Improving Europe's Competitiveness

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Role of Open Markets, Emerging Technologies, and Strategic Alliances

Title: Improving Europe's Competitiveness - Role of Open Markets, Emerging Technologies, and Strategic Alliances

Publisher: Centre for European Perspective (CEP), Grajska cesta 1, 1234 Loka pri Mengšu

Editor: Magdalena Rakovec

Language editing: Teja Zupančič

Images and Design: 3D Art d.o.o. with the help of Microsoft Copilot

Print run: 300

Ljubljana, March 2024

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Foreword

Artificial intelligence (AI) is already shaping our daily lives, and its impact is expected to grow in the coming years. Slovenia is committed to the use of AI as a tool that will fundamentally improve the well-being of humanity. Our ambition is to be at the forefront of AI development and implementation among European Union member states.

There are countless practical applications of AI that have already been demonstrated in medicine, industry, energy, transport, agriculture, services, climate change mitigation, smart planning, etc. Our National Programme for Artificial Intelligence (NpAI) serves as a strategic framework, focusing on supporting the entire innovation lifecycle in six key areas: health, Industry 4.0, digital public services, language technologies, sustainable food production and environment, and spatial planning.

The NpAI's vision is to bring more than 40 years of AI research in Slovenia to international recognition. Our goal is to excel in knowledge transfer and promote high-quality, ethical, and secure AI technologies embedded in user-friendly and trustworthy services and products, while preserving our national cultural identity.

We also strive to establish a legal and ethical framework that provides legal certainty and predictability for all stakeholders involved in the development and use of AI, while reflecting European values and principles as well as supporting and ensuring respect for the human rights and fundamental freedoms of all people affected by AI.

In line with the NpAI, we consider international cooperation to be essential for the implementation of an AI framework that is comparable across countries and ensures trustworthy AI, which is consistent with ethical principles and human rights and puts people and their well-being first.

That is why we are actively participating in organisations that share our vision: the AI Act at the EU level, the definition of AI at the OECD, the Convention on Artificial Intelligence at the Council of Europe, and the UNESCO Recommendation on the Ethics of Artificial Intelligence.

The recently harmonised Act on AI is a landmark step towards harmonising the rules on artificial intelligence in the EU. It does not regulate the technology itself, but its use. Slovenia's approach to this legislation is multi-faceted, focusing on international cooperation, comprehensive regulation, and a risk-based approach. We advocate a single regulatory framework that promotes transparency and predictability, ensuring that the development of AI is consistent with human rights and democratic principles. Slovenia stresses the need for a technically precise definition of AI systems, while at the same time advocating interoperability and the adaptability to rapid technological progress.

The NpAI is a strategic roadmap for the development of AI in Slovenia, in line with our position on the AI Act. It aims to create a dynamic AI ecosystem, focusing on education, human resources, and innovation support. The programme emphasises the introduction of AI solutions across sectors, including businesses and public administration, to improve efficiency and service quality. It also underlines the importance of establishing a robust technological infrastructure for AI research and application, while at the same time ensuring ethical practices and building public trust in AI.

One of the pillars of the Slovenian policy is the promotion of research and innovation. We believe that the AI Act should create space for research and development activities and exempt them from certain regulatory constraints, provided that they adhere to ethical and professional standards.

This approach not only encourages innovation, but also ensures that Europe remains at the forefront of AI development, bridging the gap between theoretical research and practical applications.

Small and medium-sized enterprises (SMEs) are the backbone of the European economy. Slovenia recognises the importance of creating a regulatory environment that supports these businesses. Our focus is on promoting flexibility within the AI Act to encourage innovation among SMEs and prevent them from being stifled by overly burdensome regulations. This approach will enable Slovenian and European companies to remain competitive in the global AI landscape.

Identifying and regulating high-risk AI applications is a priority for Slovenia. We advocate clear criteria that reflect the diverse nature and impact of AI systems. Moreover, Slovenia emphasizes the importance of explainability and human oversight, particularly in sensitive areas like judicial or administrative decision-making. This approach ensures that AI systems are not only effective but also understandable and respectful of fundamental human rights.

While fostering innovation, Slovenia is committed to ensuring the ethical use of AI in public safety. We agree with the proposed prohibitions on certain AI practices that may compromise human dignity and rights.

Ensuring public trust in AI technologies is paramount, and this can only be achieved through a balanced approach that prioritizes safety and ethical considerations.

As we embark on this new era of AI-driven growth, Slovenia's position on the AI Act, coupled with the ambitious goals of the NpAI, reflects a deep commitment to both innovation and ethical responsibility. Our approach balances the need for a competitive advantage with the imperative to safeguard fundamental values. This balance is crucial not only for Slovenia, but for the EU as a whole, as we strive to lead the world in the ethical, safe, and innovative development of AI.

To conclude, the role of AI in improving the competitiveness of EU businesses cannot be overstated. However, what will truly define Europe's future in the digital age is the ethical and safe application of AI, as championed by Slovenia through both the AI Act and the NpAI.

Dr. Emilija Stojmenova Duh
Minister of
Digital Transformation

Introduction

In 2020, the COVID-19 pandemic served as a stark wake-up call, emphasizing the urgent need for the European Union (EU) to improve its resilience against crises. Two years later, with the Russian aggression against Ukraine, the focus of the EU shifted towards urgent improvements to the EU's security. **Now, in 2024, as we stand on the brink of a new era dominated by artificial intelligence (AI), our focus is shifting towards enhancing the EU's competitiveness.**

AI and other emerging technologies are disruptive technological forces with the power to accelerate economic growth and reshape industries in profound and unprecedented ways. If the EU is to be a global economic powerhouse, it will have to wholeheartedly embrace the vast potential of AI. The EU's commitment to embracing AI and other emerging technologies will have to be reflected in substantial investments in research and development, a forward-thinking regulatory environment that fosters innovation while ensuring ethical standards as well as safe and trustworthy technologies, and a robust infrastructure that supports the growth of AI technologies and their implementation.

This technological revolution is taking place in a volatile and unstable global geopolitical and geoeconomic environment. We are witnessing a shift from the era of hyper-globalization towards a new paradigm of localization. Navigating this transformed landscape is a complex task, especially with the global development of AI and other emerging technologies and their standards demanding a collaborative effort. **Recognizing the importance of working together is essential to ensure that advancements in technology benefit all, contributing to a more interconnected, prosperous, and resilient global community.**

This publication is our contribution to the discussion on how to improve the EU's competitiveness in the contemporary global landscape by leveraging the power of emerging technologies, especially AI, open markets, and strategic alliances. Each contribution is concluded with the authors' policy suggestions aimed at enhancing the EU's competitiveness. In our commitment to embrace AI, we have chosen to use AI-generated images throughout our publication, demonstrating one of the many ways AI can be integrated into our work.

In the first chapter of the publication, Mario Guvo delves into the shift from globalization to localization, what this entails for the technological revolution, and how the EU should navigate these developments to improve its competitiveness. How joining the digital and green revolution can contribute to improving the EU's political and economic advantages in an increasingly multipolar world is the main focus of the article by Maciej Gora. The potential of data is explored in the article by Barbara Matijasic, analysing what kind of environment is needed in the EU to fully tap into the potential of data. Matthias Bauer and Fredrik Erixon discuss the potential of AI for the EU's competitiveness and advocate a balanced approach to AI regulation. Staying on the topic of AI, Mario Guvo explores the EU's role in regulating and developing AI models, especially Large Language Modules (LLMs), and how they can be utilized to improve the EU's competitiveness. In the final article of the publication, Peter E. Johnson analyses how Europe's technological leadership compares to other countries and what path it should take going forward to maintain its competitive edge.

Europe between Globalization and Localization

Open Markets and AI

BY MARIO GUVO,
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Summary

This article discusses critical shifts in global economics, technology, and European Union's strategic response within the context of AI revolution. A trend from globalization towards localization is signalled by geopolitical tensions and protectionist measures, risking a potential impact on the long-standing economic expansion driven by free trade. While free trade has historically catalysed prosperity and innovation, evidenced by its contribution to the US economy, localization threatens to slow down or completely revert technological progress and global GDP growth.

Innovation is bolstered by trade liberalization, cooperation, and international competition. Open markets have led to increased R&D and patent filings, and crucially, they have advanced AI, which relies on extensive, diverse data sets. In contrast, closed markets limit innovation and adaptation to global digital standards.

AI acts as a game-changer in global supremacy, with countries like China poised for substantial economic gains. For Europe to remain influential, we must actively participate in shaping AI development within an ethical framework reflecting democratic values. The EU's strategy focuses on increasing investment and leveraging the single market, which is a data-rich environment crucial for AI development.

It is essential to remember that international cooperation is crucial for us to align AI development with EU values. Integrating ethical standards and partnering with tech allies will enable us to safeguard democracy and the free world. Through such collaboration, the EU aims to shape global AI ethics and establish itself as a pivotal player in AI governance and advancement. While the EU must promote free trade, it must also not be blind to the political repercussio ns that arise from overrelying on foreign actors.

Global Economic Shifts

The international economic landscape is at a critical juncture, as trends toward localization challenge the post-WWII era of globalization. Ongoing geopolitical tensions have put a strain on the free trade paradigm that dominated the world from the fall of the Berlin wall to 2016.

From 1950 to 2023, under the oversight of the World Trade Organization, global merchandise exports soared from €58 billion to €31 trillion, highlighting globalization's role in economic expansion[1]. Yet, recent trade wars, kinetic wars, and movements like Brexit signal a counter-shift. The UNCTAD observed a **fall of almost 5% in global trade amid geopolitical tensions, with the drop equalling around €1.5 trillion**[2], potentially undermining decades of economic integration.

[1] Evolution of trade under WTO, https://www.wto.org/english/res_e/statis_e/trade_evolution_e/evolution_trade_wto_e.htm
[2] https://unctad.org/news/global-trade-expected-shrink-nearly-5-2023-amid-geopolitical-strains-and-shifting-trade

Proponents of free trade, citing the principle of comparative advantage, assert it as a prosperity catalyst. For example, free trade has made the US economy approximately €2 trillion richer annually in the post-WWII period.[3] However, localization can curb these gains; the OECD warns against decreased global GDP growth with increased protectionism, possibly fuelling inefficient local subsidies and economic disparities. The McKinsey Global Institute cautions that less integration could mean a 10% global output reduction by 2030, disproportionately affecting the less affluent and less educated.

Addressing globalization's downside—job displacement and inequality—requires a nuanced policy approach. **It has become evident that an overly deep economic connection with authoritarian major players cannot only be dangerous, but also enrich our competitors and increase their capabilities.** The EU has to be aware of the fact that China's threat to democracy and rise to power would not be possible without unhindered US and EU investments in the country. On the other hand, Russia's invasion of Ukraine is also a good example of how both the EU and the US have unknowingly helped this invasion, as Russia's military capabilities have been increased primarily with Western capital. Another good example is Iran, as the lifting of sanctions has not made the regime more peaceful, but encouraged it to use the newly acquired capital to sow chaos across the ME.

Last but not least is Azerbaijan's invasion of Ngorno Karabagh, which was also enabled by the EU, as we could not afford to say anything to a crucial gas supplier amid the ongoing heightened tensions with Russia.

We have to promote free trade, but we must prioritize democracies and friendly non-democratic regimes like the ones in North Africa or the Gulf. We must avoid falling into the same trap with Russia as soon as this war ends, as there will inevitably be a push for the complete reintegration and restoration of economic ties. This must not be discouraged, but disabled, as we saw what the risks are.

As the EU faces this turning point, strategic alignment with its values is essential to maintain a competitive yet equitable economic landscape.

The Nexus of Open Markets and Technological Advancement

Open markets are critical to promoting technology and innovation by enabling seamless cross-border interaction and exchange. This global engagement supports domestic innovation through the introduction of advanced technologies and competition-driven R&D. The World Bank data reveal a positive correlation between trade openness and a nation's R&D intensity.[4]

The tangible impact of open markets is evidenced by increased business innovation outputs, such as the uptick in patent filings following the institution of NAFTA. The free movement of skilled labour across open markets also brings diverse expertise conducive to innovation.

[3] „America's payoff from engaging in world markets since 1950 was almost $2.6 trillion in 2022", G. C. Hufbauer, M. Hogan, 2023. https://www.piie.com/publications/policy-briefs/americas-payoff-engaging-world-markets-1950-was-almost-26-trillion-2022
[4] Trade as Engine of Growth; Sputtering but Fixable", F. Ohsorge, L. Quaglietti, *World Bank*, 9.

Closed markets, on the other hand, restrict innovation by limiting exposure to global standards and trends. The OECD reports lower digital innovation in countries with stringent services trade policies.

In the AI sector, where data is king, the role of open markets is amplified. AI's advancement relies on broad data accessibility for algorithm training and improvement. The IDC projects soaring AI market revenues, favouring countries engaged in open-market economies.

The EU aims to capitalize on this through its Digital Single Market Strategy, which envisages a barrier-free digital sector. Historical evidence and current data solidify the link between open markets and technological progress, underscoring the need for the EU to champion open-market economies while balancing fair competition and privacy protection to realize the potential of AI and upcoming technologies.

AI Revolution and Global Dominance

Within the expanding universe of technological advancements, artificial intelligence (AI) stands as the most disruptive force, with the potential to redefine global dominance of the current economic frontrunners. AI is poised not only to overhaul entire industries, creating new economic leaders, but also to transform national defence systems and governmental infrastructures.

Countries that can harness AI effectively are slated to experience significant leaps in GDP and productivity. PwC forecasts that **AI could have contributed up to $15.7 trillion to the global economy by 2030**, with China potentially seeing a 26% boost to its GDP from AI, indicating how it could reshape economic superpower standings.[5]

AI's influence extends beyond sheer economic might—it can redefine social structures, streamline governance, and push the boundaries of scientific research. As traditional industries are enhanced with AI-driven efficiencies, the new landscape will reward those who are innovators and early adopters. For Europe to maintain relevance, it must not only participate in AI development, but also actively shape its trajectory, ensuring it is being created within an ethical framework that supports its democratic values. **The EU's approach to becoming a leader in AI will have profound implications for its future economic positioning and geopolitical influence.**

Europe's AI Strategy and the Single Market

Europe finds itself balancing regulatory diligence with the urgency of maintaining a competitive stance in AI, against aggressive investments from AI leaders like the United States and China. The European Commission has committed to nurturing an AI ecosystem that marries innovation with European values, proposing a strategic investment increase to €20 billion annually for the next decade.

However, with recent investments in AI and blockchain not exceeding €3.9 billion, there is a call for Europe to transition from a regulatory focus to **active innovation leadership**.

The EU single market, the bedrock of Europe's economic vigour, is central to Europe's AI competitiveness. Encompassing over 450 million consumers, the single market provides a wealth of data, essential for AI growth and facilitating synergies to accelerate AI innovation at lower costs.

[5] "2024 AI Business predictions", PWC, 2024, https://www.pwc.com/us/en/tech-effect/ai-analytics/ai-predictions.html.

Europe's strategy includes fortifying the digital single market, removing barriers to digital services and products, ensuring seamless data flow, and enabling joint AI research across member states.

Enhanced with strategic AI investments and innovation-centric policies, the EU's approach places the single market not only as a mechanism for trade, but as a catalyst for a unified European AI breakthrough. **This combination of investment, policy, and robust market infrastructure positions the EU to potentially leapfrog in the global AI race, provided it maintains its core values.**

International Cooperation and Value Alignment

Fostering international cooperation is critical for advancing AI in a way that aligns with Europe's democratic values, including human rights and freedom of speech. The EU seeks to shape global AI norms to reflect these values.

Global partnerships, standardizing ethical AI practices, and initiatives like the Global Partnership on AI (GPAI), within the G7 and G20 contexts, enable **the EU to contribute to responsible AI development that upholds democracy and prevents the deepening of global divides.**

Strategic alliances with like-minded tech partners bolster joint research and establish shared AI markets founded on mutual values. This coordinated approach facilitates the EU's navigation between innovation and the protection of socio-political models.

Through international collaboration, the EU strives to influence AI ethics and governance worldwide, balancing progress with the preservation of its fundamental principles.

In an era of uncertainty and heightened tensions, it is important for the EU to adopt a leading role in the AI market, while at the same time maintaining close cooperation with allies like the US, Canada, Australia, New Zealand, Japan, and South Korea. These are the only countries with which it is relatively safe to develop critical emerging technologies, otherwise, we risk the technologies falling into the wrong hands.

Policy Recommendations

We have to be very careful when engaging in free trade with hostile and authoritarian nations. Special attention must be paid to China, Russia, and smaller but still not any less dangerous actors like Iran or Turkey. It has become evident that free trade does not result in automatic liberalization of society, but it can often have reverse effects. Thus, it is essential to develop a **European foreign investment strategy** that favours democratic regimes and imposes restrictions on investments in potential ideological competitors, like the ones mentioned earlier.

The digital single market opens up new possibilities. We must foster this with a re-branding of the currently existing technological centres that are available all around Europe. The EU should create an **initiative across all member states to establish dedicated AI research and implementation offices inside existing technological centres**. Such offices would help start-ups with AI implementation inside the technological centres, but they would also promote AI-specific start-ups within that space.

EU development of emerging technologies like AI should be done in cooperation with the strategic partners—like-minded, trusted partners. Realistically speaking, developing AI technologies in any other country, or in coordination with any other country, is very dangerous not only for the EU but also for the world. AI will be a force multiplier, and it will be crucial to shield advancements in technology from hostile regimes. Therefore, it should not be only regulation that specifies it but also direct communication with companies engaged in that field about the need for EU protection.

Future-Proofing Europe

The Green-Digital Nexus as Europe's Strategic Imperative

BY MACIEJ GÓRA
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Introduction

In the coming decades, Europe will face a series of challenges, with three of them standing out as the most critical: digital transformation, green transformation, and the maintenance of political and economic advantages in an increasingly multipolar world. Each of these challenges may both impact European Union's standing on the international stage as well as decide on the dynamics of integration and the direction of its evolution.

An insufficiently rapid digitalization of the economy risks slowing down economic growth. As systemic rivals leverage technologies such as AI, quantum computing, and advanced data analytics, this weakness might irrevocably undermine Europe's competitiveness. A slowdown in technological development can also impede the formation and maintenance of strategic alliances, crucial for effective technology governance on a global scale. This might further undermine the political and economic influence of the European Union. Climate change, apart from direct losses in the billions tied to biodiversity loss and ecosystem devastation, could catalyse migrations towards the European continent, leading to socio-political crises. The imperative to maintain advantages in an increasingly hostile world was starkly demonstrated by the conflict in Ukraine, revealing the vulnerability of European nations to geopolitical tensions.

To effectively address these challenges, the European Commission under the leadership of Ursula von der Leyen has introduced a range of far-reaching initiatives for the years 2019–2024, including *the European Green Deal*, *Europe fit for the Digital Age*, and *A stronger Europe in the world*. A great number of these initiatives intertwine in a conceptual framework crucial for fostering Europe's competitiveness—the green-digital nexus.

At the heart of this concept lies the conviction of EU policymakers that the mutual interplay and reinforcement of each transformation's aspects (the so-called twinning), their effective implementation, and the establishment of an industrial base connecting these solutions will not only meet the challenges associated with digitalization advancement and the climate crisis, but will also generate strategic advantages in the coming decades. This will enhance Europe's resilience in the face of economic decoupling by focusing on cutting-edge innovations, modernizing its industries, and creating positive shifts in EU labour market and related skills, allowing it to compete in difficult and quickly maturing markets of digital and green innovations.

Software and Hardware Patch for Climate Change and Europe's Competitiveness

Digital transformation is highly energy-intensive, with the Information and Communication Technology (ICT) sector accounting for a significant share of global carbon dioxide (CO_2) emissions. It is estimated to account for 1.5 to 4 percent of global carbon dioxide emissions, rivalling commercial aviation or maritime transportation. The primary culprits behind these emissions are consumer electronics, data centres, and, to a lesser extent, connectivity networks[1]. With over 3 billion people globally still offline, it is inevitable that the digitalization process will continue, along with increasing greenhouse gas emissions.

According to the International Telecommunication Union, in order to proportionally contribute to achieving climate goals related to staying below the 1.5 degree Celsius threshold, the sector must halve the amount of pollutants it generates[2].

[1] World Bank, Green Digital Transformation: How to Sustainably Close the Digital Divide and Harness Digital Tools for Climate Action. Executive Summary, p. 19–20, access: 28. 12. 2023
[2] Ibidem, p. 24.

This task becomes even more challenging when considering the rebound effect, where increased efficiency in ICT leads to greater consumption, indirectly stimulating energy- and resource-intensive activities, such as increased water usage for the purposes of cooling down data centres and manufacturing components. Another significant problem is the escalating issue of electronic waste. 57.4 million tons of e-waste were produced in 2021, and the amounts may have reached 75 million tons by 2030. Currently, less than 20% of the generated amount is recycled[3]. The integration of green and digital technologies is expected to both mitigate these risks and also bolster Europe's competitiveness by establishing a robust industrial sector and breaking free from unreliable supply chains.

For years, the European Union has been a leader in green technologies, particularly in sustainable mobility, smart grids, and wind power. However, if it aims to continue leading the market and ensure open strategic autonomy, it must cater more strongly to cutting-edge innovation, such as hydrogen technologies[4] and green-digital nexus solutions.

Especially crucial in this context is the pursuit of innovation to exert greater control over energy economics and the supply of critical materials. The conflict in Ukraine and supply chains disruptions during the COVID-19 pandemic revealed Europe's vulnerabilities in managing these economically pivotal sectors, emphasizing the need for independence in these domains.

There are many instances where green and digital technologies can help reduce those vulnerabilities. For instance, leveraging solutions in advanced data analytics, novel sensors, satellite data, and the blockchain aim to enable accurate prediction of energy demand and consumption levels. This approach introduces more innovative models of energy management, such as energy-as-a-service and bidirectional transmission models. AI can optimize energy flows and design more efficient, smart energy grids. High-connectivity networks, IoT devices, and digital twins will enhance monitoring, data governance, and interoperability between energy sources, laying the foundation for the implementation of a circular economy. These solutions are poised to assist in decarbonizing the economy, addressing the adverse effects of climate change, and contributing to Europe's energy self-sufficiency.

Race for the Inevitable Future

As indicated in the European Investment Bank report, "*[a]t the intersection of green and digital technologies, leading early in innovation may create a winner-takes-all effect.*[5]" With the increasingly devastating effects of the climate crisis, markets will seek companies offering modern products and digital solutions based on sustainability principles. **Despite ambitious plans by European leaders and a solid starting position, it remains questionable if Europe can propel itself to the forefront of this race.**

Based on the 2020–2021 data, the European Union surpassed the United States in green technology patents by 50%, with Japan and China trailing behind. Additionally, the European Union outpaced the United States by 76% in patents integrating both green and digital technologies, exceeding China's count fourfold in this combined category[6]. However, while excelling in green technologies, it is crucial to acknowledge that the EU lags behind in digital innovations, primarily in research and innovation. This is due to various reasons, especially insufficient investments in the sector compared to the US and China[7].

According to data analysed by researchers from the University of Leuven and the European Investment Bank, based on the 2021 EIB survey on US and EU companies' digital technology use and climate change investments, **European companies are slower to digitalize compared to their American counterparts.** They invest more in green technologies and utilize green and digital twinning, but such are typically longer-operating firms that are less inclined to invest in future research and development[8].

[3] International E-Waste Day: 57.4M Tonnes Expected in 2021, https://weee-forum.org/ws_news/international-e-waste-day-2021/, access: 28. 12. 2023.
[4] European Investment Bank, Investment Report 2022/2023. Key findings. Resilience and renewal in Europe, https://www.eib.org/en/publications/investment-report-2020-key-findings.htm, p. 4, access: 30. 12. 2023.
[5] European Investment Bank, Investment Report 2020/2021. Key findings. Building a smart and green Europe in the COVID-19, https://www.eib.org/en/publications/investment-report-2020-key-findings.htm, p. 11, access: 30. 12. 2023.
[6] EIB Investment Report 2020/2021: European Union is leading the way in green technology investment, https://www.eib.org/en/press/all/2021-028-eib-investment-report-20202021-european-union-is-leading-the-way-in-green-technology-investment, access: 30. 12. 2023.
[7] Ulmann L., Accelerate the Green and Sovereign Digital Transition in Europe, The European Files, March 2023, p. 72, https://www.europeanfiles.eu/wp-content/uploads/2023/02/Accelerate-the-green-and-sovereign-digital-transition-in-Europe-Issue-72.pdf, access: 31. 12. 2023.
[8] Veugelers R., Faivre C., Rückert D., Weiss C., The Green and Digital Twin Transition: EU vs US Firms, Intereconomics: Review of European Economic Policy, Sciendo, vol. 58(1).

The persistent inability to achieve Lisbon Agenda's goal of allocating 3% of the European budget to research and development, now lagging behind both the US and China, is a factor that could drastically reduce Europe's competitiveness in this area. Other challenges include the inadequate compatibility of data from various sources and regions, the absence of standardized reporting criteria for sustainability information, and the failure to recognize digital technologies within the 2020 framework to facilitate sustainable investment. There are also systemic challenges faced by every region: the lack of a skilled workforce and challenges related to cybersecurity[9].

The progress of green and digital development is also hindered by persistent barriers in the single market, such as fragmentation across national borders, overregulation, and the lack of incentives for innovation and upscaling. These issues were partially addressed in the *Green Deal Industrial Plan*, announced as the European response to the American *Inflation Reduction Act*. However, its announcement did not generate widespread enthusiasm; instead, there is a prevailing belief that these changes have not gone far enough to rival other block policies.

Ensuring parallel transformations of Europe also faces a pivotal challenge in securing access to critical materials essential for component construction for emerging technological solutions. Raw materials such as lithium, cobalt, and graphite, largely sourced from Turkey or South Africa, play a crucial role not only in end-solutions like electric vehicles, but also in storing energy generated from green sources. Rare earth elements are indispensable for constructing items such as wind turbines, LED displays, smartphones, and electric motors, with up to 98% of the latter sourced from China[10]. Russia also plays a significant role in the global critical material supply chain.

In response to this threat, the European Union enacted the *Critical Raw Materials Act* in November 2023. It aims to reduce the dependence on suppliers by diversifying EU imports, easing regulations on domestic extraction efforts, strengthening circularity, and investing in research on potential substitutes and efficiency[11]. However, this cannot be achieved without strategic collaboration with like-minded partners in at least two areas. Firstly, in the transatlantic dimension, there is a need to coordinate global governance to ensure an adequate supply of materials for the European and North American industries. Secondly, **promoting a diplomatic and policy dialogue with countries capable of meeting some demands for critical materials,** especially those in African nations, is required. Establishing a multi-level, two-way dialogue will not only secure the supply of necessary materials, but also strengthen relationships facilitating economic exchanges with developing countries.

As Europe struggles to increase its competitiveness through the green-digital nexus, other global powers are also stepping up their efforts in establishing robust industrial bases for these solutions. In the United States, the Biden administration developed a comprehensive plan totalling $2.3 trillion, aiming to expedite the shift towards sustainability by channelling investments into infrastructure, innovation, and skills development, with a significant focus on digital advancements. The green-digital nexus was also included in a $369-billion envelope of tax credits direct rebates promoting green technology manufactured in North America[12]. Similar endeavours are underway in Asia, where South Korea's recovery plan allocates $63 billion for green initiatives, and Singapore's Green Plan for 2030 emphasizes fostering new environmentally friendly digital solutions[13]. The most significant systemic rival, of course, is China, the current undisputed leader in green transformation, investing the most globally in this field[14], producing, selling, and operating the

[9] The European Round Table for Industry, Towards an EU Action Plan for a Digitally Enabled Green Transition, https://ert.eu/wp-content/uploads/2022/10/ERT-Digital-Green-Transition-Expert-Paper-final.pdf, p. 14–17, access: 7. 1. 2024.
[10] European Commission, Rare earth elements, permanent magnets, and motors, https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/rare-earth-elements-permanent-magnets-and-motors_en, access: 4. 2. 2024.
[11] Dentons, EU Critical Raw Materials Act – what does it mean for business?, https://www.dentons.com/en/insights/alerts/2023/december/7/eu-critical-raw-materials-act-what-does-it-mean-for-business, access: 4. 2. 2024.
[12] Euronews, The EU's new industrial strategy will aim to have 40% of its green technology homegrown by 2030, https://www.euronews.com/my-europe/2023/03/16/the-eus-new-industrial-strategy-will-aim-to-have-40-of-its-green-technology-homegrown-by-2, access: 10. 1. 2024.
[13] Microsoft-EY, The twin transition: a new digital and sustainability framework for the public sector, https://wwps.microsoft.com/wp-content/uploads/2021/05/MSFT_EY-digital-sustainability-paper_final.pdf, p. 11, access: 10. 1. 2024.
[14] International Energy Agency, World Energy Investment 2023. Overview and key findings, https://www.iea.org/reports/world-energy-investment-2023/overview-and-key-findings, access: 11. 1. 2024.

most electric vehicles[15], covering 60% of global zero-carbon technology manufacturing[16], and pursuing a dynamic domestic and international policy in coordinated green and digital solutions.

However, participating in the subsidies race to support the green and technology transitions may not be the best option for Europe. Attempts to reconcile European states' political positions and state aid subsidies while ensuring a fair playing field among European businesses is a daunting task, one that has already faced a series of setbacks. The biggest one was the abandonment of the European Sovereignty Fund, intended to finance green and digital projects from a newly collected pool of collective debt, and having it replaced with the Strategic Technologies for Europe Platform (STEP), which, apart from €10 billion in new public funds, is repurposing money from other programs. In its current form, it is unlikely that STEP will maintain EU's internal market or unite EU industrial policy[17]. Furthermore, relaxing state aid rules has resulted in the dominant advantage for large member states and businesses – for example, Germany and France alone received nearly 80% of the subsidies granted by the original European Temporary Crisis Framework in 2022. This is particularly concerning when considering evidence that the twin transition might widen the gap between poor and wealthy regions in Europe, diminishing their cohesion[18]. While subsidies are important for scaling up certain industries and sectors, more focus should be put on facilitating favorable business conditions, especially for SMEs, and ensuring integrity and equality within the Single Market.

[15] International Energy Agency, Global EV Outlook 2023. Executive summary, https://www.iea.org/reports/global-ev-outlook-2023/executive-summary, access: 11. 1. 2024.
[16] Makaroff N., Kalcher L., Competing on Zero-Carbon Technologies, Strategic Perspectives. 2023, Brussels, p. 7.
[17] Blake A., Can IPCEIs fill in the gaps left by a failed EU Sovereignty Fund?, https://www.realinstitutoelcano.org/en/blog/can-ipceis-fill-in-the-gaps-left-by-a-failed-eu-sovereignty-fund/, access: 4. 2. 2024.
[18] Maucorps A., Römisch R., Schwab T., Vujanović N., The Impact of the Green and Digital Transition on Regional Cohesion in Europe, Intereconomics, 2023, 58(2).

Conclusion

In the race to maintain its standing at the forefront of the emerging global order, Europe finds itself at a critical juncture. The EU must, with unwavering determination and strategic foresight, continue supporting green-digital nexus projects and strive to assert control over a substantial portion of its supply chains through the establishment of strategic alliances and support to the single market. Without this, the EU will not be able to deliver on its climate goals or effectively compete with modern industries in other blocs. This is a vital step for ensuring competitiveness, building resilience, and establishing open strategic autonomy – as well as producing a profound socio-economic change.

Policy recommendations

Integrating green and digital projects demands a **multi-faceted focus on economic, social, and political cohesion.** Collaboration within the EU and with private and civil society stakeholders is key.

Establishing common digital and sustainability standards is vital for transparent project assessment and cross-sector cooperation.

Initiating comprehensive green and digital diplomacies now is crucial for building trust and establishing future-oriented relationships with partners.

In the face of structural skills and education gaps and socio-economic changes, programs should prioritize **preparing the labour force for new technologies while emphasizing a sustainable approach to life.**

Developing solutions supporting the twin transition, particularly those related to data-sharing and cybersecurity, is critical.

The Power of Data-driven Economy

Quality Data and Technology are Catalysts for EU Competitiveness

BY BARBARA MATIJASIC, MBA
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For the past 25 years, we have directly observed the Internet's power to transform the world, disrupt supply chains, and add value to the global economy, showcasing the profound and wide-ranging effects of innovation. The focus today is on the data-driven economy, emphasizing an economy powered by data and emerging technologies. This article explores regulatory measures tied to recent advancements in data utilization, including the support from the European Union, and presents best-practice examples from the private and public healthcare sectors in Slovenia. By examining how the European Union and Slovenia are adopting advanced technologies in healthcare, this snapshot highlights the pivotal role of data in shaping the future and underlines its importance in maintaining competitiveness. In a modern global digital ecosystem, a network of companies, individuals, and institutions collects, organizes, and exchanges data to create economic value. Results of the new 2021–2023 European Data Market study[1] published in February 2024 show that **in 2023 the EU27 data economy passed the threshold of €500 billion,** with an annual growth of 9.3% in 2022. By 2025, the data economy is projected to have grown to €659 billion, with a GDP share of 4.9%. By 2030, the EU27 data economy is expected to have reached between €851 billion (5.8% of GDP) and nearly €1 trillion (6.5% of GDP), with growth driven progressively by indirect impacts like enhanced spending and in come across all sectors due to the use of data and data-related products and services. Emerging technologies are significantly transforming the socio-economic environment; public administration and professional services sectors are among the fastest growing, with health and transport also experiencing notable expansion.[2]

A View from the Top

The European data strategy from February 2020 outlined a plan to establish shared European data spaces across several key sectors: health, agriculture, manufacturing, energy, mobility, finance, and public administration.[3] What underpins all European data spaces is common data infrastructures and governance frameworks, which facilitate data pooling, access, and sharing.[4] In this context, two critical pieces of legislation have been put in place to protect the rights and interests of citizens while simultaneously fostering industrial and technological development. They play a vital role in laying the foundation for achieving the objectives outlined in the European data strategy[5]:

In the data-driven economy, ethical issues, such as the uneven distribution of benefits, new data-trading methods, secondary data use, and the vulnerability of information infrastructure, are arising. Across different sectors, the demand for a human-centric approach is intensifying, with an emphasis on privacy, data management, and equitable use to directly advantage the data subjects. At the heart of robust and competitive economies lie stable health systems and data-driven healthcare, underscored by the implementation of quality and interoperability standards aligned with FAIR principles, which stand for findability, accessibility, interoperability, and reusability. In the context of data-driven healthcare, this means that data are easy to locate, accessible under clear conditions, compatible with other data sets, and usable for multiple purposes. This approach facilitates better decision-making, enhances patient care, and supports the overall sustainability of health systems by ensuring that data can be effectively shared and used across different platforms and by various stakeholders in the healthcare sector. And because resilient healthcare is so crucial to the overall resilience of a country, it is vital that these principles are understood at a basic level, prioritized in the eyes of decision-makers, and effectively implemented.

[1] https://digital-strategy.ec.europa.eu/en/library/results-new-european-data-market-study-2021-2023
[2] European DATA Market Study 2021-2023 D2.8, FINAL REPORT ON POLICY CONCLUSIONS, February 2024.
[3] https://digital-strategy.ec.europa.eu/en/policies/strategy-daa
[4] https://digital-strategy.ec.europa.eu/en/policies/data-spaces
[5] https://www.google.com/url?q=https://digital-strategy.ec.europa.eu/en/policies/strategy-data%23:~:text%3DThe%2520Data%2520Act%2520entered%2520into,the%2520European%2520economy%2520and%2520society&sa=D&source=docs&ust=1707827636020921&usg=AOvVaw0AI6BIx4Wj9ZniG7Qm5Ean

- The **Data Governance Act (DGA)** serves as an all-encompassing framework to manage the reuse of public or protected data across diverse sectors. It aims to facilitate data sharing by regulating new entities known as data intermediaries and promoting data sharing for altruistic reasons. The DGA covers both personal and non-personal data, with the **General Data Protection Regulation (GDPR)** applying whenever personal data are involved. To boost confidence in data sharing and reuse, the DGA includes additional safeguards alongside GDPR provisions, such as using only adequate and relevant data that are limited to what is necessary in relation to the purposes for which the data are processed (data minimisation). These provisions protect the rights and freedoms of the people whose personal data are processed. Establishing this trust is vital for expanding data availability in the market.

- The **Data Act** became effective on January 11, 2024, serving as a cornerstone of the European data strategy. Its primary aim is to position Europe at the forefront of the data economy by leveraging the growing volumes of industrial data, thereby delivering benefits to both the European economy and society.

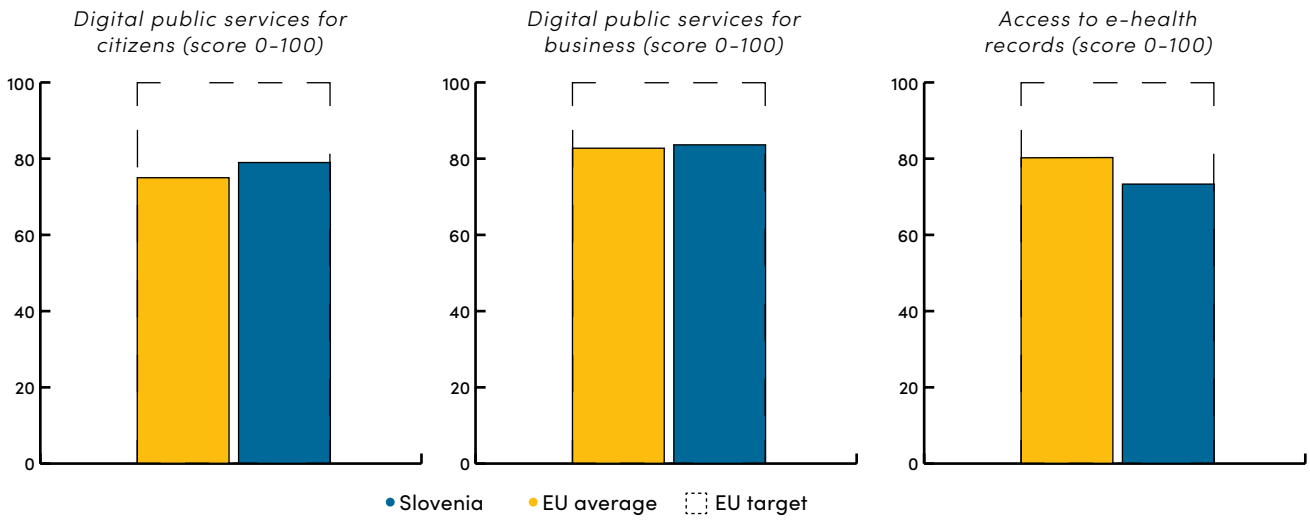
Tjaša Sobočan, advisor to the Minister for Digital Transformation of Slovenia, makes a crucial observation: "Data sharing is vital for building trust in a modern digital society as well as building a transparent and effective data-driven economy. There are at least four key aspects to pursue: *enabling digital infrastructure, boosting digital competences of experts and end-users (citizens), building trust through digital public services, and promoting innovation through new digital technologies such as artificial intelligence.* The goal should always be a user-friendly experience – by using credible data that support new digital technologies and build a well-informed society. Ensuring accessibility to quality open data, we can advance the potential for improved or new digital public services (among EU countries especially), economic growth, informed policymaking, enhanced research, and innovation, and deliver better results within areas, such as healthcare, education, or public administration. As an example, the European Health Data Space Regulation opens space for a safer health data management, giving the public and private sectors an opportunity to access quality and diverse datasets, and by that optimize existing or new digital health solutions as well as support decision-making within the field. Realizing that quality data are crucial for the modern society and economy, which supports advanced data technologies, the question on data-driven economy should always start with *how* and *who*, not *why* or *when*."

Utilizing Support from the European Union

Over the past two decades, Slovenia has made significant progress through collaboration, with the EU emerging as its largest investor and a key contributor to its economic progress. This partnership has been instrumental in fostering a data-driven economy, emphasizing the importance of securing funding and investments for sustained growth.

For instance, Slovenia's Recovery and Resilience Plan with a budget of €2.5 billion dedicates €0.5 billion (21%) to digital transformation. As of April 2023, Slovenia has met 12 milestones and targets, including four digital measures, under its first payment request of €49.6 million. These measures focus on the economy's digitalization and the enhancement of public services, establishing a foundation for future digital advancements.[6] At the moment, Slovenia excels in the digitalization of public services, particularly in the access to electronic health records, outperforming the EU average. Also, the 2022–2027 e-Health Strategy outlines a comprehensive framework for improving healthcare through digital means, supported by the European Commission's Technical Support Instrument. Recent updates to the Central Registry of Patient Data (e.g. integration of patient demographic data, attribute-based access control and national language processing text search) further illustrate Slovenia's commitment to a more digitally inclusive healthcare system.

[6] https://digital-strategy.ec.europa.eu/en/library/country-reports-digital-decade-report-2023



A recent OECD OURData Index 2023 (Open Data Index) ranked Slovenia seventh, staying among the top ten OECD countries that *"consistently and systematically ensure adequate access to open data and promote the use of credible data for the benefit of society and the economy" (MDP, 2023)*[7]. By being committed to trusted data management with cloud technologies, national and cross-border data interoperability, and data spaces, **Slovenia serves as a good example of a proactive stakeholder in a data-driven economy.**

Unlocking Potential

Data sharing and secondary data use are well-understood concepts – yet not fully adopted. Banks and insurance companies use big data to mitigate risks and combat fraud, while healthcare providers share patient information to develop research and offer tailored treatments. Experience from these sectors show how accessible and exchangeable data can increase collaborative efforts and value. **Surprisingly, it is still estimated that organizations tap into only a half of their data's potential.**[8]

Some key decision-makers might be held back by worries about costs and risks when it comes to data-sharing. These concerns should be balanced with the proper understanding of data protection and use as well as recognizing the transformative power of data for generating value along the entire supply chain. Embracing data-sharing fully means recognizing its role in strategic alliances, fostering co-creation and collaboration.

By working together, organizations can spark innovation and develop solutions that help both the economy and society. A deep understanding of the change management that comes along with the innovative use of data *(and implementing its practices)* should be taken into consideration early on. BILDAI, or the Bled Institute for Leadership in Digital Transformation and Artificial Intelligence, exemplifies a successful strategic partnership between IEDC, or Bled School of Management, and Roche Slovenia. This collaboration is promising significant advancements in data-driven leadership as well as change management approaches.

[7] https://www.gov.si/novice/2023-12-27-slovenija-v-deseterici-najboljsih-drzav-pri-zagotavljanju-dostopa-do-verodostojnih-podatkov/
[8] https://www.sitra.fi/en/articles/making-it-easier-to-monitor-the-development-of-the-data-economy-weve-put-together-a-tool-to-track-indicators/

BILDAI goes beyond being a mere theoretical concept; it aspires to emerge as a pivotal centre for research, education, and innovation in the realm of the data-driven economy and artificial intelligence, with a special focus on health care. The partnership between IEDC, School of Business Bled, and Roche Slovenia aims to enhance and solidify global insights into data-driven healthcare and thus the required transformation together with understanding the art of change management and advanced engagement of artificial intelligence. In the words of Eva McLellan, General Manager of Roche Slovenia, "*the data-driven economy demands understanding data and a significant shift in mindset, embracing continuous learning and experimentation".* To help with this, the new institute will prioritize digital leadership, ensuring readiness of future leaders to navigate and shape the future.

Slovenia's proactive approach to data storage and management already paid off. It played a pivotal role in its highly effective response to the coronavirus outbreak, marking it as one of Europe's success stories during the first wave of the pandemic. Slovenia's national eHealth infrastructure, or the interoperability backbone, facilitated a quick and targeted approach to COVID-19, despite not being originally designed for pandemic response. In collaboration with the Slovenian Ministry of Health and the National Institute of Public Health, the Better platform developed a national COVID-19 screening data management solution within only 14 days in December 2020. This rapid deployment of a data management solution enabled the immediate availability of screening and testing data for patients, allowing for prompt actions to mitigate the virus' spread and effectively shorten lockdown periods. Real-time data also supported proactive healthcare interventions, improving care quality both during the pandemic and in routine healthcare settings, by facilitating data sharing across platforms and directly with patients, thus enhancing the timeliness of physician feedback and patient safety as well as showcasing Slovenia's agile and effective digital health strategy during the pandemic[9]. **It is safe to say that the infrastructure necessary for establishing a modern, data-driven healthcare system is in place.**

However, the implementation process seems to be challenging. Many organizations operate as a silos, leading to disjointed efforts. By addressing this issue collaboratively, Slovenia has the potential to become a leader in this field – *ideally before the advent of a situation like* '*COVID 2.0*'.

Often, challenges of this matter lie within people, some who may lack an inclination towards digital innovation for different reasons, typically due to their mindset and a lack of trust.

What are the key factors to ensure success in the data-driven economy?

To succeed in an economy driven by data, it is important to thoroughly understand data and their importance. Equally important is prioritizing change management from the start, given the common issue of resistance to change.

By clearly illustrating and communicating upcoming shifts in roles, and by encouraging active participation, we can foster a collaborative environment where everyone contributes to the transition. We have to be committed to equality, inclusion, collaboration, and the open exchange of knowledge, all supported by governance frameworks rooted in clear principles.

Decision-makers and regulators face the complex task of adapting laws and policy frameworks in the data-driven economy, which are intertwined with a deep understanding of market shifts, a willingness to embrace risks, and the need to ensure the interoperability of digital infrastructures. The European Union is crafting professional and strategic approaches to data management and digital leadership that essentially charge the data-driven economy. Future priorities include improving data quality and literacy across the board, ensuring that the information driving decisions and feeding emerging technologies are reliable and robust, and emphasizing the continuous training and development of the workforce. These initiatives are crucial for enhancing European Union's standing in the global data-driven economy.

[9] https://news.better.care/en/better-platform-enables-rapid-response-for-covid-19-pandemic-with-data-management-support-to-screen-results-in-slovenia

Policy recommendations

Improve the quality of data and data literacy.

Foster open markets by innovation and high-quality projects.

Master change management approaches and tools.

Prioritize investments in leadership in the data-driven economy.

Champion strategic alliances, partnerships, and collaboration.

Embracing the Potential of Artificial Intelligence:

A Path to EU Competitiveness

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Abstract

We highlight the critical importance of AI in boosting the EU's global competitiveness. Our analysis underscores the transformative potential of AI across various sectors and calls for regulatory adjustments to ensure that the EU can leverage AI for growth while maintaining ethical standards. We critique the EU's proposed AI Act for potentially stifling innovation due to several restrictive regulatory approaches. Advocating a balanced approach to AI regulation, we stress the **need for the EU to foster an environment that encourages open markets and international cooperation, particularly with the US.**

Introduction

The 21st century has ushered in a new era of technological innovation, with artificial intelligence (AI) currently at its forefront. AI has the transformative potential to reshape industries, economies, and societies in profound ways. Its ability to process vast amounts of data, recognise patterns, and make decisions with increasing accuracy is driving innovation across diverse sectors. From healthcare and finance to manufacturing and agriculture, **AI is catalysing advancements that were once unimaginable. It is not merely a technological advancement; it is a catalyst for innovation, efficiency, and the creation of new value chains.**

In this essay, we explore the pivotal role of AI in the European Union (EU) and its potential to enhance the EU's international competitiveness. We will delve into the proposed *Artificial Intelligence Act* (AI Act) and critically examine its approach to AI regulation. We argue that while regulation is essential to safeguard citizens and maintain ethical standards, an overly restrictive AI Act would hinder innovation and position the EU as a laggard in AI development and deployment. We will draw insights from various industry perspectives, focusing on economic implications of such regulation, the need for a more nuanced regulatory framework, and the importance of open markets and strategic alliances with like-minded countries, especially the US, to ensure that the EU remains at the forefront of digital innovation.

AI as a Catalyst for Innovation

Artificial intelligence is not only a technological advancement; it represents a paradigm shift in how we approach problem-solving and decision-making. Its ability to analyse data, recognise patterns, and make predictions has opened new frontiers in innovation**. AI-driven solutions are making processes more efficient and creating entirely new market opportunities.**

Consider the healthcare sector, where AI-powered diagnostic tools can analyse medical images with unparalleled accuracy, aiding in early disease detection and treatment planning. In finance, AI algorithms are revolutionising investment strategies, optimising portfolios, and improving fraud detection. The manufacturing industry benefits from predictive maintenance, reducing downtime and costs. In agriculture, AI-driven precision farming optimises resource utilisation, increasing crop yields while minimising the environmental impact. These are just a few examples of AI's transformative potential.

A challenge for the EU is that most innovation in AI, particularly in the context of significant investments and advancements, is coming from the US. This is evidenced by the massive investments from US-based Big Tech companies like Microsoft, Google, and Amazon into AI start-ups, and Silicon Valley investors and US venture firms being actively involved in the AI space. The dominant role of US tech giants and venture capital firms in driving AI innovation contrasts with the situation in the EU, where concerns about stringent regulatory proposals, such as the proposed AI Act, potentially hindering innovation were highlighted.

In 2023, the landscape of AI investment was dominated by an unprecedented frenzy led by large technology companies such as Microsoft, Google, and Amazon, who outspent traditional venture capital firms in securing stakes in the burgeoning sector of generative AI start-ups.[1] These companies alone accounted for two-thirds of the $27 billion raised by AI newcomers, a surge triggered notably by the launch of OpenAI's ChatGPT in late 2022.

[1] See, e.g., FT (2023). Big Tech outspends venture capital firms in AI investment frenzy. Available at https://www.ft.com/content/c6b47d24-b435-4f41-b197-2d826cce9532.

This trend underscores a significant shift in the innovation ecosystem, highlighting the enormous financial capabilities of established tech behemoths to influence the direction and control of AI development.

The massive investments by US tech firms not only spotlight their intent to lead the AI revolution, but also illustrate the challenges faced by venture capital firms. The latter, traditionally pivotal in nurturing innovation, find themselves increasingly side-lined in the race for cutting-edge AI technologies due to the sheer scale of funds required and the rapid consolidation of the market around a few leading AI models and companies. For instance, Microsoft's $10 billion investment in OpenAI and substantial funds raised by Anthropic signal a move towards a landscape where the capacity to provide both financial resources and critical infrastructure, like cloud services and advanced computing power, becomes a key determinant of success in AI development.

This paradigm shift raises concerns about the future of innovation, particularly **in regions like the EU and its Member States, where the proposed regulatory framework threatens to further complicate how AI can be adopted across the single market.** The EU's proposed AI Act, aimed at regulating the deployment and development of AI, poses a risk of stifling innovation by imposing stringent controls that could deter investment and slow down the pace of AI advancements within the bloc. It may inadvertently favour the consolidation of AI development in the hands of a few global tech giants, potentially limiting the diversity of innovation and the emergence of new players in the field.[2]

The EU's Innovation and Regulatory Crossroads

Utilising the transformative potential of AI in the EU is essential for enhancing European businesses' competitiveness on the global stage. Recent data from the 2,500 globally leading companies in R&D-driven industries reveal significant shifts in investment trends across various industries, with notable changes in the EU's share of capital expenditure and R&D investments relative to other major players like the US and China.[3] These numbers, summarised in Table 1, highlight several key trends that should give rise to concerns in EU politics:

- **US economic supremacy**: Particularly in high-tech and R&D-intensive sectors like software & computer services and pharmaceuticals, the US maintains or even increases its leading position.

- **China's rising capacities:** In sectors like technology hardware & equipment and electronic & electrical equipment, China has significantly increased its investment share, indicating its growing role in these industries.

- **The EU's challenges in ICT and related industries: In sectors such as software & computer services and technology hardware & equipment, the EU's investment share has markedly declined, highlighting the risk of falling behind in key areas of technological innovation**. This trend underscores the urgency for the EU to foster an environment that not only encourages investment in AI, but also supports its development and deployment across critical sectors. The software & computer services sector, with investments reaching €371,306 million, remained heavily dominated by the US, which slightly increased its share to 76%. In contrast, China's share jumped from 1% to 13%, indicating rapid growth in its software and computer services investments. Similarly, the technology hardware & equipment sector saw significant investments, totalling €376,197 million, with the US and China dominating the field. While the US slightly reduced its share from 50% to 48%, China nearly doubled its stake from

[2] See, e.g., Barron's (2023). AI Is in the Hands of Big Tech. EU Regulation Could Help It Stay That Way. Available at https://www.barrons.com/articles/ai-regulation-eu-big-tech-c4d130ce. Also see Bloomberg (2023). US Warns EU's Landmark AI Policy Will Only Benefit Big Tech. Available at https://www.bloomberg.com/news/articles/2023-10-06/us-warns-eu-s-landmark-ai-policy-will-only-benefit-big-tech?embedded-checkout=true.
[3] European Commission (2024). The 2022 EU Industrial R&D Investment Scoreboard. Available at https://iri.jrc.ec.europa.eu/scoreboard/2022-eu-industrial-rd-investment-scoreboard.

10% to 19%, highlighting its aggressive expansion into the technology hardware & equipment sector. Conversely, the EU27 experienced a substantial decrease in their investment share, dropping by 30% to only 8%, reflecting a broader trend of a declining European influence in this critical sector.

- **Risk of falling behind in traditionally "less digital" industries:** The data illustrate a mixed picture of the EU's position in industries like pharmaceuticals & biotechnology and automobiles & parts, where it maintains a significant but declining share. Meanwhile, emerging areas such as travel & leisure and leisure goods show a dramatic increase in the EU's investment share, suggesting potential new avenues for leveraging AI to gain a competitive edge. These shifts underscore the need for a nuanced approach to AI regulation that balances the protection of ethical standards and citizen welfare with the imperative to stimulate innovation and investment. **By adopting a regulatory framework that is flexible and forward-looking, the EU can capitalize on the opportunities presented by AI,** ensuring its industries remain competitive and continue to drive economic growth in the digital age.[4]

2022 CapEx investments and R&D expenditure, 2022, and relative change over the period 2013–2022[5]

Rank	Industry-ICB3 sector name	Total investment in 2022, in EUR million	Share US	Share China	Share EU27	Share Rest of World	Share Japan	Relative change EU27, 2013-2022
1	Technology hardware & Equipment	376,197	48%	19%	8%	21%	4%	-30%
2	Software & Computer Services	371,306	76%	13%	4%	4%	3%	-53%
3	Automobiles & Parts	369,875	22%	15%	35%	6%	22%	-10%
4	Pharmaceuticals & Biotechnology	296,379	49%	9%	17%	19%	6%	-17%
5	Oil & Gas Producers	233,152	17%	31%	13%	38%	1%	-4%
6	Electronic & Electrical Equipment	230,980	8%	32%	10%	37%	13%	-30%
7	Chemicals	120,233	13%	26%	17%	27%	17%	-44%
8	Construction & Materials	84,726	2%	75%	12%	6%	5%	-62%
9	Electricity	81,367	0%	30%	42%	12%	15%	-18%
10	Fixed Line Telecommunications	76,622	26%	1%	56%	17%	0%	24%
11	Mobile Telecommunications	60,873	2%	67%	0%	0%	31%	n/a
12	General Industries	57,262	22%	19%	11%	26%	21%	5%
13	Health Care Equipment & Services	49,544	50%	7%	29%	8%	6%	20%
14	Industrial Engineering	49,426	9%	38%	26%	13%	15%	-17%
15	Industrial Metals & Mining	48,038	0%	52%	17%	16%	16%	-32%
16	Food Producers	38,304	23%	27%	11%	33%	6%	-38%
17	Aerospace & Defence	36,607	44%	3%	38%	15%	0%	-7%
18	Travel & Leisure	35,084	7%	12%	44%	15%	22%	397%
19	Leisure Goods	34,316	15%	6%	3%	23%	53%	129%
20	Mining	33,593	0%	48%	5%	46%	1%	194%

[4] See, e.g., Cova et al. (2022). Artificial Intelligence and Quantum Computing as the Next Pharma Disruptors. Available at https://pubmed.ncbi.nlm.nih.gov/34731476/. Also see Clinical Trials Arena (2023). Quantum medicine: how quantum computers could change drug development. Available at https://www.clinicaltrialsarena.com/features/quantum-computers-drug-development/?cf-view.

[5] European Commission (2024). The 2022 EU Industrial R&D Investment Scoreboard.

Economic Implications of Restrictive AI Regulation

As AI continues to evolve and permeate every aspect of society, policymakers in Brussels and the Member States are faced with critical decisions. The proposed AI Act, with its commendable intention of protecting citizens and maintaining ethical standards, adopts a precautionary principle-based approach to AI regulation. While the principle itself is essential for risk management, it carries the risk of being overly restrictive.

The EU's approach to AI regulation stands in contrast to other potential regulators, particularly the US and China. These countries may opt for regulatory frameworks that encourage experimentation and faster market entry for AI applications. The EU risks falling behind in both AI development and deployment if its regulatory environment is perceived as hostile to innovation.

The economic implications of a restrictive AI Act are profound. Firstly, overly vague and/or restrictive regulations discourage investment in AI research and development within the EU. Innovators and entrepreneurs may seek more supportive environments, leading to a corporate "brain drain" that diminishes the EU's intellectual and innovative capital.[6]

Moreover, companies that are already leveraging AI to optimise processes and develop new products could face onerous compliance burdens. This is particularly concerning for small and medium-sized enterprises (SMEs), which may lack the resources to navigate complex regulatory landscapes. As a result, the very businesses that are integral to the EU's economic and ICT fabric could find themselves at a disadvantage, unable to harness the full potential of AI.

A New Framework for AI Regulation

To strike a balance between regulation and innovation, a more nuanced, risk-based approach to AI regulation is needed. Such an approach would categorise AI applications based on their risk level and apply corresponding regulatory scrutiny. High-risk applications would face more stringent controls, whereas low-risk applications could benefit from a lighter regulatory touch.

This framework aligns with the EU's objectives of a deeper single market. **By standardising regulations across EU Member States, the EU can facilitate a seamless single market for AI products and services. This, in turn, enables European businesses to scale up and compete globally, ensuring that the EU remains an attractive destination for innovation and investment.**

The Role of Open Markets and Strategic Alliances

Open markets are fundamental to fostering innovation. They encourage competition, which drives technological advancement and economic growth. For the EU to maintain its competitiveness, it is crucial to create a regulatory environment that not only allows EU-based companies to innovate, but also attracts international investors and innovators.

Strategic alliances, especially with countries like the US at the forefront of digital innovation, play a pivotal role in bolstering the EU's position in the global digital economy. These alliances provide a platform for sharing best practices, harmonising regulatory approaches, and fostering innovation through cross-border collaboration.

Concluding Remarks: Balancing Regulation with Innovation

The proposed AI Act has sparked considerable debate regarding its potential to either support or inhibit the EU's aspirations for global leadership in AI and ICT innovation. On February 2, 2024, all EU Member States unanimously passed the AI Act. This means that it has cleared a crucial hurdle, and it is now on the European Parliament to agree or not to agree in April or May.

[6] See, e.g., Unternehmertum (2022). AI Act Impact Survey, Exploring the Impact of the AI Act on Startups in Europe. Available at https://www.unternehmertum.de/en/topics/ai/threat-to-innovationsurvey-european-start-ups-on-eu-ai-act. Also see Times Magazine (2023). OpenAI Could Quit Europe Over New AI Rules, CEO Sam Altman Warns. Available at https://time.com/6282325/sam-altman-openai-eu/.

Experts continue to highlight a concern that its regulatory strictures will inadvertently impede the dynamism required for the EU to become competitive, particularly against the technological prowess of the US, as US-headquartered companies currently lead in the AI innovation sphere.

AI indeed has huge potential to change many industries worldwide. This gives the EU a chance to lead in tech innovation beyond ICT industries. By being more open in regulation, the EU can create an environment that supports new solutions across industries. This would help open markets and boost international partnerships, especially with the US, through trade, investments, and platforms for regulatory cooperation like the EU-US Trade and Technology Council.

The European Parliament should aim for a more flexible and more precise AI regulatory framework that assesses real AI risks. This approach would sufficiently protect citizens and encourage innovation across the EU's wide and broad single market.

Policy Recommendations

Implement a differentiated regulatory approach: adopt a nuanced, risk-based regulatory framework for AI that differentiates between applications based on their potential risks and benefits. This approach would ensure that high-risk applications are adequately regulated to protect consumer rights and ethical standards, while enabling low-risk applications to thrive with minimal regulatory interference, fostering innovation and competitiveness.

Promote open markets and competition: ensure that the AI market remains open and competitive. This involves policies that encourage competition and entry of new players in the AI sector and other technology-intensive industries in Europe. Policies include supply-side measures, both horizontal and sector-specific polices, targeted at improving the functioning of the EU's highly fragmented single market.

Strengthen international cooperation: forge strategic alliances and partnerships, particularly with like-minded regions such as the US, to share best practices, align regulatory standards, and foster cross-border innovation. This would not only enhance the EU's competitive position, but also ensure it plays a leading role in shaping global norms and standards for AI.

Support research and development (R&D) partnerships: increase investment in AI research and development within the EU and with partners outside the EU, focusing on ethical AI and technologies that can lead to sustainable competitive advantages. This includes funding for universities, start-ups, and public-private partnerships, as well as incentives for international businesses to invest in AI R&D. Ensuring access to adequate resources and infrastructure for researchers and entrepreneurs will be key to maintaining and enhancing the EU's innovation ecosystem.

EU's Role in Regulating and Developing AI Models

Overview of the LLM models that are under development, lessons from private companies in the US, and how Europe can ensure competitiveness in this sector where we already see lagging from European companies

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Introduction

The burgeoning field of Large Language Models (LLMs) has seen notable developments, with OpenAI's GPT series leading the way. As generative AI is integrated into platforms, these models are transforming various sectors through enhanced user experiences and real-time data processing. Policymakers need to consider potential partnerships with companies like OpenAI and Google, which are expanding into Europe and aiming to align with EU values and regulations, including the commitment to data privacy. **The EU should also promote promising European LLM models like the Mistral AI, as they are already on an impressive trajectory**. Moreover, the European Language Grid exemplifies the EU's own contributions by fostering systemic language technology advancements.

With significant investment disparities between the EU and the US in AI technology, there are lessons to be drawn from the private sector's successful AI integrations, such as Microsoft's incorporation of AI into its products, which has revolutionized efficiency across industries. **Ultimately, AI should be seen as a foundational building block that enables innovation, not an end product.**

The EU plays a strategic role in shaping the future of AI, leveraging its impressive and growing pool of AI professionals and a robust IT industry. Capitalizing on the EU's larger share in industrial production as opposed to the US, policymakers should promote the use of AI across various sectors. A key advantage lies in the EU's legislative approach to AI and data protection, such as through the GDPR and the AI Act, setting benchmarks globally and ensuring clear, transparent frameworks that facilitate integration and safeguard innovations. **Emphasizing data security in the IT infrastructure is paramount, and efforts toward a transatlantic alliance rooted in democratic values could reinforce the position of the free world in the AI landscape.**

Overview of the Current LLM Models

OpenAI is the leader in the industry with its famous Generative Pre-Trained Transformer models, popularly dubbed GPT, with the number referring to the model in use. This model rose to popularity with its GPT-3 version and has significantly improved its basis with the 3.5 and 4 models. The GPT-4 model parameters have been expanded greatly, opening a new era in not only text generation, but also video and image generation. OpenAI is by far the biggest company in the sphere, and it has a specific ownership structure that is focused on transparency as well as generating new revenue for further development. The ownership allows greater potential interoperability between researchers and the company, and **that is one of the areas where the EU should reach out to OpenAI specifically to expand into Europe not only its business endeavours but also their R&D ones.**

The Gemini model is Google's answer to OpenAI's success. The launch of the Gemini model, which is open to the public, was the first competitor at scale for OpenAI. The biggest advantage of Gemini is being directly connected with the biggest search engine in the world in real time. Google is deeply integrated with the Western regulatory framework, and specifically with the EU framework. **The company has consistently expanded its workforce in Europe and has made significant strides to work in lockstep with the EU to ensure data privacy and a wider commitment to freedom and EU values**. This also opens up the possibility for a partnership that would build upon good relations and practices that exist.

One of the most promising projects, which has not received its due attention from the public, is the Mistral AI project. It is an LLM model developed by a dedicated team of AI professionals in France. **Mistral AI's most recent model, Mixtral 8x7B, shows very promising results, and it outperforms its near peers like Google's LLAMA 2 model and GPT 3.5 turbo.** The EU should encourage this company to be incorporated in a similar way as OpenAI, as a public-private joint ownership, and the EU institutions should encourage the development of this company greatly.

Mixtral models developed by Mistral AI could be used by European companies to similar effect to Microsoft's use of GPT models. Mistral AI would develop the technology and have its own interface for easier access, but it would also enable existing reputable European tech companies to incorporate the models into their products. This makes it easier for everyone involved—the public has oversight over technology development, AI developers have the freedom from usual corporate goals that do not apply to a sensitive technology like AI, and existing corporations have access to the technology without the need to create expensive R&D development departments.

Mistral AI should be encouraged by the EU to incorporate and develop in a similar way as OpenAI, but instead of Microsoft as the chief investor, the EU should leverage European private investments in this company and in return ensure availability of its technology to European companies for scaling and impact.

This is one of the ways in which the EU can create a viable technology without too significant market intervention that can rival US-developed models and that would ultimately lead to more value-based competition.

Mistral AI's model benchmarked against comparable LLMs in French, German, Spanish and Italian

	Active Params	Arc-c	French HellaS	MMLU	Arc-c	German HellaS	MMLU	Arc-c	Spanish HellaS	MMLU	Arc-c	Italian HellaS	MMLU
LLaMA 1 33Bw	33B	39.3%	68.1%	49.9%	41.1%	63.3%	48.7%	45.7%	69.8%	52.3%	42.9%	65.4%	49.0%
LLaMA 2 70B	70B	49.9%	72.5%	64.3%	47.3%	68.7%	64.2%	50.5%	74.5%	66.0%	49.4%	70.9%	65.1%
Mixtral 8x7B	12B	**58.2%**	**77.4%**	**70.9%**	**54.3%**	**73.0%**	**71.5%**	**55.4%**	**77.6%**	**72.5%**	**52.8%**	**75.1%**	**70.9%**

Mistral AI's model Mixtral benchmarked across a variety of standardized challenges against similar models, already showing better results

	LLaMA 2 70 B	GPT - 3.5	Mixtral 8x7B
MMLU (MCQ in 57 subjects)	69.9%	70.0%	**70.6%**
HellaSwag (10-shot)	87.1%	85.5%	86.7%
ARC Challenge (25-shot)	85.1%	85.2%	**85.8%**
WinoGrande (5-shot)	**83.2%**	81.6%	81.2%
MBPP (Pass@1)	49.8%	52.2%	**60.7%**
GSM-8K (5-shot)	53.6%	57.1%	**58.4%**
MT Bench (for Instruct Models)	6.86	**8.32**	8.30

The EU has also provided a large contribution to the LLM space with the European Language Grid (ELG). The ELG is an incredible network where users can find all sorts of different tools and organizations that are engaged in Language Technology (LT) development and implementation.

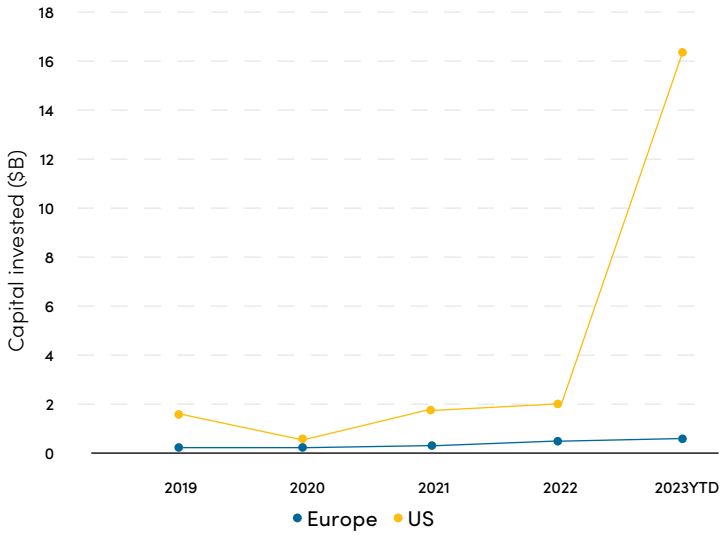
The ELG is a great network that allows individuals to access tools, information, and networking opportunities. It incorporates 24 official EU languages as well as more than 1,500 organizations engaged in the LT community.

There are multiple other companies that develop their own dedicated LLM models like Grok from Twitter/X, Cohere from the company of the same name, Llama by Meta, etc.

Lessons from the Private Sector in the US

If we look at the sheer amount of capital that is being invested in the EU and the US in the AI field, the difference is stark. In 2023, the top 10 rounds in the EU raised approximately 2.5 billion euros in funding, whereas the sum of the top 10 rounds in the US equalled 14.2 billion euros.[1] While there is more VC capital available in the US, we still have to look at how companies approached the issue of AI and what has allowed US companies to outraise their EU counterparts by 6 : 1. Even in the case of European companies like Mistral AI, we still see US companies like Salesforce or private VCs being the chief investors in this technology. **One of the best ways to ensure greater capital availability is the liberalization of pension fund investments across Europe**. Most pension funds are very risk-averse and tend to focus on government bonds and safe assets in various baskets. Pension funds should be encouraged to dedicate a larger percentage of their portfolios to promote investments, with a particular focus on emerging technologies like AI. The EIB should also assist these investments with guaranteed leverages for strategic sectors where the EU needs to be at the forefront of humanity. The EU single market is the biggest one in the world, and EU companies have a lot of potential to grow inside the market, but the availability of greater access to capital needs to be ensured.

Total capital investments in AI companies by region, where the divergence shows a period of strong capital investment in AI in the US, with more modest results from Europe



LLMs as building blocks, not final products, and how they synergize with smaller enterprises

Most of us view OpenAI's GPT as a final product, one which we interact with to assist us in our tasks. But that is an incomplete picture of the technology, as the LLM models are primarily foundational technologies that can create incredible ecosystems. **To use present examples, the LLM technologies should be viewed more like Google's search engine than Google's e-mailing service.**

Numerous smaller enterprises, including the ones from the EU, have found innovative ways of leveraging AI technologies in a relatively short period of time. **One great example is text-to-speech companies, which have revolutionized accessibility in technology and are providing natural and responsive voice interfaces**.

This has opened up massive opportunities for new content creation, free from the usual constraints that come with big studios and expensive audio equipment unavailable to the wider public.

[1] „AI: The 2023 renaissance" by the State of European Tech, 2023, https://stateofeuropeantech.com/reading-tracks/ai-the-2023-renaissance.

The EU's Strategic Role in Fostering a Competitive AI Ecosystem and Shaping AI's Future

While we have focused heavily on some of the advantages of the US, there are also tangible advantages that the EU benefits from in the development and proliferation of AI technologies. The most important aspect is the human capital—the EU had more than **120 thousand dedicated AI professionals in 2023**. These AI professionals are part of a more **than 5.5 million workforce that is currently active in the IT sector**. This not only ensures that enough AI professionals are trained each year, but that they are also joining an advanced and vibrant IT ecosystem, which will enable easier integration and technological proliferation. The share of industrial production as a GDP percentage is around 15% in the EU, while in the US it is around 11%.[2] This creates a golden opportunity, as AI is not the focus of the industry in the same way as it is the focus of the IT sector.

Although there are many potential AI applications for AI integration in the industrial sector, we have to focus on short-term applications. **The EU should encourage companies in the digitalization drive to adopt AI LLM models for their day-to-day business operations, as the technology is still not at the level that it should be for certain technical implementations**.In direct terms, this means that companies should be encouraged to adopt AI in their everyday operations, from sending e-mails to taking notes at meetings.

The upcoming Microsoft Office AI-enhanced edition would be a significant improvement for most medium- and large-scale companies that already use the Office suite. EU should encourage all users to adopt the AI-enhanced options to free up time from sometimes tedious day-to-day business operations.

Advanced short-term solutions should also be encouraged—for instance, the EU should encourage companies that aim to create chatbots and similar customer support products based on existing models with EU funds and EIB investments.

One of the big advantages of the EU is the existing legislature, which not only focuses on AI through the EU AI Act[3], but also centres on the wider infrastructure pertaining to data which is under GDPR rules protection. **While most US companies had mixed reactions to the GDPR when it was first put into place, it was still accepted as the only clear framework for personal data worldwide**. The GDPR is seen as a benchmark for data protection in the free world, and it is difficult to find any criticism of the tone and desired outcome of the Regulation. The previous grey zone of personal data has been made much more transparent, and companies know what certain countries will expect of them, which eases integration and regulation.

While AI acts are important, the real protection of AI will be ensured around the surrounding IT infrastructure that hosts the AI ecosystem. General data protection, as well as stringent hardware rules, are the only way to ensure the true safety of data and any AI developments. **In the IT sector and the digital sphere, even the slightest backdoor can prove fatal to any R&D development. Years of hard work can be undone with a single USB stick or a corrupt Wi-Fi card inside your phone that no one could even imagine being compromised.** All-encompassing security must be a new benchmark for the entire IT sector if we are to ensure data and patent protection from hostile actors. A transatlantic alliance will be fundamental in championing AI guided by democratic principles, ensuring that the free world maintains its edge over authoritarian regimes.

[2] https://data.worldbank.org/indicator/NV.IND.MANF.ZS?locations=US
[3] "AI Act, Consolidated Text" by the European Commission, 24. 1. 2024, https://artificialintelligenceact.eu/wp-content/uploads/2024/01/AI-Act-Overview_24-01-2024.pdf.

Policy Recommendations

LLMs like OpenAI's GPT are a foundational stone and not a final product. Enable existing start-ups and companies to build upon the already developed AI models and focus on short-term implementation as well as long-term research and development. Enable the procurement of AI models and their training at a normal cost of any EU grant or digitalization effort from companies.

All data centres and hardware used in IT installations can only come from close allies with similar values. Compromised hardware from authoritarian regimes can have unwanted backdoors. Communicate to companies that an all-encompassing security framework is essential for any AI company. State security services and EU agencies should conduct checks on the hardware that is used to develop sensitive technologies.

Draw in existing companies like OpenAI, Google, and Microsoft to ensure that AI is developed also in the EU. The risk for the EU is the technology being developed in the US and India, with the EU used primarily as a market. Encourage market leaders from the US to establish dedicated AI centres within the EU. The EU should take a positive approach and employ tax breaks, guarantees for data centre investments, leverages, and unlimited human capital of the greatest quality.

The EU should promote greater liberalization of pension funds that allow for more high-risk investments towards promising European companies. This will not only benefit the AI ecosystem, but the business community at large. EU companies often feel that the current amount of available capital is not sufficient, so they go to the US to incorporate. This can be avoided if pension funds are freed up for riskier investments and significant funds for promising start-ups become available in every EU country.

The EU has a large industrial base and production capacity. While AI LLM models are not currently suitable for direct technical applications within the industry, they are perfectly suited for everyday business operations**. EU industrial companies should be encouraged to embrace AI LLM technologies in everyday business operations**, which will increase productivity, but also alleviate some of the pressure these companies feel to outsource outside the EU. Also, they should be encouraged to embrace short-term advanced applications like the implementation of customer support chatbots based on existing technologies. This should be implemented through existing digitalization drives with explicit wording and encouragement towards companies, as well as direct communication with industry leaders that AI implementation in companies will be backed by EU funds and EIB loans.

What's Europe's "Ace" for Developing the Future Leaders of Big Tech?

Are Regulations Holding Europe Back?

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In the intricate dance of innovation and regulation that defines the global technological landscape, Europe's distinctive approach—its regulatory framework—stands out as both its ace and its Achilles' heel. This comprehensive analysis delves into how Europe's strategy for fostering technological leadership through regulation compares with the varied approaches of its global competitors: the United States (US), the United Arab Emirates (UAE), the United Kingdom (UK), China, India, and Brazil. By examining these diverse strategies, we gain insight into the multifaceted nature of global tech competition and the paths Europe might take to maintain its competitive edge while navigating the complexities of innovation governance.

The future of emerging technologies in Europe is a topic of great interest and significance, and this paper will focus on blockchain, which is emblematic of themes we see in other spaces as well, from cloud computing to artificial intelligence. Europe's "Ace," which gives it a special advantage, is its regulations. In the long-term, whether it is MiCA for blockchain, GDPR, or the evolving rules for artificial intelligence, it is the certainty and clarity of the regulatory landscape that stand out. However, this same Ace risks holding Europe back if not implemented correctly, with competitors in the tech space also accelerating their growth.

Although not the largest market for blockchain, the EU market has the fastest predicted growth of major markets. To look at the most direct competitors (and allies), the total market value of blockchain in North America stands at nearly double the market value of Europe. A large part of this can be explained by much larger pools of venture capital funds that are based in the US, leading companies that want to grow to locate or re-locate to the US market. However, despite more available funds, the blockchain market is expected to grow the fastest in Europe, at a compound annual growth rate (CAGR) of about 72% through 2028, indicating massive potential for growth in the region.

This contrasts with the expected growth of 54.8% for the United States, 7.9% for the United Arab Emirates, and –3.9% for the United Kingdom, even though these markets also have relatively large pools of capital.

Europe's regulatory environment stands as a beacon of strategic governance that not only nurtures the growth of its markets, but also positions the continent as a formidable player in the rapidly evolving blockchain and cryptocurrency industry. There is an intricate relationship between European Union's (EU) regulatory framework and the competitiveness of its markets, focusing particularly on the blockchain and cryptocurrency sectors. The EU's supportive and harmonized regulatory environment fosters innovation, ensures fair competition, and ultimately strengthens Europe's position in the global digital economy.

Foundation of Europe's Regulatory Environment

At the heart of Europe's approach to regulation is the EU's commitment to creating a level playing field for businesses, which is crucial for fostering a competitive market environment. This is achieved through a harmonized regulatory framework that not only supports but actively promotes innovation, unified standards, and the development of small businesses. Such an environment is indispensable in the blockchain and cryptocurrency industry, where the pace of innovation and the need for clear regulatory guidelines are paramount.

The EU's competition rules are meticulously designed to promote fair competition practices. These rules ensure that all businesses, regardless of their size, have an equal opportunity to compete, thereby preventing monopolies and ensuring that consumers have access to a wide variety of choices and fair pricing. This regulatory approach not only supports the growth of businesses, but also protects the interests of consumers, ensuring that they benefit from the innovations and efficiencies generated by a competitive market.

Strengthening the Single Market through Regulatory Initiatives

The importance of regulatory initiatives in enhancing innovation and competitiveness within the European single market cannot be overstated. The EU's Annual Single Market and Competitiveness Report serves as a testament to this, highlighting the need for systematic assessments of the impact of legislative proposals on competitive conditions. This ensures that regulatory initiatives are both proportionate and consistent across the EU, thereby preserving an open and attractive single market. These efforts are particularly relevant in the context of the blockchain and cryptocurrency industry. The industry thrives on innovation and the rapid development of new technologies and business models. By emphasizing the need for regulatory initiatives that incentivize innovation, the EU not only fosters a conducive environment for the growth of this industry, but also ensures that Europe remains at the forefront of digital innovation.

The United Arab Emirates: Building a Future-Forward Tech Oasis

The UAE has emerged as a visionary in the tech domain, particularly in blockchain and AI, through its forward-looking strategies and investments in digital infrastructure. The country has adopted a proactive stance towards technology, seeking to become a hub for digital innovation through initiatives like the Dubai Blockchain Strategy and the establishment of the world's first AI university. The UAE's regulatory environment is characterized by its agility and openness to innovation, attracting tech companies and startups from around the globe.

The United Kingdom: A Post-Brexit Pivot to Tech Leadership

With a rich history of innovation and a strong financial services sector, the UK is looking to leverage its regulatory independence to create a more flexible and supportive environment for tech companies. Post Brexit, the UK is keen to assert its technological sovereignty and enhance its competitiveness on the global stage. Initiatives such as the UK's Digital Strategy aim to foster growth in AI, digital health, and fintech, balancing regulatory oversight with an ambition to lead in these sectors.

China: State-Driven Tech Ascendancy

China's approach to becoming a global tech leader is heavily state-driven, with significant government investment in technology sectors such as AI, 5G, and blockchain. China's regulatory environment is unique, offering support and resources to favored industries while maintaining tight control over the internet and digital platforms. This strategy has propelled China to the forefront of technological development, particularly in digital payments and e-commerce, while raising questions about surveillance and data privacy.

India: Leveraging Demographic Dividends and Digital Initiatives

India's tech landscape is characterized by its vibrant startup ecosystem, bolstered by a young and tech-savvy population. Government initiatives like Digital India and supportive policies for startups have played crucial roles in promoting innovation. India's regulatory approach, focusing on digital infrastructure and financial inclusion, aims to position the country as a leader in digital innovation and services, making it an attractive destination for tech investment and development.

Brazil: A Rising Star in Latin America's Tech Scene

The Brazilian government's support for innovation and digital entrepreneurship, coupled with a regulatory framework that is evolving to accommodate new technologies, positions Brazil as a key player in Latin America's tech growth story. Its strengths are in fintech, agtech, and digital services. Brazil's challenges, including infrastructure and education, are counterbalanced by its potential as a market and a hub for innovation.

Opportunities and Challenges in the Blockchain and Cryptocurrency Industry

The blockchain and cryptocurrency industry presents a unique set of opportunities and challenges for Europe. The EU's regulatory framework offers a supportive ecosystem for businesses to thrive in a large and diverse market. This is crucial for startups and small businesses that are often at the forefront of innovation in this sector. By providing clear guidelines and support, the EU enables these businesses to navigate the complex landscape of the blockchain and cryptocurrency industry, thereby contributing to the overall competitiveness of Europe's markets. MiCA, for example, has created clear but strict rules. While in contrast, although the US market is currently the leader in blockchain and growing, its myriad of regulators at both the local and national levels but lack of clear definitions of who governs and regulates which segments of the blockchain space, has held back growth that could have been even greater. Horizon Europe, as the largest global innovation and research fund, and the New European Innovation Agenda, combined with regulatory "sandboxes" to experiment with new technologies with less regulatory constraints, as well as the Green Deal Industrial Plan all combine to create a foundation for robust technology sector growth. **The greatest challenge to regulators is keeping regulations apace with the rapid technological advancement and global nature of the blockchain and cryptocurrency markets, without creating regulations that are overly burdensome and hold back the industry.** The EU must therefore balance the need for innovation-friendly policies with the imperative to protect consumers and ensure the stability of financial markets.

Europe's Path Forward: Learning from Global Competitors and Not Constraining Itself

As Europe seeks to navigate the delicate balance between regulation and innovation, the strategies of its global competitors offer valuable lessons. The agility and investment-driven approaches of the UAE and China, the ecosystem diversity of the United States, the strategic independence of the UK, the demographic leverage of India, and the emerging market dynamism of Brazil all provide insights into how Europe can refine its regulatory framework to foster innovation while maintaining its commitments to security, fairness, and transparency.

Europe's ability to adapt its regulatory strategies in response to rapid technological advancements and the shifting global dynamics will be critical in maintaining its competitive edge. By drawing on the strengths and lessons of its global competitors, Europe can enhance its Ace, ensuring that its regulatory environment continues to be a catalyst for innovation and a cornerstone of its technological leadership on the world stage.

Policy recommendations

How should Europe adapt its regulatory policies or prevent them from constraining innovation?

The first recommendation is to apply the Innovation Stress Test, developed by the European Economic and Social Committee (EESC) Employers' Group, to ensure that a ruling is not only aligned with European principles, but that it is also not creating constraints to innovation. The model of the Innovation Stress Test ensures that rules are not created in a vacuum and that both guiding principles of the European Union and the needs of the industry are accounted for.

Following on this, the Innovation Stress Test should be applied to existing rules, regulations, and laws. This set of ten questions offers a common-sense approach that can also give a common model to apply across sectors of technology rules and regulations.

A "gap analysis" comparing regulations across key areas of emerging technologies and businesses between the EU and other leading markets should be conducted. Personally, I have conducted research studying models within the European Union and looking for gaps between what is in Europe and what takes place in Europe's development partners, who can learn from what Europe is doing, but in this space, we also need to have analysts and researchers look in detail at the gaps between Europe's policies and those of the other countries mentioned in this article.

Europe as a Global Leader in Blockchain and Cryptocurrency, and the Emerging Technology Overall

In conclusion, Europe's regulatory environment plays a pivotal role in shaping the competitiveness of its markets, particularly in the blockchain and cryptocurrency industry. However, although growth rates in sectors like blockchain are increasing, there remains a risk of regulations being a double-edged sword slowing growth relative to other countries and regions. Evaluating the current and upcoming rules and regulations that relate to the emerging technology, as well as analyzing gaps between the regulatory policies of Europe and other parties, will be key to ensuring that the regulatory environment remains Europe's ace, not its Achilles' heel.

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