national, ethnic, or social origin), incorrect generalizations, and judgments with morally condemnable consequences, as well as the use of indecent or morally offensive expressions, are also difficult to detect and prevent. A solution to the above could only be achieved through careful selection of training data and constant evaluation and improvement of models regarding these issues. However, programmers must consider that efforts to proactively eliminate all sources of negative bias from training data are unrealistic. Instead, a strategy to neutralize already known forms of bias through targeted training (night training) may yield positive results. A similar approach was adopted by the programmers of ChatGPT, which proved to be more capable of addressing criticisms received by previous GPT models[171].

Another challenge that must be addressed pertains to the Greek language and its use by a model targeting the Greek reality. As highlighted by Alexandros Melidis, General Director of the Open Technologies Organization (EELLAK), a catalytic factor for the development of NLP in Greece would be "*public investment in the development and democratic evolution and governance of a large language model in Greek.*" However, as estimated, there is currently no sign of progress in this direction. Georgios Karachalios, Deputy Director of the Public Employment Service (OAED), agrees, estimating that "*the Greek language and its access to information constitute a significant barrier to the rapid development of GenAI in Greece, as the scope (scientific or otherwise) of the reference field is limited,*" while clarifying that "*the rich electronic availability of foreign language, especially English, books, textbooks, reports, and general information creates citizens of multiple speeds.*"

Multilingual AI models have the potential to revolutionize communication beyond language barriers, but their training presents many challenges and complexities. Issues related to bias, fairness, and data quality are critical concerns that require increased attention and ongoing research.

Finally, technological challenges concern the infrastructure for managing large datasets, training productive artificial intelligence models, and hosting the applications that will emerge. These infrastructures are divided into two categories: (a) **High-Performance Computing (HPC)** systems for training and (b) **large data** centers for data and application management in the next stage.





[171] https://leam.ai/feasibility-study-leam-2023/

Sustainable AI

The evolution of AI technology is a multifaceted issue that concerns its sustainable use, its evolution at the algorithmic level, infrastructure level, and application level. AI consumes significant amounts of electricity and enormous computational power, especially when models consist of a massive number of parameters. It is expected to soon consume energy equivalent to that of an entire country[172]. Therefore, the scientific community is constantly seeking new technologies aimed at a "green" and more efficient world. The discovery of such technologies may potentially delay AI progress. Learning algorithms and lifelong learning algorithms must also further evolve to allow the creation of new intelligent systems. The latter pertains to the scenario of creating General AI (Artificial General Intelligence), i.e., AI capable of perceiving, learning, and performing tasks that require human intelligence[173]. This is one of the hypothetical future stages of the industry's evolution, provided that technological as well as theoretical obstacles are overcome.

Transformation of the Innovation Ecosystem

More than 90% of experts, i.e., 27 out of 30 empirical research informants, estimate that the penetration of AI into Greek daily reality is currently minimal to negligible and essentially concerns limited areas of activity (see Figure 9). G. Nicoletakis (100Mentors) points out:

"*If we, as a country, wait for developments to happen, foreign companies will come that will not cater to our own 'content' because we will not have created an environment that favors interactions. At this moment, there is no difference between Greece and other countries regarding GenAI AI, they are all at day zero. However, global risks exist, and there seems to be no provision yet in the Greek political discourse on how we will prepare for the transition to AI. It has tremendous impacts/consequences that if not anticipated, we will have 'digital floods and fires.' In political terms, we must understand that the game is played by everyone, it has nothing to do with the size of a country, and if we want to position ourselves, then context in the flow is necessary.*"

According to K. Kyranakis, the creation of an integrated AI ecosystem presupposes "*the formation of an investment-friendly climate that will lead to increased funding, easy and cost-effective access to critical computing infrastructure such as GPUs and cloud services,*" while the representative of SEV distinguishes "*public and private investments in computing power and incentives for businesses to integrate GenAI solutions.*"

For the further utilization and establishment of AI technology, a representative of a multinational technology company argues that "*the acceleration of digital transformation in both the public and private sectors is necessary through the adoption of cutting-edge technologies and sustainable digital technology products such as cloud computing and digital office tools that can host a wide range of data and provide the increased computing power required for AI systems.*"

According to A. Stasis, "*the adoption of GenAI depends on factors such as infrastructure, education, institutional framework, and the readiness of society.*" *Similarly, K. Sampatakakis estimates that "an inhibitory factor in the adoption of GenAI by large companies is the ethical issues it creates as well as the accompanying risks. Legal departments of companies are unable to quantify this risk as legislation does not reflect the latest technological developments. From this perspective, the main catalytic factor would be an innovative legislative intervention, not to restrict the use of GenAI as wrongly chosen by other European countries, but instead to encourage its use by accurately defining the rules and protecting the users (citizens or companies) of AI.*"

This view is shared by Professor Cleo Sgouropoulou of the Department of Computer Engineering and Informatics at the University of Patras (and a Board Member of EDSA), who believes that "*the development and adoption of GenAI in society largely depend on legislative regulations, rules, and policies set by the government*" and supports "*the development of a national strategy for artificial intelligence that will include GenAI and the establishment of a National Authority to oversee compliance with the legal framework for the development, placement in the market, and use of AI systems.*"

[172] https://www.nytimes.com/2023/10/10/climate/ai-could-soon-need-as-much-electricity-as-an-entirecountry. html

[173] https://www.millennium-project.org/artificial-general-intelligence-issues-and-opportunities-paper/

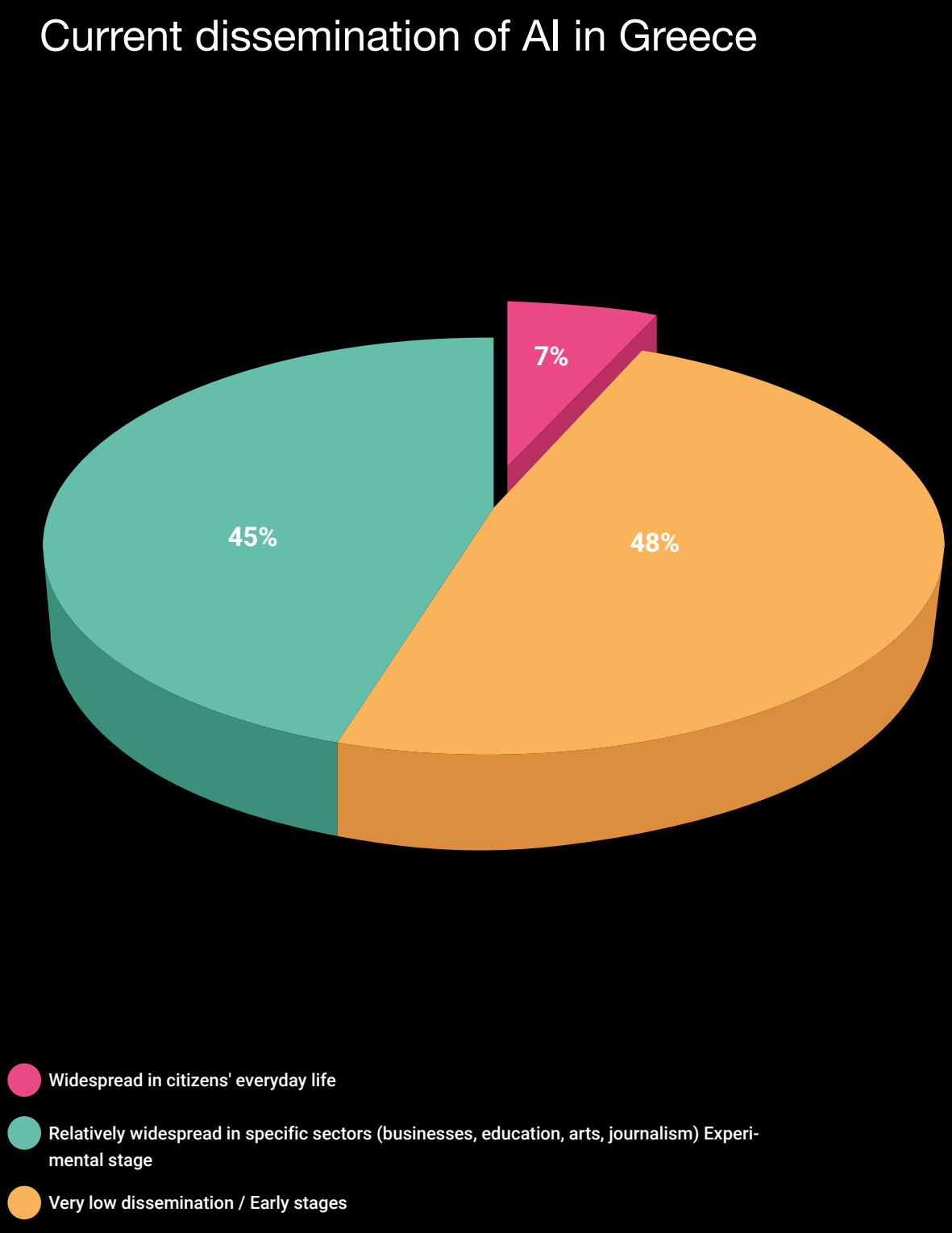
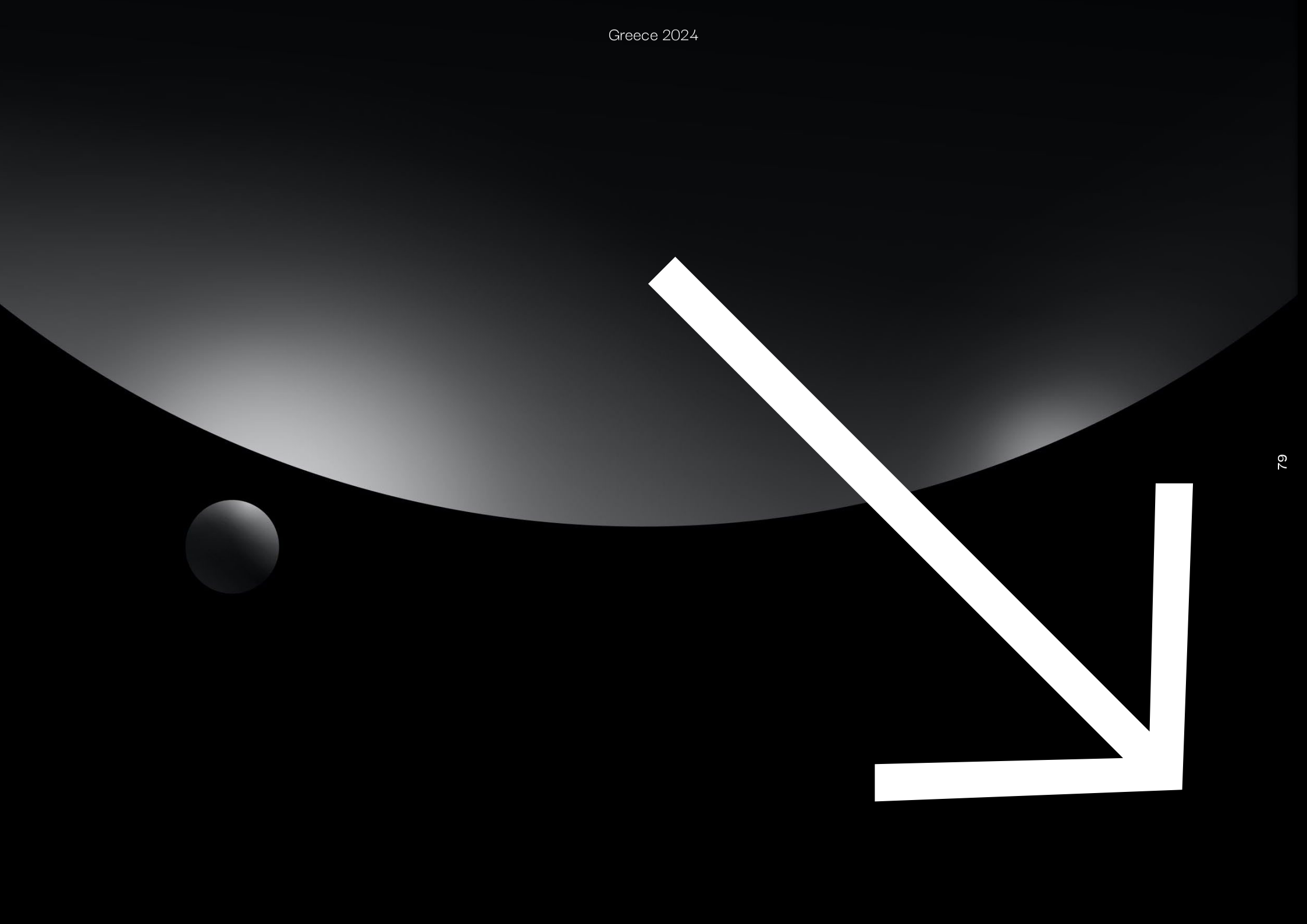


Image 9: *Experts' perceptions of the current spread of AI in Greece.*



"Ailing" Rates and Premature Acceleration

The evolution of the AI ecosystem can delineate a delicate path between delayed adoption and premature adoption of innovative technologies. According to estimates, the representative of a multinational technology company states that "*by 2030, the market for AI products is expected to reach $500 billion.*" However, in Greece and other countries, one of the uncertainties is "the slow adoption of productive AI technologies and the inability to keep up with global competition." Similarly, the representative of the Hellenic Federation of Enterprises (SEV) expresses reservations about the "*ailing rates of transition from an immature Industry 4.0 to Industry 5.0, combined with technological fatigue (tech fatigue) of people and businesses.*" Dimitris Skaltsas, CEO & Co-founder of Intelligencia AI, adds: "*While GenAI creates opportunities for economic growth, the risk increases for countries that do not create the appropriate conditions for the proper adoption of such applications, potentially lagging behind in the global economy.*" This delay may be compounded by "*use without full understanding*" and "*dependence on imported technologies.*" However, Nikos Sarris of the Athens Technology Center highlights the "*risk of introducing technology into areas where it is not yet ready, with the threat of acceptance of immature applications in critical sectors and the substitution of human resources in areas where human resources are still essential.*"

Quality and Quantity of Data / Infrastructure

To produce reliable and high-quality results, AI models require large volumes of data, and often this data needs to be of high quality. This creates the need for substantial computational infrastructure for processing and training these models. Dimitris Skaltsas (CEO & Co-founder of Intelligencia AI) points out:

"*If the country wants to effectively participate in the AI and GenAI era, access to data is essential. This is necessary both to fuel applications that will be commercially available and to enable Greek companies to create new applications and actively participate in the emerging global market.*"

The uncertainty of finding quality and large-scale data in languages with few digitized corpora, such as Greek, is significant. The same applies to the infrastructure required for data management and storage, as well as for data training. As noted by the representative of SEV, "*the use of AI will be practically infeasible or ineffective even in its most basic forms (e.g., chatbots) in the absence of a comprehensive public data management system, a culture of open data, and a culture for data-driven decisions. Even in cases where specialized administrative units have been created for data utilization in decision-making, they do not serve their purpose as they are not supplied with data.*"

Training, updating, and upgrading AI models require seamless access to High-Performance Computing (HPC[174]) infrastructure. These infrastructures require continuous hardware upgrades and specialized personnel, as well as significant energy costs and the need to reduce environmental footprint. These factors make HPC infrastructures indispensable, necessitating continuous investments *and funding in both hardware and human resources.*

In addition to the above-mentioned - extremely important - quantitative issue regarding the volume of data and the capacity of the infrastructure, an additional qualitative issue arises with AI. Specifically, with the use of AI, massive prototypes and thus primary data (we are not talking about metadata here) will be generated, which will be entirely artificially constructed and not "real". Therefore, we are called upon to manage a qualitatively different situation, where our systems that will self-train through machine learning will do so in part from the history of primary data that will be created as products of AI[175].

[174] https://www.hpc.grnet.gr/, https://grnet.gr/2022/11/29/pr-neo-eurohpc-supercomputer-daedalus/

[175] At the moment, there is an ongoing international discussion on this topic, and a significant distinction between real-life historical data and synthetic data is being emphasized. Synthetic data not only refers to intentionally anonymized data but also to data constructed by AI. For a thorough analysis of this issue in applied, regulatory policies, see Floridi, L. (2019), referenced above.

Ethics and Prejudices

Ethical concepts such as autonomy, justice, transparency, and responsibility, and how they are influenced or modified by AI, are at the center of an ongoing discussion, especially regarding new technologies like AI models. The tendency of AI systems to perpetuate or even exacerbate existing biases, prejudices, and inequalities poses a significant ethical challenge. As Cleo Sgouropoulou estimates, "*the widespread use of GenAI without by design and by default guarantees of protection for fundamental rights and freedoms may lead to the reproduction and reinforcement of social and racial prejudices*", while for Nikos Sarris, Technology Advisor at Athens Technology Center (ATC), the visible risk is "*the danger of improper and unethical use of AI technology and the risk of its introduction into areas and critical sectors that are not yet ready, with the threat of acceptance of immature applications*".

Due to emerging issues of potential algorithmic bias and new forms of privacy violation through AI, the global research community[176] is already developing tools and methodologies towards an algorithmic right to oblivion, where models are designed to "forget" training data, the large-scale data they use to self-train *(the so-called "forget set")*. Furthermore, the ability that is beginning to become available to the general public to make public use of machine learning technologies has made it even more imperative to develop new technological ways to preserve the privacy (through "oblivion") of citizens' personal data, against on-demand trained machine learning models. How developers, researchers, businesses, and the public sector in Greece will ultimately address these emerging techno-ethical issues and work together to minimize the ethical side effects of AI remains uncertain[177].

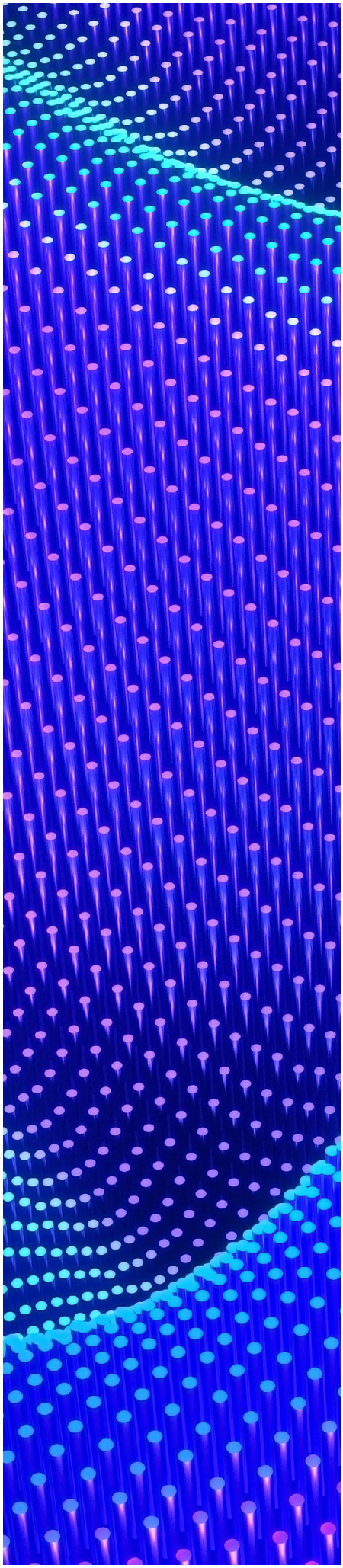
[176] As an example, recently from the team at Vanderbilt University: Abbasi, A., Thrash, C., Akbari, E., Zhang, D., & Kolouri, S. (2023). "CovarNav: Machine Unlearning via Model Inversion and Covariance Navigation." https://arxiv.org/abs/2311.12999

[177] Creative Dock's REPORT, ibid.

Regulatory Framework

The development and convergence of regulatory frameworks on a global scale for the responsible use of artificial intelligence, and specifically for AI models, remain uncertain. It is worth mentioning that the discussion about the impact of regulation on freedom of expression through AI, as well as on user access rights, has evolved to the point where it is already a legal precedent that "*algorithmic code constitutes speech*". Even aspects of centralized regulation regarding the policing of code development can potentially violate provisions regarding freedom of expression under the First Amendment of the US Constitution. Governments also face the challenge of balancing innovation and responsible adoption, concurrently with fundamental ethical issues such as data privacy and intellectual property protection. The extent to which the framework and regulatory measures will evolve (with the EU AI Act as a spearhead) and how they will influence the development and implementation of AI constitutes a major concern[179]. As Kyriakos Sampatakakis (Accenture Greece) observes, "*a holistic regulatory framework akin to the General Data Protection Regulation (GDPR) will be needed to define operational terms and protect citizens from a technology that, as it seems, is so disruptive and complex that they cannot easily understand its risks*", while Vasilis Kostakis, Professor of Peer-to-Peer (P2P) Governance Technology at Tallinn University of Technology (TalTech) and Researcher at Harvard University, emphasizes the "*ethical and legal issues*" arising from decisions made by algorithms.

In any case, uncertainties regarding the regulatory framework of AI, for example whether it will focus on the technology or its usage, whether it will target application apps or base models, and what will be classified as "high-risk", remain fresh and are reflected in extensive multi-month consultations with social parAlers and countries at the European level. It is critical whether base models upon which thousands of downstream applications rely, especially in a rapidly evolving and unpredictable technology landscape, will be included in a high-risk tier of regulation and its associated requirements. Furthermore, whether the issue will be harmonized legislatively in the form of recommendations or law enforcement remains open. The trend already by late November 2023 is that regulation will focus on usage rather than the technology itself, and that AI decision-making models will not substitute but merely complement human judgment, assessment, review, and final accountability. A potential technological regulation could either evolve into a hindrance, impeding the rapid advancement of AI at the European level, or strengthen the European industry against the expectation of monopolization in the European market by the already established North American giants of the sector, who often insist on drafting self-regulatory policies in an attempt to disengage as much as possible from governmental regulations.



[178] Bradford, A. (2023). Digital empires: The global battle to regulate technology. Oxford University Press.

[179] Creative Dock's REPORT, ibid.

Public Perception and Acceptance

The level of public trust in AI and GenAI technologies will determine their adoption and integration into everyday life. Already, with the development of the internet, the collective ability of individuals in modern democratic countries to distinguish truth from falsehood, political fiction from non-existence, or logic from non-existence has been fundamentally questioned[180]. This continues to occur within the context of an inevitable transformation characterized by the current digital era, a cultural technique that alters people's perceptions of the world, their self-understanding, and their actions. M. Patiniotis warns of a potential "*intensification of technophobia phenomena and reinforcement of romantic technophobia,*" while K. Kyranakis speaks of the danger of "loss of sense of reality" and points out:

"*Technological advancement has profoundly affected the way we communicate, inaugurating a world where communication relies primarily on digital media. GenAI has the ability to offer interactive experiences to the user through human-machine interaction, but it is not always clear how this affects the perception of reality. Therefore, there is a risk of loss of sense of reality by the user, with possible psychological implications, including the emergence of negative emotions, such as depression.*"

How businesses and developers can address public concerns, demonstrate responsible practices, and build trust remains uncertain. Conversely, the same applies to the overall public perception of the benefits and risks of GenAI[181].

[180] Benkler, Y., Faris, R., & Roberts, H. (2018). Network Propaganda. Oxford University Press.

[181] Ibid.

Transformation of the Workforce

As our empirical research has revealed, the loss and/or inadequacy of the workforce constitute the primary factor of uncertainty, according to experts. K. Kyranakis points out:

"GenAI *can automate tasks previously performed by humans. This fact can lead to job losses, especially in areas related to content production, service provision, and decision-making. Technology brings changes to how market needs are served, leading to the transformation of the work environment and required skills. Workers who cannot keep up with the rapid progress of technology and acquire the new necessary skills may find themselves in a precarious position in relation to the labor market.*"

While C. Sgouropoulou estimates that "*new positions related to* GenAI *and related fields will emerge,*" a member of the academic staff of the University of Crete and an expert in these matters points out that "*countermeasures will be needed to create these new positions.*" The representative of SEV (Hellenic Federation of Enterprises) expresses reservations regarding the "*inadequacy of the workforce and the lack of personnel with basic and advanced skills in GenAI,*" while noting that "*according to the OECD, the available workforce with expertise in* GenAI *(AI workforce) amounts to 0.2%, is over 40 years old, and does not regularly update its knowledge. In contrast, in countries like Switzerland, over 40% of executives and employees in GenAI have received some form of training in the last month compared to just 5% in Greece.*"

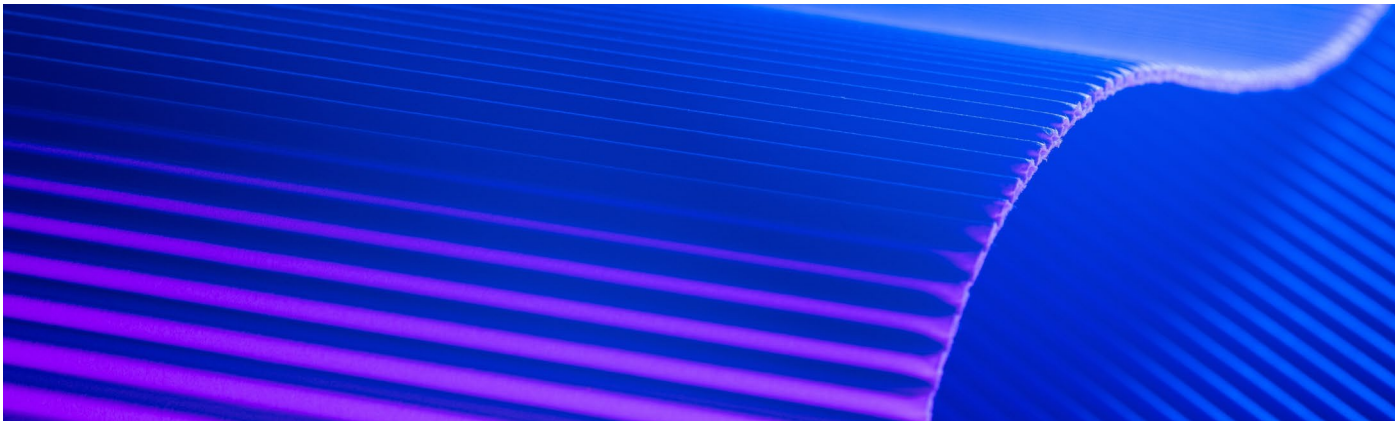
The impact of AI and GenAI models on our country's workforce is uncertain, with potential consequences ranging from job loss, exacerbation of digital illiteracy, and undermining of labor dignity, to the upgrading and protection of human labor, and the creation of new professional roles and significant opportunities for our society as a whole.

It is worth mentioning the relative optimism and self-confidence of Greeks regarding the future of the labor market in the face of advanced technologies (such as GenAI), as recorded in the recent empirical survey *World Internet Project Greece* (WIP-GR), conducted on a nationwide scale by the National Centre for Social Research (EKKE)[182].

Despite rapid technological advancement, seven out of ten participants in the survey are confident that their jobs will not be threatened by AI, while 22% of respondents are concerned that some computer program will replace them in the future. Since the first industrial revolution, technological innovation has brought about various and radical disruptions to work patterns, either by partially replacing humans or by creating new job positions and freeing them from tedious, monotonous routine activities.

This is why, as advanced software penetrates professional fields that may not be considered repetitive or mundane, the looming replacement of humans by technology sparks discussions not only about their position in the job market but also about the promotion of skills, especially digital skills, that need to be acquired. As noted by Yiannis Rizopoulos, "*while GenAI may indeed provide solutions for increasing productivity while simultaneously reducing costs, resulting in enhanced competitiveness, however—at least in the transitional stage we are currently undergoing—the 'side effects' will be more than noticeable in the workforce that fails to adapt, upgrade, or where necessary, reconfigure its skills, in line with the demands of the new normal.*"

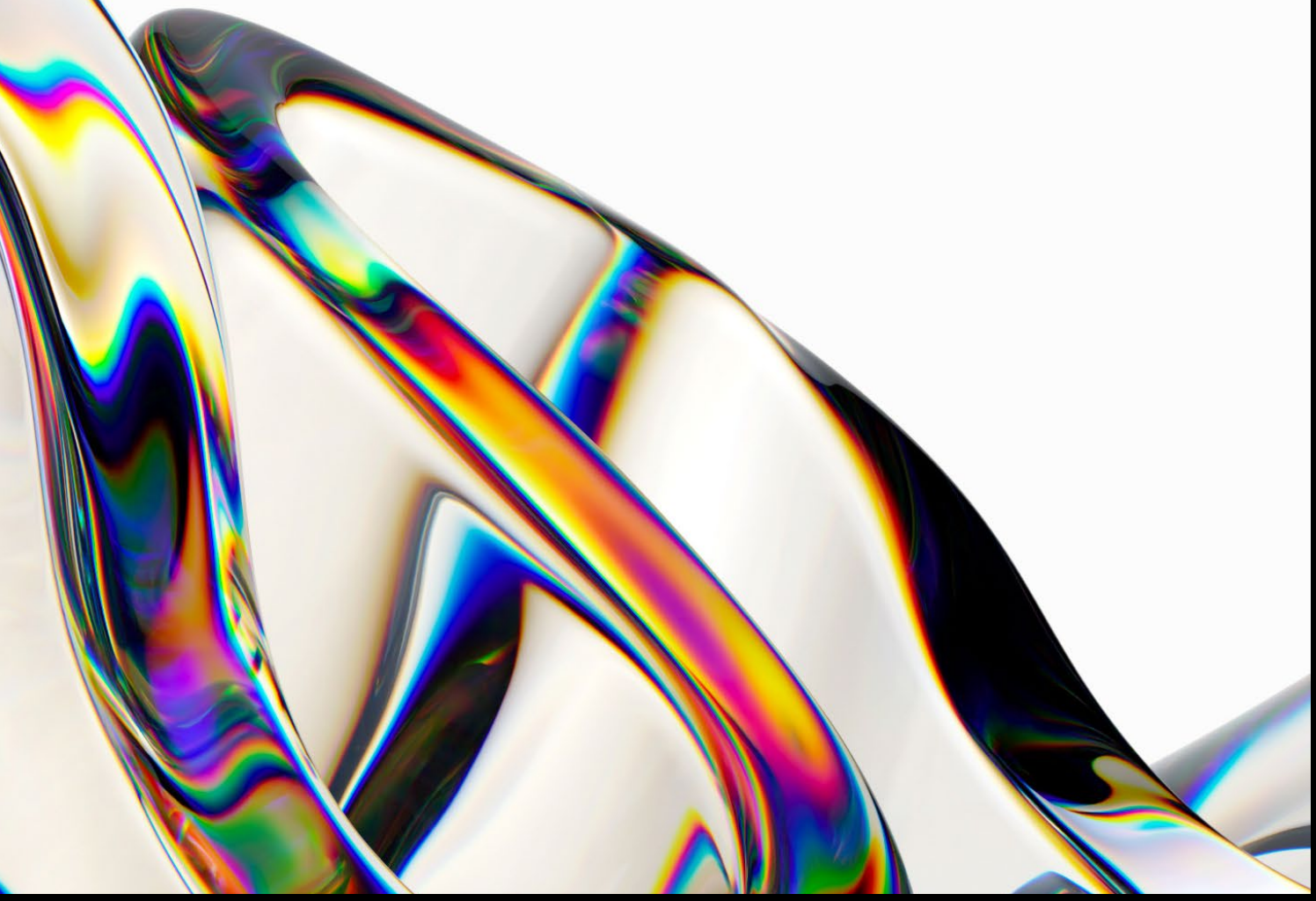
Ultimately, the extent to which individuals and organizations can acquire the necessary skills and adapt to these critical changes remains empirically an open question[183].



[182] See: Tsekeris, X., Demertzis, N., Papadoudis, G., Linardis, A., Mandenakis, K., & Christofilopoulos, E. (2023), ibid.

[183] Miao, F., & Holmes, W. (2023). Guidance for generative AI in education and research. UNESCO Publishing. See also: Tsekeris, C., & Christofilopoulos, E. (2023). The Green and Digital Future of Work in Greece Towards 2050. Friedrich-Ebert-Stiftung Griechenland. https://athens.fes.de/event/the-green-and-digital-future-of-work-in-greece-towards-2050

Productive AI & Greece 2030



Productive AI & Greece 2030

Exploring the future of artificial intelligence productivity:
The logic behind scenario creation

The rapid advancement of AI has sparked many discussions about its potential future impacts on society, politics, economy, work, and our daily lives. In a constantly evolving socio-technological environment, understanding the practical uncertainties and potential long-term directions that AI may take is crucial for responsible strategic planning and policymaking.

Practical uncertainties, such as those described above, as well as the concept of *radical uncertainty itself*, are at the core of foresight studies. This entails a creative and constructive perception of uncertainty, methodologically linked to the construction of *alternative scenarios* for the future. This allows us to avoid myopic mindsets, upgrade our thinking, better prepare for tomorrow, identify systemic forces of change, contingencies, and risks, become more adaptive, flexible, and resilient, and design realistically sustainable long-term policies.

Alternative scenarios provide comprehensive images of *possible futures* that are available to us, dynamically changing and modifying based on human behaviors, political choices, decisions at various levels of governance, shifting value standards, shaping public opinion, unforeseen events, natural disasters, etc.

This is precisely the advantage of foresight, which does not seek to confirm or legitimize existing experiences and knowledge, nor to predict the future, but to enrich and broaden our perspective on complex and nonlinear developments, so that we become familiar with uncertainty and the idea that there are multiple futures, multiple "*other worlds*[184]" in the form of unfolding possibilities already before us.

It is noteworthy that in recent years, it has been observed at an international level that the introduction of a strategic foresight maturity index brings beneficial returns to businesses, measurable even in capitalization[185] indicators. In this sense, foresight scenarios serve as a practical aid for businesses and organizations, especially in view of the emerging developments introduced into the market by AI.

[184] The empirically fertile position on "multiple worlds" - valuable for policy decision makers in conditions of high uncertainty and "black swans" - has been enriched by theories of tropic logic and counterfactuals, primarily David Lewis's theory. At the European Union level, such technical terms are already being utilized in many research reports, especially when analyzing impact evaluations. See, for example: https://ec.europa.eu/social/main.jsp?catId=738&langId=el&pubId=8313&furtherPubs=yes. From the perspective of anticipation, the works of Roberto Poli, professor at the University of Trento and former UNESCO Chair in Anticipatory Systems, are significant. See Poli, R. (2019). "Handbook of anticipation: Theoretical and applied aspects of the use of the future in decision making." Springer Verlag.

[185] In an empirical study by Rohrbeck and Kum (2018), a categorization of companies in the sample into four efficiency categories regarding strategic foresight indicators emerged:
- Vigilant: These companies correctly focused on their foresight practices, aiming far and wide to envision future scenarios. They managed to proactively anticipate impending changes rather than react after they occur.
- Neurotic: These companies persistently chose an overarching but overly magnified view of the field, devoting excessive resources to studying trends or even considering quite irrelevant and incomplete versions of economic developments, at the expense of preparing for short-term issues.
- Vulnerable: These companies were not adequately prepared, did not aim deep, wide, or far enough into future scenarios to plan effectively. To draw an analogy with photography, the issues here were not so much about lens selection but about focusing and processing the image correctly, resulting in minimally developed images that hindered future readiness.
- In danger: These companies, although equally exposed to risks as vulnerable enterprises, chose not to have long-term planning. In the photography analogy above, they simply made no effort to place the film in the camera or, possibly, to remove the lens cap from the start. See: Rohrbeck, R., & Kum, M. E. (2018). "Corporate foresight and its impact on firm performance: A longitudinal analysis." Technological Forecasting and Social Change, 129, 105-116.

Scenarios for AI in Greece

Therefore, scenario creation is a powerful and effective tool to recognize the "whisper of approaching events" (Cavafy) and to leave "*the garden with branching paths open to multiple futures*" (phrase from Borges' well-known story "The Garden of Forking Paths"[186]). As we mentioned earlier, socio-technological developments are unpredictable; there is no specific "secure" future[187].

It is important to emphasize here that this "certainty" pertains to the probabilistic dimension of assessments. Foresight methodology does not create insecurity; on the contrary, it aims to make social systems sustainable and citizens psychosocially resilient so that they can feel secure embracing uncertainty. In any case, there is room for dynamic assessments, for recognizing trends and weak signals, for systematically exploring the horizon, and studying uncertainties.

In this discussion, we included a comprehensive system of uncertainties, based on the findings of empirical research with 30 experts, on the broader detection of the environment (trends, opportunities, vulnerabilities), as well as on current literature, executive reports, and other Greek and international studies to which we refer. This analysis of this "system" ultimately led us to formulate four different alternative scenarios for the future (futures) of AI in Greece, with a time horizon of 2030[189].

[186] It is worth mentioning that research on futures has also progressed towards capturing personality types, depending on our relationship with them. Authors Katie Bishop King and Julia Rose West, in their book titled "Futures Thinking Playbook" (2018), develop four idealized future-oriented personality types:
1) Observers: Individuals who embody the archetype of the "observer" personality, believing their role is to monitor what is happening but not intending to shape it.
2) Navigators: Individuals who embody the archetype of the "navigator" personality, believing the future is uncertain and constantly evolving, and that our actions only navigate safely within the boundaries set.
3) Explorers: Individuals who embody the archetype of the "explorer" personality, striving to explore the new and the prospects unfolding before them.
4) Mapmakers: Individuals who embody the archetype of the "mapmaker" personality, accepting that the future holds a range of possibilities and opportunities, believing that our decisions will crucially determine it.

[187] The "one and only" scenario for the future would leave us unprepared and vulnerable to unpredictable disruptions and emerging changes in the system, while also removing the big picture of opportunities to exploit.

[188] We add to the aforementioned research the recent Strategic Foresight Study on the "Future of Innovation Environment in Greece until 2035", conducted in 2022 as a collaboration between the UNESCO Chair for Future Studies, the Special Secretariat of Foresight of the Presidency of the Government, and the Hellenic Development Bank of Investments (HDBI). Accessible at the following link: https://foresight.gov.gr/studies/meleti-stratigikis-proorasis-sxetika-me-to-mellon-tou-perivallontos-kainotomias-stin-ellada-eos-to-2035/ /

[189] We reiterate here that this is an original choice informed by the entirety of responses provided by experts and the broader research process of horizon scanning. It is grounded in previous proven methodologies of foresight, such as that of Professor James Dator from the Hawaii Research Center for Futures Studies in the USA. See, for example: Gidley, J. (2022). The Future: A Very Short Introduction. Heraklion: University of Crete Press, pp. 116-117.

The four scenarios are represented in quadrants, as shown in the diagram below (Figure 10)[190]. When selecting the variables represented[191] by the axes, we sought two variables that we assume and argue will have *the greatest impact on the future* (futures) of AI in the country, but are also extremely uncertain on their own. Each quadrant represents a possible combination of the influential and uncertain variables we selected:

- **The horizontal axis:** Will high or low-quality policies be adopted for AI and specifically for AI? Will the evolution of AI be associated with high or low-quality governance of the technology and its applications?
- **The vertical axis:** Will we have high or low progress of AI models? Will its technical capabilities develop much or little?

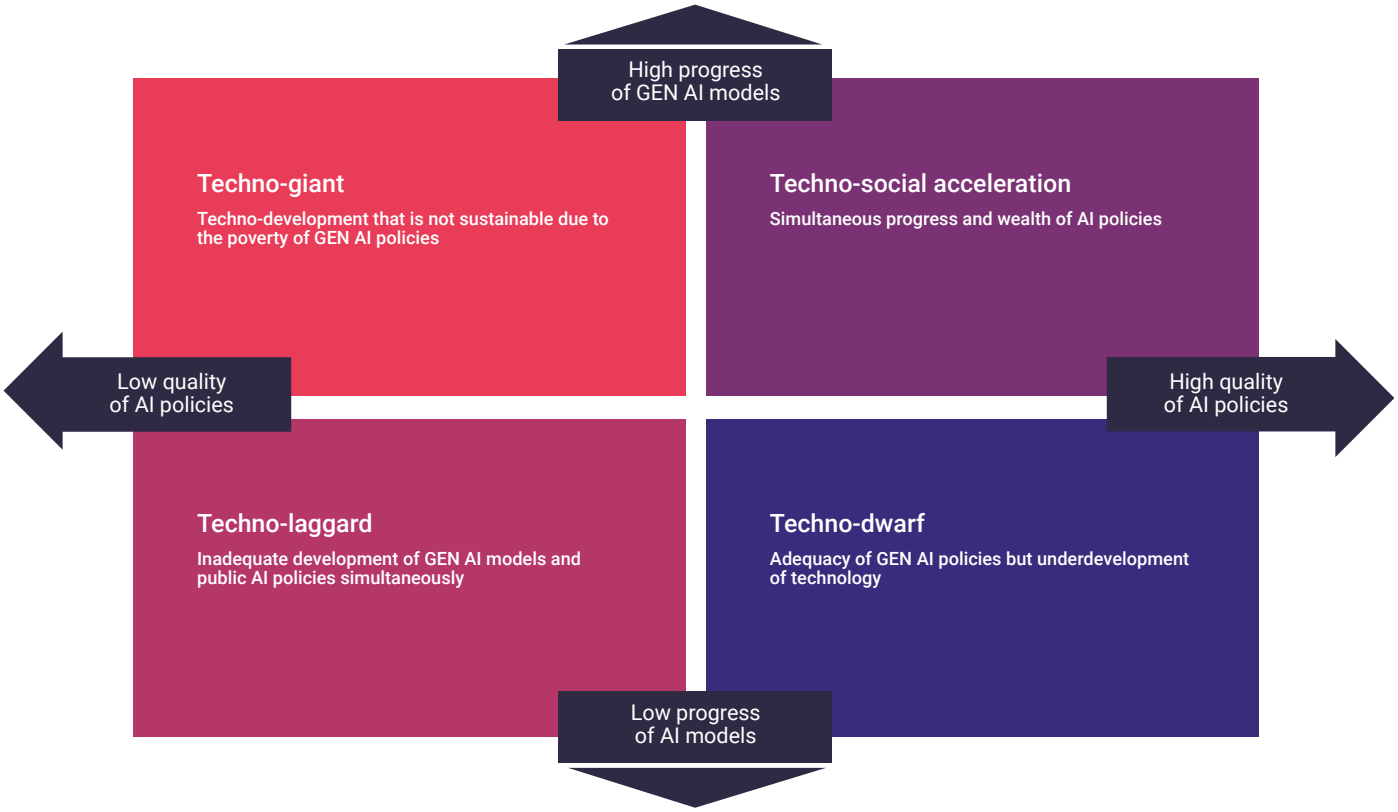


Image 10: *Representation of four scenarios in quadrants, with the X (horizontal) axis being the quality of policies for AI and the Y (vertical) axis being the level of progress of AI models.*

[190] In each scenario, the factors influencing the development of the ESCO ecosystem (e.g., values and norms, regulatory rules, skills, technological advancements, etc.) evolve differently over the coming years.
[191] Specifically, we support this based on the research process of questionnaires and interviews with experts representing various stakeholders (public administration, academic research community, market and businesses, civil society), as well as the identification of the overall environment and the review of current scientific literature and executive reports from multinational consulting firms and think tanks.

Scenario 1: *Techno-social acceleration.*
In this scenario, the technologically advanced world is described as resilient and liberated from technophobic constraints, while sustainability and the value of the AI ecosystem are at a high level, along with a healthy and robust liberal political system. In this scenario, we envision a modernizing and adaptive environment where AI is widely adopted and integrated into various aspects of daily life. It represents the optimism surrounding the potential of AI in general to enhance the efficiency of governance, the productivity of the economy, and the well-being of citizens, within a responsible, ethical, and forward-thinking framework where technology and society coexist functionally and synchronize rapidly. Here, Greece in 2030 effectively leverages the opportunities emerging in all economic sectors and continuously strengthens its position in the international system (Image 11).

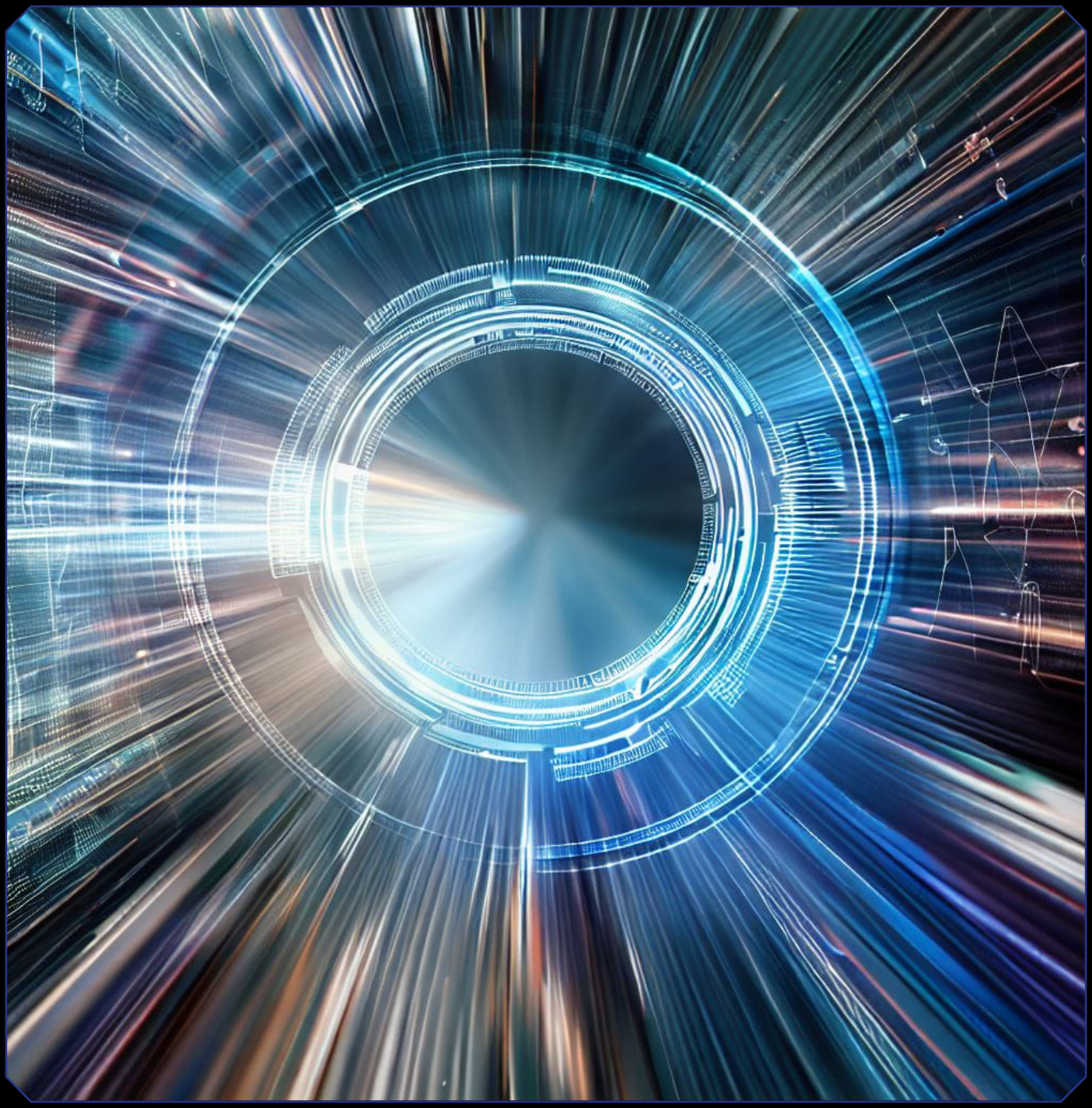


Image 11: *Visualization of Scenario 1 through GenAI - Bing's Dall-E Image Creator*

Scenario 2: *Techno-dwarf.*
This is a world where an open economy dominates and a set of well-intentioned political agendas prevail, however, the AI ecosystem loses its sustainability and momentum and is not a priority. This scenario depicts a negative situation where strict regulations are imposed on the development of AI (with strong disagreements within the EU), which may reach a point of stifling or limiting its apparent progress. Concerns are raised here about excessive regulation and its potential impacts, as well as about inflated bureaucracy, while significant obstacles to technological advancement and innovation are highlighted among other issues (Image 12).

Image 12: *Visualization of Scenario 2 through GenAI - Bing's Dall-E Image Creator.*

Scenario 3: *Techno-social lag.*
This scenario represents a reluctant or underdeveloped AI ecosystem, with a decline in the progress of AI models and a reduction in techno-social dynamics, in a closed, fragmented, and technophobic world, along with shortsighted strategies and a significant lack of ethical and regulatory frameworks, public policies, and institutional interventions. Here, AI faces social rejection due to emerging gaps and inequalities, misuse, inefficiency, and distrust stemming from inadequate regulations and significant legal and ethical shortcomings (Image 13).

Image 13: *Visualization of Scenario 3 through GenAI - Bing's Dall-E Image Creator.*

Scenario 4: *Techno-giant.*
This scenario depicts a "giant with glass legs" and represents an AI ecosystem that reflects the global technological explosion within a socio-cultural and political environment that fails to convert speed into adaptation, to incorporate modern techno-developments, and to leverage the opportunities and possibilities they offer. This scenario shows a rather unsustainable future where AI is not bounded by rules and evolves continuously and uncontrollably, fueling technophobia and creating widespread distrust and intense concerns about potential violations and abuses (Image 14).

Image 14: *Visualization of Scenario 4 through GenAI - Bing's Dall-E Image Creator.*

Techno-Social Acceleration

Society Embracing AI: Creating a New World of Innovation, Creativity, and Collaboration

The analytical prioritization of the most positive scenario is strategically important because, as Seneca said, *no wind is favorable if you do not know which port you are heading for*. In this study, therefore, we chose to emphasize the scenario of "*techno-social acceleration*". In this possible future of Greece in 2030, AI models have made significant progress, and their use is widespread. Alongside technological flourishing, there has been significant development in proactive governance of technology in the country. Such governance includes flexible policies for innovation and technology risk management, proactive regulation of private activity, encouragement of invention and development of new technologies in the outward-looking domestic ecosystem, functional convergence of technology and ethics systems (aligning technology with societal values), simultaneous development of relevant resources (data, computing power) and education, research, and talent in our country.

The optimistic spirit of this scenario is shared by many experts. With reference to the current developments in AI, for example, Y. Rizopoulos (Boussias Media) points out that: "*speaking generally about the AI ecosystem and its penetration into our lives, there is no doubt that the prospects are enormous. Combined with the resolution of many pending issues regarding digital transformation, the establishment of necessary infrastructure, and the education/training of the necessary human capital, this ecosystem can act as a catalyst for the gradual creation of a different, much more developed Greece, particularly through the use of automation, digital twins, and decision support.*"

Overall, in Scenario 1, sustainability and the value of the domestic innovation ecosystem are at a high level, while nascent AI businesses are supported by private capital, mainly from international philanthropic foundations and a large number of interested "business angels" from abroad providing seed capital. These businesses enjoy broad societal acceptance and are closely linked to the technology transfer offices of universities and research centers in the country, which are steadily developing. For example, K. Sampatakakis (Accenture Greece) anticipates:

"*a revolution in education at all levels with extensive use of GenAI by students/learners as well as educators, enhancing personalized teaching and empowerment of inclusion. Rapid growth of the IT sector, with the creation of new innovative startups and an increase in the capabilities and business volume of major companies in the sector. Increased productivity and cost reduction in all businesses in the country, small and large (telecommunications, banks, energy companies, retail chains, technical consulting firms, law firms, accounting firms, etc.) through the integration of AI into multiple business processes.*"

According to the scenario of "techno-social acceleration," Greece by (not so distant) 2030 has significantly strengthened investments in data centers, safeguarding its national digital sovereignty, and established itself as a regional and global hotspot for technological innovation, accumulating geopolitical power and creating dependencies. It also establishes itself as a hub for the production, dissemination, and exchange of knowledge on the Ethics of AI - with the contribution of highly specialized scientists who have settled in the country from universities and research centers abroad (brain gain).

This positive scenario encompasses three main characteristics:

Firstly, it reflects the optimism to harness the exponential power of AI to improve society. AI, if adopted responsibly and with institutional mechanisms that set the necessary ethical and legal boundaries, has the ability to bring about substantial and radical changes in primary production, industry, healthcare, education, public administration, and the overall economic activity of the country, empowering citizenry and enhancing the quality of life and democracy.

Secondly, it aligns with the idea that the responsible integration of AI into daily life is not only feasible but also desirable. It emphasizes the importance of implementing carefully selected, dialogically processed, and forward-thinking national ethical codes and regulatory frameworks that, in conjunction with the European regulation on AI (AI Act), can creatively guide the development and use of technology, while ensuring compliance with appropriate technical standards and norms, especially for high-risk AI systems.

Thirdly, it focuses on the possibility of a "positive" future, in which we can enjoy the benefits of AI having built not only strong infrastructure but also a robust reservoir of digital human capital (education, skills and abilities, multilingualism, talent, research, and education), social capital (digital solidarity and responsibility, inclusion, cohesion, and trust), and institutional capital (wealth of formal and informal institutions that will incorporate AI into all areas of society and the economy). All of the above are the main "battlefields[192]" where the great challenge of techno-social acceleration and leadership will be won for the country.

In conclusion, given the generalized unpredictability of the system, scenario planning is a suitable tool for exploring future worlds characterized by variability, uncertainty, complexity, and ambiguity. While each scenario represents a different aspect of this complex and fragile landscape, the specific scenario of "techno-social acceleration" was selected as a source of inspiration for the responsible and sustainable development and integration of AI into the Greek economy and society. This future envisions maximizing the potential benefits of AI while mitigating negative surprises to the extent feasible and promoting the synchronization of technology and society, with a primary focus on digital ethics.

Issues of digital ethics and regulation, such as transparency, accountability, and responsibility[193], are inextricable[194], especially in the contemporary historical context where, according to recent findings from the World Values Survey[195], authoritarian understandings/views of democracy abound in contrast to liberal ones. According to the Opinion of the German Ethics Council[196], the use of AI should encourage human flourishing, not diminish it. Ultimately, as indicated by recent European legislative developments, governance of the digital realm is equally as important as the production and use of innovation, reflecting both general ethical principles and the collective values of society.

Technological progress and its effective governance lie at the heart of the ideal scenario, the realization of which requires dynamic diagnosis of the potential "catalysts[197]" of the system (see Figure 15) and a set of multi-level public policies in general. Subsequently, we describe and develop some of these policies which, in some way, "attract" positive futures and to some extent "mitigate" the negatives and unpleasant surprises.

[192] Scharre, P. (2023). Four battlegrounds: Power in the age of artificial intelligence. WW Norton & Company.

[193] Especially regarding the issue of responsibility, we must once again draw from the distinguished theoretical work of technoethics by Hans Jonas, who, advocating for an intergenerational ethic of responsibility that considers the future, argued that the planet does not belong to us: we have inherited it from our children! See Jonas, H. (2003). Das Prinzip Verantwortung: Versuch einer Ethik für die technologische Zivilisation, Frankfurt a.M.: Suhrkamp. Additionally, Werner, M.H. (1994). Dimensionen der Verantwortung. Eine Werkstattbericht zur Zukunftsethik von Hans Jonas, in: Dietrich Böhler (1995), Ethik für die Zukunft: Im Diskurs mit Hans Jonas, C.H. Beck, pp. 303-338. Finally, on the level of public policy, see the UNESCO Bioethics Report. https://unesdoc.unesco.org/ark:/48223/pf0000378723

[194] Bockting, C. L. et al., ibid.

[195] https://www.worldvaluessurvey.org/

[196] https://www.ethikrat.org/en/press-releases/press-releases/2023/ethics-council-artificialintelligence- must-not-diminish-human-flourishing/

[197] The catalysts rapidly alter the flow of events, appearing faster than the mega-trends and prompting people to take action more quickly than in slow, overarching trends. See, for example, https://ec.europa.eu/assets/epsc/pages/espas/chapter2.html

Key catalyst for the evolution of GenAI in Greece

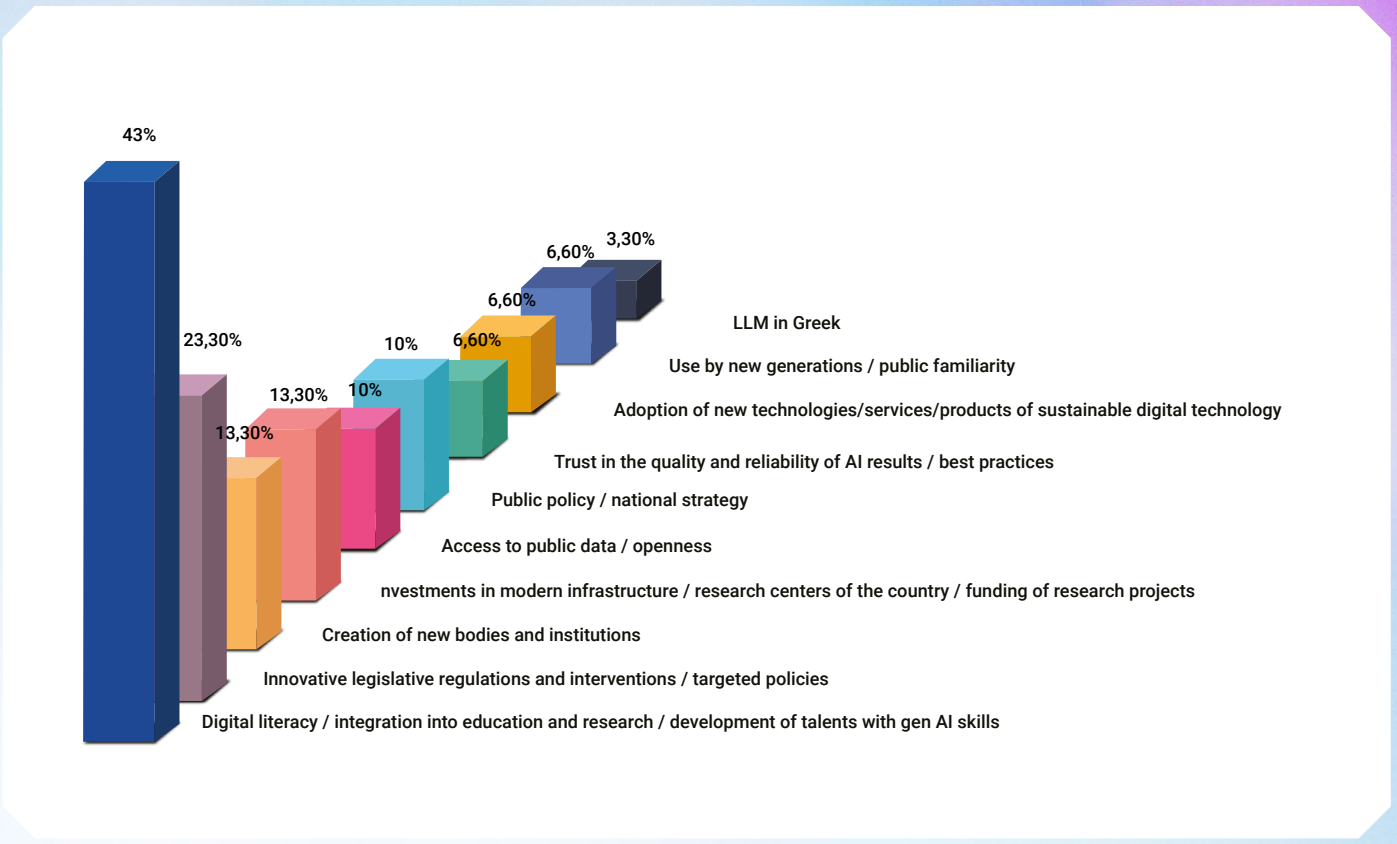
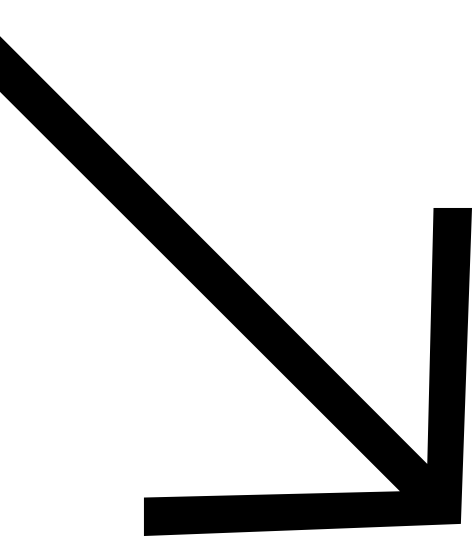
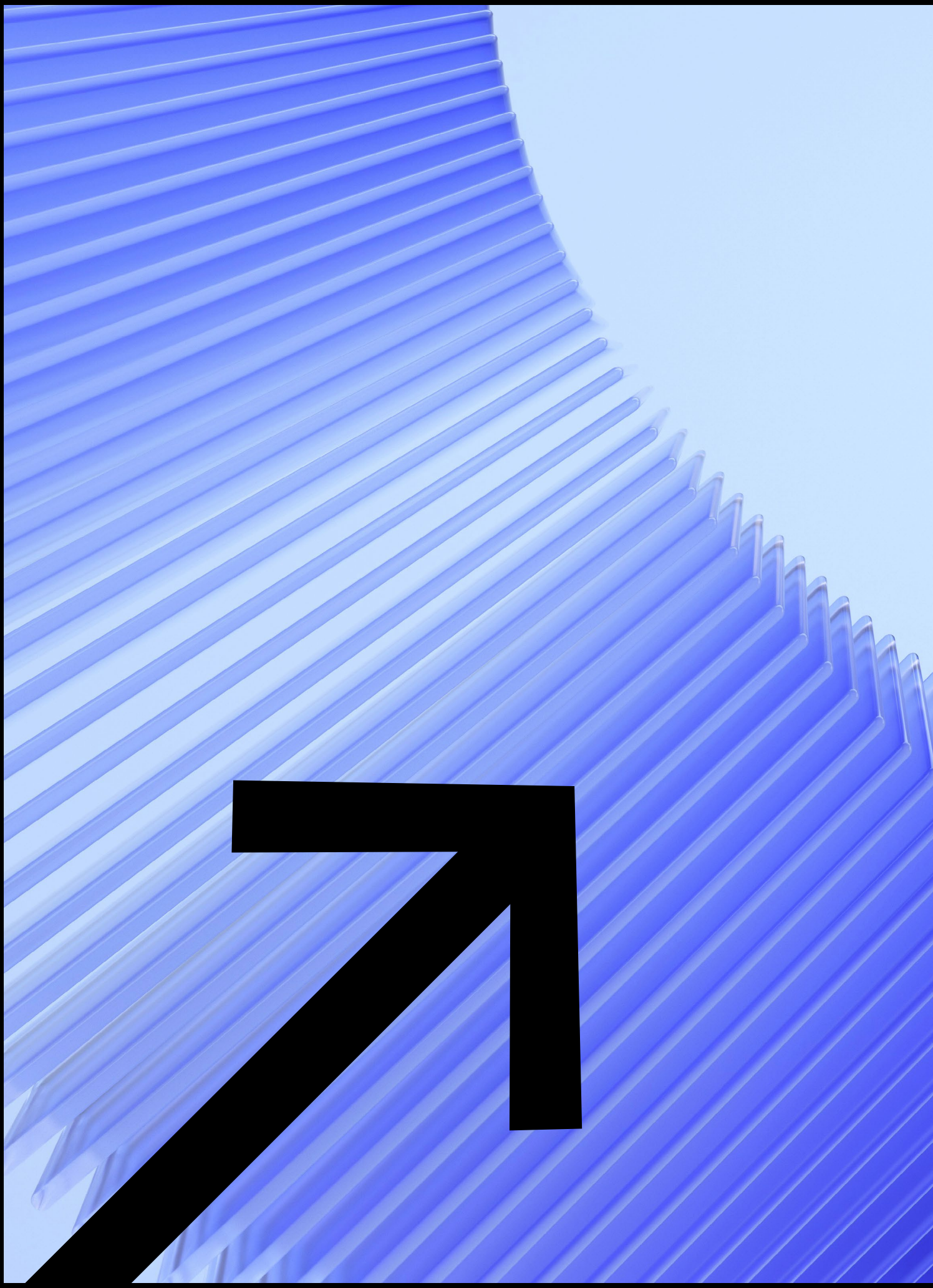


Image 15: *What the experts said about the Catalyst Factor for the evolution of AI in Greece.*





Policy Proposals

Policy Proposals

A responsible and balanced approach to future-oriented and forward-looking policies may need to take into account the difficulty but perhaps also the harmfulness of an attempt at absolute and preemptive regulation of the exponential, outward trend of AI. We must, with Aristotelian prudence and moderation, navigate the balance between: a) on the one hand, the tendency towards deregulation (something that may technologically assist the tool itself by generating new rules that may progressively contradict its creator's original intentions), and b) on the other hand, the traditional horizontal policy of the "precautionary principle" that the EU traditionally and justifiably adhered to. There is a critical ongoing debate at both the institutional level and at the level of member states as to whether, in the field of AI, the precautionary principle is inadequate, or at least not sufficient[198].

Regulatory policies for AI issues at a supranational level have already been initiated in the past. For instance, as early as 2019, a relevant proposal by the OECD (OECD Recommendation on Artificial Intelligence) has been adopted by 46 countries, establishing five fundamental principles based on values for the creation of trustworthy AI systems, as well as five key policy actions for the creation of a beneficial AI ecosystem for society. More recently, in April 2023, it investigated the recent development of "large language models," while in June 2023, it issued an impact study of AI on science and the future of research[199]. In a more recent document[200], the OECD emphasizes issues of responsibility[201] and reliability in AI development, the measurability of AI trends and developments[202], risk management, and accountability determination[203]. Noteworthy in terms of forward-looking strategy is the establishment by the OECD of a Future of AI Experts Group[204], while it has already issued a scenario study with a timeline horizon of 2035[205]. In summary of its forward-looking intention, the OECD states in its recent document that "today's questions will help shape tomorrow's vision.[206]"

It is worth noting that in a recent joint convergence act between Germany, France, and Italy, it is proposed that self-regulation of Base Models be mandatory through ethical codes of conduct, with the caveat that "untested norms" will not be allowed and that the public posting of model cards, containing relevant information allowing understanding of the functions, capabilities, and limitations of the Models, based on the best practices of the developers[207]' community, will be required. They also converge on the proposal of an AI governance body for oversight. The three major European countries also agree that regulation will apply to application products and not to the technology itself. It is also significant that in the concluding paragraph of the joint "Joint Non-Paper" of the three countries, the adoption of a forward-looking adaptability is explicitly agreed upon, whereby new standards should allow for the integration of future capabilities[208].

[198] The inadequacy of the precautionary principle lies not only in the argument of libertarianism, according to which it is not sufficiently "liberal" and hinders technological development, but also in its partial and insufficient ability to control the rapid evolution of the technological field and the accompanying uncertainties. This is because it is based on a measurable cost-benefit metric of the theory of "rational choice" for shaping policy decisions, which requires a large and coherent volume of data, which cannot be obtained at this stage. The risks of emerging technologies are novel, involving both "synthetic" and simultaneously primary data, as well as progressive "autonomous" rephrasing of algorithmic rules by the algorithm itself. In any case, adopting a future-oriented and optimistic acceptance and promotion of technological advancements is coherent and does not contradict the strategic adoption of policies that enhance citizens' sense of security.

[199] https://www.oecd.org/publications/artificial-intelligence-in-science-a8d820bd-en.htm

[200] OECD Work on Artificial Intelligence, Council 13-14 September 2023 Room Document No. 6. σελ. 5 κ.έ.

201 https://oecd.ai/en/

[202] https://www.oecd.org/publications/oecd-framework-for-the-classification-of-ai-systems-cb6d9ecaen.htm

[203] https://www.oecd-ilibrary.org/science-and-technology/advancing-accountability-in-ai_2448f04b-en

[204] https://oecd.ai/en/network-of-experts/working-group/10847

[205] https://search.oecd.org/economy/global-scenarios-2035-df7ebc33-en.htm

[206] “Today’s questions will help shape our vision for tomorrow”, OECD Work on Artificial Intelligence, Council 13-14 September 2023 Room Document No. 6, p. 3.

[207] https://www.reuters.com/technology/germany-france-italy-reach-agreement-future-ai-regulation-2023-11-18/

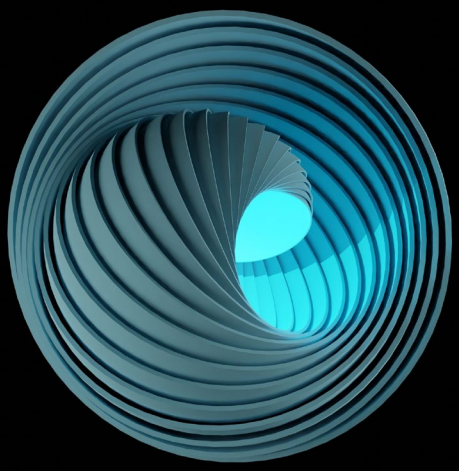
[208] “European standards could also be an important tool in this context as this also creates the adaptive capacity to take into account future developments. Further standardization mandates could be foreseen in this regard”. Τίτλος του non-paper: “An innovationfriendly approach based on European values for the AI Act- Joint Non-paper by IT, FR and DE

Furthermore, although there is no absolute consensus among the European Union, the United States, and the United Kingdom regarding what constitutes "high risk" concerning AI issues, it seems that the two countries favor the establishment of AI Safety Institutes[209]. Considering that such technological advancement cannot be regulated independently by any single country, leaders from 28 countries, including China, have signed the Bletchley Declaration, a joint act of solidarity regarding the risks of this technology. Indeed, within the framework of the Declaration, British Prime Minister Rishi Sunak explicitly showed forward-looking sensitivity, stating that "the convergence of major AI-producing countries helps us ensure the long-term future of our children and grandchildren."[210]

As for the situation in Greece, the scenario of techno-social acceleration is the one that offers the most benefits for Greek society with the adoption of AI. The widespread use—and particularly the use with positive impact, where opportunities "translate" into reality—flows with a series of technological, ethical, and socio-political challenges that require complex and forward-thinking approaches. The way in which the appropriate environment for the flourishing of the positive scenario can be shaped involves a wealth of policy decisions and public policies based on targeted axes. In this section, policy proposals originating specifically from the study and analysis of the opportunities and challenges regarding the use of AI in the national context are presented.

[209] https://www.reuters.com/technology/ai-summit-start-global-agreement-distant-hope-2023-11-03/
[210] https://www.reuters.com/technology/britain-publishes-bletchley-declaration-ai-safety-2023-11-01/

Ethical Guidelines and Supervision Mechanisms



The establishment of ethical guidelines and supervision mechanisms in the field of AI in Greece, and specifically in AI, aims to ensure the responsible development and use of this technology. The guidelines should reflect both societal values and general ethical principles, promoting excellence and safety, transparency and innovation, human benefit, and the fight against digital (or algorithmic) social discrimination and inequalities, as well as human control. If the development of algorithmic decision-making is taken to extremes, argues John Tasioulas, Director of the Institute for Ethics in Artificial Intelligence at the University of Oxford, "*the very idea of democracy may be at risk, as democracy involves free and equal citizens participating in self-governance through collective decision-making, providing each other with understandable reasons for the decisions they make. In short, we are not only interested in the quality of the decisions made, but also in the way in which they are made. Because of this, we must work for the safe integration of AI systems into human decision-making processes and not allow systems to replace humans in cases where this would yield sufficient results.*[211]"

As empirical research has shown, potential social and economic digital inequalities, mainly due to differences in access to AI technology, as well as the risk of discrimination, are high on the agenda of experts regarding the negative development of the AI ecosystem in Greece[212]. Therefore, at the national level, the co-creation of soft law guidelines is proposed, initiated by public authorities and involving social parAIers and other stakeholders.

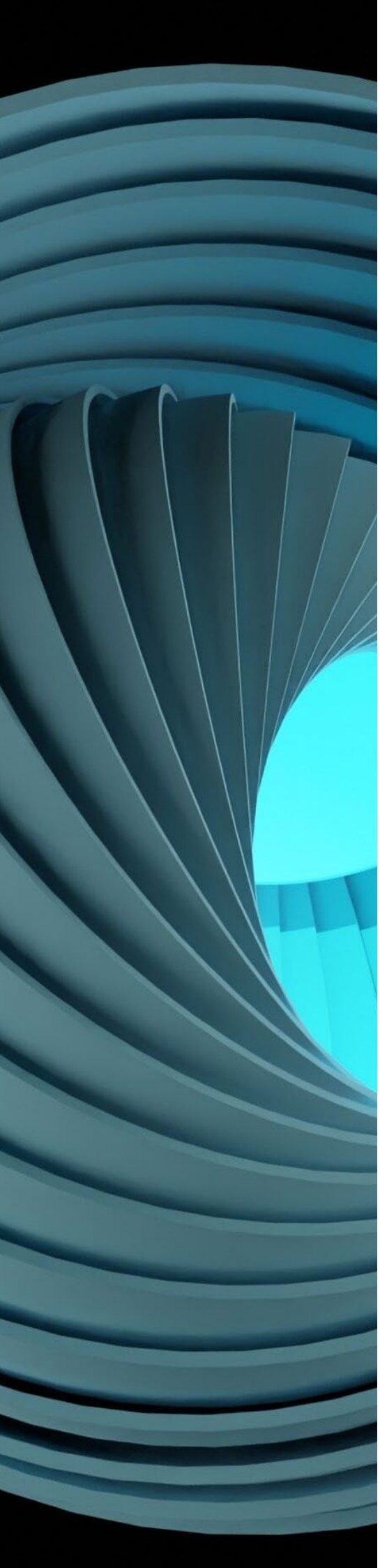
Digital literacy and the need for innovative regulations and interventions were the two main catalysts for the development of AI in Greece, as highlighted by empirical research. Georgios Nicoletakis, CEO of the company 100 Mentors, recalls the case of the United Kingdom, which decided to invest in cutting-edge AI and estimates that it is important "*to have a healthy ambition at the country level that will manage to have companies and academics using these tools. If this happens, we can become a hub of knowledge in the tradition of Socratic thought.*"

In this direction, the representative of SEV recommends "*the multiplication of talent with ICT skills.*" Additionally, Dimitris Eforakopoulos, President & CEO of Info Quest Technologies, suggests "*strengthening undergraduate / postgraduate university programs.*" In the same line, two senior consultants of multinational Human Resources Consulting companies, as well as the representative of SEV, propose supporting universities towards technological development and integrating AI into the educational sector, while Yiannis Kompatsiaris, Principal Researcher at the Information Technologies Institute (ITI) of CERTH, recommends "*digital literacy, research and development, education, and information for the creative use of technology and safe use in cases of misinformation.*"

However, for the widespread adoption and ethical use of AI models, the collaboration of a "functional" regulatory framework is necessary, with supervisory and enforcement capabilities through administrative structures that will ensure not only the correct market and use of AI systems but also transparency in data and the education of models, the accountability of educational institutions and businesses, as noted by Cleo Sgouropoulou.

The goal here is "*to improve the quality of GenAI results and significantly communicate best practices to the public and the scientific community, in order to promote and prevail the benevolent use of this technology,*" as highlighted by Athena Vakali, Professor of Computer Science & Director of the Data and Web Science Laboratory at Aristotle University of Thessaloniki (AUTH).

In this direction, George Karachalios, Deputy Governor of the National Documentation Centre (EKT), proposes "*the establishment of new bodies such as an AI Observatory as well as a Network of Bodies to promote AI within the framework of the National Alliance for Digital Skills.*" In the same vein, Vasilis Vasilopoulos, Data Protection Officer at ERT, advocates "*the creation,*



under the high supervision of the AI committee, of a specialized accelerator following the Mass Challenge model, connected with Universities, Research Centers, startup hubs, ICT companies, Independent Authorities, and Financial Organizations, which will also function as a high specialization educational center."

Furthermore, Antonis Stasis, General Director of Digital Governance at the Ministry of Digital Governance, emphasizes the importance of education and societal readiness for establishing a creative ecosystem. In the same vein, Cleo Sgouropoulou proposes the creation of "*educational infrastructure, programs, and campaigns to raise awareness among the public, businesses, and professionals regarding the use, ethics, and security of AI,*" while George Karachalios recommends informational seminars for the proper and rational use of new AI technologies. Additionally, George Nicoletakis (CEO, 100 Mentors) suggests disseminating practical case studies "*to move from awareness to implementation. Measurement and evaluation of these actions.*"

Through the establishment of proactive monitoring and control mechanisms, systematic and effective monitoring of the implementation of ethical guidelines and legislation will be feasible, ensuring that AI is used in a way that respects human rights and the demand for individual and social well-being. Overall, this approach concerns the preparedness of Greek society for the development of AI in a just and sustainable manner, while promoting innovation and growth in this sector. It also involves strengthening the necessary "institutional triangle" between digital governance, digital regulation, and digital ethics.

[211] https://www.ot.gr/2021/12/03/plus/interviews/i-texniti-noimosyni-i-eleytheria-tis-voulisis-o-aristotelis-kai-o-kant/ See also Panagopoulou-KouAlatsi, F. (2023). Artificial Intelligence: The Path to Digital Constitutionalism: An Ethical-Constitutional Perspective. Papazisis Publishing House.

[212] It should be noted that, according to the Global Risks Report 2022 (World Economic Forum), "digital inequalities" are among the systemic risks that Greece will face in the coming years. Addressing "digital poverty" now involves interventions that empower digital users to benefit from it, rather than just focusing on internet access. There is a need to examine digital policy interventions that can be adapted to demographic and economic changes through consistent and long-term investments. On this point, see https://www.thebritishacademy.ac.uk/news/new-report-proposes-six-policy-lessons-to-address-digitalinequality

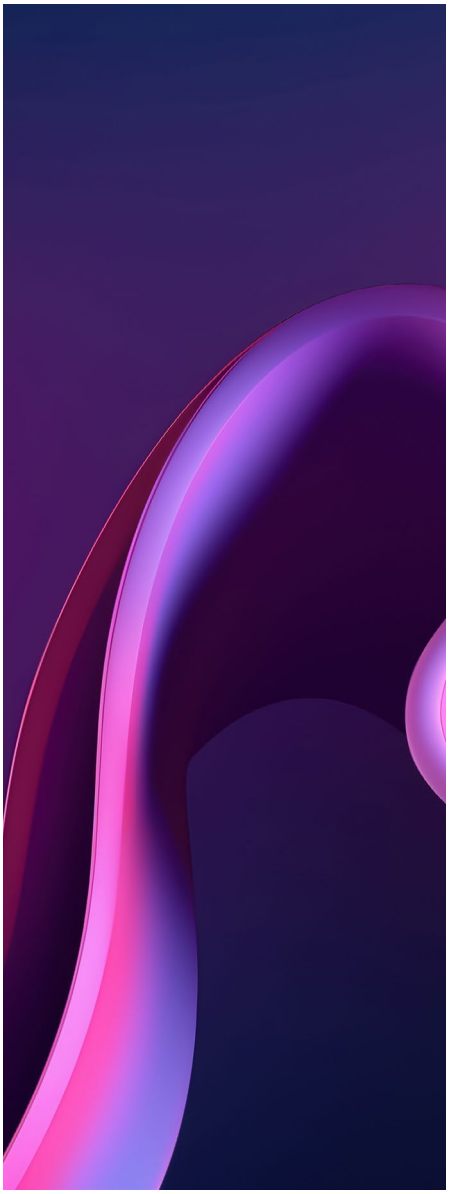
Investments in Infrastructure

Investing in the creation of infrastructure for the development and training of AI algorithms is vital for Greece. AI can offer significant benefits, such as increased productivity, enhancing the competitiveness of the economy, accelerating the digital transformation of businesses, and creating new opportunities across all sectors of the industry.

Such investment initiatives - combined with investment in digital education and digital social cohesion - could make Greece a leader in a rapidly growing global digital economy, the value of which is estimated to exceed $100 trillion by 2025, according to estimates by the World Economic Forum. By developing and training Greek AI systems in domestic infrastructure, Greece will be able to operate independently, without the need for external resources or systems, thereby strengthening the country's national technological sovereignty.

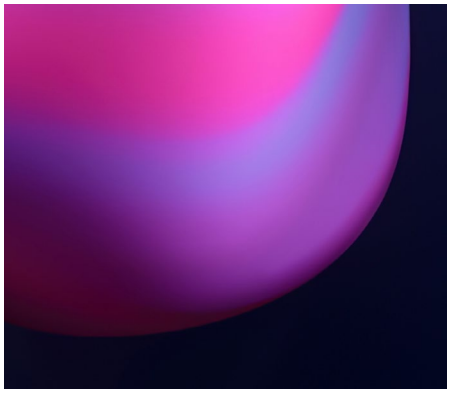
Therefore, investment in education infrastructure (HPC), management and storage of big data (data spaces), as well as hosting productive AI applications (data centers), is necessary for the development of the sector and the country's independence in terms of infrastructure and data security. The same applies to research and investment in new technologies of these infrastructures, such as quantum computers, which will provide a significant advantage in the field of innovation.

This proposal requires active participation and proactive coordination between planning and implementation bodies of major investments, as well as bodies initiating the training or seeking suitable human resources for the proper and effective use of these infrastructures, such as the National Network of Technology and Research Infrastructure (EDETE), Research Centers, Ministry of Digital Governance, Ministry of Education, Religion, and Sports, Ministry of Development and Investments, etc.



Availability and Data Privacy

To ensure a balanced approach, it is proposed to establish clear, transparent, and strict policies for data availability to data management entities, especially those handling sensitive and/or personal data (e.g., tax authorities, social security funds, insurance companies, research infrastructure organizations, etc.). Data controllers must ensure that data is accessible for the development of "genetic" or "productive" models, while also adhering to high standards of privacy and security. This includes methods such as anonymization and pseudonymization of personal information, as well as compliance with applicable data protection regulations, such as the General Data Protection Regulation and the AI Act. Furthermore, it is important to upgrade processes for monitoring and preventing breaches to ensure data security by the Hellenic Data Protection Authority (HDPA). The goal is the ethical and responsible use of data in AI, while also ensuring their availability for innovative applications, with respect for the privacy of personal data.



Motivations for Research and Development

Following the above, the creation of a forward-thinking environment for innovation and systematic networking and[213] collaboration between the academic community, industry, and the public sector are crucial for research and development in the field of AI in Greece. This framework should include, among other things, the formulation and implementation of a long-term and evidence-based planning involving various stakeholders (relevant ministries, universities, research centers, representatives of productive entities, chambers of commerce, etc.). The evaluation and enhancement of research centers and increased funding in the AI sector are among the key tools of forward-looking innovation policies. This correlates with the extraction of innovation and intellectual property and the maturation of technology transfer structures concerning AI and other "disruptive" technologies.

Moreover, the establishment of documented and outward-facing policies promoting parAIership with businesses and encouraging education, training, and lifelong learning in the AI sector will help in closely connecting knowledge production and research with the market, as well as in creating a critical mass of specialized personnel to meet emerging needs. In general, policies for research and education should aim to shape a competitive and innovative national ecosystem of exponential technologies, contributing to the comprehensive development and sustainable progress of the Greek economy and society.

[213] See the aforementioned Strategic Foresight Study on the "Future of Environmental Innovation in Greece until 2035" for further information.

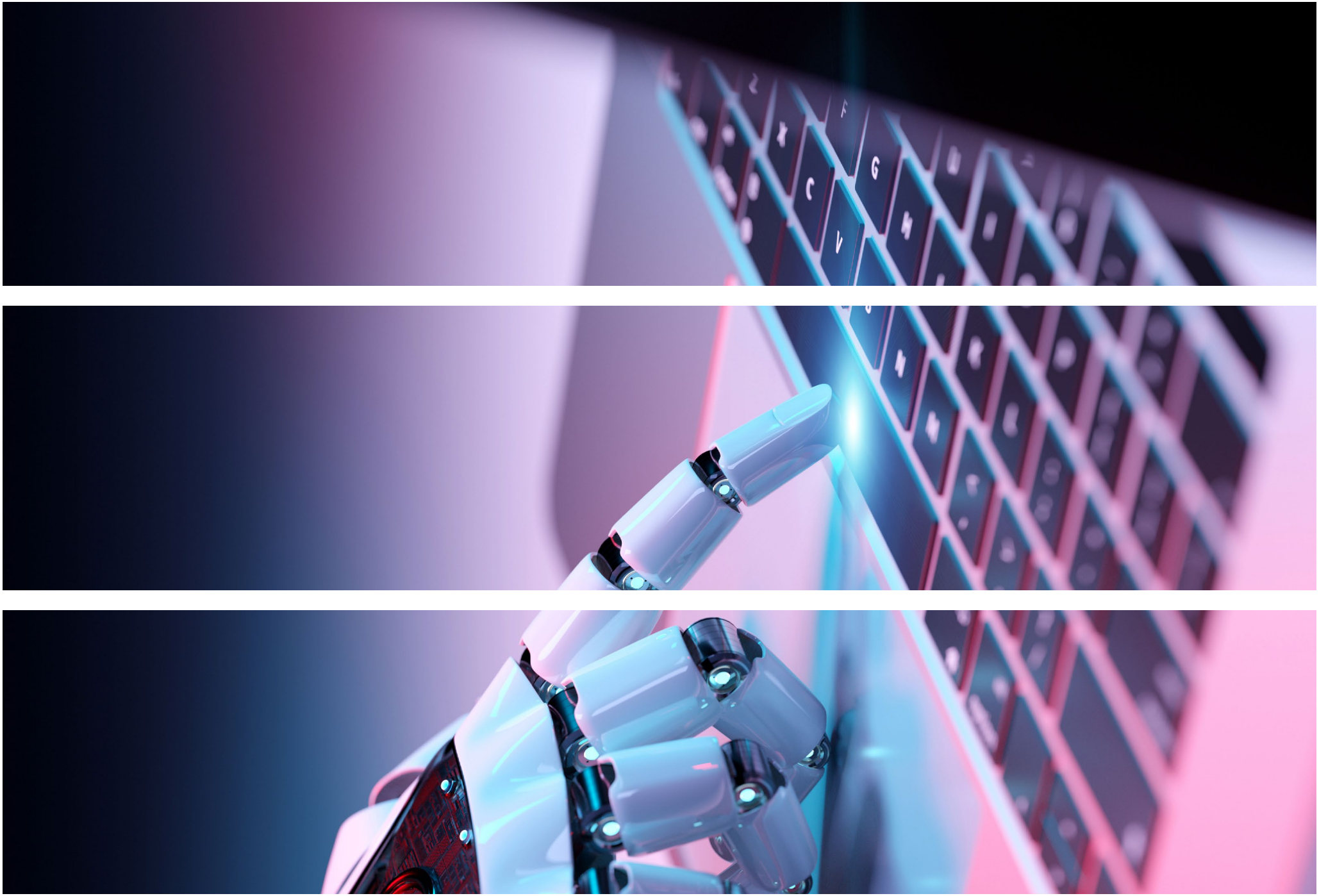
Enhancing Education - Lifelong Learning

In this context, the establishment of programs to enhance formal and informal education tailored to the new capabilities of AI[214] is proposed. The implementation of specialized lifelong learning and continuous professional training programs, based on collaborations between private and public entities, will allow for the effective assimilation and utilization of this exponential technology[215]. These programs should operate on terms of transparency, fairness, inclusiveness, and ethical use of technology, promoting dynamic understanding of emerging opportunities. Additionally, the establishment of forward-thinking monitoring and evaluation mechanisms that will enable the continuous adaptation of programs to AI developments and societal needs is considered essential. Thus, this technology can be integrated in a creative and sustainable manner, promoting continuous education and future-oriented addressing of risks and challenges that may arise, as well as assisting in the resilient transformation of both the new and existing workforce (particularly in reintegration into the job market).

This proposal can be implemented through the collaboration of various central and decentralized administration bodies (Ministry of Education, Religion, and Sports, Ministry of Digital Governance, Ministry of Labor and Social Affairs, Research Centers, Universities, and their Research and Development Institutes, etc.), as well as social parAlers and other relevant stakeholders. Specifically, for the broad cultivation of "digital intelligence[216]" and the dissemination of AI skills in the fields of citizenship, education, employment, and ICT professionals, with particular emphasis on vulnerable populations and affected geographical areas, further leveraging the National Alliance for Digital Skills and Employment[217] and the National Academy of Digital Skills[218], in collaboration with the Public Employment Service[219], would be beneficial. Finally, the strategic combination of digital skills with "green skills,[220]" "sustainability skills,[221]" and "future skills[222]" would be of strategic

importance. Future skills, of course, are linked to the spirit of long-termism, the ethical mindset that prioritizes long-term future thinking and its positive influence.

[214] pecifically regarding educators at all levels of formal education, immediate initiatives and actions are required from the relevant authorities (In-Service Training Seminars, Teaching and Learning Support Centers). Certainly, AI could be used to quantify and process educational objectives, especially in primary and secondary education.
[215] It is noteworthy that the skills that need to be widely cultivated within an upskilling/reskilling framework are not only "hard" or "technical" skills. In the context of strategic foresight, the so-called "soft" or "horizontal" skills appear to be more important. These skills involve critical thinking, creativity, imagination, flexibility, communication, and time management.
[216] https://www.weforum.org/press/2018/09/oecd-ieee-and-dqi-announce-platform-for-co-ordinatingdigital-intelligence-across-technology-and-education-sectors/
[217] https://www.nationalcoalition.gov.gr/
[218] https://nationaldigitalacademy.gov.gr/
[219] https://www.dypa.gov.gr/
[220] https://www.weforum.org/agenda/2022/09/green-skills-workforce-better-world/
[221] See IE University Center for the Governance (2023), ibid.
[222] https://www.iesalc.unesco.org/en/2020/04/14/future-skills-the-future-of-learning-and-highereducation/

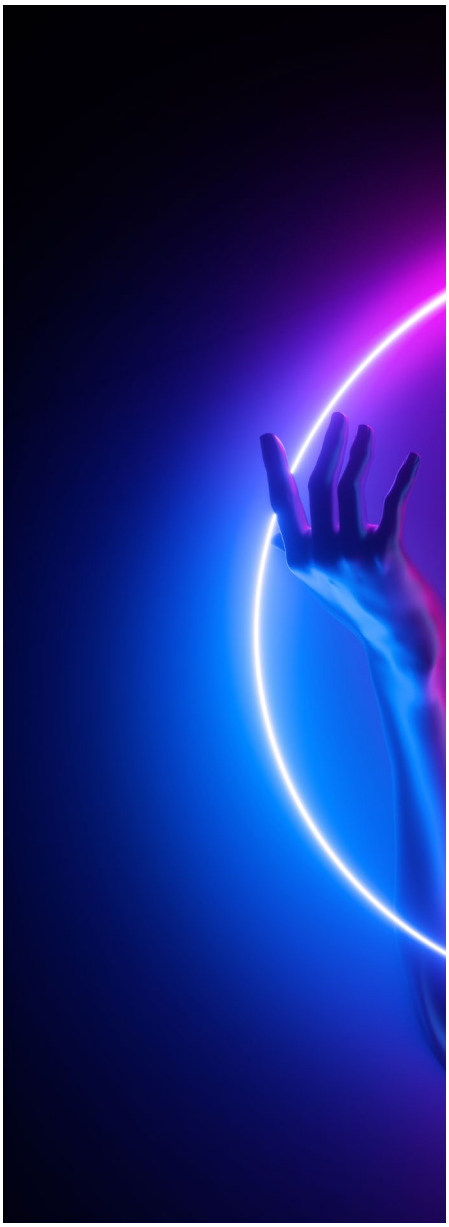


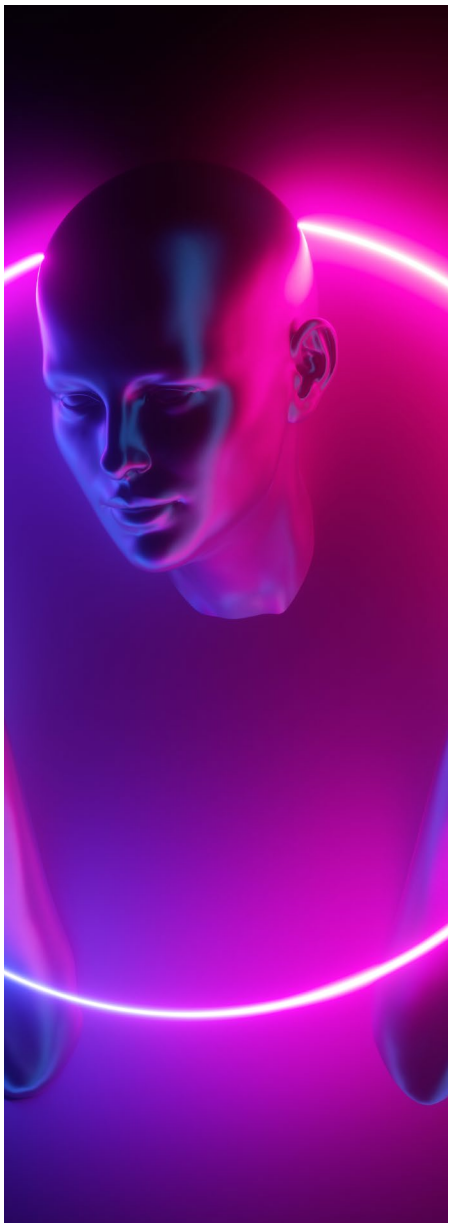
AI Diplomacy

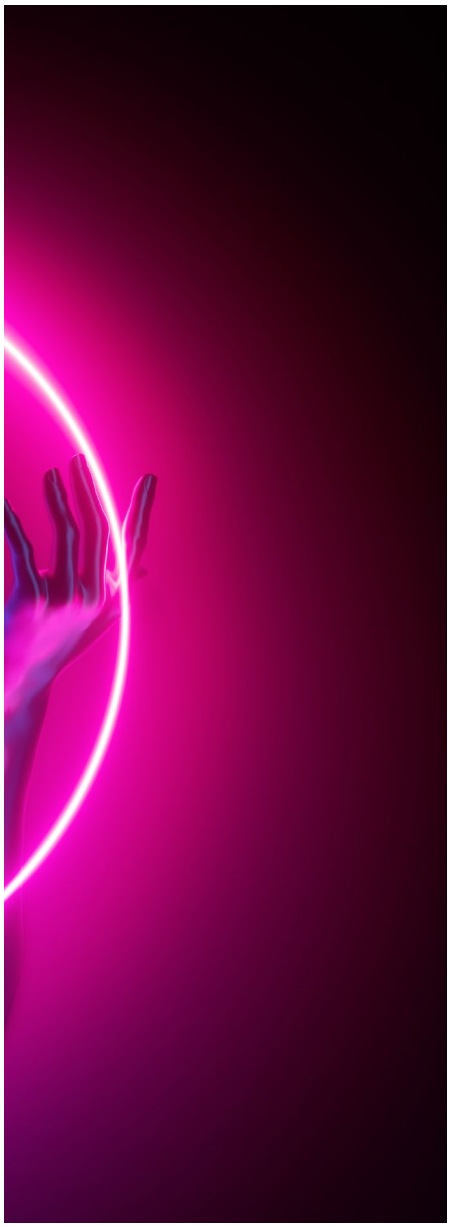
Artificial Intelligence Diplomacy refers to the practice of using AI and other disruptive technologies in the field of international relations and diplomacy. It involves strategically using AI for managing global risks and challenges, enhancing diplomatic efforts, and shaping foreign policy. It signifies the recognition of the transformative potential of AI, and even more so of AI Ethics, aiming for a forward-looking approach to addressing the global impacts of its exponential growth. This includes negotiations, parAIerships, and dialogues with other countries to ensure that AI technologies are developed and utilized in a manner that is compatible with universal values.

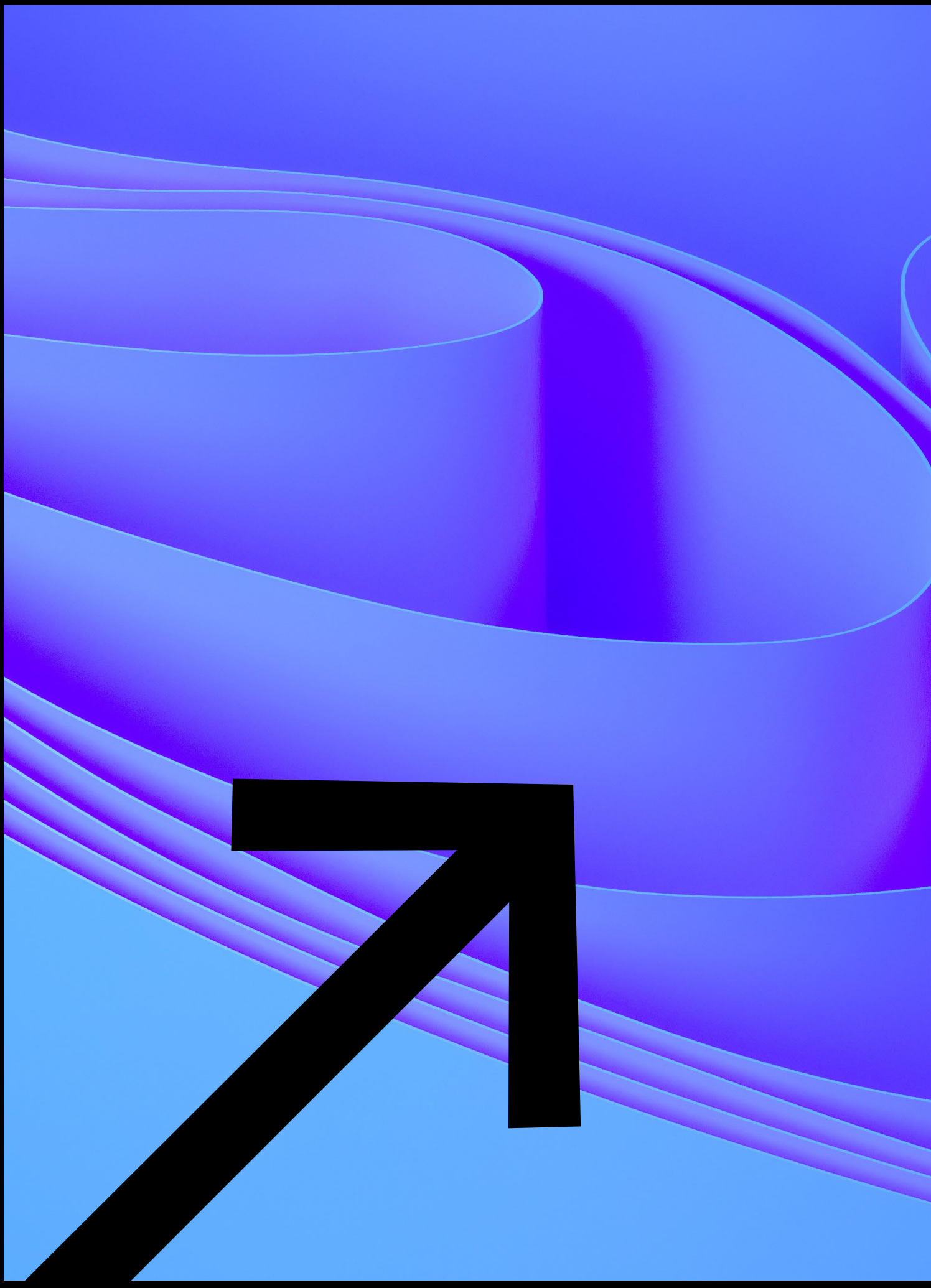
Therefore, proactive planning and the development of a policy for AI diplomacy in Greece are recommended, with the aim of promoting international engagement and cooperation, especially in the field of AI Ethics. Priority should be given to active participation in international initiatives (e.g., the Global ParAIership on Artificial Intelligence, etc.) and the pursuit of agreements with other countries to promote a clear and responsible development of AI Ethics on a global scale.

AI diplomacy can strengthen national digital sovereignty and Greece's relational influence, as well as making it a global player in the field of AI Ethics and facilitating the internationalization of research centers and businesses through international parAIerships that could potentially serve as a lever for development.









Towards a Positive Narrative

Towards a Positive Narrative

The highly complex AI promotes human knowledge but not human understanding, contrary to the logic we have been accustomed to since the Enlightenment[223]. This divergence between knowledge and understanding manifests (1) in a profound transformation in the cognitive structures of society and in the way institutions and identities are formed and organized, (2) in the accelerating alteration of its fabric of reality, and (3) in the redefinition of human relationships and abilities. It is no coincidence that most of the experts who participated in the empirical research consider that the impact of AI on Greek society will be significant (Figure 16), while the majority express optimism about how AI will affect and what changes it will bring to Greek society (Figure 17).

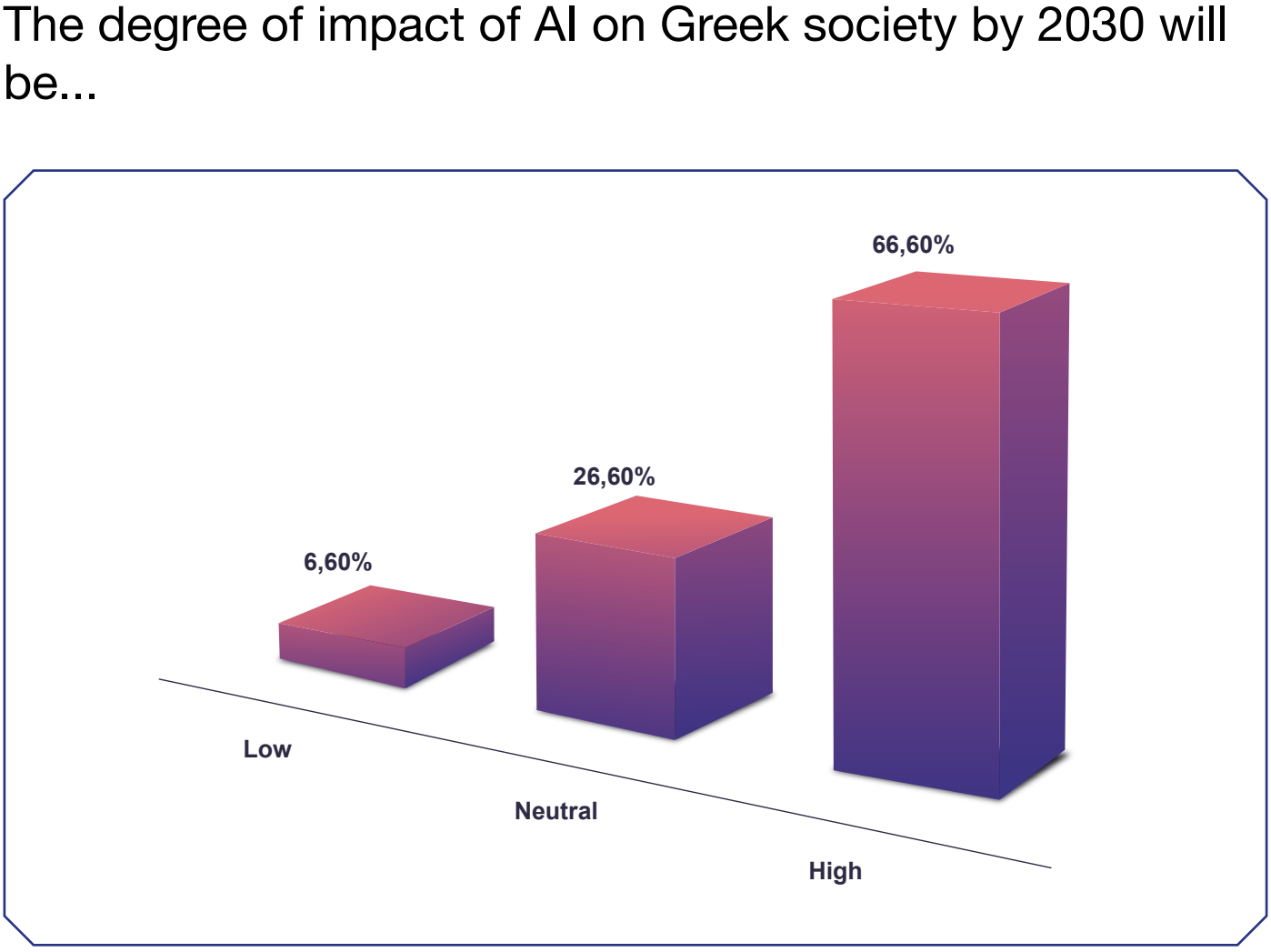


Image 16: *The degree of impact of AI on Greek society based on the responses of experts.*

[223] Kissinger, H.A., Schmidt, E., & Huttenlocher, D. (2023). The age of AI and our human future. Hachette UK.

The stance of the experts regarding the impact of AI on Greek society

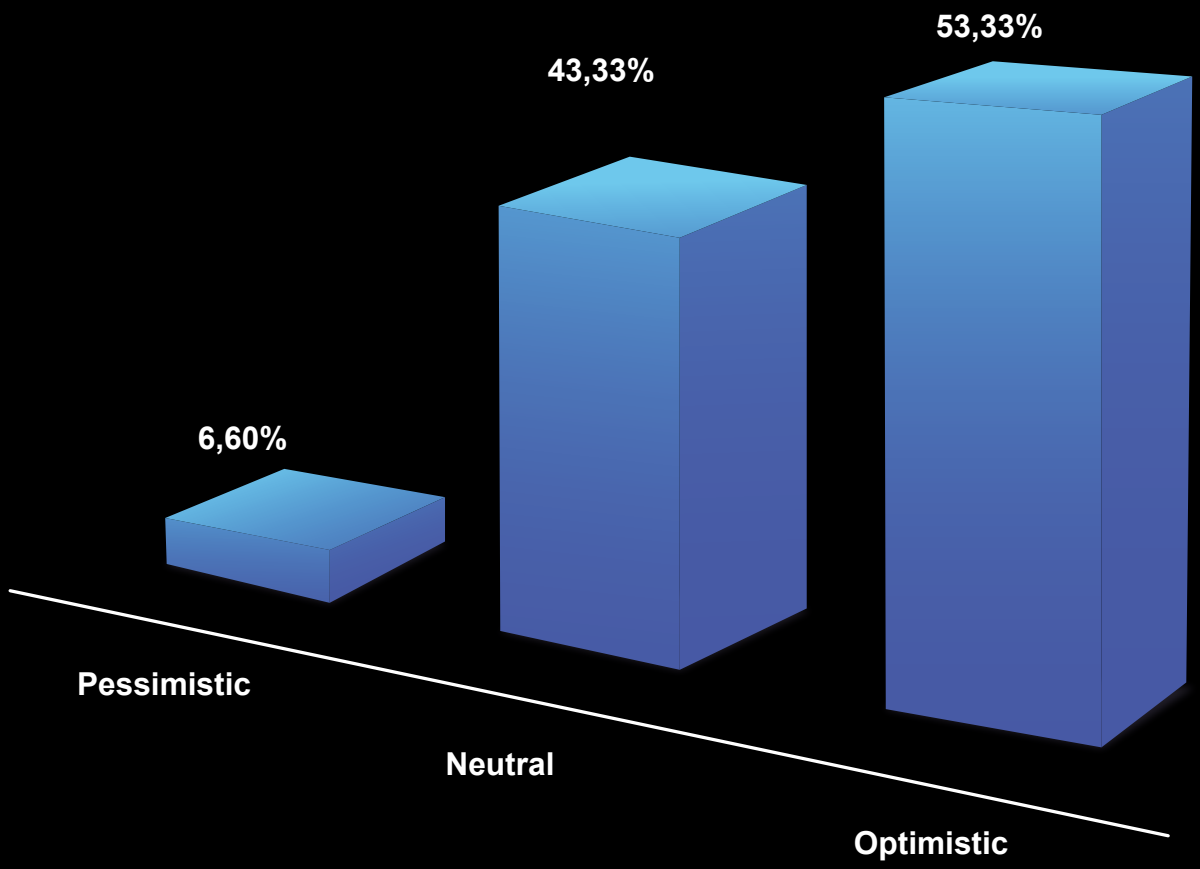


Image 17: *The stance of the experts regarding the impact of AI on Greek society.*

At present, we can identify several "weak signals" of the profound impact of Large Language Models, even in Greece. In other words, these models represent the first signs of the "big wave" that is beginning to crash around us[224]. In 1996, thirty-six million people were using the internet. By the end of 2023, usage will surpass five billion users by a large margin. This reflects the kind of dynamics we should expect for AI. In the coming years, AI will become "ubiquitous" as much as the internet itself: equally available, and even more exponential.

At today's level of computing and computational power, we already have an almost human level of performance in tasks ranging from speech transcription to text generation. As AI continues to scale, the ability to accomplish more and more tasks at our (human) level - and beyond - will become increasingly feasible. Many experts estimate that AI will continue to improve radically, and so far, there seems to be no obvious upper limit. However, this scaling comes with a complex array of positive and negative phenomena and developments.

Recently, it has become quickly apparent that these models often cause concern, actively producing harmful and toxic content, such as racist or sexist remarks, or conspiracy theories with significant influence. Given that they are trained on many of the unstructured data available on the open web, they randomly reproduce and even reinforce the pervasive biases and prejudices of society unless carefully designed to avoid such pitfalls.

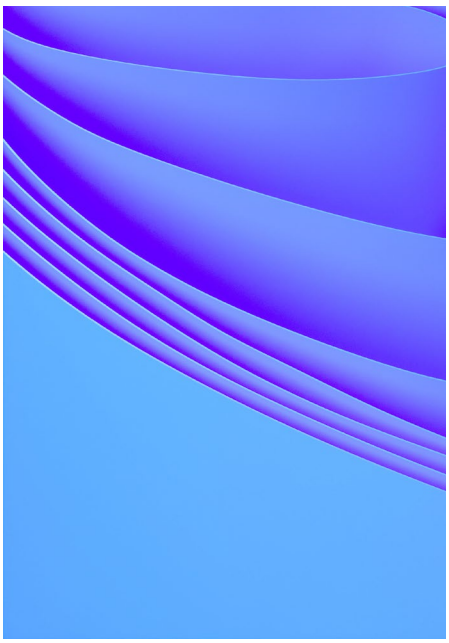
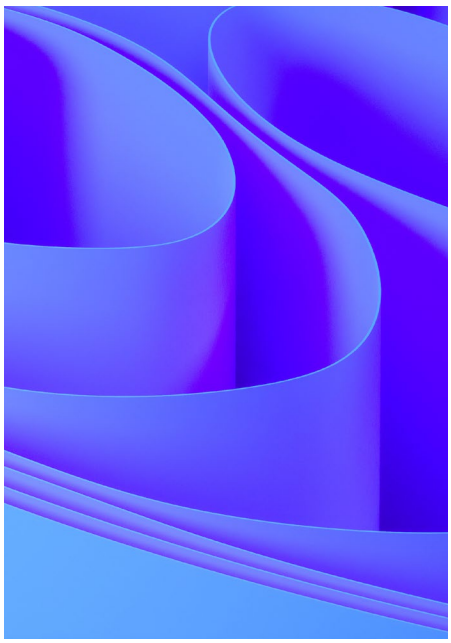
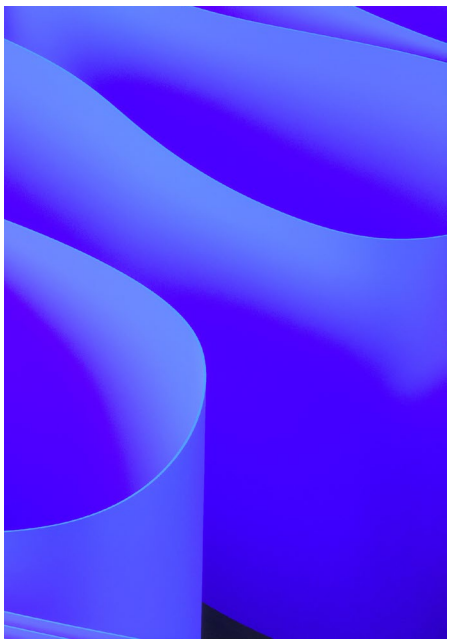
[224] Suleyman, M., & Bhaskar, M. (2023), ibid.

The introduction of AI into our digital world adds another layer of complexity to the impacts of Social Media, allowing for the production and dissemination of extremely realistic synthetic content, thus making it harder to distinguish truth from fiction (something, as Hannah Arendt argued, is a precondition on which totalitarianism relies). It also poses challenges for content moderation efforts, as content generated by AI may evade detection algorithms, leading to the spread of harmful and misleading information and fake news. Furthermore, the misuse of AI can facilitate further organized and orchestrated campaigns of misinformation, exacerbate the spread of online abusive behaviors, and undermine trust in digital platforms.

In light of the above analysis, we must systematically cultivate the belief that a broader and better understanding of AI - what it is, how it works, what it can do, what it cannot do, whom it affects, what the implications are, and how we can make our voices heard - is essential for building digital trust. In other words, to increase the percentage of the population that feels confident in using AI responsibly. A critical aspect of this goal is to ensure that AI is developed and disseminated in a transparent and ethical manner.
Over the past few months, we have observed that public discourse on AI often includes a significant degree of exaggeration and obscuring of its capabilities and outcomes. This is commonly referred to as "AI Hype."

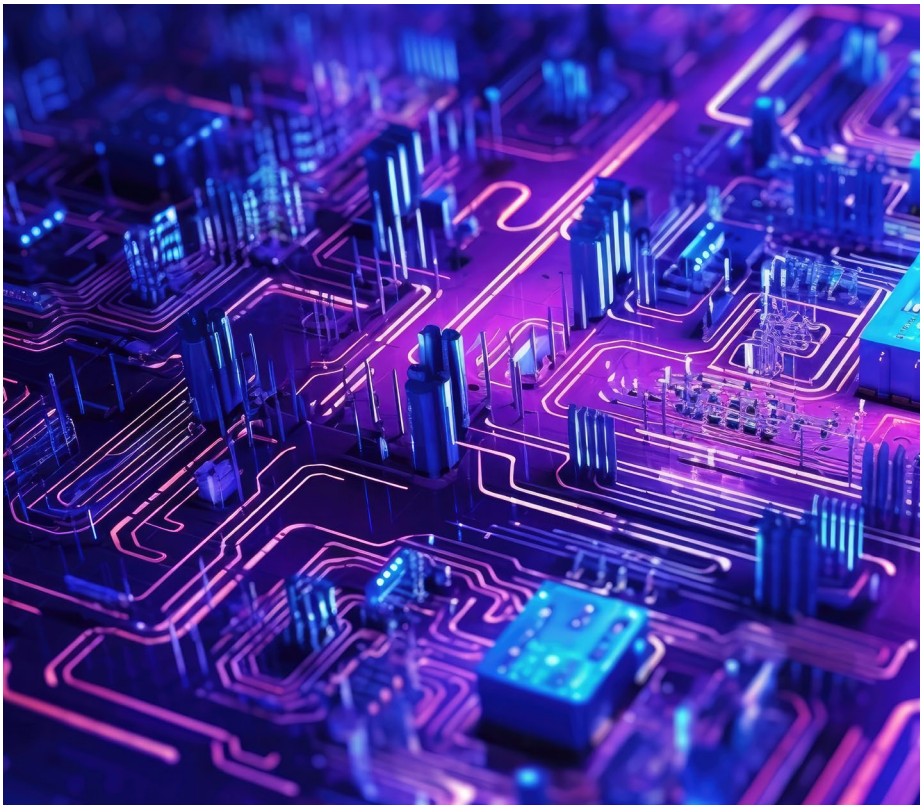
More specifically, on March 29, 2023, in light of the remarkable explosion of Large Language Models and AI, the Future of Life Institute issued an open letter[225], co-signed by many influential figures, from renowned intellectuals (such as Yuval Noah Harari) to top entrepreneurs (such as Elon Musk). This letter constitutes an emotionally charged appeal for an urgent halt in the development of the "most powerful" AI, a global "time-out," to establish limits and "protective safeguards" on the path towards an existential catastrophe for humanity. In the same spirit of exaggeration, another open letter, from the Centre for AI Safety, warns that "mitigating the risk of extinction from Artificial Intelligence should be a global priority.[226]"

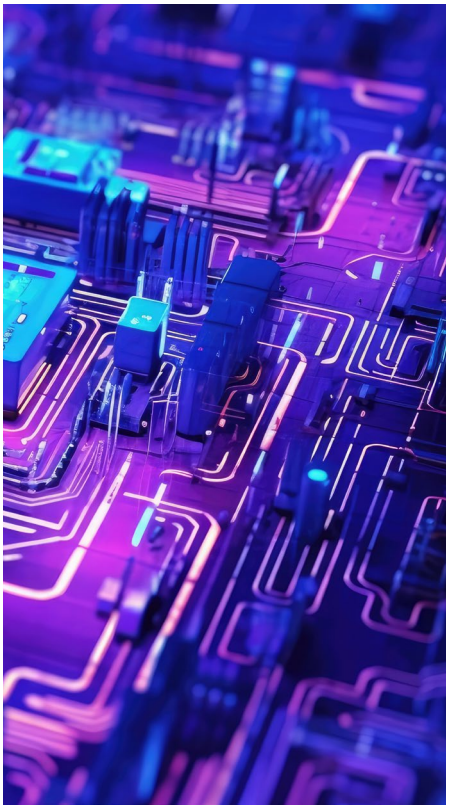
In essence, the distorted - often exaggerated - portrayals of AI undermine substantive and constructive public discourse, hindering the development of effective policies and funding plans. Misinformation about AI manifests in many different ways, through various mechanisms, serving diverse purposes. It is often linked to utopian or dystopian sensitivities, as well as misconceptions and misunderstandings in general about AI. Many times, exaggerations are fueled by a lack of literacy and general education about AI, which is reinforced by advertising campaigns in media, marketing, and entertainment industries, which in turn can be influenced by technology vendors. In these contexts, we have a potential cycle of disinformation advertising campaigns.

225 https://futureoflife.org/open-letter/pause-giant-ai-experiments

226 https://www.safe.ai/statement-on-ai-risk





Overall, exaggerations work detrimentally to the public understanding of AI as well as the understanding of new forms of power, while simultaneously obscuring or misdirecting attention from real (and current) social, ethical, and inclusive issues that require urgent focus and resolution, such as discrimination, inequalities, underrepresentation, platform labor, biased algorithmic decision-making, and unfair extraction practices.

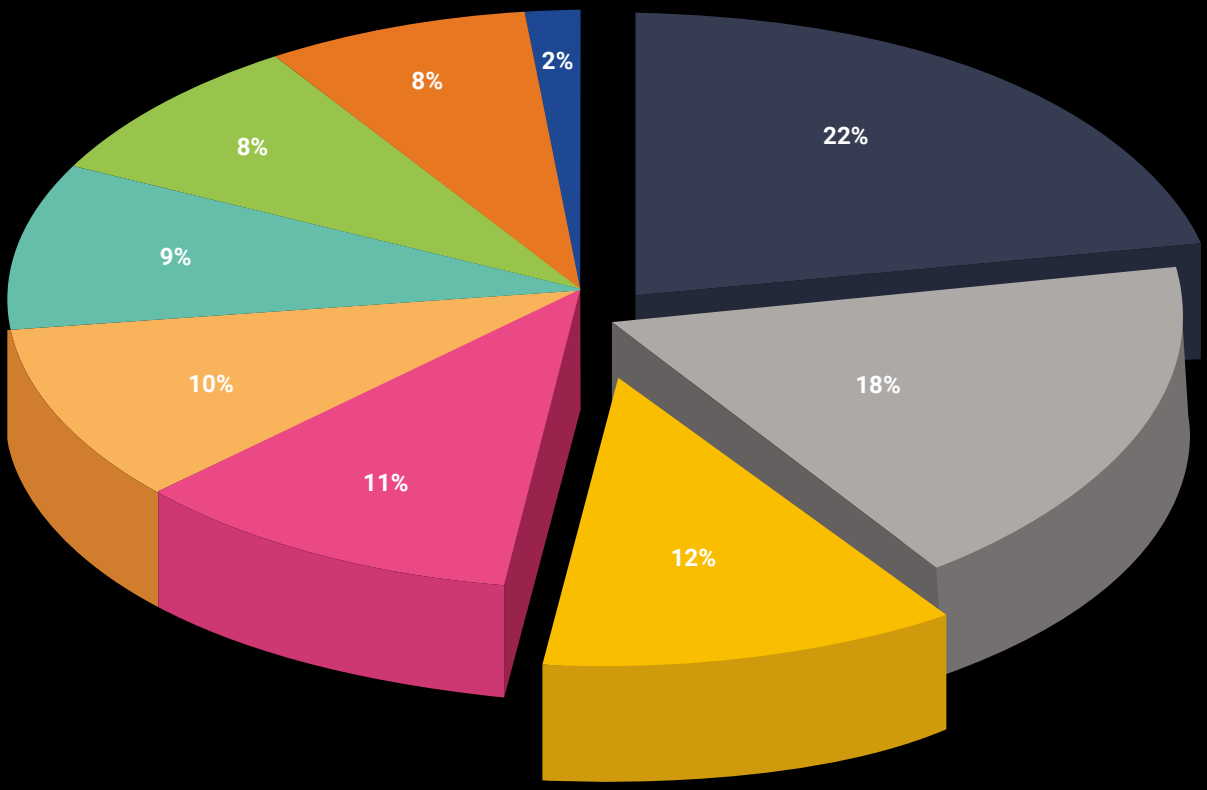
In a different, more realistic line of thought, against the cultivation of fear, ethical panic, and insecurity, Rashik Parmar, the Chairman of BCS-The Chartered Institute for IT, recently presented a joint statement of significant experts proclaiming that AI will not evolve into a modern "Terminator," but into a reliable assistant in learning, work, healthcare, and entertainment[227]. They argue that the most suitable way to achieve this is by managing and governing AI according to specific technical and professional codes of ethics and international ethical standards, as well as systematically building digital trust. Experts must convince the general public about the responsible and beneficial development and use of AI.

AI is a journey without a return ticket, but this journey doesn't automatically pose existential threats to humanity, nor does it inevitably culminate in the nightmarish scenario of "evil robots" replacing humans. On the contrary, it can be a force for rejuvenating innovation, imbuing meaning, and effecting qualitative change, provided we make bold and critical decisions today, dialogically processed and collectively agreed upon, with an emphasis on multilateral cooperation, the triad of human-social-institutional capital, digital rights, proactive regulation, and the global goals of sustainable development.

In order for AI to fulfill its promises for a better future, as aptly argued by Daron Acemoglu and Simon Johnson in their recent book "Power and Progress," it must align with collective values, and its impact must be brought under society's control. In this positive direction, the interdisciplinary approach of strategic foresight can substantially assist us, reminding us how futile and counterproductive simplistic dualistic analysis (whether idealization or demonization), the obsession with prediction, and adherence to a "one-size-fits-all" scenario—positive or negative—are, favoring the "politics of inevitability" (Timothy Snyder).

[227] https://www.bcs.org/articles-opinion-and-research/bcs-open-letter-calls-for-ai-to-be-recognised-as-force-for-good-not-threat-to-humanity/ . See also: LeCun, Y., & A. Ng (2023). Yann LeCun and Andrew Ng: Why the 6-month AI Pause is a Bad Idea. https://www.youtube.com/live/BY9KV8uCtj4

Factors that will facilitate the development of AI in Greece



- Favorable investment climate/increased funding in computing infrastructure/incentives for businesses.
- Accessibility and affordable prices of new technology.
- New and more experienced generations in technology.
- New entrepreneurial opportunities and incentives.
- Progress and maturation of the expansion of new technology/technical capabilities of Gen AI.
- Increased public and private funding.
- Facilitating the resolution of trust issues (e.g., interest from regulatory authorities and stakeholders in user protection, etc.).
- Legal regulations and institutional interventions.
- Increased rates of skill acquisition by experts and digital literacy among citizens.

Image 18: *What did the experts say about the facilitating factors for the development of the AI in Greece?*

As we have seen, we can achieve a higher degree of dynamic understanding of the evolving ecosystem of AI in Greece, as well as resilient preparedness against the unforeseen and the unknown, through proactive utilization of "facilitating factors" (see Figure 18) and a "quantum" logic exploration of a wide array of diverse "potential alternative futures." An exploration devoid of fear and passion, but imbued with interdisciplinary spirit, methodological flexibility, creativity, and imagination.

These potential future scenarios are depicted in scenarios that obviously do not constitute predictions or "clairvoyant properties," as the system is inherently unpredictable, with the available alternatives subject to gradual or abrupt modification or alteration. Nevertheless, scenarios highlight trends or megatrends and contribute to dynamically understanding/diagnosing and managing (but not to "solve" or "cure") the complexity and non-linearity within a more structured framework. They help us not to venture "into the dark" (to use a phrase from George Seferis' "Last Station"). The alternative scenarios of our research present four different and equally plausible versions of the future, highlighting a range of challenges, uncertainties, and opportunities that require continuous monitoring.

As AI models continue to strengthen continuously, as their cost decreases and access to them increases, as the ability to write and use language inevitably becomes a competence of machines, the full potential of this new powerful technology becomes increasingly apparent. No longer in terms of scientific imagination, but in the form of a practical tool that constantly disrupts the world and soon will be available to billions of people. However, AI is not just a "tool," a "system," or a "platform," but a transformative meta-technology, a technology behind technology[228]. It constructs tools and platforms; it is a creator of systems of all kinds. In other words, we are at a turning point in human history, at a significant crossroads in the evolution of our culture.

Meanwhile, the global geopolitical and geo-economic order is becoming increasingly uncertain, complex, and unstable. AI seems to reinforce these systemic characteristics and indicates the need for an "exponential" and forward-thinking mindset. We cannot be certain about what the future holds for us, nor can we avoid the continuous disruptions in an era of perpetual crisis. But it is up to us to leverage this generalized uncertainty/complexity, to set long-term goals, to be adequately prepared, and to work towards the most favorable scenario - namely, the scenario of "techno-social acceleration" - aiming to enhance the country's capacity for sustainable development and resilient prosperity, based on dynamic diagnoses of the trends, uncertainties, and opportunities emerging around us.

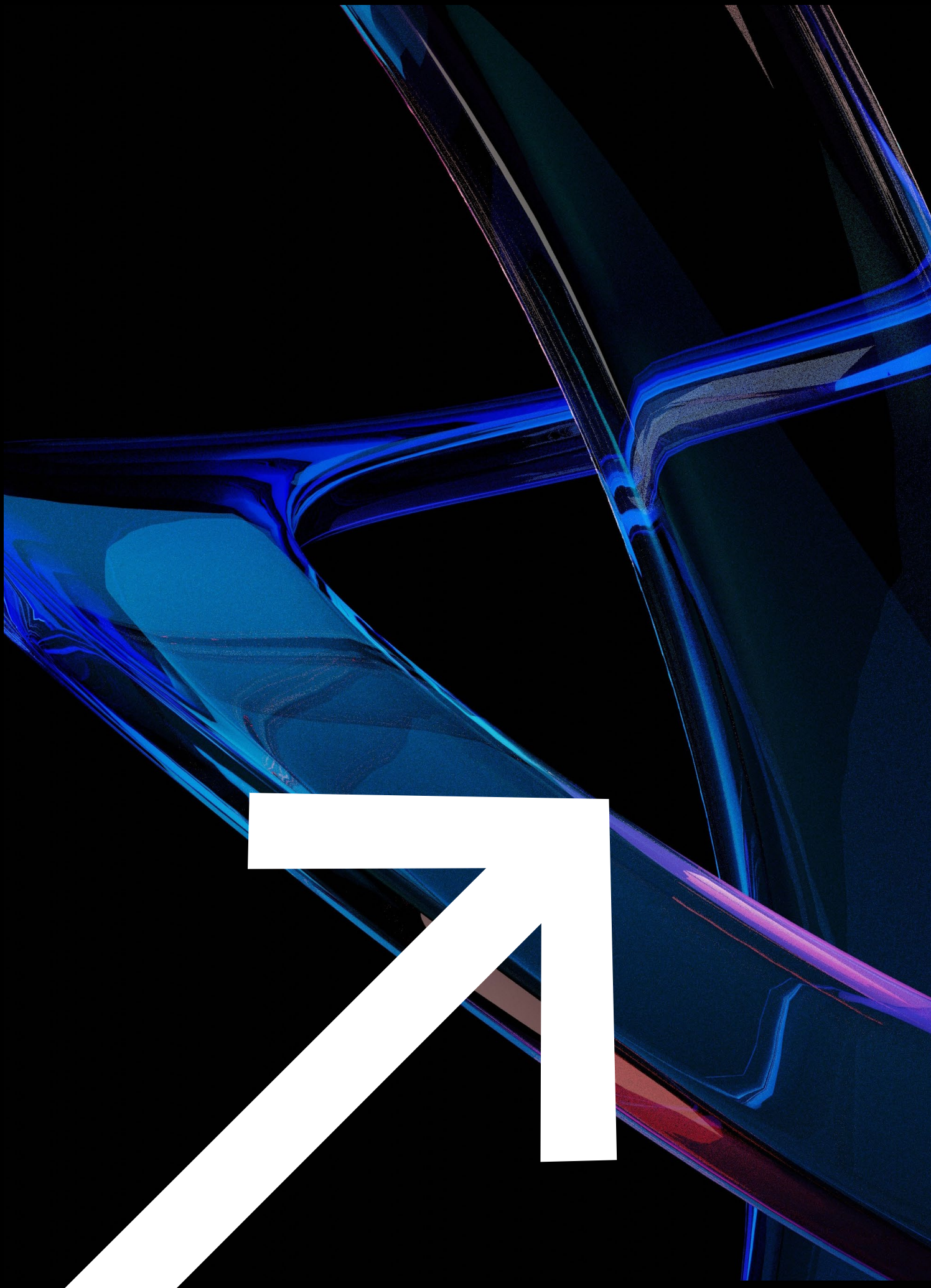
Modern societies are called upon to upgrade their economic and political organization, to adapt institutions and mentalities, and to devise new rules and codes of coexistence. In other words, we need not only better linguistic models but also new models for the real world we live in, new cognitive categories, and new ethical standards. We need a vision, a positive narrative for AI. In this context, Greece indeed possesses and can effectively leverage a wide range of capabilities, with its human potential at the forefront, so that it not only follows the train of the Fourth Industrial Revolution but also takes a leading role in the emerging technological and productive model, shaping developments and actively and responsibly participating in the global dialogue on the future of AI with confidence and optimism.

[228] Ibid.

Appendix 1 – Terminology

Terms	Description
Generative Artificial Intelligence (Generative AI)	Generative Artificial Intelligence (Generative AI) is a subset of artificial intelligence distinguished by its ability to create new texts, images, or other types of content by simulating and mimicking patterns and structures from large datasets (training big data). It involves algorithms and models that prioritize the creation of results that did not exist in the natural world but simulate it, often using templates, patterns, and structures derived from the aforementioned training datasets. The development of deep learning methods, especially models such as Generative Adversarial Networks (GANs) and Recurrent Neural Networks (RNNs), has been one of the most significant advancements in generative artificial intelligence. In many areas, these models have proven capable of generating data that is not only realistic but also internally consistent.
Large Language Models (LLMs)	Large Language Models (LLMs) are a subset of AI aimed at producing text that resembles human speech.
Adversarial Attacks	Adversarial Attacks, also known as "Adversarial Attacks," are a technique in the fields of machine learning and artificial intelligence that attempts to violate or deviate the performance of a machine learning model with deliberate modifications to input data. These modifications are usually very small and imperceptible to human observers but sufficient to mislead the machine learning model.
Multimodal AI	Multimodal AI is a type of artificial intelligence that can process, understand, and/or produce results for multiple types of data. Multimodal AI systems are trained using videos, audio, speech, images, text, and a variety of traditional numerical datasets. Thus, many types of data are used simultaneously to assist AI in producing more complex and accurate results, something lacking in earlier applications.
Model Drift	Model Drift refers to the phenomenon of decreased effectiveness of machine learning models after the initial training period.
Multilingual Models	Multilingual Models are a type of machine learning model that can understand different languages.

Terms	Description
Metaverses	Metaverses are virtual worlds where users can interact with others and their environment in 3D digital worlds.
Digital Literacy	Digital Literacy is an individual's ability to find, evaluate, and communicate information using typing platforms or digital media.
Foundational Models	Foundational Models, within the context of AI, typically refer to pre-trained large language models that serve as a basis for various natural language processing tasks (NLP). These models are usually designed to learn patterns, structure, and semantics of language from various data sources. A suggested example of a foundational model is the GPT (Generative Pre-trained Transformer) series by OpenAI, such as GPT-3.5. Foundational models can undergo adjustments for specialized uses.



Appendix 2 - Experts

Experts

1. **Accenture Greece:** Kyriakos Sampatakakis, Country Managing Director, Managing Director Central-Eastern Europe, Communications-Media-High Tech

2. Member of the Board of Directors of a Multinational Human Resources Company

3. Representative of a Multinational Technology Company

4. **WIDE Services P.C:** Katerina Tsadima, Head eLearning Instructional Designer of the Greek Premium Certified Moodle ParAIer (WIDE Services)

5. **Homo Digitalis** (NGO for the defense and promotion of Human Rights in the digital age): Lefteris Helioudakis, Secretary of the Board

6. **KPMG:** Greek Branch of a Multinational Consulting Company, Human Resources Services Consultant

7. **Hellenic Federation of Enterprises (SEV):** Dr. Maria Bozoudi, Senior Advisor, Industry, Development, Technology & Innovation Sector

8. **University of the Aegean:** Lilian Mitrou, Lawyer, Professor, School of Engineering, Department of Information and Communication Systems Engineering

9. **Public Employment Service (DYPA):** George Karachalios, Deputy Governor

10. **Panteion University:** Konstantinos Karpouzis, Department of Communication, Media and Culture, Assistant Professor

11. **100 Mentors** (Research and development services for interactive multimedia products-employee training platform): George Nicoletakis, CEO

12. **Hellenic Broadcasting Corporation (ERT):** Vasilis Vasilopoulos, Data Protection Officer

13. **Institute of Small Business of the Hellenic Confederation of Professionals, Craftsmen & Merchants (IME GSEVEE):** Scientific Staff

14. **Intelligencia AI** (Artificial Intelligence company supporting the development of new drugs): Dimitris Skaltsas, CEO & Co-founder

15. **Boussias Media:** Giannis Rizopoulos, Journalist (NetFax – netweek) & Coordinator of conferences/ workshops

16. **P2P Lab (research hub on technology & practices):** Vasilis Kostakis, Professor of Technological Governance and Sustainability at TalTech, Estonia, researcher at Harvard University, USA, & founder of the research hub P2P Lab

17. **Aristotle University of Thessaloniki (AUTH):** Athena Vakali, Professor of Computer Science & Director of the Data and Web Science Laboratory (Datalab https://datalab.csd.auth.gr/), Co-founder of the spinoff Exanta

18. **University of West Attica:** Cleo Sgouropoulou, Professor, Department of Computer Science and Engineering, Member of the Board of Directors of UWA, Member of the BoD of ESDIT

19. **National Center for Research and Technological Development - Institute of Informatics and Telecommunications (NCSR-ITI):** Yiannis Kompatsiaris, Principal Researcher

20. **Foster+ParAIers** (international architectural, urban planning, and design/environmental sustainability firm): Martha Tsingari, Senior ParAIer and Head of the Applied R+D (ARD) team

21. **Ministry of Digital Governance:** Konstantinos Kyranakis, Deputy Minister

22. **Info Quest Technologies:** Dimitris Eforakopoulos, President & CEO

23. **Victus Networks:** Antonis Hondros, CEO

24. **Open Technologies Alliance (EELLAK):** Alexandros Melidis, General Director

25. **International Strategic Communications and Crisis Management:** Stratos Safioleas, CEO (Specialist in Technology Policy and Engineering Management)

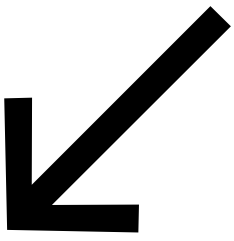
26. **National and Kapodistrian University of Athens:** Aristotelis Timpas, Professor, Department of PHI

27. **National and Kapodistrian University of Athens:** Manolis Patiniotis, Professor of History of Science and Technology in Modern Times, Department of Sociology

28. **Athens Technology Center - ATC (software development company facilitating workflow with modern technologies):** Nikos Sarris, SME Technology Consultant

29. **Ministry of Digital Governance:** Antonis Stasis, General Director of Digital Governance

30. **University of Crete:** Professor of Philosophy, Laboratory of Bioethics



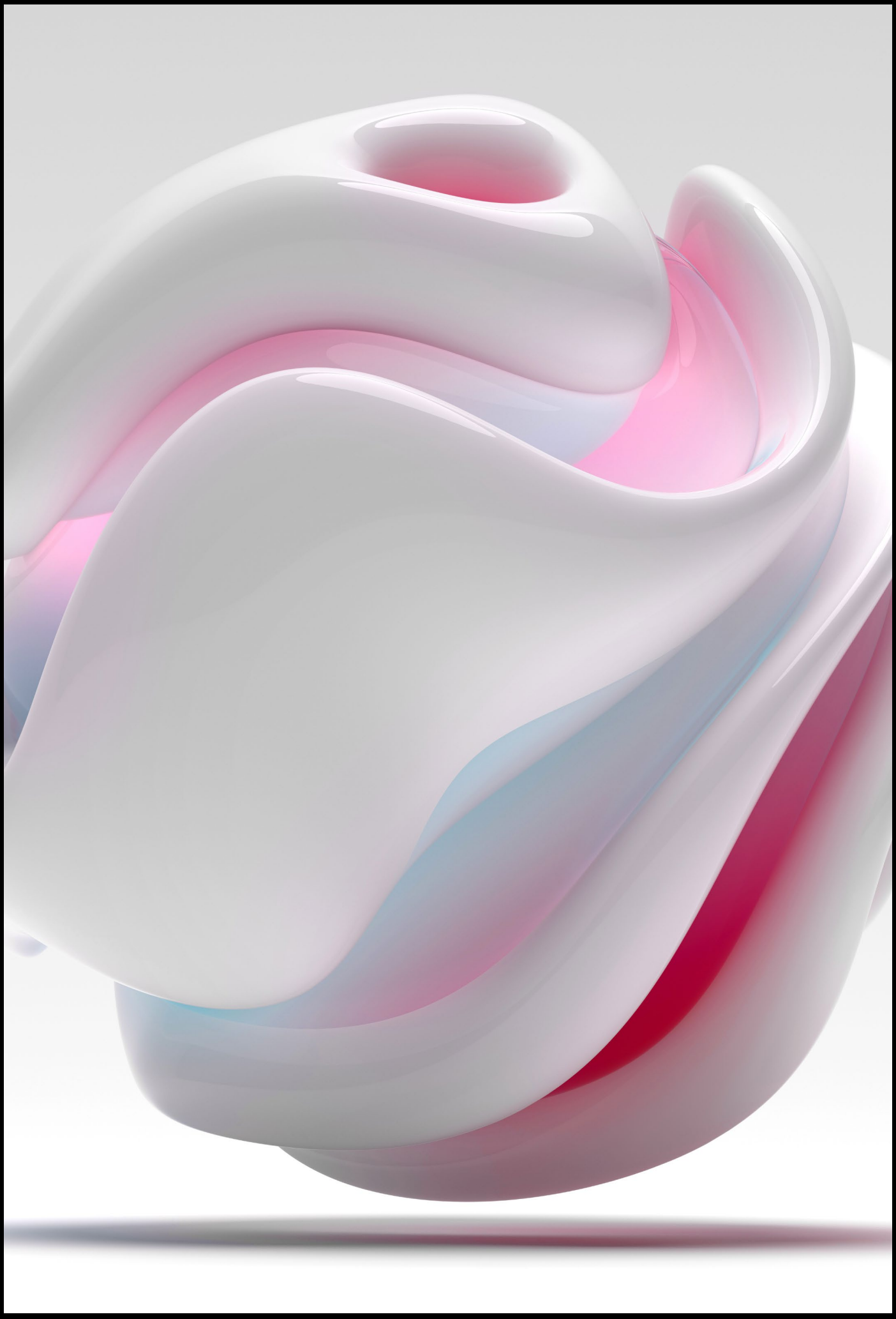
Excerpts from discussions

31. **Tourist Educational Institute:** Education Department Representative

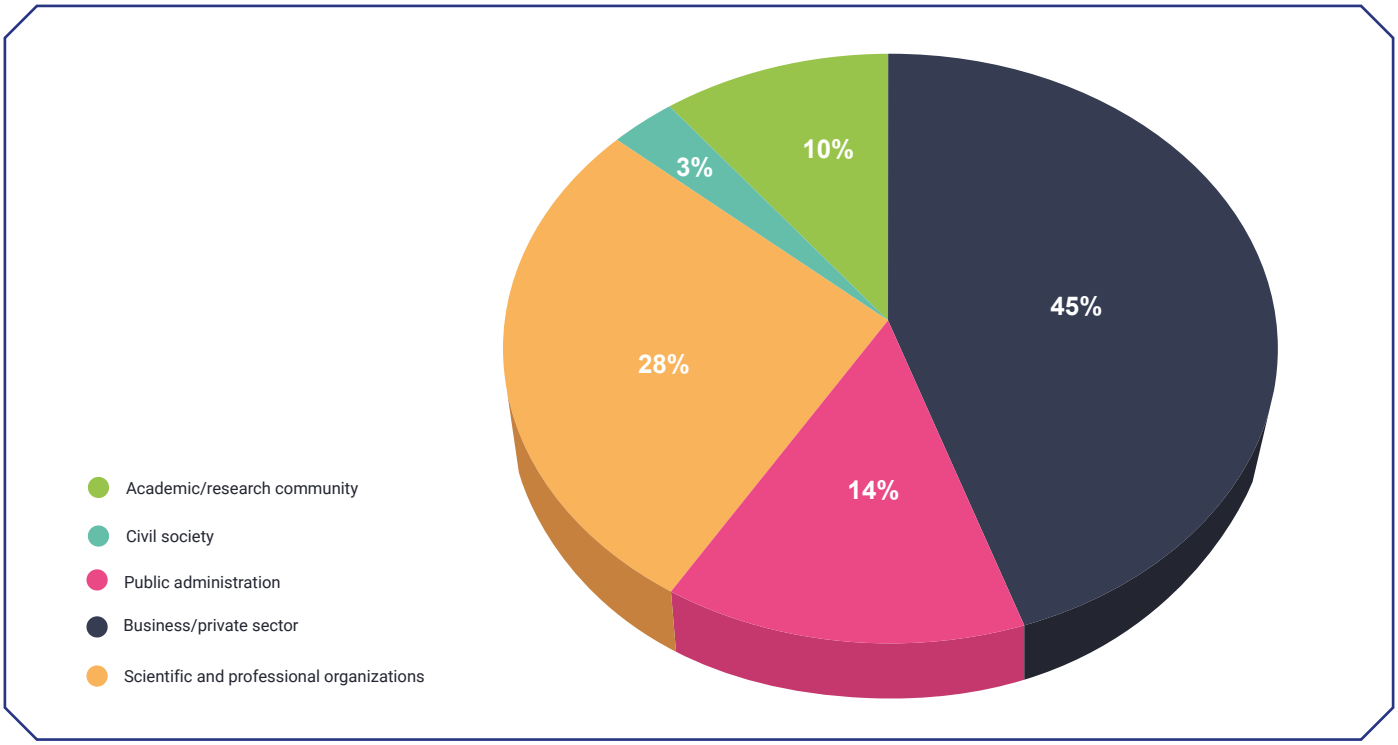
32. **Centre of Planning and Economic Research (KEPE):** Theodoros Tsekeris, Researcher

33. **Centre of Planning and Economic Research (KEPE):** Athanasios Hymis, Researcher

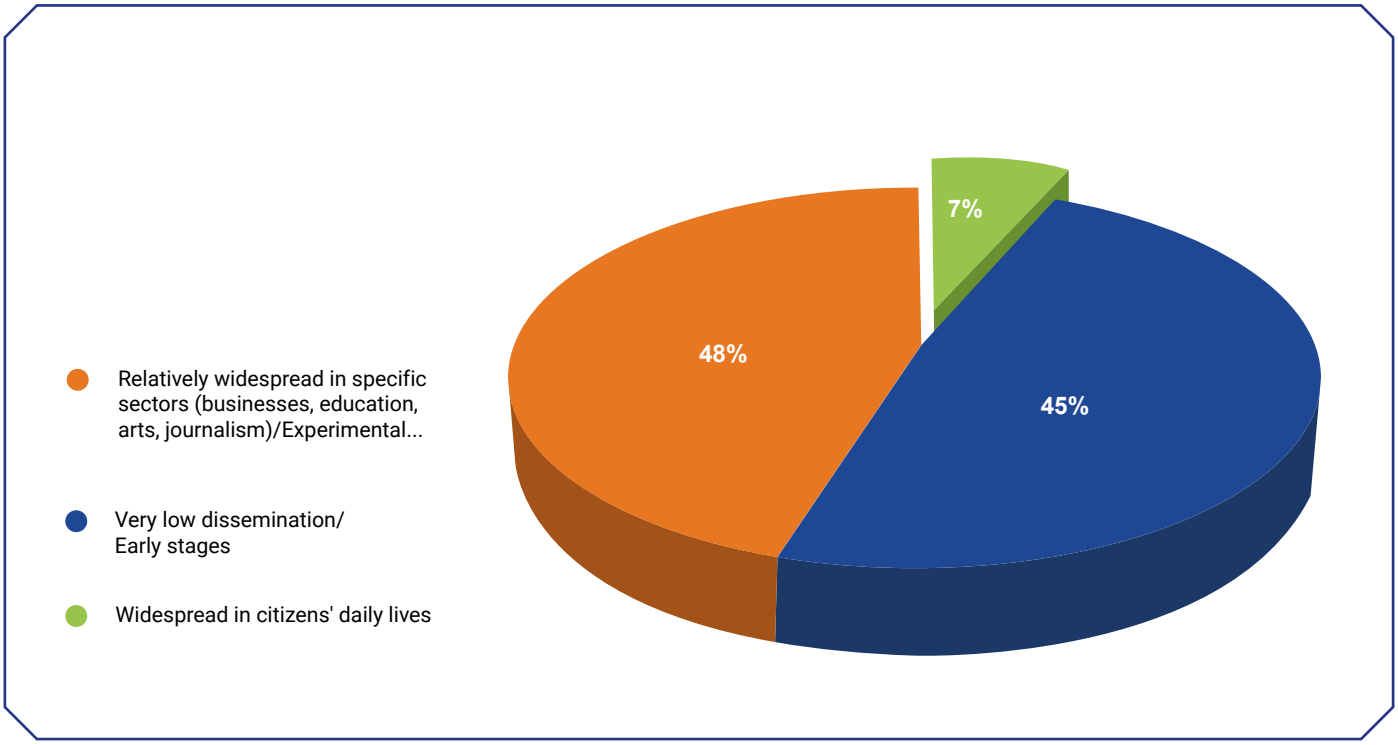
Appendix 3 - Questionnaire Charts



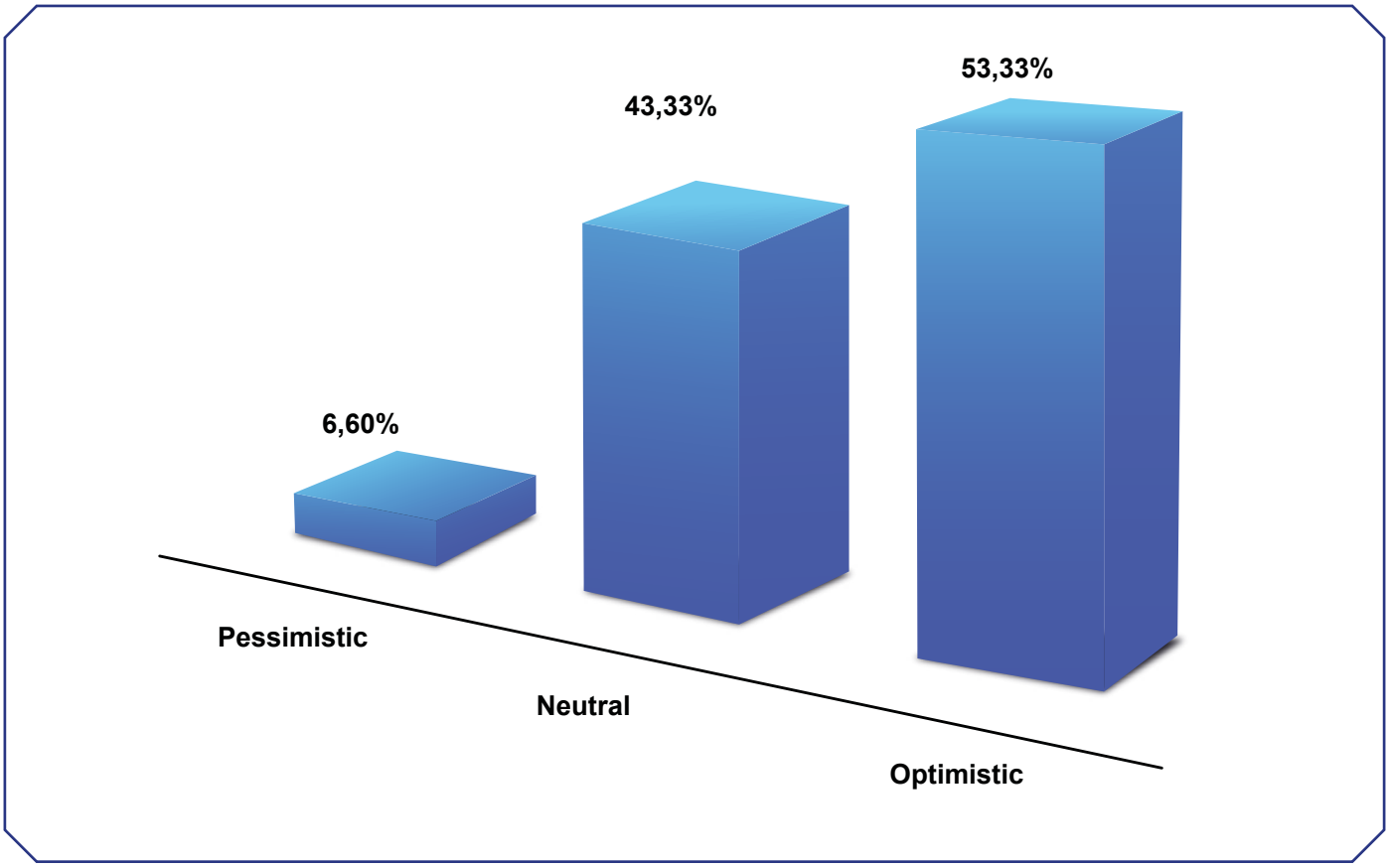
1. Participant Fields



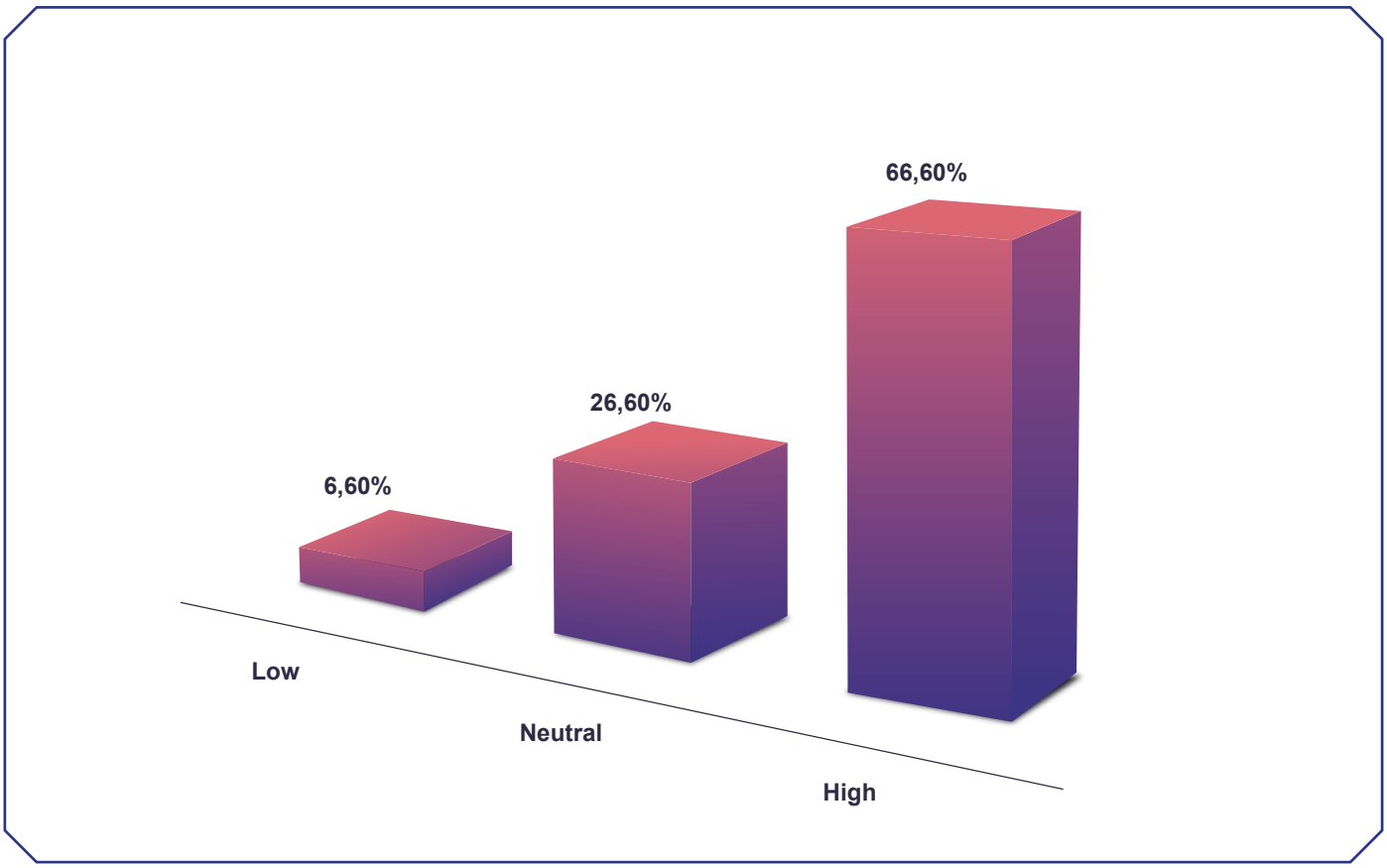
2. In your opinion, to what extent does GenAI exist in the Greek reality? (e.g., productive sector, education, research, healthcare services, administration, commerce, businesses, arts, or as perceived by the general public)



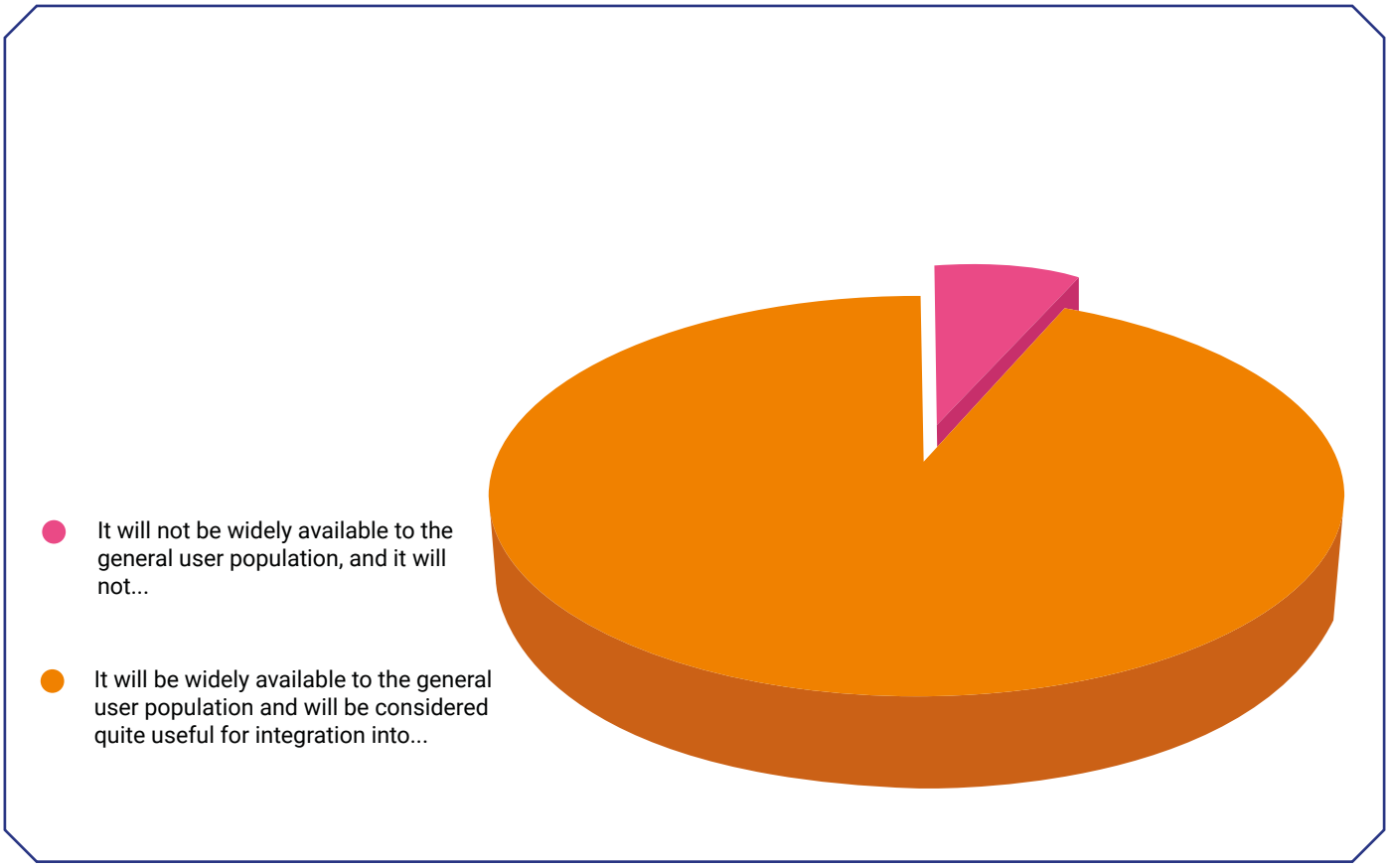
3. Regarding the impact of GenAI usage on Greek society by 2030, would you say your overall stance is…



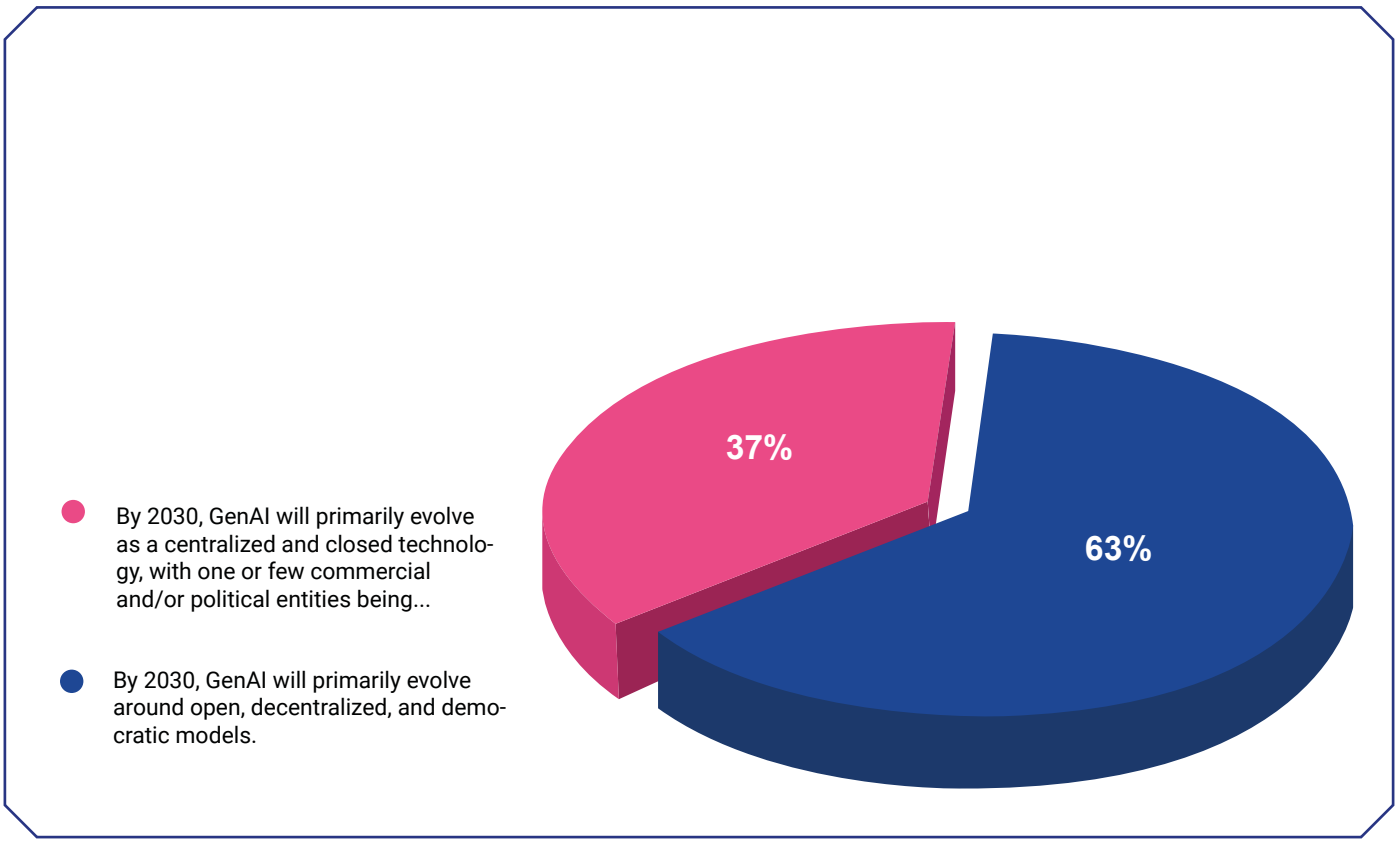
4. Considering the level of GenAI's impact on Greek society by 2030, how would you characterize it?



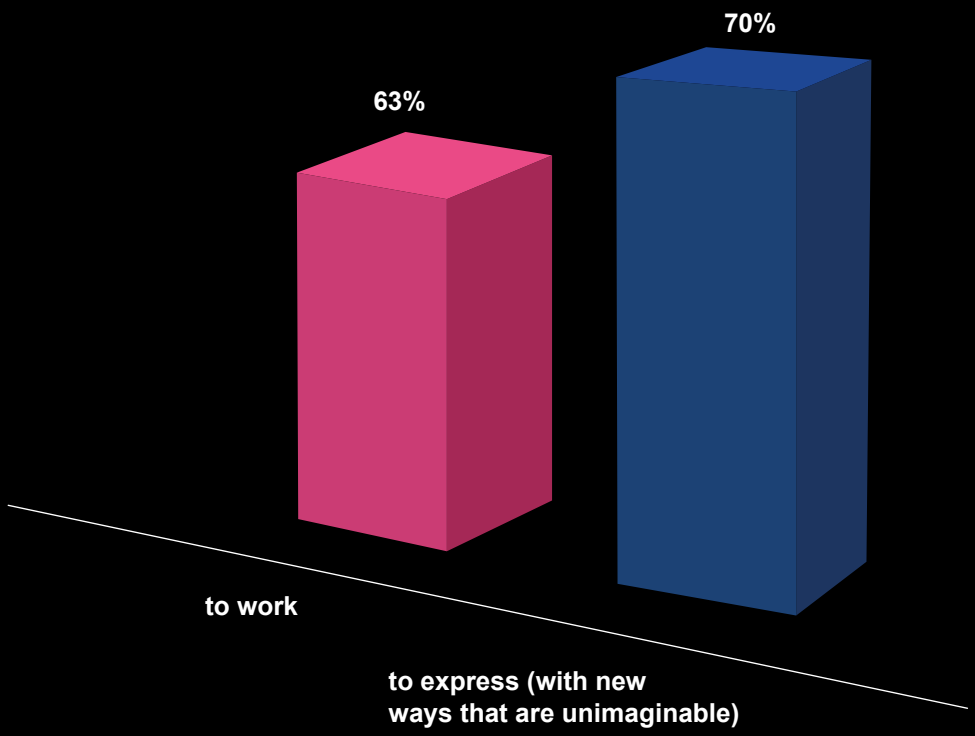
5. Which of the following positions would you say represents your view regarding GenAI accessibility to the general public by 2030:



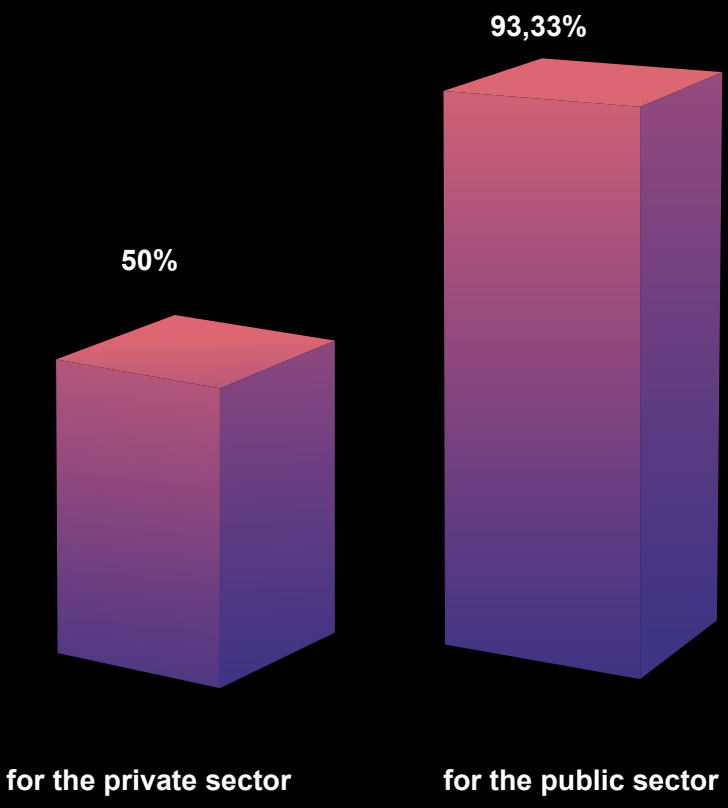
6. Which of the following positions would you say represents you regarding how GenAI technology should be: open and decentralized or closed and centralized?



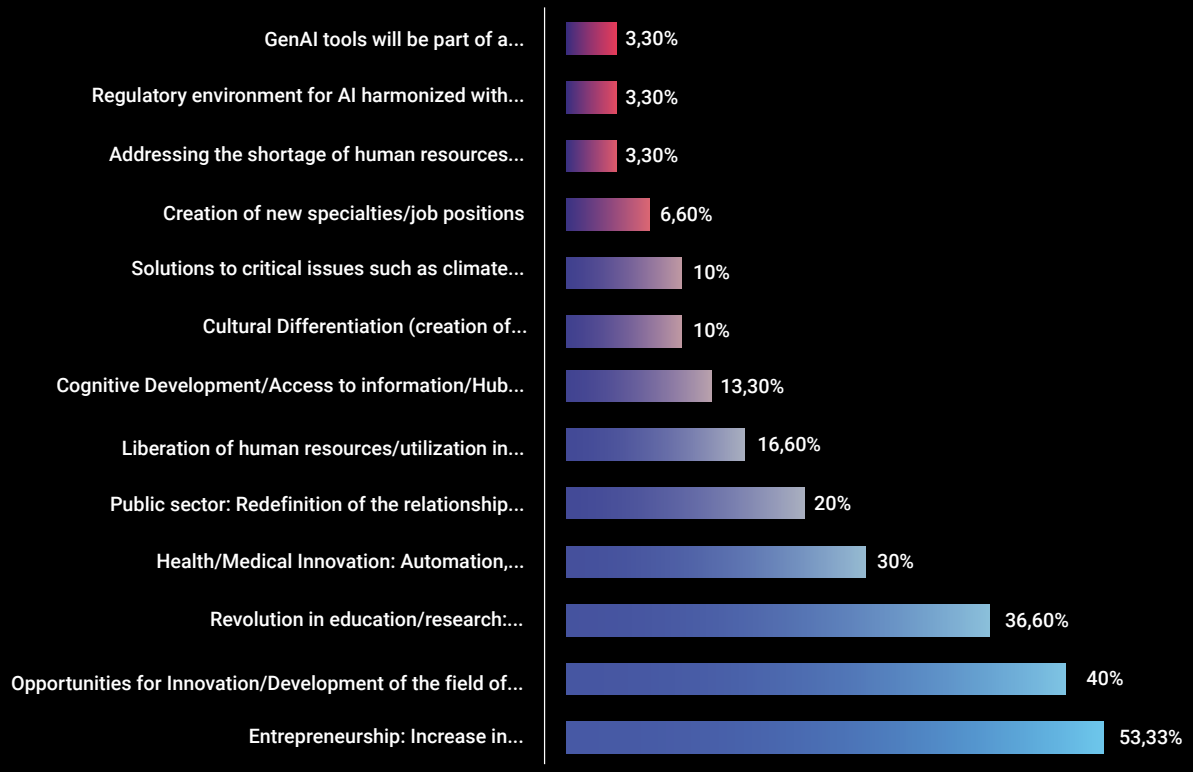
7. In your opinion, by 2030, will it be the norm for users in Greece to use GenAI?



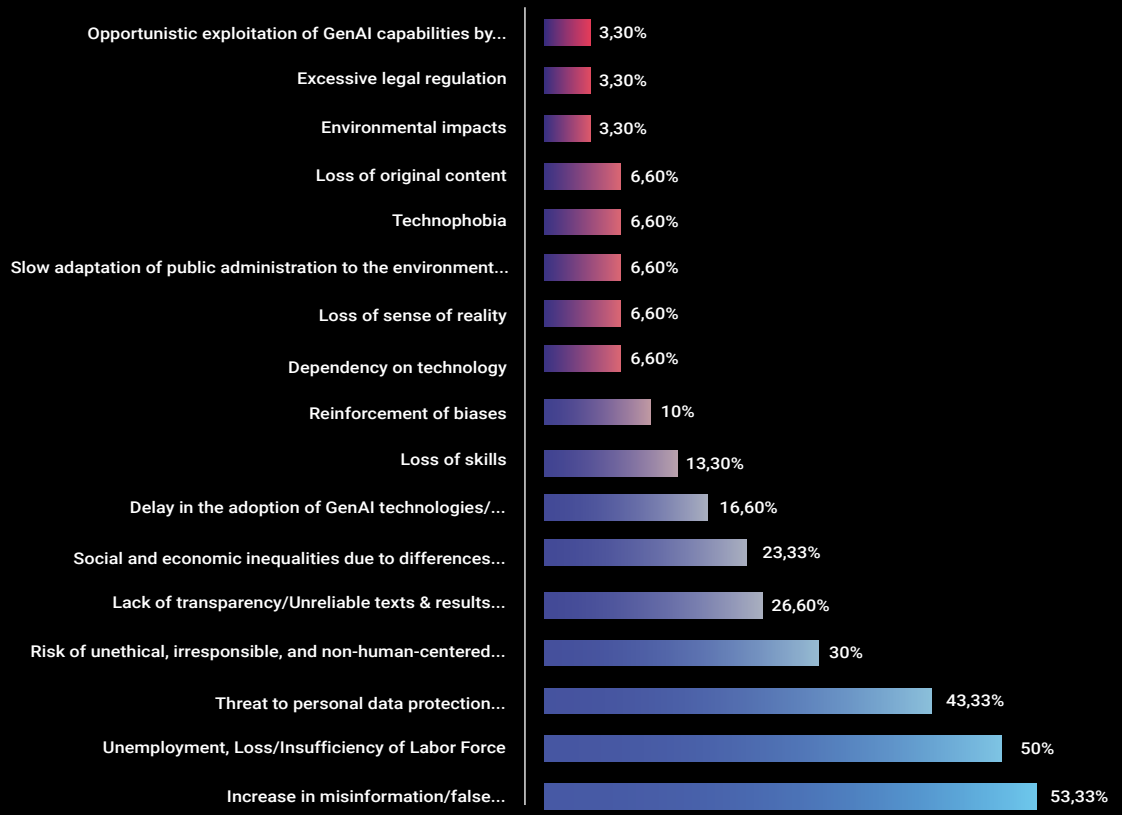
8. By 2030, will GenAI be indispensable?



9. Positive characteristics of the GenAI ecosystem in the country by 2030 would include:

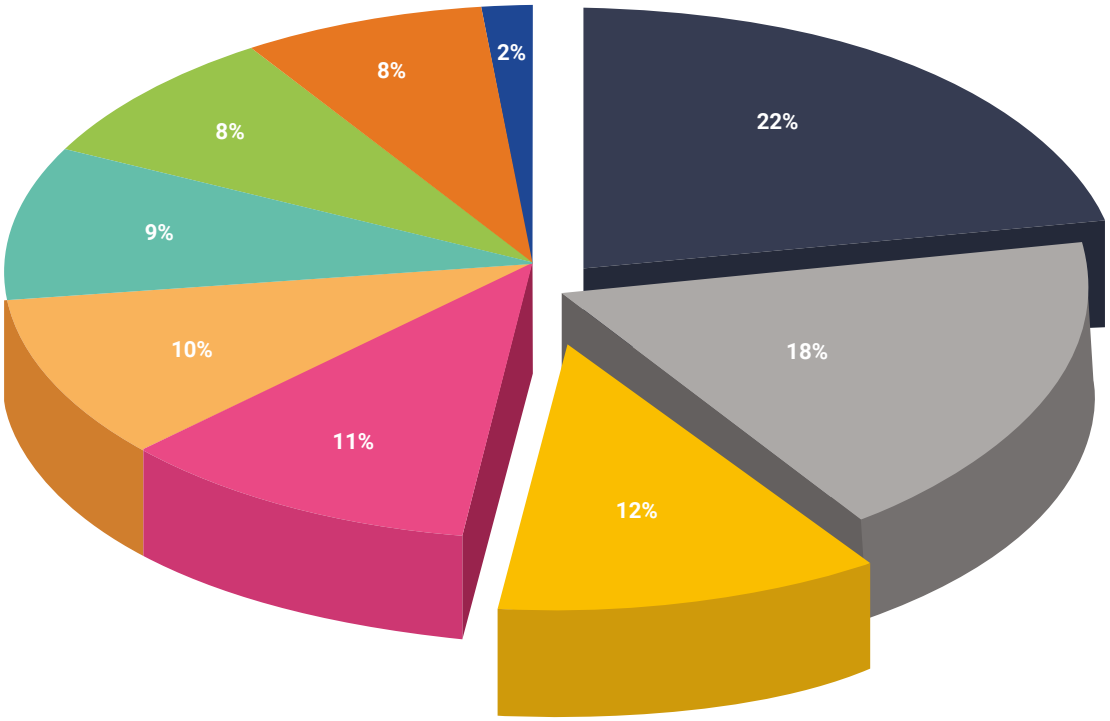


10. Negative characteristics of the GenAI ecosystem in the country by 2030 would include:



11. Who would you say are the most significant facilitators for the development of GenAI by 2030?

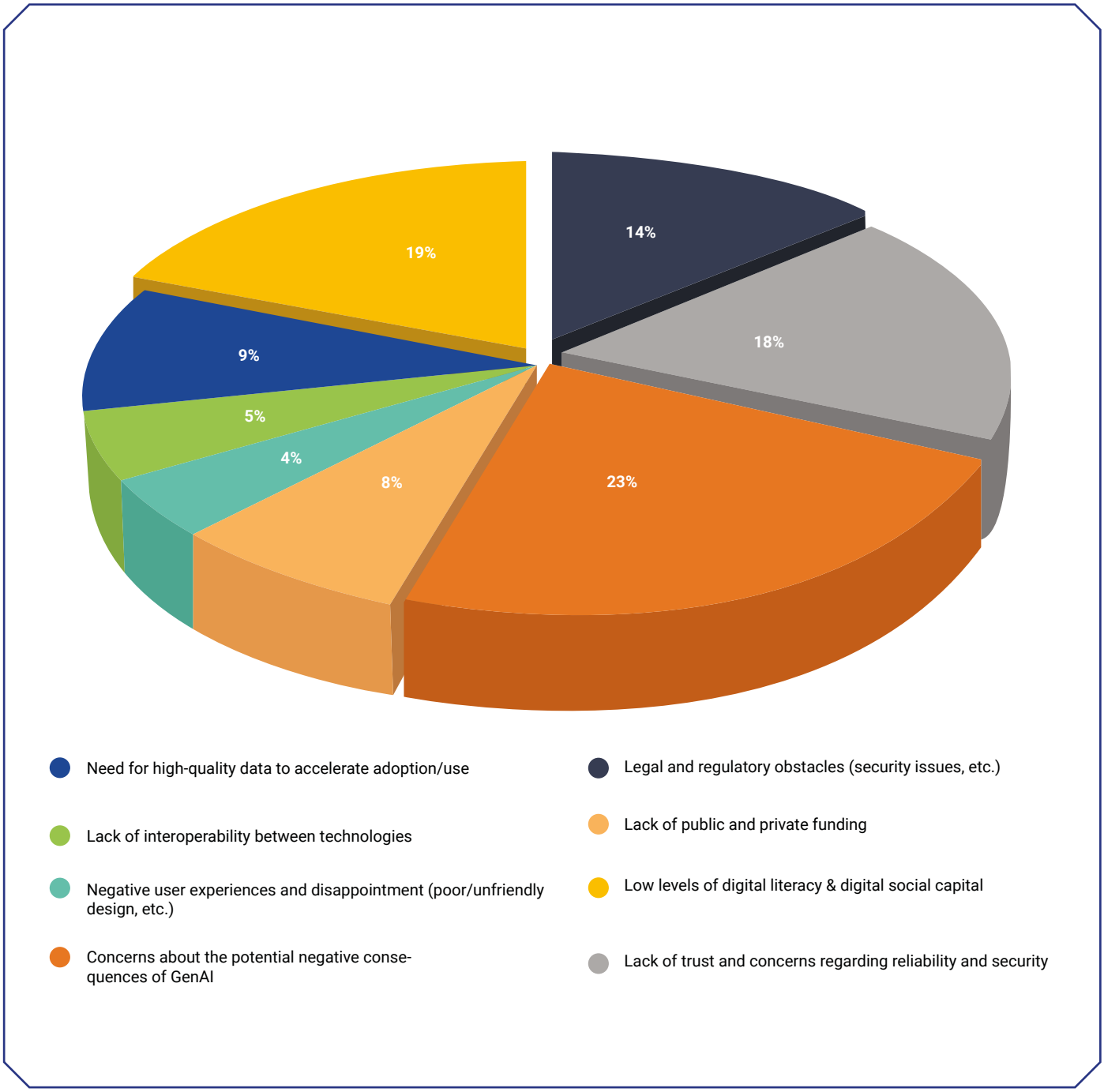
Facilitating factors for the development of GenAI in Greece



- Pro-investment climate/increased funding in computing structures/Motives in businesses
- Accessibility and affordable prices of the new technology
- New and more experienced generations in technology leading the use of Artificial Intelligence
- New business opportunities and incentives (e.g., new ways of building relationships between businesses and users, new revenue streams, etc.)
- Progress and maturation of the expansion of the new technology/technical capabilities of GenAI
- Increased public and private funding
- Facilitation in resolving trust issues (e.g., interest from regulatory authorities and entities for user protection, etc.)
- Legal regulations and institutional interventions (e.g., security and privacy issues, data protection, etc.)
- Increased rates of skill acquisition by experts and digital literacy by citizens

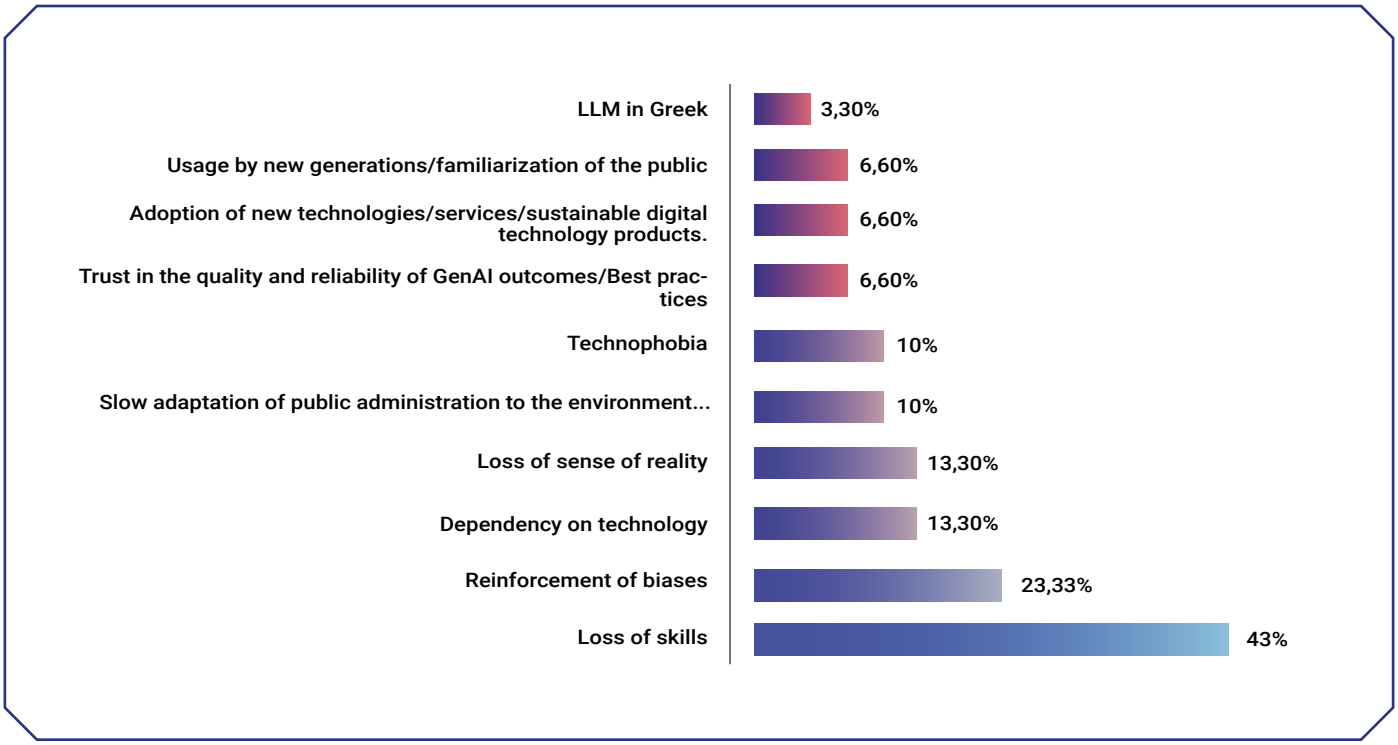
12. Who would you say are the most significant inhibiting factors for the development of GenAI by 2030?

Inhibiting Factors for the Development of GenAI in Greece



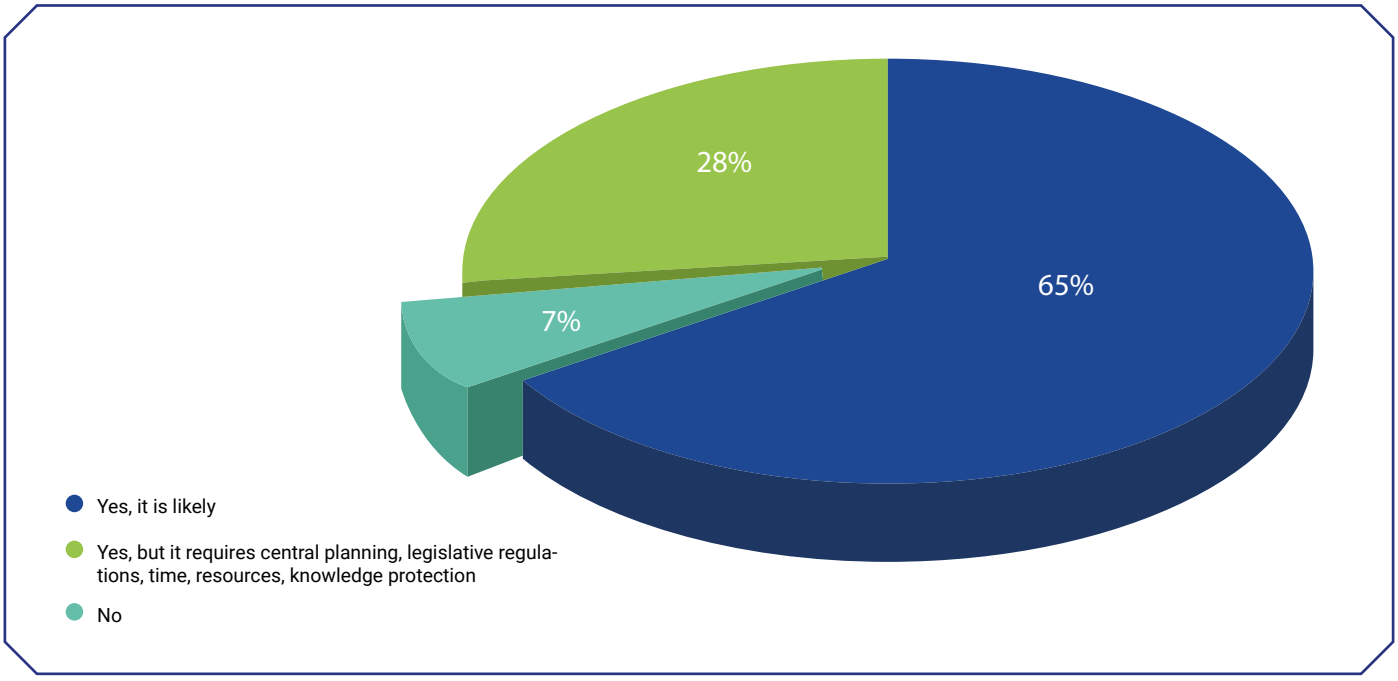
13. If you had to mention only one catalyst factor for the evolution of GenAI in Greece, who would that be?

Catalyst Factor for the Evolution of GenAI in Greece

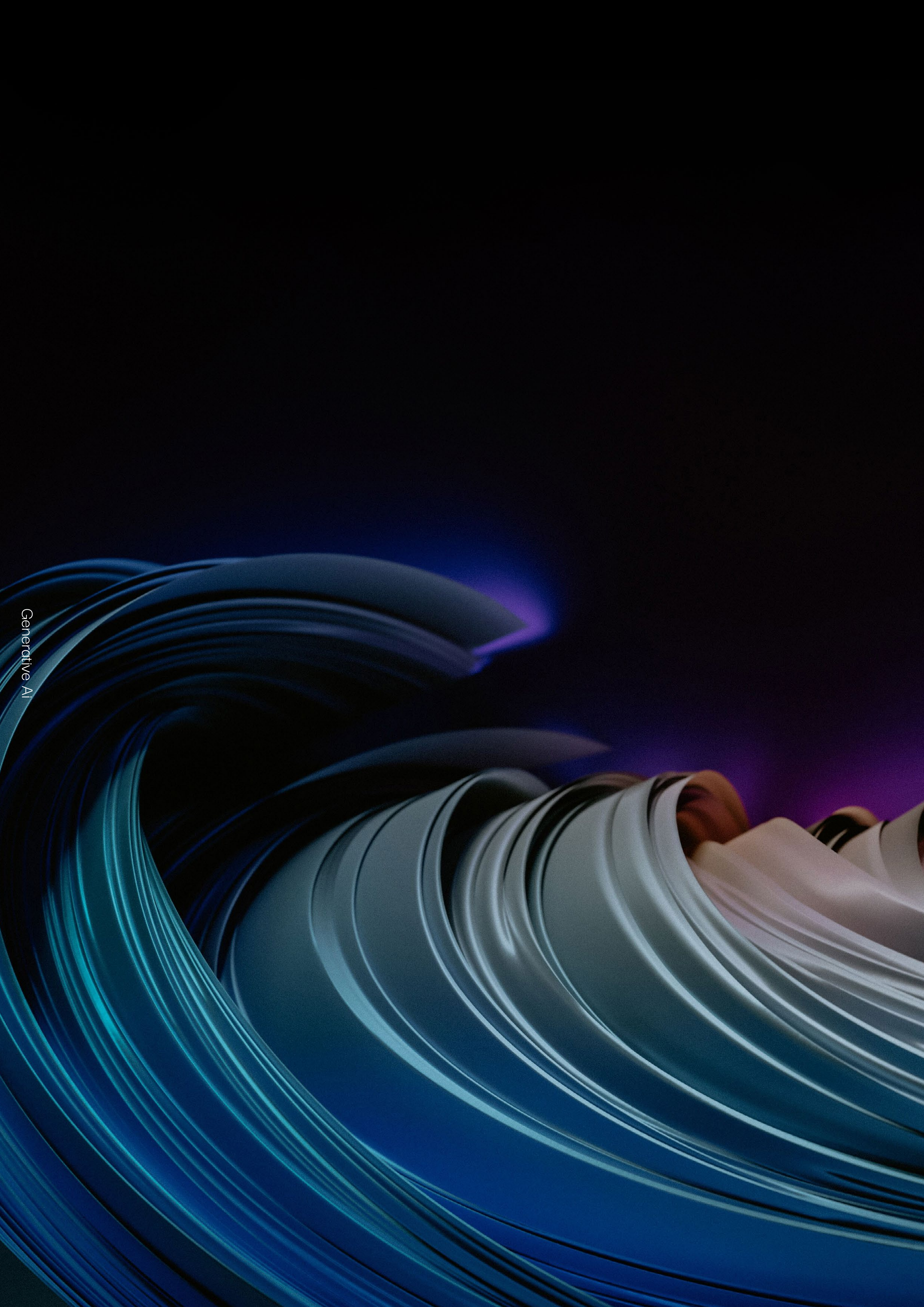


14. In your opinion, by 2030, will it be the norm for the country's universities to use GenAI applications?

By 2030, will it be the norm for the country's universities to use GenAI applications?



Greece 2024



Trends - Opportunities for Greece - Vulnerabilities - Uncertainties -
Scenarios - Policy Proposals -

GenAI & Greece 2030

Greece 2024

Designed by Banana Creative Studios

Disclaimer:

This document is a translation of the original report written in Greek. It is important to note that this translation has been partially generated by an artificial intelligence (AI) system. While efforts have been made to ensure accuracy, translations produced by AI systems may not always capture the full nuances, context, or intricacies of the original text.

Therefore, this translated version should be used for informational purposes only and it may not be suitable for legal, official, or other purposes. By using or relying on this translation, you acknowledge and accept the inherent limitations of AI-generated translations and agree that no liability shall be imposed on the translator or any associated parties for any inaccuracies, errors, or discrepancies in the translated text.

NATIONAL CENTRE FOR SOCIAL RESEARCH (EKKE)
& NATIONAL CENTRE FOR SCIENTIFIC RESEARCH
"DEMOCRITOS"

HELLENIC REPUBLIC
Presidency of the Government
Special Secretariat of Foresight