Towards a Y-shaped technology stack? Prospects for global cooperation on AI

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The rise of Artificial intelligence (AI) as a powerful general-purpose technology has led many governments to develop national strategies to achieve competitiveness and, increasingly, foster responsible AI development. As of today, according to the OECD more than 60 countries around the world have adopted a national AI strategy, and a few countries have also advanced regulatory proposals to ensure that the benefits of AI are maximized, and the corresponding risks are mitigated.[1] Looking at national strategies, the prospects for global alignment on AI appear rather gloomy: political leaders such as Xi Jinping and Vladimir Putin have stated that whoever will dominate AI in the future, will also achieve world dominance.[2] The mounting rivalry between the United States and China, and the more general deterioration of the multilateral order have become clear obstacles towards convergence on responsible AI uses. At the same time, a vibrant global community continues to cooperate at the more technical level, in standardization bodies such as ISO, IEC, IEEE and the ITU.[3]

This paper assesses the prospects for global AI cooperation in light of current developments. Section 1 below reflects on the impact AI will likely have on industry and society, and its projected evolution over the coming years. Section 2 briefly outlines the different approaches adopted in the United States, in China and in the EU on various aspects of AI policy. Section 3 assesses the prospects for international cooperation on AI, by outlining alternative scenarios. Section 4 briefly concludes.

1. AI, industry and society: a look into the future

There is no doubt that AI bears the potential to massively contribute to global production and prosperity. Market analysts forecast an estimated boost of 16 percent, or US$13 trillion to global output by 2030, thanks to global AI implementations. Global corporate investment in AI has reached US$60 billion in 2020, and is expected to double by 2025.[4]

1.1 AI and industry: past, present, and future

Until recently, AI solutions for industry were mostly focused on the use of so-called “rule-based systems”, in which machines execute complex operations based on inputs and instructions provided by their developers; and on industrial robotics, which embedded relatively simple forms of AI. More recently, the availability of digitized data and the rise in computational capacity have led to breakthroughs in a more data-hungry family of learning-based techniques, known as “machine learning”. Variants of this techniques have been developed, which feature the use of neural networks, enabling AI systems to learn over time how to optimize a given function, through repeated exposure to huge quantities of data. This makes machine learning at once extremely dependent on the availability of large quantities of high-quality data; extremely accurate in performing specific narrow tasks, often surpassing the ability of human beings; and potentially very energy-consuming, due to the need to process large datasets and train the algorithms.

Key industrial use cases today include anomaly detection (often performed through expert systems); predictive analytics and maintenance; industrial robotics; and various approaches to the optimization of the supply chain. In specific sectors, AI has proven to significantly increase efficiency and productivity, for example through the deployment of deep learning for predicting failures in equipment, or for scheduling and dispatching. At the same time, industrial AI applications face specific problems, including limited data availability; the multi-modality of data (i.e. data comes from different devices and sources, often in different formats), the need for explainable decisions; the deployment of different models; the need to constantly update and interconnect models and controlling possible mistakes. The next few years will see the explosion of the Internet of Things, with cyber-physical objects embedding both sensors and actuators, in a way that leads to new frontiers in automation and key tasks such as

[1] See the portal of the AI Policy Observatory at http://OECD.ai.

[2] See, for references, Renda, A. (2019), *Artificial Intelligence: Ethics, Policy and Governance Challenges,* CEPS monograph, Brussels.

[3] ISO is the International Organization for Standardization (www.iso.org). IEC stands for International Electrotechnical Commission (www.iec.ch). The IEEE is the 'Institute of Electrical and Electronics Engineers (www.ieee.org). And the ITU is the International Telecommunications Union (www.itu.int).

[4] See https://www.statista.com/statistics/1229130/ai-investment-and-funding-worldwide/

predictive analytics and maintenance.

These features are both a blessing and a challenge for the future of AI, especially in industrial applications. Increasingly, companies involved in AI development have to invest enormous resources to train algorithms that end up achieving only marginal progress over their predecessors in terms of accuracy: the recent State of AI 2020 report denounced the skyrocketing investments needed, as well as the exponential growth in energy consumption of some of the most advanced models.[5] And the reliance on IoT solutions raises the issue of security, as the "attack surface" becomes denser, and many devices are still unduly exposed to external attacks: most businesses around the world are far from adequately prepared to face mounting cyber risks.[6]

This, in turn, may lead future AI applications to partially depart from machine learning, to embrace less data-hungry solutions such as deep Bayesian (or probabilistic) programming; and to rely on more decentralized architectures and so-called "embedded AI", which processes smaller datasets as locally as possible to avoid latency, rising computing costs, and possible security fallacies due to heavy reliance on connectivity. Additional reasons for prioritizing decentralized architectures include the need to achieve resilience (which typically requires building intelligence at the edges of a network); the need for more sustainable solutions (edge/cloud architectures are in most cases saving on energy consumption compared to purely centralized cloud solutions); and the need to avoid that data and value are easily captured by large tech giants, which dominate cloud services.[7]

1.2 AI and the future of work

Alongside developments in industrial AI applications, the issue of future skills and jobs is emerging vibrantly as a key priority for domestic industrial policy. Commentators and scholars are divided between "tech optimists", who believe that AI will be a net job creator; "tech pessimists", who believe that AI will destroy more jobs than it will create; and "tech realists", who believe that the future lies in building mixed teams with humans and AI systems becoming complementary.[8] In reality, active public policies will make a big difference: governments can promote human complementary skills, and reward the employment of humans alongside machines rather than promoting full job automation. This also depends on whether governments pursue an AI policy aimed at industrial competitiveness through cost-cutting; or whether AI and industry are approached as means rather than ends, and policy are oriented towards medium term outcomes such as the Sustainable Development Goals. The impact of AI on jobs, in this respect, appears largely endogenous, and dependent on government priorities: adopting a view of industry that is in line with Society 5.0, or with the similar "Industry 5.0" concept being developed by the European Commission, means prioritizing human-centric, resilient and sustainable business models: this, in turn, may lead to proactive labor policies to ensure that human-machine cooperation is as productive as possible. This is further supported by the observation that at the team level, human-AI teams appear to drive very significant productivity increases, in the range of 30% to 40%.[9]

For developing countries, however, such a strategy may be particularly challenging. For the reasons stated in the previous section, many industrialized countries are trying to shorten their supply chains and reduce their dependency on the rest of the world; this also means the repatriation of key parts of the supply chain, the consequent automation of tasks at work to contain costs, and the exclusion of entire countries from the geography of global value chains. This is one of the reasons why the projected impact of the digital transformation on countries in the Global South, according to existing studies, is not going to be as beneficial as for China, and most OECD countries.

Another important aspect of work organization in the age of AI is the increased prominence of algorithmic governance, particularly in the context of digital labor platforms.[10] The platform model, in and of itself, represents a different governance form than the traditional enterprise: key differences include relatively small workforce in terms of employees; the reliance on a vast network of independent contractors, with rather weak rights in terms of the labor relationship; and the entirely algorithmic governance of the relationship between platform and businesses. This situation led to the further deterioration of the condition of workers in labor platforms, leading some countries to start imposing the equivalent treatment of independent contractors to employees, and in a few cases also the possibility for workers or their representatives to access and audit the

[5] For example, absent new research breakthroughs, achieving a reduction in ImageNet error rate from 11.5% to 1% would require an estimated 100 billion USD. See stateof.ai

[6] See, for an explanation, • Griffiths, M., L. Pupillo, S. Blockmans and A. Renda (2019), Strengthening the EU's Cyber Defense Capabilities, Report of a CEPS Task Force.

[7] See Renda, A. (2021) Making the digital economy "fit for Europe". *European Law Journal*. 2021; 1– 10. https://doi.org/10.1111/eulj.12388.

[8] See Spencer et al. (2021), Digital automation and the future of work, Study for the European Parliamentary Research Services, PE 656.311.

[9] See Malone T. (2018), *Superminds – the surprising power of people and computers thinking together.* Little, Brown and Company. ISBN-13: 9780316349130 11. https://cci.mit.edu/superminds/

[10] See the ILO World Economic and Social Outlook Report 2021, The role of digital labor platforms in transforming the world of work, at https://www.ilo.org/global/research/global-reports/weso/2021/WCMS_771749/lang--en/index.htm.

algorithm used to monitor them.

Here too, as the reflection on the use of AI in industrial relations advances, the need to find a good balance between workers' well-being, social sustainability and industrial competitiveness is leading some countries to adopt a more cautious approach to AI. In a nutshell: not everything that *can* be automated *should* be automated.

1.3 AI and society: mitigating risks and preserving resilience

The rise of big data and machine learning already had pervasive impacts on our societies, which the COVID-19 pandemic has exacerbated in many respects. The rise of superstar firms was largely powered by massive investments in machine learning, aimed at developing search and recommendation engines, detecting patterns in user behavior, and nurturing advertising-based business models. The rise of content moderation platforms and social media deeply transformed the democratic process and citizens' access to information, exposing society to the risk of a deep manipulation of the public debate.[11]

Governments around the world have soon realized the opportunities and challenges that AI can present for society. On the one hand, a vibrant international community has formed around the promotion of responsible AI uses, under the belief that uncontrolled AI deployment can, in some instances, lead to risks for safety and security (e.g. when AI is deployed with insecure IoT, or to control critical infrastructure); and also to risks for human rights such as privacy and data protection, freedom of expression, human agency, freedom to conduct a business, freedom of assembly, and many others.[12]

As always happens with very powerful technologies, the use of AI has been found to potentially empower citizens and communities, through more effective and efficient public services; but also, to pave the way towards bias, discrimination, and intrusion into people's privacy. In many democracies, cases of private user surveillance and "hypernudging", i.e. use of AI to induce consumption of political choices, have already emerged.[13] And the use of AI in government has already led to worrying results in terms of discrimination (e.g. the U.S: COMPAS), possible user profiling and social scoring (the Dutch Syri and Danish Gladsaxe algorithms). In China, the use of AI by governments has led to widespread, institutionalized forms of citizen surveillance and social credit scoring. Likewise, the use of technologies such as facial and body recognition in public places has raised important concerns on possible discrimination and misuse of citizens' data by public authorities.

However, if properly used, AI also has the potential to empower citizens, by facilitating their access to a wide spectrum of information, their engagement with government, access to personalized health, education and government services, and the prospect of focusing on intellectually rewarding tasks, while automating the most repetitive ones both at work and in the daily life. The diffusion of chatbots and companion robots has proven, especially in Japan, to potentially improve citizens' well-being: at the same time, concern was expressed that in some cases it may be difficult for individual users to distinguish non-human interfaces from human ones. Emerging solutions, such as extended reality and grief bots, also raise concerns as regards the impact on human agency, when it comes to distinguishing what is real from what is fake. The diffusion of sophisticated machine learning techniques such as Generative Adversarial Networks is a case in point here, with ramifications also in the geo-political sphere, especially in the case of so-called "deep fakes".[14]

2. National AI strategies: an overview of the main differences

Faced with the outstanding opportunities offered by AI development as well as the need to mitigate the corresponding risks, more than 60 countries have launched *ad hoc* strategies and very ambitious investment plans. However, while the United States and China initially launched initiatives that were mostly aimed at achieving industrial leadership in AI, the European Union adopted since the beginning a more cautious approach, aimed at combining an "ecosystem of excellence" with an "ecosystem of trust". Accordingly, when comparing national strategies, it appears clearly that the US and China are poised to dominate the AI investment and innovation landscape in the years to come. More specifically, the US private investment rose to €31 billion in 2018, coupled with 5.1 billion in public investment; whereas in China, the figures stand approximately at €21 billion and 6.8 billion, respectively.[15] The EU currently features private AI investment of €3.4 billion, and approximately €1.5 billion

[11] See Zuboff, S. (2019), *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power.* Profile Books. 2019.

[12] For an extensive analysis, with references to all the cases mentioned, see Renda et al. (2021), Study to support an impact assessment of regulatory requirements for Artificial Intelligence in Europe, at https://op.europa.eu/en/publication-detail/-/publication/55538b70-a638-11eb-9585-01aa75ed71a1.

[13] See Karen Yeung (2017) 'Hypernudge': Big Data as a mode of regulation by design, *Information, Communication & Society*, 20:1, 118-136, DOI: 10.1080/1369118X.2016.1186713.

[14] See Collins, A. (2021), *Forged Authenticity: Governing Deepfake Risks*, IRCG Policy Brief, at https://www.epfl.ch/research/domains/irgc/specific-risk-domains/projects-cybersecurity/forging-authenticity-governing-deepfake-risks/

[15] See Kevin Körner (2020), (How) will the EU become an AI Superstar?, DB Research Policy Note.

of public investment. For Japan, private investment was estimated at $1.6 billion in 2019.[16]

That said, the push for international alignment on responsible AI development mostly originated in Japan, Canada, and France in the context of the G-7, and was later significantly advanced by the European Commission, with the appointment of a High-Level Expert Group on AI, which drafted ethical principles for trustworthy AI, for the first time aiming to translate principles of responsible AI development into concrete requirements, which later were embedded into the proposed AI Act. The latter proposes a four-level risk classification for AI, with some AI applications being considered as prohibited (so-called "redlines"); high-risk AI applications (an estimated 5%-15% of total AI solutions on the market) being subject to extensive regulatory requirements; moderate-risk applications (mostly chatbots), being subject to *ad hoc* transparency requirements; and low-risk AI system being only subject to a voluntary code of conduct regime.

Most of this work was then reflected in the adoption by the OECD AI Principles, which were broadly endorsed also at the G-20 level and echoed in China by the adoption of the Beijing AI principles.[17]

In this ever-changing context, certain legal systems, such as the EU, are more likely than others to develop a solid regulatory framework for AI, whereas others (e.g., Singapore, and to some extent China) appear to be more willing to let the market develop without rigid regulatory control. In this context, the United States recently developed guidance to federal agencies on the approach to adopt when regulating AI; and also developed, through the Government Accountability Office, an accountability framework.[18]

Against this backdrop, Japan stands out thanks to its peculiar approach, which so far entails no rigid regulatory framework, but features Contract Guidelines on Utilisation of AI and Data, 'a reference for businesses that explains approaches to concluding (i) contracts for utilisation of data, or (ii) contracts for the development and utilisation of software using AI technology'.[19] The Guidelines describe the main challenges, unresolved issues, model contract clauses, elements to be considered in the preparation of contract clauses, and other key points.

Key elements that differentiate national strategies on AI include: the focus on human rights, typically more present in the EU, but also vividly represented by Japan's emphasis on Society 5.0; the approach to AI risk, which appears to be more cautious in the EU in the presence of significant concerns for fundamental rights and safety; the focus on sectoral policies and standards, more oriented towards uses of AI "for good" (e.g. for decarbonization, health, sustainable development) in the EU compared to the US and China.

Other key elements to be considered in appraising national AI strategies are: (i) the possible regulation of large digital platforms, which already saw important developments in the EU (P2B regulation; Digital Services Act; Digital Markets Act); in Japan (Act on Improving Transparency and Fairness of Digital Platforms), and possibly also in China; (ii) the rise of national strategies aimed at reducing dependencies on foreign economies, particularly in China, the United States and also in the EU (so-called digital sovereignty), often leading to ambitious programs to revamp the production of semiconductors, and the preservation of the data in the national territory; and (iii) emerging regulations aimed at restricting the free flow of personal and also industrial data, to avoid the phenomenon of "value capture": this is specifically the case of the European Union, where the General Data Protection Regulation, the proposed Data Governance Act (and the forthcoming proposal on the Data Act), coupled with the launch of the GAIA-X project, aim at increasing Europe's share of the data economy, and promoting EU solutions in the forthcoming edge/cloud architectures prevailing in industry.[20]

These differences are important when one looks at the prospects for international alignment on AI. The next section reflects on this issue more in depth.

3. What prospects for international AI collaboration?

Looking at the current, gloomy situation in the multilateral order, one would not place a very high bet on the possibility that the world's superpowers converge on responsible and sustainable uses of AI. And as a matter of fact, it appears that a meaningful, truly global agreement will not be possible in the coming years, if not on very specific technical aspects of AI policy. This is regrettable,

[16] See Stanford university's Human-Centered AI (HAI), *The Artificial intelligence Index Report 2021*. At https://aiindex.stanford.edu/wp-content/uploads/2021/03/2021-AI-Index-Report_Master.pdf.

[17] https://www.baai.ac.cn/news/beijing-ai-principles-en.html.

[18] See US Government Accountability Office (2021), *Artificial Intelligence: An Accountability Framework for Federal Agencies and Other Entities*, https://www.gao.gov/assets/gao-21-519sp.pdf

[19] See Japanese Ministry of Economy, Trade, and Industry (2019), *Report compiled by Like-minded Members of Working Group on Studying Model Terms and Conditions for Contracts on Data Sharing-type (Platform-type) Contracts as Effort Involving Contract Guidelines on Utilization of AI and Data.* The current version of the guidelines is available at https://www.meti.go.jp/english/press/2020/pdf/0330_004a.pdf.

[20] See Renda, A. (2020). *Single Market 2.0: The European Union as a Platform*. In S. Garben & I. Govaere (Eds.). *The Internal Market 2.0* (Modern Studies in European Law, pp. 187–212). Oxford: Hart Publishing.

especially in light of current trends, which show an ongoing fragmentation of the technology stack, leading to a possible "splinternet", i.e. the separation of the technology infrastructure in two or more incompatible ecosystems.[21] The splinternet is likely to be accelerated by the widespread use of data localization measures, which contrast with open trade and Japan's proposed "free flow of data with trust"; as well as by the rivalry between the US (where Chinese technologies have been excluded from parts of the market out of suspected espionage and threats to national security); and China (where the government is tightening the grip on large tech giants, banning their IPOs in the US).

The terrain of this battle is now reaching also developing countries, where China has already signed deals with more than 40 countries on the deployment of the Digital Silk Road: the latter takes the form of an entirely self-sufficient technology stack, from infrastructure to platforms and services, and as such is likely to representative an alternative ecosystem compared to the technology stack emerging in the rest of the world.

The possible splinternet appears to be a worst-case, undesirable scenario. Perhaps a more granular and accurate way of looking at possible patterns of future collaboration is to distinguish between different levels of cooperation (technical, political); different extents of cooperation (exchange of practices, broad alignment, harmonization, or even joint action); and different geographic scopes (global, or cooperation at G-7 level, or bilateral cooperation schemes).

The current landscape of international cooperation offers a rich blend of initiatives. A recent effort by the Brookings Institution and CEPS, involving seven governments (Australia, Canada, the EU, Japan, Singapore, the UK, and the US), started mapping possible areas for international collaboration.[22] Such areas fall in three main domains: regulation, standards, and R&D projects.

3.1 International regulatory cooperation

International regulatory cooperation has the potential to reduce regulatory burdens and barriers to trade, incentivize AI development and use, and increase market competition at the global level. In this domain key areas for future cooperation include the following:

- A commitment to duly consider international alignment and convergence when crafting national policies.
- Agreeing on a common, technology-neutral definition of AI for regulatory purposes.
- Converging on the adoption of a risk-based approach to AI regulation.
- Sharing experiences and developing common criteria and standards for auditing AI systems.
- Establishing a joint platform for regulatory sandboxes.
- Cooperating on AI use in government: procurement and accountability.
- Consolidating sectoral cooperation on AI use cases.

In addition, a key area for international collaboration and convergence is data governance. This includes a robust and coherent framework for data protection and data sharing; but also opening government data, improving data interoperability, and promoting technologies for trustworthy data sharing. Here, besides almost insurmountable difficulties in advancing towards a truly global harmonization, even narrower international collaboration between like-minded countries seems to be impaired by some of the rigidities of the EU GDPR, especially when it comes to the data minimization principle; as well as the lack of a comprehensive framework for data protection and privacy in the United States, which the EU continues to consider as providing. At the same time, the EU Data Governance Act and the GAIA-X project both appear to represent a possible obstacle to international data flows, inasmuch as they lead to imposing data localization requirements.

3.2 Cooperation on international standards for AI

Another key area, in which a community of experts and scholars appear to be truly engaging in global cooperation, is that of technical standards. These include those developed by standards development organizations like the ISO/IEC and IEEE, which ensure that global AI systems are ethically sound, robust, and trustworthy, that opportunities from AI are widely distributed, and that standards are technically sound and research-driven regardless of sector or application.

Here, tensions have emerged in particular due to the direct involvement by the Chinese government in standard-setting activities, especially in the ITU but also in other organizations. Such a state-led approach, so far, does not seem to have led to a massive shift in the design and selection of standards, also thanks to the fact that a "one country, one vote" policy continues to apply in organizations such as the IEC/ISO. To be sure, there is a need to protect and relaunch the current global approach, by engaging with China and other non-democratic countries in the preservation of a truly global infrastructure, at least as far as technical standards are concerned.

3.3 Cooperating in large-scale mission-oriented projects

Besides regulation and standards, countries could achieve convergence in the domain of research and development,

[21] https://www.theguardian.com/global-development/2021/jun/03/chinas-splinternet-blockchain-state-control-of-cyberspace

[22] See Kerry C., J. Meltzer, A. Renda (2021), *Strengthening International Cooperation on AI: a Progress Report.* Brookings-CEPS Forum for Cooperation on Artificial Intelligence (FCAI), forthcoming in October 2021.

another truly global community in which researchers from disparate nationalities co-author papers on a regular basis.[23] Here, global challenges require global solutions, as well as a global agreement to share data and trial innovative technology solutions, particularly based on AI and related technologies, such as the Internet of Things. Key domains include climate change, biodiversity and communicable diseases: for climate, I recently proposed the creation of a mission-oriented "International Earth Station", which would parallel the distributed governance of the International Space Station, and also of other large-scale projects such as CERN and the Human Genome Project.[24] Focusing on ambitious, concrete projects for a more prosperous future in the long-term is perhaps the best way to ensure that the global AI community continues to work together in the years to come, despite tensions and conflicts at the higher, geopolitical layer.

4. Conclusion: a Y-shaped technology stack?

This paper has portrayed a rather mixed picture for global AI cooperation and governance going forward. Key challenges in the coming years include the rampant rivalry between the US and China; the resurgence of digital sovereignty stances in various countries; the rising obstacles to global data sharing; the expansionist aims of China with its Digital Silk Road; and the broad divergence between the agenda of countries that are more focused on competitiveness, and those that are more focused on medium-to long-term sustainability.

In light of these developments, it is reasonable to expect (and to some extent, even hope) that the future technology stack for digital technologies including AI, will take a Y-shape. On the one hand, as the bottom half of "Y", there may be enduring convergence on technical standards, including those being developed in the ISO/IEC Joint Technology Committee 1 (Subcommittee 42), and in the IEEE; and less likely, on a limited number of global mission-oriented R&D projects. On the other hand, as the top half of "Y" which has two branches, a fragmented landscape will persist in terms of cooperation on regulatory matters, on data governance and protection, as well as on uses of AI in government and in trade relations: in those areas, perhaps the most optimistic scenario, as one of the two branches of the top half of "Y", is that the Global Partnership on AI (GPAI), hosted by the OECD, succeeds in bringing together industrialized countries by deepening convergence on tools for AI accountability, the refinement of AI principles for specific use cases, and agreement on prohibited uses of AI. A less optimistic scenario, as the other branch of the top half of "Y", is the fragmentation of international AI governance into a web of bilateral and minilateral agreements, including the EU-US Technology and Trade Council, regional agreements, APEC's Digital Economy Steering Group, the D5 recently formed by Estonia, South Korea, Israel, New Zealand, and the UK; the "Quad" formed by the U.S., Australia, Japan, and India; or recent US attempts to launch cooperation networks with seven EU member states, Australia, Canada, and South Korea, "to provide values-based global leadership in defense for policies and approaches in adopting AI."[25]

[23] Haotian Hu, Dongbo Wang, and Sanhong Deng, "Global collaboration in artificial intelligence: Bibliometrics and network analysis from 1985 to 2019," *Journal of Data and Information Science,* Vol. 5 Issue 4, September 2020, https://www.researchgate.net/publication/347517300_Global_Collaboration_in_Artificial_Intelligence_Bibliometrics_and_Network_Analysis_from_1985_to_2019.

[24] See Renda, A. (2021), AI and Green: the Forest and the Trees. At https://futurium.ec.europa.eu/en/european-ai-alliance/blog/ai-and-green-forest-and-trees?language=it.

[25] "AI Partnership for Defense is a Step in the Right Direction – But Will Face Challenges", Lena Trabucco, October 5, 2020, http://opiniojuris.org/2020/10/05/ai-partnership-for-defense-is-a-step-in-the-right-direction-but-will-face-challenges/.

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