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A Future European Union 'Quantum Act'? Critical Lessons from the Global AI Governance Debate

ABSTRACT: The year 2025 was officially designated by the United Nations as International Year of Quantum Science and Technology (IYQ) to commemorate the 100 years since the initial formulation of quantum theories. In July 2025, the European Union (EU) released its 'Quantum Europe Strategy: Quantum Europe in a Changing World', which recognizes that 'today we stand at an inflection point, as the global race to harness quantum technologies accelerates, moving beyond the labs and entering real-world applications'. The same strategy also includes the goal to present a proposal for an EU Quantum Act in 2026, similar to the draft AI Act first released in 2021. With many more countries preparing quantum strategies or laws and working on quantum technologies, the terminology of a 'regulatory race' is reminiscent of the language used in the current global artificial intelligence (AI) debate. Debates about AI have revealed several critical shortcomings that have hindered the development of consistent and adequate legal frameworks governing AI and related technologies at the national, regional and global levels. This article seeks to point out the major shortcomings underlying the present AI governance and regulatory debates and identify the lessons that can be learned for future regulatory debates on quantum technologies and a possible draft 'EU Quantum Act'. In essence, it argues that it is necessary to first develop 'quantum intelligence' or 'quantum literacy'—understood as the conceptual and cognitive skills adequate to the challenges posed by quantum technologies—before adopting new laws.

KEYWORDS: EU Quantum Act, Quantum Revolutions, Quantum Technologies, Global AI Governance Debate, EU AI Act, Space-Time, Future of Law

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I. INTRODUCTION

Those who are not shocked when they first come across quantum theory cannot possibly have understood it.
Niels Bohr[1]

The year 2025 was designated as the International Year of Quantum Science and Technology (IYQ) by the United Nations General Assembly (UNGA) in order to recognize 'the 100th anniversary of the development of the methods of quantum mechanics'.[2] In July, the European Union (EU) released its 'Quantum Europe Strategy' to recognize that 'advances in quantum science represent some of the most transformative developments in technological history'.[3] The same strategy also foresees the creation of a EU-level governance framework in the form of a proposal for a Quantum Act to be presented in 2026.[4] Many other jurisdictions have already adopted similar quantum strategies or even binding laws as a means to address the consequences of the development of quantum technologies.[5] The recent rise of quantum technologies has been dated to the beginning of the new millennium and has been termed the 'second quantum revolution'.[6] The second quantum revolution is now starting to achieve the potential promised by the revolutionary theoretical breakthroughs of the first quantum revolution that took place more than 100 years ago, which was said to have given us 'new rules that govern physical reality'.[7]

During the past hundred years, representatives of the so-called 'hard sciences', economists and developers of various new technologies

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[1] Alan A Grometstein, *The Roots of Things: Topics in Quantum Mechanics* (Springer 1999) 4.

[2] United Nations General Assembly (UNGA), 'Resolution adopted by the General Assembly on 7 June 2024: International Year of Quantum Science and Technology, 2025' (19 June 2024) A/RES/78/287.

[3] European Commission, 'Communication from the Commission to the European Parliament and the Council: Quantum Europe Strategy: Quantum Europe in a Changing World', COM (2025) 363 final (2 July 2025) (EU Quantum Strategy).

[4] ibid 4 and 15.

[5] See eg US National Quantum Initiative Act (2018) 132 Stat. 5092 Public Law 115–368 (21 December 2018); See also Government of India, Department of Science & Technology, 'National Quantum Mission (NQM)' <https://dst.gov.in/national-quantum-mission-nqm> accessed 7 November 2025; Cabinet Office of the Government of Japan, 'Quantum Technology Innovation' <https://www8.cao.go.jp/cstp/english/quantum/index.html> accessed 7 November 2025; Singapore National Quantum Office, 'Singapore's National Quantum Strategy' (30 May 2024) <https://nqo.sg/nqs/> accessed 7 November 2025; The State Council of the PRC, 'Quantum Tech, Embodied AI, Biomanufacturing—China Doubles Down on Emerging Industries' (28 December 2024) <https://english.www.gov.cn/news/202412/28/content_WS676f38b1c6d0868f4e8ee534.html> accessed 7 November 2025.

[6] Lars Jaeger, *The Second Quantum Revolution: From Entanglement to Quantum Computing and Other Super-Technologies* (Springer 2018) 13.

[7] Jonathan P Dowling and Gerard J Milburn, 'Quantum Technology: The Second Quantum Revolution' (2003) 361(1809) Philosophical Transactions: Mathematical, Physical and Engineering Sciences 1655, 1674.

have capitalized widely on the seemingly 'spooky at a distance'[8] and 'paradoxical'[9] observations from the quantum world and turned their theories into real-life practical phenomena, as described in the following quote:

> *From modern chemistry to solid state physics, from signal processing to medical imaging systems—today we encounter quantum physics everywhere. We trust its laws when we get into a car (and rely on on-board electronics), power up our computer (which consists of integrated circuits, i.e., electronics based on quantum phenomena), listen to music (CDs are read by lasers, a pure quantum phenomenon), undergo X-ray or MRI scans of our bodies, let ourselves be guided by GPS, or communicate via mobile phone. According to various estimates, between one-quarter and one-half of the gross national product of industrialized nations today is directly or indirectly based on inventions that have their foundation in quantum theory.* [10]

Given the present pace of technological innovation, many more 'spooky technical gadgets' using quantum technologies will soon follow suit and invade markets and lives. Already, there are signs for many promising applications of quantum technologies, such as quantum computers using 'entangled states to perform complex calculations at speeds unattainable by classical computers', quantum communication developing highly secure communication systems, like quantum cryptography, or quantum sensors being used as highly sensitive diagnostic tools with the potential for 'for early and more accurate disease detection, revolutionary imaging techniques, accelerated drug discovery, and the advent of personalised medicine'.[11]

Meanwhile, policymakers and lawmakers—aside from a few notable exceptions—seem far from grasping the implications of this accelerating trend and remain desperately clinging to the 'laws' formulated by the classical physics of the pre-quantum era. They seem to have a blind spot for the fact that relativity theory and quantum physics 'undermined the classical physics and introduced new concepts that not only changed physics but also pervaded and gave shape to the modern culture'.[12] There

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[8] *The Born-Einstein Letters; Correspondence Between Albert Einstein and Max and Hedwig Born From 1916 to 1955* (Walker 1971) 159.

[9] Kelvin J McQueen and Lev Vaidman, 'How the Many Worlds Interpretation Brings Common Sense to Paradoxical Quantum Experiments' in Rik Peels, Jeroen de Ridder and René van Woudenberg (eds), *Scientific Challenges to Common Sense Philosophy* (Routledge 2020) 40.

[10] Jaeger (n 6) 13; Michele Grossi, Alberto Di Meglio and Sofia Vallecors, 'Spooky Quantum Action: From Thought Experiments to Real World Quantum Technology Application' in Marilena Streit-Bianchi and Vittorio Gorini (eds), *New Frontiers in Science in the Era of AI* (Springer 2024) 35, 40.

[11] Michele Grossi, Alberto Di Meglio and Sofia Vallecorsa, 'Spooky Quantum Action: From Thought Experiments to Real World Quantum Technology Application' in Marilena Streit-Bianchi and Vittorio Gorini (eds), *New Frontiers in Science in the Era of AI* (Springer 2024) 35, 41 and 45; Kelvin Mpofu and Patience Mthunzi-Kufa, 'Quantum Technologies Are Coming to Change Your Future (Fast)' (2024) 20(2) Quest 25, 30, <https://hdl.handle.net/10520/ejc-quest-v20-n2-a8> accessed 7 November 2025.

[12] Pedro Pereyra, *Fundamentals of Quantum Physics: Textbook for Students of Science and Engineering* (Springer 2012) 1.

is a lack of consideration for the foundation of law in science,[13] or the 'interrelation between human laws and the laws of nature'.[14] Even if human laws are not be consistent with the laws of nature, humans should at least strive to act consistently with the their own findings as observed and formulated by science.

Thus, while quantum technologies are rapidly advancing to transform the world, prevailing legal understanding and reasoning remain seemingly stuck in a pre-quantum age. The prevalence of outdated modes of (legal) thinking means that there is a serious danger to merely supplant future quantum laws with remodelled versions of existing laws or institutions without adequate creative efforts to foster new modes of legal thinking in line with the scientific foundations on the basis of which new technologies have been developed. Instead, new laws are proposed to regulate novel technologies but they are based on old (and scientifically obsolete) thinking. This trend has already been witnessed in the present hype shaping the public and regulatory debates regarding artificial intelligence (AI) technologies. The same old mistakes are already beginning to emerge in the ideas and language underlying 'new' proposals for an EU Quantum Act. They apply the same terminology of a regulatory race, divide even the entangled global reality of the quantum world into one of 'like- and non-like-minded countries' or propose institutional frameworks merely copy-pasted from the International Atomic Energy Agency or EU AI Office.[15]

The paradoxical and seemingly spooky nature of quantum mechanics—manifested, for instance, in 'no-go theorems' that describe states appearing physically impossible—[16]calls for bolder, more innovative and more comprehensive steps. The future regulation of quantum technologies, it is argued, cannot be achieved by the simple adoption of a new act or a series of new acts compiled from bits and pieces eclectically selected from existing examples. It needs sound preparatory, parallel and, most of all, farther-reaching, efforts, such as to renew a constructive quest for humanity's long-range goals 'in light of the scientific discoveries of

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[13] Roscoe Pound, 'The Foundation of Law' (1961) 10(2) American University Law Review 124, 142.

[14] Gian Marco Solas, 'Interrelation of Human Laws and Laws of Nature? Codification of Sustainable Legal Systems' 2025(2) Journal of Law, Market & Innovation 165.

[15] See eg Mauritz Kop, 'Towards a European Quantum Act: A Two-Pillar Framework for Regulation and Innovation' (2025) arXiv:2509.14262, 1, 11, 19 and 45, <https://doi.org/10.48550/arXiv.2509.14262> accessed 7 November 2025.

[16] See eg Christof Wetterich, *The Probabilistic World: A Fundamental Approach to Quantum Mechanics and Probabilistic Computing* (Springer 2025) 495.

the past few hundred years'.[17] This also implies creative ideas about future multi-level governance models for society matching a networked 'world brain',[18] which shall be accompanied by the gradual realization of 'the necessity and to feel the urgency of forming one single body coextensive with itself'.[19] Last, but not least, it also means the courage to critically question existing patterns of thoughts or biases, to transcend boundaries drawn a long time ago and to train and learn new modes of thinking based on a new logic.

Put simply, these multiple challenges can only be successfully tackled by the development and training of novel cognitive skills. In accordance with the two quantum revolutions, these cognitive skills are called 'quantum intelligence', which has been said to entail the following:

> *The journey of quantum intelligence is an invitation to embark on a transformative odyssey, where we transcend the limitations of our current existence and step into the boundless realm of possibility.* [20]

Aiming to transform the present states of uncertainty into possibility, this article aims to highlight the various shortcomings in the present global AI governance to avoid similar errors being made and more valuable time being lost in addressing the opportunities and risks related to quantum technologies. Future quantum technologies are expected to bring even more unprecedented transformations to the world, more revolutionary than those of 'the agrarian, industrial, and computer revolutions combined'.[21] Most of all, this article criticizes the dominant narrative of the debate to ensure that, unlike the way in which the global AI governance debate evolved, the coming regulatory debates on quantum technologies will be based on a strong 'quantum literacy' or well-informed public. These conditions are necessary to guarantee that the future regulation of quantum technologies will be met by adequate legal instruments and institutional frameworks, *before* their derivative products hit the markets.

To this end, the article first sheds light on the current status quo of quantum technologies and advocates for the gradual emergence of a global discussion of a future 'quantum law' (Section 2). To this end, it draws lessons from the flawed narrative dominating the AI debates and the missed opportunities arising from this (Section 3). The next section uses the European Union to further exemplify the serious consequences

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[17] Gerald Feinberg, *The Prometheus Project: Mankind's Search for Long-Range Goals* (Garden City 1968) 13.

[18] Herbert G Wells, *World Brain* (MIT Press 2021).

[19] Pierre Teilhard de Chardin, *Activation of Energy* (A Harvest Book 1978) 15.

[20] Pasquale De Marco, *The Quantum Intelligence* (Pasquale De Marco 2025) 166.

[21] Hilary G Escajeda, 'The Vitruvian Lawyer: How to Thrive in an Era of AI and Quantum Technologies' (2020) 29(3) Kansas Journal of Law & Public Policy 421.

of obsolete modes of thinking about, and framing, legal problems, as the EU's unique role as a supranational organization also allows its findings to be applied, mutatis mutandis, to the present international legal system (Section 4). Finally, the article offers a brief outlook on the legal preparations that should be undertaken in law and legal thinking under the banner of 'quantum literacy' or, more broadly, 'quantum intelligence'. In clear distinction from the term 'AI', quantum intelligence should not be understood as a form of super-intelligent technology, as the uncritical use of the term 'AI' often suggests. It is indeed understood as a 'transformative journey', but one that seeks to close the present gap between human-made laws and the laws of nature in order to successfully tackle the regulatory challenges arising from the transformative and disruptive effects of quantum technologies (Section 5).

II. THE FUTURE REGULATION OF QUANTUM TECHNOLOGIES: ANOTHER GLOBAL RACE?

There are numerous reasons why the status quo of the regulation of quantum technologies is best described by the common adage 'the future is now'. It has also been called the 'next big thing'[22] and described as a 'quantum race' that will reshape war, peace and the world order in the twenty-first century.[23] The reason is that knowledge of the quantum world is already more than a century old, as is recognized by the year 2025 being called the IYQ. The related United Nations General Assembly resolution stresses that quantum science and technology, particularly through 'global cooperation, awareness and education', is capable of addressing some of the most important global governance challenges, and helping to improve 'the quality of life in countries around the world'.[24] Similarly, in close alignment with relativity theory, the UN Summit of the Future acknowledged the need to understand 'the interconnectedness of past, present and future' in efforts to 'ensure a more sustainable, just and equitable world for present and future generations'.[25] For reasons that seem illogical—or perhaps symptomatic for the fragmentation of the presented international legal system—other outcome documents from the

[22] Gary Marchant and others, 'Learning from Emerging Technology Governance for Guiding Quantum Technology' (2025) 31(2) Richmond Journal of Law & Technology 266, 267.

[23] James Der Derian and Stuart Rollo, '"Quantum 3.0": What Will It Mean for War, Peace, and World Order?' (2024) 5(1) Global Perspectives 1, 1 <https://doi.org/10.1525/gp.2024.93888>.

[24] UNGA (n 2).

[25] United Nations, 'Pact for the Future' (October 2024) <https://www.un.org/sites/un2.un.org/files/sotf-pact-for-the-future-December k.pdf> accessed 7 November 2025.

same summit, such as the *Pact for the Future, the Global Digital Compact, and the Declaration on Future Generations*,[26] remain completely silent on quantum technologies and solely focus on AI and related technologies.[27]

Even if one argued that the future is not here yet, it is approaching at a breakneck and still accelerating speed. The acceleration of change is reflected in the denotation of the present era as the Anthropocene, or a period in which humans have become the dominant force shaping the Earth's ecosystems,[28] which is also referred to as the 'great acceleration'.[29] At this point in history, the level of global cooperation in a number of fields, such as climate change, technology in general as well as quantum technologies in particular will largely determine 'whether Homo sapiens can navigate the challenges of the Anthropocene successfully'.[30] Already, the acceleration of change and its effects are being noted everywhere.[31] The global effects have been said to be experienced as a psychobiological condition or as a 'future shock', with change being its disease.[32] The description of change as a disease matches the connection between the acceleration of change and a rise in the use of oxymora and paradoxes as the linguistic symptoms through which the trauma of the future shock manifests itself.[33] The linguistic rise of oxymora (eg AI, virtual reality, or synthetic biology), portmanteau words (eg nutriceutics) and paradoxes (eg privacy paradox) is strongly correlated with the ongoing trends of technological convergence.[34] These rhetorical figures of speech account for the fact that former classifications and lines of distinctions are becoming increasingly blurred. More profoundly still, they pose significant challenges, which is why they warrant a new mind set and a

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[26] United Nations, 'Summit of the Future Outcome Documents: Pact for the Future, Global Digital Compact and Declaration on Future Generations' (September 2024) <https://www.un.org/sites/un2.un.org/files/sotf-pact_for_the_future_adopted.pdf> accessed 7 November 2025.

[27] See also AI Advisory Board, 'Governing AI for Humanity: Final Report' (United Nations 2024) 8.

[28] Will Steffen and others, 'The Anthropocene: Conceptual and Historical Perspectives' (2011) 369(1938) Philosophical Transactions of the Royal Society 842, 843.

[29] Will Steffen and others, 'The Trajectory of the Anthropocene: The Great Acceleration' (2015) 2(1) The Anthropocene Review 81, 82.

[30] Sangaralingam Ramesh, *The Political Economy of Contemporary Human Civilisation, Volume II: From Quantum Computing and Nuclear Fusion to War and Conflict* (Palgrave Macmillan 2025) 299.

[31] James Gleick, Faster: *The Acceleration of Just About Everything* (Vintage Books 2000) 6; Hartmut Rosa, *Social Acceleration: A New Theory of Modernity* (Columbia University Press 2013) 97–99.

[32] Alvin Toffler, *Future Shock* (Pan Books 1971) 12 and 19.

[33] Rostam J Neuwirth, L*aw in the Time of Oxymora: A Synaesthesia of Language, Logic and Law* (Routledge 2018) xiii; See also Rosalie Littell Colie, *Paradoxia Epidemica: The Renaissance Tradition of Paradox* (Princeton University Press 1966) 508.

[34] Rostam J Neuwirth, 'Essentially Oxymoronic Concepts' (2013) 2(2) Global Journal of Comparative Law 147, 152.

closer consideration of science in law backed by more transdisciplinary research.[35]

Both trends, change and its acceleration, have long affected, if not driven, the field of law. Change has repeatedly been identified as a fundamental problem for law, and the rule of law in particular.[36] Its acceleration, notably in the form of a faster pace of technological innovation, continues to add new concrete problems of regulation, such as an urgent need for laws to be better future-proofed as a way to contain the resulting disruptive effects and uphold the rule of law. Convergence adds to this fundamental problem as it challenges existing legal classifications, categories, and concepts.[37] In the wake of the digital revolution, various novel convergence products, from minivans to ebooks, and from cosmeceuticals to the smartphone, have rendered numerous former legal classifications obsolete. The fact that these new technologies are often described by way of oxymora[38] creates concrete conceptual problems for their legal qualification, as regards their tariffication and their classification as a good or a service, a personal car or a van, a cosmetic or a medicinal product, and so on.[39]

The latest addition to the serious legal challenges posed by convergence products is derived from various smart technologies, such as those of AI or large language models. A recent WTO report on AI and large language models also indirectly recognized these problems by noting the 'broad spectrum of technologies with numerous applications', such as 'general-purpose technology'.[40] AI technologies in combination with virtual, augmented or extended realities (VR, AR, or XR), which are also already

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[35] Richard Huggett and Raymond M Lee, 'Problems and Prospects of Portmanteau Titles and Other Neologisms for Interface Disciplines in the Earth and Life Sciences' (2024) 48(4) Progress in Physical Geography 551.

[36] International Court of Justice, *North Sea Continental Shelf*, [1969] ICJ Rep 3; Manfred Lachs, 'Thoughts on Science, Technology and World Law' (1992) 86(4) The American Journal of International Law 673, 698; Mark L Johnson, 'Mind, Metaphor, Law' (2007) 58(3) Mercer Law Review 845, 845.

[37] Sang M Lee and David L Olson, *Convergenomics: Strategic Innovation in the Convergence Era* (Gower 2010); Iris Eisenberger, 'Technik der Grundrechte—Grundrechte der Technik' in Michael Holoubek, Andrea Martin and Stephan Schwarzer (eds), *Die Zukunft der Verfassung–Die Verfassung der Zukunft? FS Karl Korinek* (Springer 2010) 115, 127 ff.

[38] Rostam J Neuwirth, 'The "Letter" and "Spirit" of Comparative Law in the Time of "Artificial Intelligence" and other Oxymora' (2020) 26(1) Canterbury Law Review 1.

[39] Rostam J Neuwirth, 'Global Market Integration and the Creative Economy: The Paradox of Industry Convergence and Regulatory Divergence' (2015) 18(1) Journal of International Economic Law 21, 31 and 41; Rostam J Neuwirth, 'The WTO in the Digital Age of Artificial Intelligence and the Future of Global Trade Governance: Some Fundamental Considerations' in Massimo Durante and Ugo Pagallo (eds), *The De Gruyter Handbook on Law and Digital Technologies* (De Gruyter 2025) 123, 131–33.

[40] WTO, 'Trading with Intelligence: How AI Shapes and Is Shaped by International Trade' (November 2024) 14–15.

intertwined in a process of mutual fusion with the Internet of Things or robotics, will carry this process further and intensify the problems.[41] Robotics has already been identified as an emerging area of research and brought into contact with quantum technologies.[42] As the next big step, AI and other existing technologies will converge with quantum technologies, resulting in 'accelerated growth effects in technological evolution'.[43] Already, the relation between quantum computing and AI technologies has been characterized as 'a ground-breaking intersection that promises unparalleled computational prowess and advanced intelligence' which 'holds transformative potential for a multitude of sectors, collectively encapsulated under the Industry 4.0 umbrella'.[44] As an example, quantum computing has been said to have the potential to render AI even more efficient but in some ways also more disturbing, which underscores the urgent need to ponder different ways 'to control any side effects of the powerful technologies we will have to deal with in the future'.[45]

Overall, the present state of technological development and convergence between different sectors, industries and technologies has been aptly summarized as follows:

> *The number of research fields developed by leaps and bounds, and they all exchanged more and more ideas with each other ranging from new quantum technologies to optimisation algorithms, from nanochemistry to reproductive genetics, from artificial intelligence to robotics, from atomic physics in imaging techniques to brain and consciousness research. Countless fields of science are today closely intertwined in a very complex way; together they form a perfect breeding ground for the emergence of new key technologies.*[46]

In their mutual creative combination, these technologies, and quantum technologies in particular, will accelerate the pace of change and amplify the disruptive effects already felt since the advent of digitization and AI technologies.[47] To best prepare for the future developments in the field of quantum technologies through law and regulation, a closer look at the present debate about the definition and status quo of the term 'quantum

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[41] Vladimir Geroimenko (ed), *Augmented Reality and Artificial Intelligence: The Fusion of Advanced Technologies* (Springer 2023).

[42] Prateek Tandon and others (eds), *Quantum Robotics: A Primer on Current Science and Future Perspectives* (Morgan & Claypool 2017) 1–2.

[43] Mario Coccia, 'Converging Artificial Intelligence and Quantum Technologies: Accelerated Growth Effects in Technological Evolution' (2024) 12(5) Technologies 1.

[44] Meng-Leong How and Sin-Mei Cheah, 'Forging the Future: Strategic Approaches to Quantum AI: Integration for Industry Transformation' (2024) 5 AI 290, 290.

[45] Carmine Granata, *A Journey into Modern Physics: From Relativity to Quantum Technologies* (Springer 2025) 167.

[46] Lars Jaeger, 'History of Technology and Its Future in the Context of Human Development' in Herman Bril, Georg Kell and Andreas Rasche (eds), *Sustainability, Technology, and Finance: Rethinking How Markets Integrate ESG* (Routledge 2022) 25.

[47] Mario Coccia, 'Disruptive Innovations in Quantum Technologies for Social Change' (2022) 9(1) Journal of Economics Bibliography 21, 22.

technologies' is also required.

A. Conceptual Challenges Posed by Quantum Technologies

The profound and truly universal nature of the findings of the first quantum revolution make them potentially relevant for all areas of human thought and action. This is already reflected in their growing relevance for a wide range of scientific fields, such as biology,[48] 'philosophy',[49] 'psychology',[50] and even 'theology',[51] to mention but a few. The multifaceted aspects of quantum theories are now being rapidly translated into quantum technologies, and are expected to be more powerful than their classical counterparts.[52] This fact exacerbates the existing difficulties in defining or confining quantum technologies. Most research initiatives, like the recent EU Quantum Strategy, identify, as the most promising technological fields, those of 1) quantum computing, 2) quantum communication, and 3) quantum sensing.[53] The EU strategy, which also aims to propose a draft EU Quantum Act in 2026, does not define 'quantum technologies'. Instead, it offers the following superficial, illustrative list of quantum technologies that are beginning to make their impact felt:

> *From Magnetic Resonance Imaging (MRI) scanners in healthcare and material advances in energy, to gravimeter sensors for geophysics and navigation, secure communications, and quantum computing solving complex problems in logistics and finance, these breakthroughs are beginning to reshape key industries and societal infrastructure.* [54]

Complementing the list, the EU Quantum Strategy, published in July 2025, equally provides a few wider array of considerations by singling out the following five interconnected areas:

> • ***Area 1 Research and Innovation****: Consolidating excellence across Europe to lead in quantum science and its industrial transformation.*
> • ***Area 2 Quantum Infrastructures:*** *Developing sustainable, scalable, coordinated infrastructure hubs to support production, design, and application development.*
> • ***Area 3 Strengthening the EU Quantum Ecosystem:*** *Securing supply chains and the industrialisation of*

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[48] Markus Arndt, Thomas Juffmann and Vlatko Vedral, 'Quantum Physics Meets Biology' (2009) 3(6) HFSP Journal 386, 397.

[49] Alfred Landé, 'Quantum Physics and Philosophy' (1958) 27(3) Current Science 81; Alberto Cordero, *Philosophers Look at Quantum Mechanics* (Springer Nature 2019).

[50] Daniel M Campagne, 'Quantum Physics and the Future of Psychology' (2019) 40(3/4) The Journal of Mind and Behavior 213.

[51] John C Polkinghorne, Quantum Physics and Theology: An Unexpected Kinship (Yale University Press 2007).

[52] Ryota Katsumi, Yasutomo Ota and Mohamed Benyoucef, 'Telecom-Band Quantum Dots Compatible with Silicon Photonics for Photonic Quantum Applications' (2024) 8(2) Advanced Quantum Technologies 1.

[53] EU Quantum Strategy (n 3) 5–11.

[54] ibid 1.

quantum technologies through investments in startups and scaleups.
*• **Area 4 Space and Dual-Use Potential Quantum Technologies (Security and Defence):** Integrating secure, sovereign quantum capabilities into Europe's space, security and defence strategies.*
*• **Area 5 Quantum Skills:** Building a diverse, world-class workforce through coordinated agile education.* [55]

In the recent debates, there had already been wider taxonomies been proposed, such as the fields of 'quantum simulation, quantum sensing and metrology, quantum computation, and quantum communication'.[56] However, there are great terminological disparities found in the different national quantum strategies. A strategy from the United States, for instance, uses the term 'quantum information science', which it defines as the application of 'the best understanding of the sub-atomic world—quantum theory—to generate new knowledge and technologies'.[57] No definition of quantum technologies can be found in this document, but national security and economic growth are identified as the priority goals.[58] A related law, the National Quantum Initiative Act, adopts similar language when it seeks to support research in 'quantum information science and its technology applications'.[59]

The present five year plan (2021–2025) of the People's Republic of China (PRC) merely mentions quantum computing together with aerospace, biotech, neuroscience, artificial intelligence, and semiconductors as priority areas of innovation for the goal of modernization.[60] In concretizing the goals, another document widely uses the term 'quantum information'.[61] A recent Action Plan to Develop Informatization Standards (2024–2027) stipulates that 'research shall be conducted on key technical standards for quantum computing, quantum communication, and quantum measurement'.[62] Singapore has also adopted several national-level quantum programs to drive research activities in the three areas of 1) 'quantum communication

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[55] ibid 2.

[56] Mateo Aboy, Timo Minssen and Mauritz Kop, 'Mapping the Patent Landscape of Quantum Technologies: Patenting Trends, Innovation and Policy Implications' (2022) 53 International Review of Intellectual Property and Competition Law 853, 853.

[57] United States National Science & Technology Council, 'National Strategic Overview for Quantum Information Science' (September 2018) <https://www.quantum.gov/wp-content/uploads/2020/10/2018_NSTC_National_Strategic_Overview_QIS.pdf> accessed 7 November 2025.

[58] ibid 11; See also Government of the United States (US), Office of the President (2025), Executive Order 14306 of June 6, 2025, 90 Fed Reg 111.

[59] US National Quantum Initiative Act (2018) 132 Stat. 5092 Public Law 115–368 (21 December 2018).

[60] Asian Development Bank, *The 14th Five-Year Plan of the People's Republic of China—Fostering High-Quality Development* (Asian Development Bank 2021) 3.

[61] See 'Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035' <https://cset.georgetown.edu/wp-content/uploads/t0284_14th_Five_Year_Plan_EN.pdf> accessed 7 November 2025.

[62] See 'Action Plan to Develop Informatization Standards (2024–2027)' <https://www.lawinfochina.com/display.aspx?id=43086&lib=law> accessed 7 November 2025.

and security', 2) 'quantum processor, computation and simulation', and 3) 'quantum sensing and metrology'.[63]

Overall, among various several stakeholders, quantum computing currently appears to be prioritized as the most important future quantum technology. This can also be seen from a related report released by the World Economic Forum (WEF) in 2022, which predicts that quantum computers will give rise to a new 'information-processing paradigm' through their ability to harness the fundamental principles of quantum physics.[64] The WEF report remains fairly general and proposes seven governance principles for quantum computing, which include the need for quantum computing to serve the 'common good' of humanity, to ensure 'human accountability', to secure 'inclusiveness' by way of a dialogue involving a truly diverse range of stakeholder perspectives, to pursue 'equitability' as a means to guarantee the fair and even distribution of quantum computing-based technologies, and to safeguard the 'non-maleficence', 'accessibility', and 'transparency' of quantum computing technology.[65]

The interconnectedness and accelerating pace of convergence between existing technologies makes it increasingly difficult for the law to arrive at a comprehensive and yet concise definition of them. The same questions will only reach greater relevance in the context of quantum technologies. Thus far, the term 'quantum technologies' can be regarded as an essentially contested concept,[66] which, however, requires clarification through constructive debates about their characteristics, risks and impacts. At present, and in view of the variety of conflicting interests in and classifications of technologies, it is likely to be best to adopt a broad and open-ended definition for future regulatory debates too. As a useful working definition, a quantum technology has been defined as a technology that 'harnesses quantum mechanical effects for its core operation'.[67] Similarly, these technologies have been defined by 'their ability to harness quantum mechanical effects in order to achieve performances that cannot be attained within the boundaries of classical

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[63] Singapore National Quantum Office, 'Singapore's National Quantum Strategy' (30 May 2024) <https://nqo.sg/programmes/> accessed 7 November 2025.

[64] World Economic Forum, 'Quantum Computing Governance Principles: Insight Report' (January 2022) 4.

[65] ibid 9.

[66] Walter B Gallie, 'Essentially Contested Concepts' (1956) 56 Proceedings of the Aristotelian Society 167.

[67] Jeremy L O'Brien, Akira Furusawa & Jelena Vučković, 'Photonic Quantum Technologies' (2009) 3 Nature Photon 687, 687.

physics'.[68] One proposal for a more restrictive definition of quantum technologies was formulated as 'the ability to harness purely quantum-mechanical phenomena to obtain a qualitative advantage over other technologies in performing certain tasks'.[69]

Spending too much time seeking a definition of quantum technologies seems a waste of time. Instead, it is important to engage in wide and inclusive debates in order to develop a 'common language' and to take preparatory steps so that a wide consensus can emerge in the future and in a future global legal order.[70] In this process, questions about the definition, meaning and scope of quantum technologies must be carefully weighed against the proposed regulatory approaches. Combinations of different regulatory approaches should be considered, as there is not merely an exclusive choice between a comprehensive (horizontal) and a sectoral (vertical) approach, or between a top-down and a bottom-up one. Instead, middle ways should also be considered.[71] Better still, entirely new models of governance need to be formulated in the context of increasing complexity and faster change, which—as indicated by the rise of oxymora—should seek a greater union of the senses to combine different approaches on the basis of their complementarity.[72] These are considered important preconditions for the successful bridging of the divide in global AI and quantum regulations in order 'to materialize a globally interoperable regulatory framework'.[73]

This regulatory balancing act has been known about for a long time, from the regulation of digital products to AI technologies.[74] Overall, the two major revolutionary theories introduced by physicists in the early

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[68] Iñigo Liberal and Richard W Ziolkowski, 'Quantum Antenna Arrays' in Y Jay Guo and Richard W Ziolkowski (eds), *Antenna and Array Technologies for Future Wireless Ecosystems* (Wiley 2022) 419.

[69] Iulia Georgescu and Franco Nori, 'Quantum Technologies: An Old New Story' (2012) 25(05) Physics World 15, 16.

[70] Andrew Halpin and Volker Roeben, 'Introduction' in Andrew Halpin and Volker Roeben (eds), *Theorising the Global Legal Order* (Hart 2009) 6.

[71] See eg Ugo Pagallo, Pompeu Casanovas and Robert Madelin, 'The Middle-Out Approach: Assessing Models of Legal Governance in Data Protection, Artificial Intelligence, and the Web of Data' (2019) 7(1) The Theory and Practice of Legislation 1, 1.

[72] See also Rostam J Neuwirth, 'Law, Artificial Intelligence, and Synaesthesia' (2024) 39(3) AI & Society 901, 906.

[73] Sangchul Park, 'Bridging the Global Divide in AI Regulation: A Proposal for a Contextual, Coherent, and Commensurable Framework' (2024) 33(2) Washington International Law Journal 216, 220.

[74] Rostam J Neuwirth, 'The "Culture and Trade Debate" Continues: The UNESCO Convention in Light of the WTO Reports in China–Publications and Audiovisual Products: Between Amnesia or Déjà Vu?' (2010) 44(6) Journal of World Trade 1333, 1335; Iris Eisenberger, *Innovation im Recht* (Verlag Österreich 2016); Rostam J Neuwirth, 'Prohibited Artificial Intelligence Practices in the Proposed EU Artificial Intelligence Act (AIA)' (2023) 48 Computer Law & Security Review 1, 2.

twentieth century, namely relativity and quantum theory,[75] strongly suggest that there is also a need to fundamentally rethink the nature, role and foundations of law for the future. In this regard, the narrower field of quantum computing technology was alone predicted to enhance the possibilities of the emerging field of computational law.[76] However, the implications of the quantum revolution for the future of law are wider, as was aptly summarized in the following paragraph:

> *Quantum logic, quantum algorithms, and quantum computing—together with our now well-established quantum understanding of the universe—can trigger quantum imaginings of law, opening up new possibilities for quantum rules, quantum adjudication, and quantum order.* [77]

Based on the available information, it is safe to argue that there will need to be more than just new laws added to an already overly complex legal system. Based on the quantum phenomena of entanglement and non-locality, it is accurate to state that, the quantum era will require entirely new philosophies.[78] However, it does not suffice to talk or philosophize about them but they need to be actively prepared by novel modes of thinking. For law, it means that a whole new dimension of legal thinking and especially 'legal imagination' will be required to effectively address the 'new legal, ethical, and distributional challenges' deriving from quantum phenomena.[79]

This legal imagination must be able to cope with the profound spooky, paradoxical and 'shocking' nature of quantum theories, which manifest themselves especially in the phenomena of quantum entanglement, superposition and non-locality. The quantum revolutions have created a reality, in both theoretical and practical terms, in which it no longer suffices merely to adopt new laws dedicated to the regulation of quantum technologies alone. Evidently, it will take a more radical effort, one that adapts the entire legal system to the new realities shaping the future political, economic, and social order. To tackle such a gargantuan task of holistic legislative and institutional reform, the law is required to integrate the latest scientific findings into the process of legal thinking. To put it simply, for an adequate 'quantum law' to emerge, it will not suffice to adopt new laws based on old thinking; instead, new modes of thinking supportive of quantum knowledge and skills will need to be promoted. Such quantum skills, however, should not merely be regarded as a means

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[75] Richard Healey, *The Quantum Revolution in Philosophy* (OUP 2017) 1.

[76] Jeffery Atik and Valentin Jeutner, 'Quantum Computing and Computational Law' (2021) 13(2) Law, Innovation and Technology 302, 302.

[77] Jeffery Atik, 'Quantum Computing and the Legal Imagination' (2022) 39(4) GP Solo 60, 60.

[78] Kop, 'Towards a European Quantum Act (n 15) 54–56.

[79] Atik (n 77) 60.

to nurture a competitive and future-ready workforce.[80] To the contrary, quantum skills leading to quantum intelligence should allow for the democratic role of education in any society.[81] In this regard, a warning has been given that various '[U]ses of quantum sensing and computing to govern human activity could displace democratic processes and become laws unto themselves'.[82] As it is well known that technological progress never automatically benefits everyone in a society,[83] it is necessary to nurture an informed citizenship who are capable of tackling democratic transformations and global challenges such as those posed by the quantum revolutions.[84] This is equally a prerequisite for the formulation and adoption of a new field of law called 'quantum law'. It is an area of law that is not simply limited to the regulation of quantum technologies.

B. The Emergence of 'Quantum Law'?

Although quantum technologies may still be in a nascent stage, there exist a few pioneering works that propose addressing the imminent regulatory challenges posed by the two quantum revolutions under the notion of 'quantum law'. The first feature of the emerging quantum law is its universal and ubiquitous nature. This leads to the need to regulate various matters regardless of location, which requires a rethinking of the 'concepts of how to construct and sustain the rule of law in order to achieve and preserve civil, social order within a digitally wired, global human population'.[85] Applied to the issue of legal enforcement, it has been predicted that, in the future, quantum law compliance would be not judged, but measured.[86] This difference is, in my view, not meant to be taken literally, but rather read as to serve as a reminder that the entire perception of space and time is already changing. The change was observed by a recorded feeling of a shrinking time or 'differential collapse in time-

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[80] Ling Li, 'Reskilling and Upskilling the Future-ready Workforce for Industry 4.0 and Beyond' (2024) 26 Information Systems Frontiers 1697.

[81] John Dewey, *Democracy and Education: An Introduction to the Philosophy of Education* (Macmillan 1923).

[82] Chris Jay Hoofnagle and Simson L Garfinkel, *Law and Policy for the Quantum Age* (CUP 2021) 350.

[83] Daron Acemoglu and Simon Johnson, *Power and Progress: Our Thousand-Year Struggle Over Technology and Prosperity* (PublicAffairs 2023) 4–5.

[84] Tetyana Hoggan-Kloubert and others, 'Civic Lifelong Education: Fostering Informed Citizenship Amidst Global Challenges and Democratic Transformations' (2023) 42(4) International Journal of Lifelong Education 335.

[85] Jeffrey Ritter, 'The Birth of Quantum Law: A Concept Paper' (2015) 2 <https://doi.org/10.13140/RG.2.1.4263.7285>.

[86] ibid.

space' as a result of faster transportation.[87] The internet, cyberspace, or virtual reality can also be seen as tools to alter perceptions of space and time, for instance by creating a sense of a ubiquitous, non-local conscious presence in real-time.

Equally, quantum law has been referred to as the 'law of the future' and defined as the 'study of quantum phenomena and features of quantum technologies determining the risks and challenges associated with the emergence of these technologies'.[88] Another commentator has described quantum law as covering 'the legal issues and challenges that stem from the unique properties and capabilities of quantum technologies, as well as the adaptation of legal theories and practices to accommodate these advancements'.[89] So far, the emerging legal commentaries, however, focus on narrower aspects, addressing more specific issues related to individual quantum technologies, such as the protection of privacy. For instance, the ability of quantum computers to efficiently solve complex factorization problems was said to pose 'a threat to current cryptographic systems and, consequently, to the data protection and privacy capabilities they offer'.[90]

Other scholarly writings have focused more on specific quantum technologies as seen from the perspective of existing areas of law. Particular attention has been paid to the issue of cybersecurity, as it is predicted that advances in quantum technologies will affect computing, cryptography and metrology. They will pose new dangers in the form of cyberattacks, broader surveillance, or other factors destabilizing national security.[91] Other specific concerns relate to the impact of quantum computing on data protection and privacy.[92] Quantum technologies have also been discussed in the context of other legal areas, such as intellectual property law and antitrust regulation.[93] In summary, it has been observed that quantum computing affects different areas of law and raises serious

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[87] Richard D Knowles, 'Transport Shaping Space: Differential Collapse in Time–Space' (2006) 14 Journal of Transport Geography 407, 407–408.

[88] Elizaveta A Gromova and Sergey A Petrenko, 'Quantum Law: The Beginning' (2023) 1(1) Journal of Digital Technologies and Law 62, 62.

[89] Islombek Abdikhakimov, 'The Emergence of Quantum Law: Navigating the Intersection of Quantum Computing and Legal Theory' (2024) 2(2) Elektron ilmiy jurnal 49, 50.

[90] See eg Luigi Bruno and Isabella Spano, 'Post-Quantum Encryption and Privacy Regulation: Can the Law Keep Pace with Technology?' (2021) 2021(1) European Journal of Privacy Law & Technologies (EJPLT) 72, 72 and 76.

[91] Walter G Johnson, 'Governance Tools for the Second Quantum Revolution' (2019) 59 (4) Jurimetrics 487, 487.

[92] Bruno and Spano (n 90) 72.

[93] Kaya DeRose, 'Establishing the Legal Framework to Regulate Quantum Computing Technology' (2023) 31(2) Catholic University Journal of Law and Technology 145, 170–71.

ethical considerations.[94] These considerations include but are not limited to increased inequality, the breaking down of current cryptography endangering safe modes of communication, money transfers or the electronic signature of documents.[95] There are, in fact, good reasons why certain advances in quantum applications may pose unacceptable risks, similar or even more serious than those associated with AI systems, such as threats to cognitive liberty, mental privacy and freedom of thought.[96] It was already suggested that similar quantum technologies may also have to be prohibited.[97] Yet, even possible prohibitions of future quantum applications need to be based on a a more profound understanding of human nature, the human senses and formulated based on a new cognitive mindset.[98] For the field of quantum communications, a field offering unparalleled security and efficiency in data transmissions, a global approach based on the comparative method has been recommended.[99]

Lastly, the increasing fusion between AI and quantum technologies will bring about further radical transformations, the effects of which have been described as 'fundamental and far-reaching as the discovery of fire'.[100] These effects will also affect the legal profession and their unpredictable consequences underscore the need for the acquisition of new human legal skills.[101] Overall, the effective global regulation of quantum technologies requires more than traditional legal skills. It also requires a sound understanding of the basic principles of the quantum world through training in 'quantum intelligence' for lawyers and everyone.[102] By the same token, future work on quantum law will require the principal elements of quantum physics to be extracted so that their relevance for law in general

[94] Kasim Balarabe, 'Quantum Computing and the Law: Navigating the Legal Implications of a Quantum Leap' (2025) 16(2) European Journal of Risk Regulation 794, 794.

[95] Ronald de Wolf, 'The Potential Impact of Quantum Computers on Society' (2017) 19 Ethics and Information Technology 271, 273.

[96] Rostam J Neuwirth, The EU Artificial Intelligence Act: Regulating Subliminal AI Systems (Routledge 2023) 2 and 101.

[97] Kop, 'Towards a European Quantum Act' (n 15) 61.

[98] Neuwirth, The EU Artificial Intelligence Act (n 96); Neuwirth, 'Prohibited Artificial Intelligence Practices in the Proposed EU Artificial Intelligence Act (AIA)' (n 74); Rostam J Neuwirth, 'Prohibited AI Systems Revisited' in Vera Lúcia Raposo (ed), The European Artificial Intelligence Act: Promises and Perils? (Springer 2025) 131.

[99] Dmitry A Kuleshov, 'The Global Approaches to the Regulation of Quantum Communication' (2023) 4(4) Digital Law Journal 54, 56.

[100] Greg Viggiano, *Convergence: Artificial Intelligence and Quantum Computing: Social, Economic, and Policy Impacts* (Wiley 2023) xi.

[101] Escajeda (n 21).

[102] See eg Mircea-Aurel Niță, 'From Emotional to Spiritual Intelligence in Public Administration' (2014) 56(1) Curentul Juridic–Juridical Current 165, 171; See also Rostam J Neuwirth, *A Quantum of Future Law: AI Technologies, Intelligence Augmentation and Four-Dimensional Thinking* (forthcoming 2026).

and quantum law in particular can be examined. To this end, it is helpful to revisit the present global debate on AI governance in order to draw some important lessons from both its important achievements and its missed opportunities.

III. LESSONS AND MISSED OPPORTUNITIES FROM THE GLOBAL AI GOVERNANCE DEBATE

AI technologies have been around for more than half a century.[103] However, the present global AI governance debate only officially started a couple of years ago. It was likely the European Commission's proposal for a comprehensive AI Act in April 2021 that sparked awareness around the world about the need to address the rising concerns posed by AI technologies.[104] Likely, it is among the AI Act's most important achievements to have raised wider ethical and legal concerns about the serious risks and dangers associated with these emerging technologies. A second achievement was to have dispelled remaining doubts about the ability of various soft law tools, like ethical principles or guidelines, to effectively constrain the potential risks and dangers posed by AI technologies or new technologies in general.[105]

Nevertheless, these soft law tools helped establish the issue of AI technologies as a global concern, as two recommendations released by the OECD in 2019 and UNESCO in 2021 confirmed.[106] The UNESCO Recommendation on the Ethics of Artificial Intelligence was adopted by the 193 UN members and acknowledged the complex challenges posed by AI technologies as follows:

> *Recognizing the profound and dynamic positive and negative impacts of artificial intelligence (AI) on societies, environment, ecosystems and human lives, including the human mind, in part because of the new ways in which its use influences human thinking, interaction and decision-making and affects education, human, social and natural sciences, culture, and communication and information.* [107]

This paragraph fittingly summarizes the complex challenges posed by

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[103] Robert Cordeschi, 'AI Turns Fifty: Revisiting Its Origins' (2007) 21(4–5) Applied Artificial Intelligence 259.

[104] Commission, 'Proposal for a Regulation Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act)', COM (2021) 206 final.

[105] Brent Mittelstadt, 'Principles Alone Cannot Guarantee Ethical AI' (2019) 1(11) Nature Machine Intelligence 501 <https://doi.org/10.1038/s42256-019-0114-4>, and Luke Munn, 'The Uselessness of AI Ethics' (2023) 3 AI Ethics 869 <https://doi.org/10.1007/s43681-022-00209-w>.

[106] Organisation for Economic Co-operation and Development, 'Recommendation on Artificial Intelligence' (OECD 2019) 6 (Recital 5).

[107] United Nations Educational, 'Scientific and Cultural Organization, Recommendation on the Ethics of Artificial Intelligence' (UNESCO 2022) 5 (Recital 1).

AI. It also highlights its profound impact on the human mind. Implicitly, it challenges some of the traditional modes of legal thought, such as dualistic thinking and its frequent use of dichotomies, by recognizing the simultaneous positive and negative impacts of AI, for instance. In this regard, the inadequacy of dualistic thinking can be illustrated by the question whether technologies are neutral. Framed as a dichotomy, this question asks whether technology is good or bad, or morally and politically neutral.[108] In line with the first Kranzberg law of technology, however, the answer is that technology is to be considered as 'neither good nor bad; nor is it neutral'.[109] This means that the question of the neutrality of technologies defies the purely binary logic laid down in the interpretative maxim *expressio unius est exclusio alterius* (the choice of one alternative excludes the other).[110] This is why attempts to apply dualistic thinking to the classification of these technologies into 'good AI' and 'bad AI' are doomed to fail,[111] particularly in view of the growing awareness about the dual-use nature of both AI and quantum technologies.[112] Even before this, dualistic thinking alone proved unable to match the reality of digital products, namely that they could 'conceivably be both a good and service at the same time'.[113] The same kind of thinking is likely to be even less adequate for the new realities created by quantum technologies, given their deep roots in paradoxes. The shortcomings inherent in an exclusively dualistic thinking also appear in other aspects of the present debates, and notably in the flawed narrative of AI governance.

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[108] Boaz Miller, 'Is Technology Value-Neutral?' (2021) 46(1) Science, Technology, & Human Values 53, 53.

[109] Melvin Kranzberg, 'Technology and History: "Kranzberg's Laws"' (1986) 27(3) Technology and Culture 544, 545.

[110] Alexandre Senegacnik, 'Expressio Unius (Est) Exclusio Alterius' in Hélène R Fabri (ed), *Max Planck Encyclopedia of International Procedural Law* (OUP 2018) para 1.

[111] Orly Lobel, 'The Law of AI for Good' (2023) 75(6) Florida Law Review 1073; Andrew W Torrance and Bill Tomlinson, 'Governance of the A.I., by the A.I., and for the A.I.' (2023) 93(1) Mississippi Law Journal 107, 139; Arshin Adib-Moghaddam, *The Myth of Good AI: A Manifesto for Critical Artificial Intelligence* (Manchester UP 2025) 10.

[112] See e.g., Andreas Brenneis, 'Assessing Dual Use Risks in AI Research: Necessity, Challenges and Mitigation Strategies' (2024) 21(2) Research Ethics 302, 303 <https://doi.org/10.1177/17470161241267782>; Michal Krelina, 'Quantum Technology for Military Applications' (2021) 8 EPJ Quantum Technology 1, 1, https://doi.org/10.1140/epjqt/s40507-021-00113-y>.

[113] Neeraj R S, 'Trade Rules for the Digital Economy: Charting New Waters at the WTO' (2019) 18(S1) World Trade Review s121, s122 <https://doi.org/10.1017/S1474745618000423> ; Rostam J Neuwirth, 'Artificial Intelligence in the Digital Economy: Multilateral and Regional Legal Challenges from the Perspective of the Indo-Pacific' (2025) 26(1) The Journal of World Investment & Trade 712, 726 <https://doi.org/10.1163/22119000-12340374>.

A. The Flawed Narrative of AI Governance

The dominant narrative of AI governance around the world has been summarized as one of a 'global race to AI regulation'.[114] Others have even compared the regulation of technologies to a 'battle'.[115] This narrative was driven by the fierce competition in the development of technologies to achieve economic and military supremacy among the leading states and economies.[116] The narrative, however, also disregards some of the fundamental insights about the value of cooperation in economics, as reflected, for instance, in the theory of comparative advantage,[117] which was translated into international trade law through the concept of 'reciprocal and mutually advantageous arrangements'.[118] Overall, there are more and more reasons to expand dualistic reasoning to 'both/and thinking' to navigate polarities, and to adopt 'fuzzy logic' or 'social fuzziology' as a framework for the new millennium.[119] Perhaps dualism is not entirely dead,[120] but it should be complemented by other modes of thinking, such as oxymoronic thinking, dialetheism and polyvalent logic.[121]

The present narrative also disregards the power of language to shape reality. Grossly negligent, it disregards two important facts, namely that language constitutes one of the main media through which law acts and that, in law, language is also a form of power.[122] Consequently, applying divisive, martial or aggressive language will not help in attempts to find global consensus on a variety of urgent global issues. Aggressive language, even if applied subliminally, is known to result in significantly

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[114] Nathalie A Smuha, 'From a "Race to AI" to a "Race to AI Regulation": Regulatory Competition for Artificial Intelligence' (2021) 13(1) Law, Innovation and Technology 57 <https://doi.org/10.1080/17579961.2021.189830>.

[115] Anu Bradford, *Digital Empires: The Global Battle to Regulate Technology* (OUP 2023).

[116] See e.g., Alfred D Hull and others, 'Why the United States Must Win the Artificial Intelligence (AI) Race' (2022) 7(4) The Cyber Defense Review 143.

[117] T G Williams, *The History of Commerce* (Sir Isaac Pitman & Sons 1926) 1.

[118] Recital 3 of the WTO Agreement, *Marrakesh Agreement Establishing the World Trade Organization*, 15 April 1994, 1867 U.N.T.S. 154, 33 I.L.M. 1144 (1994).

[119] Brian Emerson and Kelly Lewis, *Navigating Polarities: Using Both/And Thinking to Lead Transformation* (Paradoxical Press 2019); Vladimir Dimitrov and Victor Korotkich (eds), Fuzzy Logic: A Framework for the New Millennium (Physica Heidelberg 2013).

[120] Mireille Hildebrandt, 'Dualism is Dead. Long Live Plurality (Instead of Duality)' in Luciano Floridi (ed), *The Onlife Manifesto: Being Human in a Hyperconnected Era* (Springer 2015) 27, 27.

[121] Neuwirth (n 33) 180.

[122] See Brian Bix, *Law, Language, and Legal Determinacy* (Clarendon Press 1993) 1; Pablo Meix Cereceda, *Lenguaje, poder y derecho en la edad de la información* (Iustel 2025) 103.

more aggressive behaviour.[123] It is known, too, that wars start in the minds of humans;[124] hence, war rhetoric likely follows similar dynamics and allows for simplified policy agendas.[125] The same has been recognized for so-called 'engineering metaphors', which helps to explain how the use of language determines final outcomes.[126] The power of metaphors to shape both thoughts and actions has been known for a long time.[127] It is, perhaps, less well known that engineering metaphors have also been found to be useful for ethical and regulatory discourses.[128] When it comes to the establishment of a future global regulatory framework for emerging technologies, the metaphor of a regulatory race therefore proves to be highly destructive, as former examples like the space race or the arms race have shown.[129] In sum, a warning has been given, especially for the military context, that a 'race to use AI to harm will not serve humanity well'.[130]

The terminology of a regulatory race is also based on an incomplete understanding of time in its relation to space and to law. Racing also suggests rushing things, which may be good in sports but rarely leads to optimal outcomes in the field of law. In the regulation of new technologies, timing is crucial and also confronts the paradox reflected

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[123] Robert Cialdini, *Pre-Suasion: A Revolutionary Way to Influence and Persuade* (Simon & Schuster 2016) 357; Alexander Todorov and John A Bargh, 'Automatic Sources of Aggression' (2002) 7 Aggression and Violent Behavior 53, 56; Baptiste Subra and others, 'Automatic Effects of Alcohol and Aggressive Cues on Aggressive Thoughts and Behaviors' (2010) 36(8) Personality and Social Psychology Bulletin 1052, 1055.

[124] Recital 1 of the Preamble of the Constitution of the United Nations Educational, Scientific and Cultural Organization UNESCO, 16 November 1945, 4 U.N.T.S. 275 (entry into force: 4 November 1946).

[125] Lori Hartmann-Mahmud, 'War as Metaphor' (2002) 14(4) Peace Review 427, 427 <https://doi.org/10.1080/1040265022000039213>.

[126] Maarten Boudry and Massimo Pigliucci, 'The Mismeasure of Machine: Synthetic Biology and the Trouble With Engineering Metaphors' (2013) 44 Studies in History and Philosophy of Biological and Biomedical Sciences 660, 660.

[127] George Lakoff and Mark Johnson, *Metaphors We Live By* (University of Chicago Press 1980) 3.

[128] Mark Coeckelbergh, 'Engineering Good: How Engineering Metaphors Help us to Understand the Moral Life and Change Society' (2010) 16 Science and Engineering Ethics 371, 371.

[129] Stuart Armstrong and others, 'Racing to the Precipice: A Model of Artificial Intelligence Development' (2016) 31 AI & Society 201, 201 <https://doi.org/10.1007/s00146-015-0590-y>; Inga Ulnicane, 'Against the New Space Race: Global AI Competition and Cooperation for People' (2023) 38 AI & Society 681, 681 <https://doi.org/10.1007/s00146-022-01423-0>; see also Tiffany C Li, 'Ending the AI Race: Regulatory Collaboration as Critical Counter-Narrative' (2024) 69(5) Villanova Law Review 981, 981.

[130] Denise Garcia, *The AI Military Race: Common Good Governance in the Age of Artificial Intelligence* (OUP 2023) 4.

in both Amara's Law[131] and the Collingridge Dilemma.[132] The dilemma consists of the following challenge:

> *If a technology can be known to have unwanted social effects only when these effects are actually felt, what is needed is some way of retaining the ability to exercise control over a technology even though it may be well developed and extensively used.*[133]

This dilemma can already be observed in the present context of AI regulation, where it gives rise to an operational paradox arising from the growing adoption of Al technologies and 'a growing need for focused direction of Al policy to advance metapolicies addressing issues like increasing geopolitical competitive concerns'.[134] In many ways, the regulation of various AI technologies has arrived or will be adopted too late, as many of their products, like large language models, had already hit the market long before the relevant laws or regulations were in place.[135] The same is likely to happen with quantum technologies unless preparations are made to enhance both quantum literacy and intelligence before regulatory debates begin.

Against the backdrop of rising geopolitical tensions, an ongoing erosion of the multilateral legal system, and growing awareness of the cross-boundary nature of AI technologies, the emphasis should not have been put on a 'global race to regulate AI'; it would be more appropriate to talk instead about joint efforts to 'globally regulate AI'.[136] At the very least, concerted actions, even if only to coordinate the emerging national or supranational laws at the global level, would have been preferable. These trends mark a serious concern, as the same narrative already appears to be being applied to the regulation of quantum technologies. Here, in spite of scientific evidence pointing at their mutual 'economic entanglement', countries are portrayed as trying 'to outcompete each other as they vie for the technology that will shape the future of warfare, information

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[131] Thomas H Davenport, *The AI Advantage: How to Put the Artificial Intelligence Revolution to Work* (MIT Press 2018) 7 ('We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run').

[132] David Collingridge, *The Social Control of Technology* (Frances Pinter 1980) 11.

[133] ibid.

[134] Matthew R Gaske, 'The Operational Paradox of Centralized Artificial Intelligence Regulation' (2024) 2 Michigan State Law Review 367, 367.

[135] See also Iris Eisenberger and Franz Merli, 'Automatisierung, Algorithmen und künstliche Intelligenz in der öffentlichen Verwaltung. Eine Positionsbestimmung' (2023) 31 Journal für Rechtspolitik 25 <https://doi.org/10.33196/jrp202301002501>.

[136] Rostam J Neuwirth, 'The Global Institutional Governance of AI: A Four-Dimensional Perspective' (2024) 1(1) International Journal of Digital Law and Governance 113, 113 <https://doi.org/10.1515/ijdlg-2024-0004>.

technology, and arguably, the new global order'.[137] The 'quantum arms race' has already begun a while ago.[138] A similar concern emerges from the EU Quantum Strategy, which reads:

> *Today we stand at an inflection point, as the global race to harness quantum technologies accelerates, moving beyond the labs and entering real-world applications.*[139]

A coherent and future-proof global coordination of emerging AI and quantum laws and regulations, however, would require the existence of an adequate international institutional framework. In this regard, the necessity to 'disincentivize a quantum arms race' and 'to align quantum advancements with global imperatives such as the UN Sustainable Development Goals (SDG)' has been mentioned.[140] Regrettably, the world is far from addressing the issue of the reform of the international legal system, as this system, which was established in 1945, has barely been reformed or updated since.[141] On the contrary, it is currently even being eroded further.

In this regard, the global debate about the regulation of AI could have prompted new reform initiatives. These new technologies offer many new possibilities, which could also provide a turning point in the history of international law. Instead of merely adding old governance models to a deeply fragmented international legal framework, entirely new governance models should have been considered. For instance, the main suggestions for the institutional global governance of AI relied on proposals for a World AI Organization, modelled on the International Atomic Energy Agency (IAEA) or the Internet Corporation for Assigned Names and Numbers (ICANN) (which would at least recognize that AI

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[137] Isabella Willhite, 'Economic Entanglement: The Quantum Race Between the United States and China' (2024) 1124 Regis University Student Publications 7, 7 <https://epublications.regis.edu/theses/1124> accessed 7 November 2025.

[138] Martin Giles, 'The US and China are in a Quantum Arms Race that Will Transform Warfare', *The MIT Technology Review* (3 January 2019) <https://www.technologyreview.com/2019/01/03/137969/us-china-quantum-arms-race/> accessed 7 November 2025.

[139] EU Quantum Strategy (n 3) 1.

[140] Mauritz Kop, 'Towards an Atomic Agency for Quantum-AI' (2025) arXiv:2505.11515 (physics.soc-ph) 1, 2 <https://doi.org/10.48550/arXiv.2505.11515>.

[141] See e.g., Joost Pauwelyn, 'The Sutherland Report: A Missed Opportunity for Genuine Debate on Trade, Globalization and Reforming the WTO' (2005) 8(2) Journal of International Economic Law 329; Neuwirth (n 136) 124; Oona A Hathaway and others, 'Crisis and Change at the United Nations: Non-Amendment Reform and Institutional Evolution' (2025) 46(1) Michigan Journal of International Law 1, 7.

involves more stakeholders than just sovereign states).[142] Common to most proposals is that they rely primarily on replicating existing governance models or structures. It is surprising that, in spite of network effects of new information technologies, most governance structures remain hierarchical, rather than adopting alternative models such as ovearchy or holarchy.[143] As will be shown below, the debate also generally disregards the application of novel modes of thinking to the institutional governance of new technologies; such novel modes proposes 'fuzzy logic governance' inspired by computer science,[144] or 'four-dimensional thinking' derived from the theory of relativity,[145] for example. Overall, most proposals merely suggest copying and pasting from one legal field to another or from the national or regional to the global level.

Reflecting both the flawed narrative and the absence of efforts to establish a more coherent global legal framework based on inclusive debates in the future is the frequent use of the hegemonic term 'Brussels effect' or its counterparts from 'Washington' or 'Beijing'.[146] This same terminology is already being applied to the emerging debate on quantum technologies, in both substantive and institutional terms.[147] In both cases, this terminology is flawed, as it treats cyberspace, often referred to as a 'placeless place',[148] as if it were strictly contained within national territorial boundaries. In the case of the non-locality or entanglement governing the quantum world, this approach seems even more old-fashioned. The approach should have been made in the spirit of 'persuasive authority' as a means to find the optimal solution to a case or problem.[149] It should not be framed as a race to see who has greatest regulatory power to coerce other jurisdictions into an involuntary acceptance of their domestic or

[142] Olivia J Erdélyi and Judy Goldsmith, 'Regulating Artificial Intelligence: Proposal for a Global Solution' (2018) AIES '18: Proceedings of the 2018 AAAI/ACM Conference on AI, Ethics, and Society 95, 95 <https://doi.org/10.1145/3278721.3278731>; Jacob Turner, *Robot Rules: Regulating Artificial Intelligence* (Palgrave Macmillan 2019) 240–242; Simon Chesterman, 'Weapons of Mass Disruption: Artificial Intelligence and International Law', (2021) 009 NUS Law Working Paper 1 <https://law.nus.edu.sg/wp-content/uploads/2021/05/009_2021_SimonC.pdf> accessed 7 November 2025; Eugenio V Garcia, 'Multilateralism and Artificial Intelligence: What Role for the United Nations?' in Maurizio Tinnirello (ed), *The Global Politics of Artificial Intelligence* (CRC Press 2022) 57, 70.

[143] Hosny A Abbas, 'Exploiting the Overlapping of Higher Order Entities within Multi-Agent Systems' (2014) 6(3) International Journal of Agent Technologies and Systems 32, 35.

[144] Max Parasol, *AI Development and the 'Fuzzy Logic' of Chinese Cyber Security and Data Laws* (CUP 2021) 11.

[145] Neuwirth (n 136) 28.

[146] Anu Bradford, *The Brussels Effect: How the European Union Rules the World* (OUP 2020) 15.

[147] See e.g., Kop (n 140) 1; Kop (n 15) 47.

[148] Pierre Levy, 'Collective Intelligence, a Civilisation: Towards a Method of Positive Interpretation' (2005) 18(3/4) International Journal of Politics, Culture, and Society 189, 197.

[149] H Patrick Glenn, 'Persuasive Authority' (1987) 32 McGill Law Journal 261, 293.

regional standards.

The same mistake was carried over to the optimal regulatory method for AI technologies. Instead of being based on a thorough comparative analysis including the wider regulatory context and vested interests, the discussion largely proceeded by using a superficial and stereotypical classification of the EU, the US and the PRC as following, respectively, a rights-driven, a market-driven, and a state-driven regulatory approach.[150] By contrast, for serious work on a consistent future global regulatory framework a wider analysis is warranted, one which reflects the world's great diversity of legal traditions as a means to bolster the efficiency, legitimacy, and sustainability of the law itself.[151] By the same token, a constructive legal debate requires the consideration of more regulatory options, such as those involving principles, risks, and standards, or else more agile, experimentalist, and enabling approaches.[152] In contrast to the competitive and divisive race narrative, a more thorough comparative analysis would have revealed more commonalities. For instance, it would have shown that the differences in AI regulation between China and the EU are very often merely symbolic or of a temporal kind, in the sense that the former opted for a sectoral approach first while the EU prioritized a comprehensive and horizontal view. Eventually, China may contemplate adopting a more comprehensive AI Code, while the EU may address different AI issues through separate and more specific instruments, such as through the proposal for an AI liability directive (which, however, was later shelved).[153] In China, meanwhile, a second version of a comprehensive draft Model AI Law was circulated in June 2025 for further discussions.[154] Similarly, the development of AI in the US is not operating in a legal void, but shows elements of a decentralized

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[150] Bradford (n 115) 33–145.

[151] H Patrick Glenn, *Legal Traditions of the World: Sustainable Diversity in Law* (3rd edn, OUP 2007) 359.

[152] UNESCO, 'Consultation Paper on AI Regulation: Emerging Approaches Across the World', CI/DIT/2024/CP/01 <https://unesdoc.unesco.org/ark:/48223/pf0000390979> accessed 7 November 2025.

[153] Commission, 'Annexes to the Commission Work Programme 2025', COM (2025) 45 final; See also Guido Noto La Diega and Leonardo C T Bezerra, 'Can There Be Responsible AI Without AI Liability? Incentivizing Generative AI Safety Through Ex-Post Tort Liability Under the EU AI Liability Directive' (2024) 32 International Journal of Law and Information Technology 1, 1 <https://doi.org/10.1093/ijlit/eaae021> accessed 7 November 2025.

[154] Hui Zhou and others, *Model Artificial Intelligence Law 3.0 (MAIL 3.0)* <https://zenodo.org/records/15761453> accessed 7 November 2025.

regulatory landscape with several laws adopted at the state level.[155] In sum, global cooperation should be intensified and more profound comparative studies of the respective legal systems as a whole are needed.[156] In these dialogues, ill-informed and preconceived opinions expressed through contested concepts should be duly avoided and instead new meaning be given to them as the result of the consensus reached through these deliberations.

The present narrative also fails to take into account the wider context in which the law operates. A wider angle reveals that the different national regulatory approaches were motivated not solely by legal and societal considerations, but more often by economic and geopolitical ones. Even a brief look at the history of technology would have helped to give an understanding that new technologies have never instantly and unconditionally (and, most of all, without adequate regulatory actions) brought greater prosperity to all.[157] In this regard, the damage caused by the overemphasis on the so-called 'Brussels', 'Washington', and 'Beijing effects' has already been mentioned. This emphasis has helped to obscure the existence of the more relevant so-called 'Silicon Valley effect'.[158] This term reveals the fact that has been overlooked, namely that the 'most influential Artificial Intelligence ('AI') companies are shaping AI's legal order and regulatory discourse to protect their business interests and shift focus away from how their practices harm human beings'.[159] The capture of regulatory discourses and practices by these companies also explains the past failure of competition rules to prevent the emergence of dominant actors in the field.[160] It may also prevent competition rules, which would ensure equal access to their services for all, being enforced in the future.[161]

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[155] Tatevik Davtyan, 'The U.S. Approach to AI Regulation: Federal Laws, Policies, and Strategies Explained' (2025) 16 Case Western Reserve Journal of Law, Technology & the Internet 223, 248 <https://scholarlycommons.law.case.edu/jolti/vol16/iss2/2> accessed 7 November 2025; Srinivas Parinandi and others, 'Investigating the Politics and Content of Us State Artificial Intelligence Legislation' (2024) 26(2) Business and Politics 240 <https://doi.org/10.1017/bap.2023.40>.

[156] See e.g., Katrin Blasek, *Rule of Law in China: A Comparative Approach* (Springer 2015).

[157] Acemoglu and Johnson (n 83) 4–5.

[158] James Mahoney and Daniel Schensul, 'Historical Context and Path Dependence' in Robert E Goodin and Charles Tilly (eds), *The Oxford Handbook of Contextual Political Analysis* (OUP 2006) 454, 457.

[159] Chinmayi Arun, 'The Silicon Valley Effect' (2025) 61(1) Stanford Journal of International Law 55, 55.

[160] Ernesto Dal Bóm, 'Regulatory Capture: A Review' (2006) 22(2) Oxford Review of Economic Policy 203, 203 <https://doi.org/10.1093/oxrep/grj013>.

[161] See e.g., Max von Thun and Daniel Hanley, 'Stopping Big Tech from Becoming Big AI: A Roadmap for Using Competition Policy to Keep Artificial Intelligence Open for All', *Open Markets Institute* (2024) <http://dx.doi.org/10.2139/ssrn.4990780>.

B. Inadequate Governance Frameworks and Path Dependence

The flawed narrative of the AI governance debate is obviously not only attributable to a single factor, such as the Silicon Valley effect. It is to a large extent 'systemic'. This can possibly explained by a path dependence caused by an inadequate legal and institutional governance framework, which made it difficult to deviate from the established path even if better alternatives existed. Nonetheless, path dependence also has a cognitive dimension.[162] This surfaces, for instance, in the concept of time as it is based on 'the idea that the most important effects of a given event may be 'temporally lagged'—i.e. not initially felt but clearly visible at a later point in time'.[163] So it is necessary to ask what happened, or where the EU took a wrong turn. This is certainly not an easy question to answer, because history, and especially its 'decisive moments', is not the result of a single action (or failure to act) but the result of the 'millions of idle human hours' that must always pass, as Stefan Zweig eloquently wrote.[164]

The quest for the causes of suboptimal outcomes is difficult because such outcomes are usually the result of complex dynamics and cannot easily be attributed to a sole factor. However, one important factor is the decisions made; these decisions are regularly taken at the outset of results just as thoughts precede actions. Decisions, too, operate in complex environments, as they are generally not taken independently from other decisions, are made in a changing environment, and depend on being pursued in a consistent manner over time.[165] Before that, decisions require reliable data and sound information to yield optimal results. With regard to the quality of information, the institutional setting in place is crucial. For this reason, the most serious and likely the principal flaw in the present EU architecture is attributable to the failure of the EU to adopt a constitution and make related reforms. In hindsight, this clearly marks the missed opportunity for a 'constitutional moment'.[166] The replacement of the constitution, the Lisbon Treaty of 2007, is, at best, a sad reminder

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[162] Sabrina Fredin, 'Breaking the Cognitive Dimension of Local Path Dependence: An Entrepreneurial Perspective' (2016) 98(3) Geografiska Annaler: Series B, Human Geography, 239.

[163] Katharina Kausche and Moritz Weiss, 'Platform Power and Regulatory Capture in Digital Governance' (2024) 27(2) Business and Politics <https://doi.org/10.1017/bap.2024.33>; Kevin Wei and others, 'How Do AI Companies "Fine-Tune" Policy? Examining Regulatory Capture in AI Governance' (2024) 7(1) Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society 1539 <https://doi.org/10.1609/aies.v7i1.31745>.

[164] Stefan Zweig, *Decisive Moments in History: Twelve Historical Miniatures* (Ariadne Press 1999) 5.

[165] Berndt Brehmer, 'Dynamic Decision Making: Human Control of Complex Systems' (1992) 81 Acta Psychologica 211, 211.

[166] Jacques Ziller, 'The Constitutionalization of the European Union: Comparative Perspectives' (2009) 55(3) Loyola Law Review 413, 413.

of a 'future that once was' or of many 'roads not taken',, as it would have helped to address the problems of a democratic deficit and the 'no demos' hypothesis, or at least to reverse the growing trends of the degradation of the quality of democracy and the increasing gap between citizens and institutions.[167]

What has ensued since then is a story of lost opportunities: moments when alternative and better options were available but were—for some reason—not taken and therefore missed. The reason is that a constitution is not only of symbolic value, but has a concrete impact on cognition, similar to that of semantic or other primes, such as national flags.[168] Even the symbolic value of constitutions has been found to reveal that 'fundamental political and legal matters are closely integrated with cultural processes related to affective responses and identification'.[169] Constitutions also allow people to disagree, to express differing views or to dissent.[170] Dissent is a safeguard of democracy.[171] However, it is not the only safeguard, and it is one that needs to be placed in a context of seeking consensus based on consent. When applied within a unitary framework allowing equal opportunities to be heard, dissent is a tool for enhancing decision making, because it stimulates original thought and cognitive activity.[172] Most, if not all, conflicts have a cognitive origin, as they are considered to be 'a category of man's mind, not in itself an element of reality'.[173]

These observations can also help to mitigate or resolve conflicts between opposing viewpoints or interests. This function of constitutions and constitutionalism is known from the area of trade regulation under the notion of 'trade and … problems' or the 'trade linkage debate', which seeks to overcome and reconcile trade concerns with what appear to be 'non-trade concerns', such as human rights, environmental protection,

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[167] Cristina Blanco Sío-López, 'The Future that Once Was: 1989, EU's Enlargement and the Free Movement of Persons' in Eleni Braat and Pepijn Corduwener (eds), *1989 and the West: Western Europe since the End of the Cold War* (Routledge 2020) 169, 181.

[168] Ran R Hassin and others, 'Subliminal Exposure to National Flags Affects Political Thought and Behavior' (2007) 104(50) PNAS 19757, 19760.

[169] Terje Rasmussen, *The Sociology of Sovereignty: Politics, Social Transformations and Conceptual Change* (Manchester UP 2003) 9.

[170] *Cf Roe v Wade* 410 US 113, 163-64(1973), stating that '[The Constitution] is made for people of fundamentally differing views …'.

[171] William O Douglas, 'The Dissent: A Safeguard of Democracy' (1948) 32(4) Journal of the American Judicature Society 104.

[172] Charlan Jeanne Nemeth, 'Improving Decision Making by Means of Dissent' (2001) 31(1) Journal of Applied Social Psychology 48, 48–49 <https://doi.org/10.1111/j.1559-1816.2001.tb02481.x>.

[173] Constantin Virgil Negoita, 'Cybernetics and Society' (1982) 11(2) Kybernetes 97, 98.

cultural diversity, or national security.[174] In attempts to reconcile these apparently divergent interests, a 'constitutional moment' has been said to be necessary to allow 'regulatory competition to develop a stable, and efficient, equilibrium'.[175] The problem of such an equilibrium, which is a guarantee of greater coherence in political decision making and greater consistency between different laws and norms, was indirectly addressed by the Maastricht Treaty's inclusion of so-called 'integration or cross-section clauses' as an innovation of, and complement to, exception clauses.[176] Instead of separating different policy areas, these clauses seek to integrate them with a view to obtaining greater policy coherence and avoiding conflicts or unnecessary duplication. Since the failure of the Havana Charter to establish an International Trade Organization in 1947, the same challenge continues to persist globally with regard to the relationship between the WTO regime and the general public international law system established under the United Nations Charter.[177] In this context, 'linkage', seeking ways to reconcile trade with other policies, has become an 'alternative framework for thinking' about the relationship between multiple legal regimes.[178]

Unfortunately, no useful lessons for the regulation of AI technologies were drawn from the earlier challenges posed by the convergence of various industries before and notably since digitization. This is why the regulatory approach to AI today is still largely fragmented along the lines of existing legal fields, such as human rights law, technology law, competition law, and intellectual property law. This fragmented approach clashes with the cross-cutting nature or multi-purpose use of AI, which requires a novel and integrated regulatory approach. Generally, the trend of a brutal 'Act-ification' of EU law means that there are too many specific laws that are far too long and detailed and fail to consider their mutual

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[174] Frank J Garcia, 'The Trade Linkage Phenomenon: Pointing the Way to the Trade Law and Global Social Policy of the 21st Century' (1998) 19(2) University of Pennsylvania Journal of International Economic Law 201; Rostam J Neuwirth, 'WTO and Intellectual Property Law in the Creative Economy' in Julien Chaisse and Cristián Rodríguez-Chiffelle (eds), *The Elgar Companion to the World Trade Organization* (Edward Elgar 2023) 169, 174.

[175] Joel P Trachtman, 'Institutional Linkage: Transcending "Trade and..."' (2002) 96(1) The American Journal of International Law 77, 92.

[176] Robert Lane, 'New Community Competences under the Maastricht Treaty' (1993) 30(5) Common Market Law Review 939; Rostam J Neuwirth, 'The Future of the Culture and Trade Debate: A Legal Outlook' (2013) 47(2) Journal of World Trade 391, 403–05.

[177] ostam J Neuwirth, 'GAIA 2048–A "Glocal Agency in Anthropocene": Cognitive and Institutional Change as "Legal Science Fiction"' in Meredith Kolsky Lewis and others, *A Post-WTO International Legal Order: Utopian, Dystopian and Other Scenarios* (Springer 2020) 71, 73.

[178] Oren Perez, 'Multiple Regimes, Issue Linkage, and International Cooperation: Exploring the Role of the WTO' (2005) 26(4) University of Pennsylvania Journal of International Economic Law 735, 735.

relationship, which makes them prone to conflict or irrelevance.[179]

In this regard, the issue of the global regulation of AI and digital technologies provides a sound argument for constitutionalism, because of the complex, dual-use and cross-cutting nature of AI technologies.[180] Because of their cross-cutting nature, AI technologies also have close links with a long list of other policies, such as those summarized by the Sustainable Development Goals (SDGs), which could also benefit from integration through constitutionalisation.[181] Unfortunately, and paradoxically, the opposite is occurring, as there are currently mutually opposed forces at work. On the one hand, there are centripetal forces in the form of technological convergence and increased concentration and oligopolistic behaviour by corporations, whereas, from a societal and legal perspective, there is a centrifugal force of fragmentation, incoherence and conflict.[182] These mutually opposed trends are aggravated by strong pushes for unilateral renationalization, regionalization, de-coupling and de-globalization.[183]

In short, the former process of European integration has lost its momentum, just as has the wide support for globalization. In Europe, Brexit, meaning the withdrawal of the United Kingdom from the European Union in 2020 following the introduction of a withdrawal clause, not only serves as an example of poor legal draftsmanship[184] but also constituted an open breach of the spirit of the underlying treaties.[185] If one tries to search for the positive out of a mistake, the Brexit crisis could have provided an opportunity by allowing the remaining EU member states to reform the

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[179] Vagelis Papakonstantinou and Paul De Hert, *The Regulation of Digital Technologies in the EU Act-ification, GDPR Mimesis and EU Law Brutality at Play* (Routledge 2024); see also Iris Eisenberger, 'Technology's Self-Governance' in Roger Brownsword and Larry A. DiMatteo (eds), *The Cambridge Handbook of the Governance of Technology* (CUP 2025).

[180] Rostam J Neuwirth, 'The Global Institutional Governance of AI: A Four-Dimensional Perspective' (n 136) 121; Rostam J Neuwirth, 'AI and Related Technologies in the Digital Economy' (n 113) 713.

[181] Xinyan Zhao, *Integrating the UN SDGs into WTO Law* (Springer 2025) 149ff.

[182] Rostam J Neuwirth, 'Global Market Integration and the Creative Economy' (n 39); Ricardo De Querol, *La Gran Fragmentacion* (ARPA 2023); Miguel Del Moral Sanchez, 'The Devil is in the Procedure: Private Enforcement in the DMA and the DSA' (2024) 9(1) University of Bologna Law Review 7, 9 <https://doi.org/10.6092/issn.2531-6133/19638>.

[183] Christian Suter and Patrick Ziltener, 'Towards Deglobalization? Studying World Society in the 21st Century' in Christian Suter and Patrick Ziltener (eds), *After Globalization: The Future of World Society* (LIT 2024) 1; Christian Kreuder-Sonnen and Bernhard Zangl, 'The Politics of IO Authority Transfers: Explaining Informal Internationalisation and Unilateral Renationalisation' (2025) 32(4) Journal of European Public Policy 954, 954 <https://doi.org/10.1080/13501763.2024.2325008>.

[184] Hannes Hofmeister, '"Should I Stay or Should I Go?" — A Critical Analysis of the Right to Withdraw from the EU' (2010) 16(5) European Law Journal 589, 602.

[185] Rostam J Neuwirth, 'The European Union as an Oxymoron: From Contest via Contradiction to Constitution?' in Julien Chaisse (ed), *Sixty Years of European Integration and Global Power Shifts: Perceptions, Interactions and Lessons* (Hart 2019) 51, 64.

EU and bring the constitutional project back on track.[186] Unfortunately, official voices to support a new push for an EU constitution have remained silent.[187] Instead of internal reforms and visionary policies to tackle the current political, economic and social challenges,[188] the EU is actively and effectively seeking to 'rearm' itself.[189] It is doing this instead of seeking global disarmament, exporting peace, and proposing constructive solutions to an intensifying human and planetary crisis. This move means the transformation from a unique supranational project 'furthering and strengthening the works of peace',[190] which was awarded the Nobel Peace Prize in 2012 'for over six decades contributed to the advancement of peace and reconciliation, democracy and human rights in Europe',[191] into a 'war economy' of its own.[192] Once described as an economic giant and military dwarf,[193] the EU seems to be aspiring to become an economic dwarf and military giant, with waning political international weight due to an 'organized hypocrisy and logic of coloniality' vis-à-vis grave violations of international law.[194] Globally, the EU's waning political weight is largely matched by its diminishing persuasive authority in legal matters. Hence, the so-called 'Brussels effect' is now becoming reduced to mere wishful thinking, as can be seen from the field of AI and other sectors, where European competitiveness is slumping. In short, what once rose from the ashes of war risks returning there, if no corrective change in

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[186] Christian Calliess, 'The Future of Europe after Brexit: Towards a Reform of the European Union and its Euro Area' (2021) 40(1) Yearbook of European Law 3 <https://doi.org/10.1093/yel/yeaa014>.

[187] Alberto Alemanno and Kalypso Nicolaïdis, 'Citizen Power Europe: The Making of a European Citizens' Assembly' (2021) 2(2) Revue Européenne du Droit 7, 13.

[188] 'The Draghi Report: The Future of European Competitiveness' (Publications Office of the European Union, 2025) <https://commission.europa.eu/topics/eu-competitiveness/draghi-report_en> accessed 7 November 2025.

[189] European Commission, *Joint White Paper for European Defence Readiness 2030*, JOIN(2025) 120 final (19 March 2025) 2, 16, 21; William I Robinson, *Global Capitalism and the Crisis of Humanity* (CUP 2014) 149.

[190] Treaty Establishing the European Coal and Steel Community (signed in Paris 18 April 1951) 261 U.N.T.S. 142 recital 4 (1951); Treaty Establishing the European Economic Community (signed in Rome 25 March 1957) 294 U.N.T.S. 5 recital 8 (1957).

[191] The Nobel Peace Prize 2012, 'Nobel Prize Outreach 2025' (22 August 2025) <https://www.nobelprize.org/prizes/peace/2012/summary> accessed 7 November 2025.

[192] Piotr Żuk, 'The War in Ukraine: Consequences for the Economy, Labour Class and Equitable Development in Europe and Beyond' (2023) 34(2) The Economic and Labour Relations Review 343, 343 <https://doi.org/10.1017/elr.2023.18>; Pere Brunet and others (eds), *Peace and Disarmament in Europe: For Shared Détente, Peace and Security* (Centre Delàs d'Estudis per la Pau 2024).

[193] Laura Chappell and others, 'Uncovering EU Strategy in Its Security Policy: An (In)coherent Actor?' in Laura Chappell and others (eds), *The EU, Strategy and Security Policy: Regional and Strategic Challenges* (Routledge 2016) 202, 202.

[194] Daniela Verena Huber, 'Organized Hypocrisy and the Logic of Coloniality. Explaining the EU's Divergent Response to Grave Violations of International Law in Russia/Ukraine and Israel/Palestine' (2025) 63(5) Journal of Common Market Studies 1638, 1638 <https://doi.org/10.1111/jcms.13737>.

direction occurs.

Regrettably, the present path threatens to confirm the sad and paradoxical observation made by Gordon W. Allport in 1954, that the discrepancy between the human mastery over technology and nature and the human mastery over human relations means that the 'surplus in wealth accumulating to the human race through applied natural science is virtually canceled by the costs of armaments and war'.[195] In view of such developments, drastic reforms leading to new institutions are needed. Based on past observations, however, such institutional reforms can only materialize when a cognitive change giving birth to new modes of thinking has taken place. The reason is that transformational change to law and its institutions arises 'not only from changes in the interests and resources of relevant actors but also from changing structures of meaning'.[196] In short, cognitive change is required because such reform or transformation usually 'goes hand in hand with *cognitive* change'.[197] Cognitive change, on the other hand, can come in two different ways. First, it is possible to notice changes in the environment and try to adapt to them with new and more appropriate modes of thinking. Otherwise, if no adaptation takes place, the situation deteriorates and 'systemic chaos',[198] or worse scenarios, regularly ensue. Exemplified by the lagging reform of the United Nations international organizations, we have reached this latter situation, with it becoming realistic to think that 'only a World War III might provide enough shock, awe, and vision to equip the UN for the future'.[199] If no change in direction in EU policies takes place, the EU, too, will face increasing dangers and possible disasters.

For the international legal system, cognitive change means deciding whether we are willing to continue with the ongoing 'crisis of international

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[195] Gordon W Allport, *The Nature of Prejudice* (Addison-Wesley 1954) xiii.

[196] Andrew T F Lang, 'Reflecting on 'Linkage': Cognitive and Institutional Change in the International Trading System' (2007) 70(4) Modern Law Review 523, 527 <https://doi.org/10.1111/j.1468-2230.2007.00651.x>.

[197] ibid [529]; see also Emanuel Adler, *World Ordering: A Social Theory of Cognitive Evolution* (CUP 2019) 3.

[198] Giovanni Arrighi, The Long *Twentieth Century*: *Money, Power, and the Origins of Our Times* (Verso 2010) 31.

[199] Antonio Donini, 'Crashing Waves and Rising Tides: The Case for UN 2.0' (2020) 62 Global Governance 262, 267.

law'[200] and let crises rule the fate of international law.[201] Alternatively, cognitive change allows a change of mind and work to take place towards the development of a future global law framework which is able to prevent and solve international crises. The same goes for the EU, which is increasingly shifting from a system of the EU governance of crisis to a deepening 'crisis of EU governance'.[202] To reverse the dependence of this dangerous path, it is necessary to change our minds, which is known to be a difficult task, as 'old habits' are known to 'die hard'. This has also been found to be a problem for dualistic thinking, because 'it is innate and modular, and innate modular beliefs are extremely hard to shift'.[203] For cognitive change to come about before disaster forces a change in minds, only learning offers a viable alternative. For learning, it is deemed to be helpful to identify and understand the underlying causes of the imminent demise.

IV. CAUSES OF THE EU GOVERNANCE CRISIS AND DEFICIENCIES IN AI REGULATION

Naturally, there exist a myriad of possible causes of the current and mounting crisis of EU (and international) governance. As possible causes of the crisis, writers mention a democratic deficit,[204] the rise of populism, misinformation, fake news and manipulation,[205] developed

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[200] See eg Miodrag Sukijasovic, 'A Cause of the Present Crisis of International Law' (1971) 65(2) American Journal of International Law 378; Rafael Domingo, 'The Crisis of International Law' (2009) 42(5) Vanderbilt Journal of Transnational Law 1543; Richard Goldstone, 'The Crisis in the Implementation of International Law' (2011) 44(1-2) Case Western Reserve Journal of International Law 13; David M Crane, 'An Age of Extremes: International Law in Crisis: Eight Challenges' (2011) 44(2) Case Western Reserve Journal of International Law 47; Joel P Trachtman, 'The Crisis of International Law' (2011) 44(1-2) Case Western Reserve Journal of International Law 407; L A Musayelyan, 'The Crisis of International Law: Civilizational and Geopolitical Factors' (2014) 26 Perm University Herald Juridical Sciences 211; Philippa Webb, 'From Crisis to Epoch: How to Understand This Era of International Law?' (2024) 25(1) Melbourne Journal of International Law 1.

[201] Pierre Auriel and others (eds), *The Rule of Crisis: Terrorism, Emergency Legislation and the Rule of Law* (Springer 2018).

[202] Tanja A Börzel, 'From EU Governance of Crisis to Crisis of EU Governance: Regulatory Failure, Redistributive Conflict and Eurosceptic Publics' (2016) 54 Journal of Common Market Studies 8, 8 <https://doi.org/10.1111/jcms.12431>.

[203] Gabriel Segal, 'Poverty of Stimulus Arguments Concerning Language and Folk Psychology' in Peter Carruthers and others, *The Innate Mind: Foundations and the Future* (vol 3, OUP 2008) 90, 101.

[204] See eg Roila Mavrouli and Arnaud Van Waeyenberge, 'EU Responses to the Democratic Deficit and the Rule of Law Crisis: Is It Time for a (New) European Exceptionalism?' (2023) 15 Hague Journal on the Rule of Law 405 <https://doi.org/10.1007/s40803-023-00198-w123>.

[205] John Erik Fossum, 'The Context of Fake News, Disinformation, and Manipulation' in Maximilian Conrad and others (eds), *Europe in the Age of Post-Truth Politics: Populism, Disinformation and the Public Sphere* (Palgrave Macmillan 2022) 31.

country syndrome and colonial logic,[206] Eurocentrism and transatlantic obedience,[207] elitism, corruption or lack of meritocracy,[208] and external shocks of various kinds.[209] These are just a few selected examples and many more exist; they merely represent the tip of the iceberg, meaning they only describe the visible symptoms and not necessarily the deeper causes, which often remain hidden at first sight.

Generally, full knowledge of the actual deeper causes of one's own individual fate is shrouded in mystery and likely constitutes life's most important but also difficult research question. The same goes for the causes of the destiny and failure of institutions governing entire countries, nations, empires, regions, or continents.[210] It can be technology, education, the economy, or the political and the legal system that makes the difference between rise or demise. Or is it that each place on Earth must traverse a series of stages to rise to fame and make an important contribution to humanity, before it makes place for the next one to follow?[211] For a complete understanding of the law of cause and effect, humans may still lack crucial pieces of information. Is it coincidence, we must ask, that science estimates that it cannot locate 95% of the matter in the universe and that humans are equally up to 95% in the dark about their own cognitive processes?[212] This means that we are likely aware of only 5% of ourselves and our environment, whereas the rest remains 'dark matter' or hidden in the unfathomable labyrinths of the subliminal world. In the complexity of the present time, science holds a paradox that

[206] Rostam J Neuwirth, 'Global Law and Sustainable Development: Change and the "Developing-Developed Country" Terminology' (2017) 29(4) European Journal of Development Research 911, 918 <https://doi.org/10.1057/s41287-016-0067-y>; Daniela Verena Huber (n 194) 1.

[207] See eg Audrey Alejandro, 'Eurocentrism, Ethnocentrism, and Misery of Position: International Relations in Europe–A Problematic Oversight' (2017) 4(1) European Review of International Studies 5; Sarah M H Nouwen, 'Exporting Peace? The EU Mediator's Normative Backpack' (2024) 1(1) European Law Open 26 <https://doi.org/10.1017/elo.2022.9>; Jeffrey Anderson and Federico Steinberg, '"The Unbalanced Transatlantic Relationship: Understanding Us Influence in Europe"' (2025) 47 Journal of European Integration 885 <https://doi.org/10.1080/07036337.2025.2537377>.

[208] See eg Savvas Voutyras, 'Anti-Populism, Meritocracy and (Technocratic) Elitism' in Yannis Stavrakakis and Giorgos Katsambekis (eds), *Research Handbook on Populism* (Edward Elgar 2024) 35.

[209] See eg Roberto Cortinovis, 'Forced Displacement and EU External Action: Exogenous Shocks, Policy Frames and Institutional Dynamics' (2017) 22(4) European Foreign Affairs Review 473 <https://doi.org/10.54648/eerr2017036>.

[210] See eg Daron Acemoglu and Simon Johnson (n 83); Julia Gray, 'Life, Death, or Zombie? The Vitality of International Organizations' (2018) 62(1) International Studies Quarterly 1, 1 <https://doi.org/10.1093/isq/sqx086>; Mancur Olson, *The Rise and Decline of Nations: Economic Growth, Stagflation, and Social Rigidities* (Yale University Press 2022) 1.

[211] See also Oswald Spengler, *The Decline of the West* (A A Knopf 1926) 3.

[212] Cf Eugene Oks, 'Brief Review of Recent Advances in Understanding Dark Matter and Dark Energy' (2021) 93 New Astronomy Reviews 1387, 1387; Leonard Mlodinow, *Subliminal: How Your Unconscious Mind Rules Your Behaviour* (Vintage Books 2012) 34; John A Bargh and Tanya L Chartrand, 'The Unbearable Automaticity of Being' (1999) 54 American Psychologist 462, 462.

tells us that we know very little of what is to be known;[213] what is worse, we also refuse to consistently apply what we have scientifically explored and therefore already do know. In short, there is a strong tendency to disregard or ignore the role and findings of science in law and policymaking.

A. Inadequate Consideration of Science

For some time, EU governance and its underlying public discourses have displayed a lack of consideration of the existing findings of science. A first obstacle to the due consideration of science for law and policymaking is the dominant paradigm of specialization, which obscures and further erodes the former unity of science (and art).[214] Yuval N. Harari aptly summarized the problem of specialization as follows:

> *Firstly, nobody knows where the brakes are. While some experts are familiar with developments in one field, such as artificial intelligence, nanotechnology, big data or genetics, no one is an expert on everything. No one is therefore capable of connecting all the dots and seeing the full picture.*[215]

The same problem was also highlighted by the observation that, from the thirteenth century to 2012, the number of disciplines offered by universities increased from seven to more than 8,000. This means that a graduate is a specialist in one discipline but 'totally ignorant in more than 7999 disciplines'.[216] The bad news for specialization is that, in an age of growing complexity, most contemporary problems can no longer be effectively solved within an artificial silo of a single lab, single policy, single scientific discipline, or single law. They require a holistic approach or, better, a 'holonistic' one. A holonistic approach is derived from the concept of a holon, and means 'to supply the missing link between atomism and holism, and to supplant the dualistic way of thinking in terms of 'parts' and 'wholes', which is so deeply engrained in our mental habits, by a multi-levelled, stratified approach'.[217]

Underlying this problem is the refusal to change one's mind (before changes are forced upon it). To give one principal example, the refusal finds its expression in the snubbing of new ideas and proposals to expand the dominant mode of dualistic thinking and binary logic to more flexible forms of paradoxical or lateral thinking using a polyvalent and fuzzy

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[213] Kenneth L Mossman, *The Complexity Paradox: The More Answers We Find, the More Questions We Have* (OUP 2014).

[214] Neuwirth, *Law in the Time of Oxymora* (n 33) 22.

[215] Yuval N Harari, *Homo Deus: A Brief History of Tomorrow* (Harper 2017) 51.

[216] Basarab Nicolescu, 'The Need for Transdisciplinarity in Higher Education in a Globalized World' (2012) 3 Transdisciplinary Journal of Engineering & Science 11.

[217] Arthur Koestler, 'Beyond Atomism and Holism–The Concept of the Holon' (1970) 13(2) Perspectives in Biology and Medicine 131, 136; see also Hillary S Webb, 'Dualism' in David A. Leeming (eds), *Encyclopedia of Psychology and Religion* (3rd edn, Springer 2020) 702.

logic.[218] This also stands in stark contrast to the scientific findings made in quantum theory and their realization through quantum technologies, such as quantum computers. Compared to classical computers, quantum computers apply a more fuzzy logic, as they function not only with '0' or '1' but also with both '0' and '1'.[219] The same logic finds expression in the novel laws and institutional frameworks governing cyberspace that are inspired by information science as applied by the Cyberspace Administration of the PRC.[220]

Another fundamental disregard of science that emerges from the field of physics relates to the concept of time, or 'space-time' to be more precise. While the EU's Quantum Strategy brags by calling Europe the 'quantum continent',[221] it fails to conform to the scientific hypotheses and observations it carries in its new normative framework. The application of an outdated scientific paradigm as the foundation for law and policymaking can be seen to flow from an outdated understanding that space and time are absolute and independent of each other. The separate conception of space and time still continues widely today, more than a century after Herrmann Minkowski's famous finding that 'space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve independence'.[222] It completely ignores the reality of a 'four-dimensional space-time continuum', as Albert Einstein described it.[223]

In other words, space-time is still considered an oxymoron, because time is considered to be a dimension separate from the three dimensions of space.[224] Similarly, most legal dictionaries today still define 'time' with no reference to its relationship to space,[225] even though black holes and the deeper mysteries of quantum physics have reached the courts for

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[218] See eg Hildebrandt, (n 121) 27; H Patrick Glenn and Lionel D Smith (eds), *Law and the New Logics* (CUP 2017); Neuwirth, *Law in the Time of Oxymora* (n 33) 22.

[219] Rosario Girasa and Gino J Scalabrini, *Regulation of Innovative Technologies: Blockchain, Artificial Intelligence and Quantum Computing* (Palgrave Macmillan 2022) 8.

[220] Parasol (n 144) 12.

[221] EU Quantum Strategy (n 3) 1.

[222] Hermann Minkowski, 'Raum und Zeit' (1909) 18 Jahresbericht der Deutschen Mathematiker-Vereinigung 75, 75; H Minkowski, 'Space and Time' in H A Lorentz, A Einstein, H Minkowski, and H Weyl, *The Principle of Relativity* (Dover Publications 1952) 75.

[223] Albert Einstein, *Relativity: The Special and General Theory* (H Holt & Company 1920) 379.

[224] Joseph Mazur, *The Clock Mirage: Our Myth of Measured Time* (Yale University Press 2020) 115.

[225] See eg Bryan A Garner (ed), *Black's Law Dictionary* (9th edn, West Group 2009) 1620; see also Günther Drosdowski (ed), *Das große Wörterbuch der deutschen Sprache: Band 6: Sp-Z* (Dudenverlag 1981) 2924 ('Ablauf, Nacheinander, Aufeinanderfolge der Augenblicke, Stunden, Tage, Wochen, Jahre').

fear of the end of the world.[226] More precisely, the application of a three-dimensional framework of space ignores important scientific observations made a long time ago about a fourth dimension of space, such as the following:

> *The conception of a four-dimensional manifold in which occur the events that are now becoming the focus of scientific thinking has brought space-time as the successor to the preceding conception of three-dimensional space and single dimensional time. This space-time is not merely three dimensional space, with an added dimension of time, but an integral fusion of space and time, since three dimensions of space, to exist anywhere, must exist in a time continuum.* [227]

It is a sad irony that a strategy boasting about future technologies completely ignores basic theoretical and cognitive underpinnings and widely ignores the fact that a new scientific paradigm, manifest in a novel mode of four-dimensional thinking, is already being applied in the design and development of a growing number of new and cutting-edge technologies.[228] This was well summarized in the following paragraph:

> *Fourth dimension thinking is the core alphabet of new cybernetic innovations in areas ranging from medical anatomical modelling, genetic sequencing of cellular development, and seemingly everywhere in large-scale construction projects where long-range planning requires tracking the future in terms of work schedules, material requirements, and financing.* [229]

Even at the micro-level of decision making, such as in the context of the regulation of AI through the AI Act, the refusal to engage seriously with the scientific and academic community becomes evident. This is another result of the 'race narrative', which aims to rush matters and still fails to succeed. Paradoxically, sometimes going slow is going fast, or festina lente (make haste slowly). This supports a paradoxical understanding of time and claims that cognitive change is preferable to new laws based on old thinking.[230] To give but one example, the regulation of 'subliminal AI systems' enshrined in Art. 5(1)(a) AI Act, was, from the time of the release of the draft proposal until its final enactment and entry into force, conducted without a serious consideration of the existing and rapidly

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[226] For the United States, see *Sancho v. United States Dept. of Energy* 578 F Supp 2d 1258, 1259 (D. Haw. 2008), affd 392 F. App'x 610 (9th Cir. 2010). For Germany, see Bundesverfassungsgericht [BVERFGE] [Federal Constitutional Court] Feb. 18, 2010, 2 BVERFGE 2502/08, 2010 (Ger.). For Austria and 19 other countries, see *Goritschnig v.* Austria App no 41028/08 (Eur. Ct. H.R. 2010) (on file with the author).

[227] Lawrence K Frank, 'Time Perspectives' (1939) 4(4) Journal of Social Philosophy 293, 293.

[228] See also Neuwirth, *A Quantum of Future Law* (n 102).

[229] Arthur Kroker and David Cook, *The Quantum Revolution: Art, Technology, Culture* (University of Toronto Press 2023) 293.

[230] See also Koen Lemmens, 'The Slow Dynamics of Legal Language: Festina lente?' (2011) 17(1) Terminology 74.

growing scientific literature on subliminal perception.[231] Far too late, a first effort to define the term 'subliminal' was published in the form of additional guidelines after the day this provision had entered into force.[232] This practice not only marks a terrible failure in temporal terms when it comes to the need for future-proofing legislation, but also fails to recognize that time and space are common sensibles,[233] or attributes of objects or events that 'really can manifest itself through all of the senses'.[234] The initial draft of the EU AI Act completely lacked considerations of the possible dangers that temporal and spatial aspects bear for the multisensory, or synesthetic, as well as transliminal (i.e. both below and above the threshold of awareness) manipulation of human thoughts and actions.[235] To put it briefly, information flows ubiquitously in space and in 'real-time'. There are further fundamental implications of the failure to give up a separate consideration of space and time in favour of a four-dimensional conception of reality, which will be outlined in the next section.

B. 'No Demos', 'No Deus' and No Constitution

Before the skill is acquired, it is difficult to assess the full scope of four-dimensional thinking. For the present purposes, it can be understood to mean attempts to integrate the temporal aspect into spatial planning. As a precondition for four-dimensional thinking, it is necessary to move from an exclusively dualistic and dialectic mode of thinking into one of dialetheism. Dialetheic thinking means accepting that there are also contradictions which are true and possible.[236] Framed differently, it can also mean complementing 'either/or' thinking with 'both/and' thinking so as to navigate polarities.[237] The need for dialetheic or oxymoronic thinking is indicated by the rise in oxymora and paradoxes, which demands that dichotomies as antagonistic pairs are regarded not as mutually exclusive but as complements to each other. The dissolution of the apparent

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[231] Neuwirth, *The EU Artificial Intelligence Act* (n 98); Neuwirth, 'Prohibited Artificial Intelligence Practices in the Proposed EU Artificial Intelligence Act (AIA)' (n 74); Christian Montag and Michèle Finck, 'Successful Implementation of the EU AI Act Requires Interdisciplinary Efforts' (2024) 6 Nature Machine Intelligence 1415.

[232] European Commission, 'Commission Guidelines on prohibited artificial intelligence practices established by Regulation (EU) 2024/1689 (AI Act)' C(2025) 5052 final (29 July 2025).

[233] Casey O'Callaghan, *A Multisensory Philosophy of Perception* (OUP 2019) 126.

[234] Lawrence E Marks, *The Unity of the Senses. Interrelations Among the Modalities* (Academic Press 1978) 32.

[235] European Commission (n 232).

[236] See Graham Priest, 'Dialectic and Dialetheic' (1990) 53 Science and Society 388, 388.

[237] Emerson and Lewis (n 119) 13 and 15.

contradiction between opposites presupposes that a higher dimension of the quality of their mutual relationship has been found and accessed.[238] In other words, this means gradually realizing that dichotomies are largely false and merely mean that 'we forget the middle and think in extremes, missing important alternatives in the process'.[239] It marks the ability to seek complementarity between opposites rather than resign before their apparent contradiction. Once the *coincidentia oppositorum* (coincidence of opposites) has been achieved,[240] it is also possible to apply oxymoronic thinking to the relationship between space and time, whence comes the conception of 'space-time' as an oxymoron, which then opens the door to four-dimensional thinking.

The lack of four-dimensional thinking in EU law and policymaking can be exemplified by looking at the field of AI regulation and the Brussels effect. First, there is a general tendency for the EU to neither remember the past nor look to the future or, in particular, to consider the need for time consistency in planning. In concrete terms, this means that there is no guarantee that the past achievements of EU integration, which established a vast internal market of 500 million citizens, will ensure a prosperous future. This is the result of a glorification of the regulatory power of the EU based on past achievements, such as the regulation of environmental standards and data protection, without paying sufficient attention to the underlying social, economic, educational, and also technological conditions. These conditions need to be put in place in order to secure not only the future competitiveness of the underlying industries, but also the technological know-how to support the drafting of excellent laws and regulations. As in the electric vehicle and battery industry,[241] in the field of AI the EU has already lost out to the US and China in the development of AI technologies.[242] It is also soon expected to lose the AI regulation race, if it continues to follow the race narrative and

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[238] Neuwirth, *A Quantum of Future Law* (n 102).

[239] Trudy Govier, 'Problems with False Dichotomies' (2003) 35(146) Humanist in Canada 31, 31.

[240] Jasper Hopkins, *Nicholas of Cusa on Learned Ignorance: A Translation and an Appraisal of de Docta Ignorantia* (The Arthur J. Banning Press 1981) 6.

[241] Andre Hemmelder and others, 'The Geostrategic Race for Leadership in Future Electric Vehicle Battery Technologies' (2025) 18 Energy and Environmental Science 6117, 6128: Dan Curia, 'Electric Vehicles: The Economics, the Geopolitics, and the Policy Lemmas Facing Europe', Ciuriak Consulting INC.Working Paper (July 2025)10 <http://dx.doi.org/10.2139/ssrn.5327778>.

[242] See also the World Intellectual Property Organization (WIPO), 'Global Innovation Index 2025' (16 Sep 2025) <https://www.wipo.int/en/web/global-innovation-index/w/news/2025/save-the-date-gii-2025> accessed 7 November 2025.

apply outdated zero-sum thinking to the matter.[243]

Among other reasons, this is also caused by a flawed understanding of time as the unit for the measurement of change. It surfaces in what I have called 'ignorant arrogance' on the part of so-called 'developed countries'.[244] The arrogance is derived from the false belief that it is enough to have become developed and that one will then remain so forever without the struggle of developing the political, economic or legal system further.[245] This misinterpretation itself originates from the false dichotomy of 'developing and developed countries', which fails to recognize the difference between the verb 'developing' and the adjective 'developed'. Or else, the same problem was described by the failure to consider the paradoxes of development.[246]

The same also matters for democracy. Democracy, to flourish, not only needs constant attention;[247] it also needs to continue 'developing' if it wants to maintain its value and not paradoxically die even at the hands of those who are democratically elected.[248] In this context, it seems to have been forgotten that 'democracy does not exist in a vacuum',[249] just as 'pure law' has been classed as an oxymoron 'since the law always needs a context within which it is to be considered'.[250] Even across different cultures, to gain an 'adequate understanding of the legal tradition of a given society, one must go beyond the law itself', as law needs to 'be understood in the context of a larger normative framework'.[251] This is why democracy is closely related to everything and everyone. It elucidates why education matters so much to democracy, because democracy is not merely a 'form of government, but primarily a mode of associated living, of conjoint

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[243] See also Tiffany C Li, 'Ending the AI Race: Regulatory Collaboration as Critical Counter-Narrative' (2024) 69(5) Villanova Law Review 981, 981.

[244] Rostam J Neuwirth, 'A Constitutional Tribute to Global Governance: Overcoming the Chimera of the Developing-Developed Country Dichotomy' European University Institute (EUI) Working Paper LAW 2010/20 (2010) 7 ff <https://hdl.handle.net/1814/15704> accessed 7 November 2025.

[245] Rostam J Neuwirth, 'Global Law and Sustainable Development: Change and the "Developing-Developed Country" Terminology' (n 206).

[246] See eg Eve Bratman, 'Development's Paradox: is Washington DC a Third World city?' (2011) 32(9) Third World Quarterly 1541, 1541 ; see also Arno Beisser, 'A Paradoxical Theory of Change' in Joen Fagan and Irma Lee Shepherd (eds) Gestalt Therapy Now: Theory, Techniques, Applications (Science and Behavior Books 1970) 70, 77.

[247] Ben Berger, *Attention Deficit Democracy: The Paradox of Civic Engagement* (Princeton University Press 2011) 3.

[248] Steven Levitsky and Daniel Ziblatt, *How Democracies Die* (Crown Publishing 2018) 3.

[249] Joseph H H Weiler, 'Does Europe Need a Constitution? Demos, Telos and the German Maastricht Decision' (1995) 1(3) *European Law Journal* 219, 222.

[250] *Silveira v. Ontario (Minister of Transportation)*[2011] (Ontario Superior Court of Justice, OJ) , 22.

[251] Xingzhong Yu, 'Normative Dualism: A New Interpretation of Chinese Legal Tradition' (2024) 1 Macau Journal of Global Legal Studies 41, 65.

communicated experience'.[252] How the collective experience from every individual is generated is largely a cognitive process, which also lies at the heart of research, learning and education. The essential role of education is explained by the Böckenförde Paradox, which, when applied to democracy, means that democracy itself 'is sustained by conditions it cannot itself guarantee'.[253] In turn, the conditions sustaining democracy are largely a cognitive process, which ideally is primarily the role of education and research as well as the media. The many novel means for individually targeting persons with specific content, even subliminally, may undermine the important role of both educational institutions and the media.

The careful cultivation of democracy appears to be like the oxymoron of 'sustainable development'.[254] It can also be described by reference to the Lampedusa Paradox, which holds that for 'things to stay as they are, things will have to change'.[255] Like freedom,[256] democracy is best addressed through the banner of paradoxes.[257] This subtle trend of the rise of oxymora and paradoxes underscores the need for a new mode of thinking, applied not only to the design of new quantum technologies but also to the old institutions of democracy and of law. There are thus good reasons why education has been called not only a necessity of life but, more importantly, a critical requisite of democracy.[258] It also explains why the 'devotion of democracy to education is a familiar fact'.[259] In this regard, Europe seems to have lost its intellectual momentum. European debates cling to too many past and by now outdated thoughts and concepts. The same goes for law, the fundamental problem of which has also been designated as change.[260] In various public and even academic discourses, no daring efforts of creative thinking are allowed or encouraged that would enable us to imagine a new society, a new model of governance, or new foundations for a future law and legal order. The European nations'

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[252] Dewey (n 81) 101.

[253] Ernst-Wolfgang Böckenförde, 'The Rise of the State as a Process of Secularization' in Mirjam Künkler and Tine Stein (eds), *Religion, Law, and Democracy; Selected Writings* (OUP 2020) 152, 167.

[254] Michael Redclift, 'Sustainable Development (1987–2005): An Oxymoron Comes of Age' (2005) 13 Sustainable Development 212.

[255] Giuseppe Tomasi Di Lampedusa, *The Leopard* (Vintage Classics 2007) 19.

[256] Karl R. Popper, *The Open Society and Its Enemies: The Spell of Plato* (vol 1, Routledge 1947) 109.

[257] See also Martyn Griffin, Daniel King and Patrick Reedy, 'Learning to Live the Paradox in a Democratic Organization: A Deliberative Approach to Paradox Mindsets' (2022) 21(4) Academy of Management Learning & Education 624.

[258] Dewey (n 81) 1.

[259] ibid 101.

[260] See also Lachs (n 36) 698; Johnson (n 36) 845.

(selective) belief in their glorious past prevents them from realizing a more glorious and bright future together and in unison with other continents.

These critical observations can be well exemplified precisely by the case of quantum and related scientific theories. While the 2025 EU Quantum Strategy celebrates quantum theory as a 'European thing' developed more than a century ago, it still today completely fails to live up to the theory's own observations, such as the idea of 'quantum consciousness'. The latter term inspired the physicist Erwin Schrödinger to state that 'in truth there is only one mind' but we are still 'not able even to imagine a plurality of consciousnesses in one mind'.[261] By now, it should be clear that '[H]uman thinking is in need of a new model that constructs the human being and consciousness within an energetic universe that is compatible with both modern science and spiritual teachings'.[262] However, developing quantum consciousness will also require us to learn the language and logic of quantum mechanics, which are oxymoronic concepts.[263] As a matter of fact, the EU and the whole world—reflected in the concept of *discordia concors*—have traits of an oxymoron.[264] However, the EU currently fails to live up to its nature as the highly innovative concept of a supranational entity.

The lack of consistency with insights from science also emerges in the context of the arguments that the predecessor of the EU had suffered from a birth defect in the form of an incomplete political union and democratic deficit.[265] This can also be linked to a flawed understanding of space-time, which manifests itself in time inconsistencies. In constitutional law, time inconsistency is understood as a lack of balance between the views of the founders of a constitution and those of subsequent generations.[266] Hence, whether the EU suffered from a democratic deficit at the outset is debatable. It certainly seems deplorable that, since then, and particularly since the failure of the EU constitutional treaty, no further actions have

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[261] Erwin Schrödinger, *What Is Life?: The Physical Aspect of the Living Cell; With, Mind and Matter & Autobiographical Sketches* (CUP 1967) 130.

[262] Kingsley L Dennis, 'Quantum Consciousness: Reconciling Science and Spirituality Toward Our Evolutionary Future(s)' (2010) 66(7) World Futures 511.

[263] David Overstreet, 'Oxymoronic Language and Logic in Quantum Mechanics and James Joyce' (1980) 9(3) SubStance 37.

[264] Werner Kaegi, 'Discordia Concors: Vom Mythos Basels und von der Europa-Idee Jacob Burckhardts' in Marc Sieber (eds), *Discordia Concors–Festgabe für Egar Bonjour zu seinem siebzigsten Geburtstag am 21. August 1968* (vol 1, Helbing & Lichtenhahn 1968) 131, 136–52; Littell Colie (n 33) 304.

[265] Jürgen Habermas, The Crisis of the European Union: A Response (Polity Press 2012) 121.

[266] George Tsebelis, 'The Time Inconsistency of Long Constitutions: Evidence From the World' (2017) 56(4) European Journal of Political Research 820, 820–821,.

been taken to address the issue. The same applies, mutatis mutandis, to the adoption of the UN Charter as the world constitution.[267]

The same flaw in temporal and spatial thinking can be exemplified by the 'no demos' thesis.[268] For several reasons, this thesis is also the result of a failure to apply a proper spatio-temporal framework because of a lack of four-dimensional thinking. As a first reason, the 'no demos' thesis is framed too narrowly and follows an outdated idea of a nation state. In truth, the term 'nation state' is an oxymoron, and is outdated, given that 'many "states" (countries) are composed of two or more ethnic "nations," and some ethnic "nations" are spread among more than one "state"'.[269] Moreover, from a scientific perspective of recent human evolutionary history, biologists and anthropologists have overwhelmingly rejected 'the partitioning of modern humans into biological "races"'.[270] From a psychological viewpoint, the concept of race has also been linked to dichotomous, or 'black and white' thinking, which was explained as follows:

> *'Black and White thinking', our concept of race emerges from dichotomized thinking. Race is a social construction. Race does not exist per se in nature, in the sense that skin color or the shape of certain facial features can be said to exist independently of our concepts.*[271]

In view of these scientific observations, one is led to ask why the law continues to operate with these false assumptions, especially when it seeks to establish a fair and equal treatment of everyone, free from discrimination based on race and other social constructs. Paradoxically, the perpetuation of discrimination today appears, to a large extent, to be carried out under the banner of 'political correctness'.[272] More accurate than the idea of a single demos appears to be the idea of a 'demoicracy', or 'a Union of peoples, understood both as states and as citizens, who govern together but not as one'.[273] However, this merely constitutes a beginning. If the EU and a future global legal order is to succeed, it must therefore continue its original efforts and work to 're-construct government and democracy

[267] See eg Bardo Fassbender, *The United Nations Charter as the Constitution of the International Community* (Martinus Nijhoff 2009) 1.

[268] Weiler (n 249).

[269] Uri Raanan, 'Nation and State: Order out of Chaos' in Uri Raanan and others (eds), *State and Nation in Multi-Ethnics Societies* (Manchester UP 1991) 3, 4–7.

[270] Fatimah Linda Collier Jackson, 'Race and Ethnicity as Biological Constructs' (1992) 2(2) Ethnicity & Disease 120, 120.

[271] Neil Altman, 'Black and White Thinking: A Psychoanalyst Reconsiders Race' (2000) 10(4) Psychoanalytic Dialogues 589, 589.

[272] Rostam J Neuwirth, 'Equality in View of Political Correctness, Cancel Culture and Other Oxymora' (2023) 8(10) International Journal of Legal Discourse 1, 9 <https://doi.org/10.1515/ijld-2023-2003>.

[273] Kalypso Nicolaïdis, 'European Demoicracy and Its Crisis' (2013) 51(2) Journal of Common Market Studies 351, 351 <https://doi.org/10.1111/jcms.12006>.

above the nation state'.[274]

As a second reason, the no demos thesis is oblivious to the 'paradox of the founding', which consists in the fact that the foundation of a democratic constitution cannot be based on democratic principles, because 'the procedures needed to secure its legitimacy cannot be spontaneously self-generated'.[275] The same has also been called the 'demos paradox', which holds that 'the composition of a demos could never secure democratic legitimacy because the composition of a demos cannot itself be democratically decided'.[276] Without seeking to resolve the paradox on the basis of a different conception of time beyond linearity, all constitutional democracies would be doomed to fail, 'provided one conceives the constitution as a project that makes the founding act into an ongoing process of constitution-making that continues across generations'.[277] The same applies mutatis mutandis to the establishment of a future global legal order.

To put it simply, no egg is, or can be, a chicken instantly. This paradoxical truth was recognized in the spirit of the EU's founding treaties, when they expressed the commitment to 'give direction to a destiny henceforward shared'[278] and 'to lay the foundations of an ever closer union among the peoples of Europe'.[279] However, this requires a vision of and for the future as a part of forecasting.[280] This insight was also known to the founding fathers, who therefore had the following belief: 'Europe will not be made all at once, or according to a single plan. It will be built through concrete achievements which first create a de facto solidarity'.[281] From this perspective, a constitution can be compared to a hysteron proteron, or a reversal of what has been perceived as the natural order of time. Theoretically, the acceptance of retrocausality or the challenge of an exclusively linear conception of time may certainly

[274] Robert Schütze, 'Demoicracy in Europe: Some Preliminary Thoughts' (2022) 47(1) European Law Review 24, 50.

[275] Kevin Olson, 'Paradoxes of Constitutional Democracy' in Hugh Baxter (ed), *Habermas and Law* (Routledge 2017) 251, 252.

[276] Aaron Maltais, Jonas Hultin Rosenberg and Ludvig Beckman, 'The Demos and Its Critics' (2019) 81 The Review of Politics 435, 435.

[277] Jürgen Habermas, 'Constitutional Democracy: A Paradoxical Union of Contradictory Principles?' (2001) 29(6) Political Theory 766, 768 <https://doi.org/10.1177/0090591701029006002>.

[278] Treaty Establishing the European Coal and Steel Community (signed 18 April 1951) 261 UNTS 140, recital 5.

[279] Treaty Establishing the European Economic Community (signed 25 March 1957) 294 UNTS 5, recital 1.

[280] ibid.

[281] European Commission Directorate-General for Communication, *The Schuman Declaration of 9 May 1950* (Publications Office 2015) <https://data.europa.eu/doi/10.2775/065> accessed 7 November 2025.

provide a useful input in the quest for new governance models.[282] Backed by quantum science, retrocausality, or the view that the future is not separate from the present or the past, should at least be pondered as possible.[283] Hans Kelsen too addressed this question and rightly wrote that 'the people—from whom the constitution claims its origin—comes into existence first through the constitution'.[284]

Perhaps it would be more adequate to invoke a '*no deus*' thesis in an age in which humanity transitions from *homo sapiens* to the next stage, in which fiction has been said to perform a crucial role.[285] However, 'fiction' should be understood in a scientific way through the oxymoron of 'science fiction' rather than in its stark opposition to fact. In this regard, the EU currently appears to be suffering from a double deficit. First, it suffers from a spiritual deficit,[286] which has been shown to being filled by an overly zealous belief in technology and AI.[287] A second related deficit is an information deficit, which appears ironic in the age of the information glut,[288] and which manifests itself less in a plurality of opinions but more in the form of misinformation, predictive programming and transliminal manipulation.[289] In this regard, the general impact and possibility of social media and now, more and more, AI through language models, offer unprecedented ways, in terms of efficiency, of manipulating the minds of the individuals and masses alike.[290] They have also been found capable of influencing cultural bias.[291]

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[282] See eg Jordi Vallverdú, *Causality for Artificial Intelligence: From a Philosophical Perspective* (Springer 2024) 85.

[283] Jai Paul Dudeja, 'Future Is Not Separate From the Present or the Past: Can Temporal Nonlocality in Quantum Entanglement Explain Retrocausality (Effect Preceding the Cause), Precognition and Déjà Vu?' (2019) 6(5) Journal of Emerging Technologies and Innovative Research 304, 304.

[284] Hans Kelsen, *General Theory of Law and State* (Russell & Russell 1961) 261.

[285] Yuval N Harari, *Homo Sapiens: A Brief History of Mankind* (Harper Collins 2015) and Harari, Homo Deus (n 215) 152.

[286] George Pennington, *Die Tafeln von Chartres* (Patmos 2023) 117.

[287] Claudia Paganini, *Der neue Gott. Künstliche Intelligenz und die menschliche Sinnsuche* (Herder 2025) 8.

[288] Mark Andrejevic, *InfoGlut: How Too Much Information Is Changing the Way We Think and Know* (Routledge 2013).

[289] See eg Elisabeth Wehling, *Politisches Framing. Wie eine Nation sich ihr Denken einredet und daraus Politik gemacht wird* (Halem Verlag 2016), Maria Luisa Stasi and Pier Luigi Parcu, 'Disinformation and Misinformation: The EU Response' in Pier L Parcu and Elda Brogi (eds), *Research Handbook on EU Media Law and Policy* (Edward Elgar 2018) 704, and Rostam J Neuwirth, 'The Global Regulation of "Fake News" in the Time of Oxymora: Facts and Fictions about the Covid-19 Pandemic as Coincidences or Predictive Programming?' (2021) 35(3) International Journal for the Semiotics of Law 831 <https://doi.org/10.1007/s11196-021-09840-y>.

[290] See also Gilad Abiri, 'Public Constitutional AI' (2025) 59(2) Georgia Law Review 601, 612.

[291] Zhaoming Liu, 'Cultural Bias in Large Language Models: A Comprehensive Analysis and Mitigation Strategies' (2024) 3(2) Journal of Transcultural Communication 1, 1 <https://doi.org/10.1515/jtc-2023-0019>.

The EU encounters another hysteron proteron, or is caught in a dilemma of an entangled loop from which, at first, no escape seems possible. Generally, the rise of the 'platform federation' has been announced as it was found that large open (digital) platforms 'wield growing power over our public sphere—and yet our politics and public debates remain stubbornly state-based'.[292] Meanwhile, generative AI and large language models offer more efficient possibilities that further blur the fragile lines between the virtual and the real worlds and open the door to far more nefarious applications.[293] Worse for the EU is that, compared to the US and China, the main competitors in AI, digital and various other technologies, the EU has largely failed to avail itself of a genuine European digital platform. This means that the EU faces further headwinds in forming a demos, as it lacks reliable and genuine digital sources of information for Europeans. There is thus a real risk that the EU may be completely misinformed and even intentionally manipulated, as European political deliberations take place on primarily US-owned and US-controlled platforms based on algorithms and big data. The risks become aggravated by the primary focus of European educational and political institutions on the transatlantic agenda, which leads to a neglect of important developments in other parts of the world such as, notably, Asia, the BRICS countries, the Asia-Pacific and Africa. It also carries the risk that when engagement with these countries or regions takes place, it is often already distorted by the bias caused by these factors. This is why interesting developments in single countries, such as the development of a 'democratic localism' including the use of AI technologies in the PRC, are not sufficiently studied in Europe.[294]

The accelerated transformations of the digital environment have profound effects on the global economy as much as on the distribution of information through the online sphere.[295] In this regard, the recurring imposition of fines, or even mega-fines, on some of the major digital market players in both the US and the EU should not deceive us into

[292] Gilad Abiri and Sebastian Guidi, 'The Platform Federation' (2024) 26(2) Yale Journal of Law and Technology 240, 240.

[293] Emilio Ferrara, 'GenAI Against Humanity: Nefarious Applications of Generative Artificial Intelligence and Large Language Models' (2024) 7 Journal of Computational Social Science 749, 749 <https://doi.org/10.1007/s42001-024-00250-1>.

[294] See eg Zhengxu Wang, Jianxiong Liu and Dragan Pavlićević, 'Democratic Localism: The Case of Grassroots Self-Governance in Urban China' (2018) 3 Chinese Political Science Review 129 <https://doi.org/10.1007/s41111-018-0097-z>, and Yiran Li, Yingying Fan and Lin Nie, 'Making Governance Agile: Exploring the Role of Artificial Intelligence in China's Local Governance' (2025) 40(2) Public Policy and Administration 276 <https://doi.org/10.1177/09520767231188229>.

[295] RD Vidican and RA Hepes, 'Competition Law in the Digital Era: Legal and Jurisprudential Challenges in Digital Markets' (2025) 19(1) AGORA International Journal of Juridical Sciences 133, 133.

believing that the problem of information deficit and bias is being solved.[296] It largely constitutes mere 'performative governance' or so-called 'theatrical deployment of language, symbols, and gestures to foster an impression of good governance among citizens.'[297] It equates to a cosmetic legal treatment using 'mock trials', addressing the symptoms and not the causes of the problem.[298]

Consequently, the EU needs to address these risks, based on its quest for 'AI sovereignty', to ensure a pluralistic but accurate source of information.[299] It marks a problem that is part of the debate about the regulation of fake news at the international level, which began in the 1950s with the Convention on the International Right of Correction.[300] The global AI sovereignty debate, however, also meets with a paradox, the 'sovereignty–internationalism paradox', which highlights the apparent contradiction of 'state control over algorithmic systems and the necessity of transnational collaboration to regulate borderless technologies.'[301]

As can be seen, very different legal problems, when investigated further, reveal 'powerful tensions, profound contradictions, and perplexing paradoxes', as James N. Rosenau described the major policy challenges of the twenty-first century.[302] Put briefly, the age of the paradox has arrived, or the cliché has become reality, as all of society has become 'paradoxical'[303] and everything else 'oxymoronic.'[304] This is neither a surprise nor a coincidence, given that the quantum world, which has long cast its shadow over technological and societal development, has been said to use

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[296] Umberto Nizza and Cristina Poncibò, 'Antitrust Mega Fines in Digital Markets and Their Impact on Compliance: An Overview of EU and US Approaches' *Stanford-Vienna TTLF Working Paper No 115* (2024) <http://ttlf.stanford.edu> accessed 7 November 2025.

[297] Iza Ding, 'Performative Governance' (2020) 72(4) World Politics 525<https://doi.org/10.1017/S0043887120000131>.

[298] Rostam J Neuwirth, 'Intellectual Property Law and Generative Artificial Intelligence: Fair Remuneration, Equality or "My plentie Makes Me Poore"' (2025) 00 Journal of Intellectual Property Law & Practice 1, 9 <https://doi.org/10.1093/jiplp/jpaf029>.

[299] Daniel Mügge, 'EU AI Sovereignty: For Whom, to What End, and to Whose Benefit?' (2024) 31(8) Journal of European Public Policy 2200, 2200 <https://doi.org/10.1080/13501763.2024.2318475>.

[300] Björnstjern Baade, 'Fake News and International Law' (2019) 29(4) The European Journal of International Law 1357, 1357 <https://doi.org/10.1093/ejil/chy071>.

[301] Artur Ishkhanyan, 'The Sovereignty-Internationalism Paradox in AI Governance: Digital Federalism and Global Algorithmic Control' (2025) 5 Discover Artificial Intelligence 123, 123 <https://doi.org/10.1007/s44163-025-00374-x>.

[302] James N Rosenau, 'Governance in the 21st Century' (1995) 1(1) Global Governance 13, 13.

[303] Charles Handy, *The Age of Paradox* (Harvard Business School Press 1995) x, and Vincent de Gaulejac, 'Vivre dans une société paradoxante' (2017) 2(24) Nouvelle revue de psychosociologie 27, 28 ('C'est la société tout entière qui devient paradoxante').

[304] Warren Bennis, *The Essential Bennis* (Jossey-Bass 2009) 403, and Neuwirth, *Law in the Time of Oxymora* (n 33).

oxymora and paradoxes as its language and logic.[305] Moreover, the entire realm of quantum theories has been called 'spooky'[306] and associated with many paradoxes.[307] At the same time, paradoxes have been used in order 'to understand quantum mechanics better'.[308] This can be read to mean that training in quantum intelligence must accompany the successful governance of quantum technologies in the future.

V. OUTLOOK FOR THE GLOBAL GOVERNANCE OF QUANTUM TECHNOLOGIES

The analysis of the global AI governance debate, when contrasted with the evolution of European and international law, reveals an important insight for the regulation of new technologies. It shows that the goal of the adoption of future-proof and adequate regulations or laws is best achieved by way of cognitive change preceding changes in law rather than the other way round. This is supported by the rising number of paradoxes and oxymora, which are also the dominant language of the growing world of quantum technologies. This trend indicates the urgent need for new ways of thinking rather than the adoption of 'new laws based on old ideas', which is equivalent to serving 'old wine in new bottles'. The same is reflected in George P. Fletcher's work on the role of paradoxes in legal thought: he stresses the importance of developing 'a deeper understanding of the legal premises that guide our thinking'.[309]

In this regard, science is asked to perform a crucial role. First, it must address the Allport Paradox and guarantee that future law is based on sound scientific knowledge and the most accurate and complete account possible of human nature, the senses, and the human mind.[310] Second, it needs to integrate all scientific theories into a more consistent and up-to-date scientific paradigm supporting legal science and law and policymaking for the benefit of everyone, following the motto 'all of science for all'. This means addressing the negative aspects

[305] Overstreet (n 262).

[306] Max Born and Hedwig Born (eds), *The Born-Einstein Letters: Correspondence Between Albert Einstein and Max and Hedwig Born 1916–1955* (Walker 1971) 159.

[307] Peter Gibbins, *Particles and Paradoxes: The Limits of Quantum Logic* (CUP 1987) 3.

[308] Yakir Aharonov and Daniel Rohrlich, *Quantum Paradoxes: Quantum Theory for the Perplexed* (Wiley-VCH 2012) 1.

[309] George P Fletcher, 'Paradoxes in Legal Thought' (1985) 85(6) Columbia Law Review 1263, 1292.

[310] Malik Bozzo-Rey, 'Indirect Legislation: It Is Just a Question of Time' (2016) 43(1) History of European Ideas 106<https://doi.org/10.1080/01916599.2016.1251722>, and Rostam J Neuwirth, 'Future Law, the Power of Prediction, and the Disappearance of Time' (2022) 4(2) Law, Technology and Humans 38, 48<https://doi.org/10.5204/lthj.2376>.

of specialization and transforming 'interdisciplinarity' from mere lip service to grant authorities and publishers into an effective mode of policymaking.

Both goals require the use of paradoxical thinking, as the related steps must simultaneously address the realms of law and of human (legal) thinking. Because of restrictions resulting from our modern language's linear conception of temporality,[311] these steps will be outlined one after the other, first under the heading of 'quantum law' and then as 'four-dimensional thinking'.

A. Legal Preparations: Towards Quantum Law

As jurisdictions around the world are preparing their national quantum strategies, and another flawed narrative of a global race in the development and the regulation of quantum technologies appears on the horizon,[312] serious efforts should be dedicated to a better understanding of the scientific implications of quantum theories, and their manifestation through quantum technologies, for life and for lawyers as 'the chief architects of our [future] legal, political, and economic order'.[313]

Fortunately, the first serious discussions of the implications of quantum theories for law have been initiated and 'quantum law' has been born and is real.[314] Some features of quantum law are that it measures and does not judge compliance, and that it is generally concerned with the deconstruction of rules into smaller and smaller units.[315] The rising significance of quantum law has been recognized as a consequence of revolutionary and disruptive developments in the field of quantum technologies; these developments should be met by anticipatory actions that address their expected ethical, legal, social, and policy implications.[316] At this early stage, it is difficult to define 'quantum law' or to concretize its major principles and features. Great efforts are still required for its further clarification and development. However, it is clear that societal and planetary concerns should form the basis for the formulation of quantum law as the law of the future. To root it in scientific findings, a good working definition of quantum law is that it should rely on 'the study of quantum phenomena and features of

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[311] See Carlo Rovelli, *The Order of Time* (Riverhead Books 2018) 111.

[312] EU Quantum Strategy (n 3) 1.

[313] Lon L Fuller, 'On Teaching Law' (1950) 3(1) Stanford Law Review 35, 37.

[314] Ritter (n 85) 1.

[315] ibid.

[316] Eline de Jong, 'Own the Unknown: An Anticipatory Approach to Prepare Society for the Quantum Age' (2022) 1 Digital Society 1, 1 <https://doi.org/10.1007/s44206-022-00020-4>.

quantum technologies'.[317] In the meantime, the 'transformative potential of quantum computing for the legal system' is being recognized.[318] This means that legal science needs to engage in the 'proactive legal adaptation and the development of new legal theories, methodologies, and practices that are responsive to the unique characteristics and capabilities of quantum technologies'.[319]

The overall complexity, cross-cutting, cross-boundary, cross-cultural and 'transformative power' of quantum technologies warrants renewed and collaborative efforts between lawyers of all jurisdictions. It also requires a strong effort by national governments and diplomats, who should enhance 'quantum diplomacy', especially in the international year of quantum science and technology and also in the quest for a successor for the SDGs.[320] Last, efforts are needed to ensure that the potential benefits of quantum technologies are shared among all humans, and that scientific progress is not slowed down or rendered impractical by national laws and policies restricting freedom of research, scientific exchanges, and collaborations. These giant tasks at the quantum level first require a new and more open human mind-set, one leading to a transformative odyssey towards 'quantum intelligence' as outlined above.[321]

Unlike the use of 'AI', the term 'quantum intelligence' should be reserved for efforts to enhance human intelligence and not as a descriptor of the efficacy of machines.[322] This is particularly true as human intelligence has many facets, meaning also that people have 'different cognitive strengths and contrasting cognitive styles'.[323] Moreover, technologies are not mere tools or utensils to shape the external world; they are also mirrors or windows to the complicated inner workings of the human brain and skills stored therein. This is why it is necessary to actively promote quantum intelligence as a way to enhance human (legal) thinking in order to put this on equal terms with the creative efforts that have helped both to formulate quantum theories and to realize them in the form of quantum technologies. This novel mode of thinking will be briefly outlined with

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[317] Gromova and Petrenko (n 88) 62.

[318] Abdikhakimov (n 89) 59.

[319] ibid.

[320] Mhlambululi Mafu and Makhamisa Senekane, 'Quantum Technology for Development Framework as a Tool for Science Diplomacy' (2023) 8 Frontiers in Research Metrics and Analytics 1, 2 <https://doi.org/10.3389/frma.2023.1279376>.

[321] De Marco (n 20) 166.

[322] Xabier E Barandiaran and others, *Decidim, a Technopolitical Network for Participatory Democracy* (Springer 2024) 55 [Italics added].

[323] Howard Gardner, *Multiple Intelligences: New Horizons* (Basic Books 2006) 5.

the help of the term 'four-dimensional thinking'.

B. Cognitive Preparations: From AI to Four-Dimensional Thinking

The term 'four-dimensional thinking' is proposed here as it offers a timely concept to allow us to integrate into human cognition the basic scientific findings of the past century. It equally pays homage to Albert Einstein's description of the world as a 'four-dimensional space-time continuum'.[324] It also acknowledges that the three dimensions of space and one dimension of time, combined, likely constitute the ultimate normative framework for orientation in reality and for guiding human decision making and behaviour. It is also a transdisciplinary concept, as numerous people from different backgrounds have shown an interest in the fourth dimension as a stepping stone to the perception of a higher dimension (of space).[325]

In law and the legal sphere, its prior use has been extremely rare. I first used it in the context of the urgent quest for an adequate global institutional framework to govern AI beyond the boundaries of existing institutions and traditional modes of thinking.[326] I saw it, in particular, as a way to 'transcend the present perception of three-dimensional space based on a greater unity of the senses (synaesthesia) and a more flexible logic'.[327] The recognition of the need for four-dimensional thinking in law, however, came earlier and was pioneered in an article entitled 'Flatlaw' by Timothy D. Terrell which was published in 1984.[328] His article was inspired by the novel *Flatland*, which used an analogy to enhance the ability to imagine the existence of a higher dimension.[329] It also recognized the need to enhance legal reasoning with the help of a fourth-dimensional perspective in order 'to explain, if not fill in, the gaps in scientific knowledge'.[330] The idea also provides many useful illustrations that are deemed useful for expanding one's imagination as the primary requirement to gradually gain access to higher dimensional thinking.

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[324] Einstein (n 223) 379.

[325] See eg Charles H Hinton, *The Fourth Dimension* (Swan Sonnenschein & Co. 1901), Linda Dalrymple Henderson, 'The Image and Imagination of the Fourth Dimension in Twentieth-Century Art and Culture' (2009) 17(1–2) Configurations 131<https://doi.org/10.1353/con.0.0070>, and Mark Blacklock, *The Emergence of the Fourth Dimension: Higher Spatial Thinking in the Fin de Siècle* (OUP 2018).

[326] Neuwirth (n 136) 38.

[327] ibid.

[328] Timothy P Terrell, 'Flatlaw: An Essay on the Dimensions of Legal Reasoning and the Development of Fundamental Normative Principles' (1984) 72(3) California Law Review 288, 336; see also Timothy P. Terrell, *The Dimensions of Legal Reasoning: Developing Analytical Acuity from Law School to Law Practice* (Carolina Academic Press 2016).

[329] Edwin A Abbott, *Flatland: A Romance of Many Dimensions* (Seeley 1884).

[330] Terrell (n 327) 336.

To provide further information about the concrete skills developed with four-dimensional thinking and its training, more space is required. For the present purpose, it suffices to outline the following contours:

Four-dimensional thinking, first of all, means knowing the concepts of oxymora and paradoxes or 'essentially oxymoronic concepts'. These concepts help to overcome the limitations inherent in dualistic thinking, dichotomies and binary logic, and to learn to regard the contradictions expressed by the juxtaposition of antagonistic concepts not merely as impossibilities but as a quest for complementarity in their mutual relations. It also means expanding the application of binary logic to a polyvalent or 'fuzzy logic'. Applied to space and time, it means that they do not exist in absolute isolation from each other but form one coherent whole. Various insights gained from lateral thinking, as a tool to restructure one's existing patterns of thought, are of great use in this context.[331]

A second essential trait of four-dimensional thinking is the critical reconceptualization of the number of the human senses and a parallel reconsideration of their relationship. This means focusing on any individual sense and all the remaining senses at the same time, so as to interpret the world through a multisensory approach. This has been described using the notion of synaesthesia, or the 'union of the senses', which has rightly been described as the 'rule' and not the exception of human perception.[332] The role of the senses is also crucial because 'time' is a so-called 'common sensible', meaning that it is an attribute of objects or events 'that really can manifest itself through all of the senses'.[333] The combined study of individual senses and their union also allows for the discovery or development of new senses or sensory skills.

The next step is to conceptualize the full integration of spatio-temporal qualities by trying to perceive time as a fourth dimension of space. In this regard, the contemplation of different kinds of works of art, not just visual art, is deemed helpful. Many useful illustrations of four-dimensional shapes can be found in the book *Surfing Through Hyperspace* by Clifford A. Pickover.[334] Four-dimensional thinking can be further trained with the help of virtual and augmented reality tools and generative AI. Their

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[331] Edward De Bono, *Lateral Thinking: Creativity Step by Step* (Harper & Row 1970) 167.

[332] Maurice Merleau-Ponty, *Phenomenology of Perception* (Routledge & Keagan Paul 1962) 229, and Noam Sagiv, Roger T. Dean, and Freya Bailes, 'Algorithmic Synesthesia' in Roger T Dean (ed), *The Oxford Handbook of Computer Music* (OUP 2009) 294, 294.

[333] Marks (n 234) 32.

[334] Clifford A Pickover, *Surfing Through Hyperspace: Understanding Higher Universes in Six Easy Lessons* (OUP 1999) 137.

simulations have been found to be able to help 'to lift an observer into the higher dimensional space, so that he or she can directly experience it [the fourth dimension] perceptually'.[335]

These few steps should provide a first small set of useful tools to prepare humans cognitively for the advent of the quantum age and for work on quantum laws with the help of four-dimensional thinking or human 'quantum intelligence'. A few more useful principles have been formulated in an article that summarized the main points to consider for education for the fourth dimension, as follows:

> *1. The universe in which we live is an intricate web of dynamic interrelationships between and among time-space-energy-matter and behaves as a totality undefined as yet. It cannot be viewed, measured, or studied as an entity apart from ourselves. We are part of the universe. The universe is part of us. We are one.*
> *2. Human beings perceive their universe through limited instrumentalities. Their findings and conclusions must reflect these limitations.*
> *3. Since human beings are part of nature and not aloof from it, their measurements and observations modify nature in ways unknown.*
> *4. Through careful observation and measurement, and within limitations of specific space-time orientations, we may predict, with much precision, many significant events.*
> *5. How our universe maintains and controls itself, however, and the nature of our involvement with the universe is, at present time, a profound mystery.*
> *6. Certitude, therefore, is beyond the scope of contemporary science.* [336]

Even if, at present, we seem to have many unanswered questions,[337] there is still a lot that we do know as a result of scientific endeavours. Furthermore, it is as a result of technologies that many quantum theories have now become accessible and real. They should encourage law and policymakers to put science in the service of humanity again, and not to waste its many useful applications in technologies on an arms race. In this regard, technologies not only provide a unique opportunity to do things but also offer a means to reflect upon human nature. Moreover, they allow the human being to be 'the artifex of his destiny'.[338]

The chance to actively shape destiny, however, also carries a responsibility and a moral weight. In this regard, science and technology offer opportunities to learn about morality and to change society.[339] One example from quantum science and technology which may have significant repercussions for a future social and legal order is the quantum insight that 'everything is connected to everything, everything

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[335] Michael S Ambinder and others, 'Human Four-Dimensional Spatial Intuition in Virtual Reality' (2009) 16(5) Psychonomic Bulletin & Review 818, 818 <https://doi.org/10.3758/PBR.16.5.818>.

[336] James Thompson, 'Education for the Fourth Dimension' (2008) 48(3) The Educational Forum 335, 341–2 <https://doi.org/10.1080/00131728409335912>.

[337] Mossman (n 213).

[338] Gaius Sallustius Crispus, *Coniuratio Catilinae Et Bellum Jugurthinum* (Aldus 1563) 95, and Henryk Hoffmann, *Latin in Modern Fiction: Who Says It's a Dead Language?* (Vernon Press 2021) 261.

[339] Coeckelbergh (n 128) 371.

is part of everything, that there really are no others'.[340] This thought, when developed further, may help to foster the emergence of an awareness of 'quantum morality', which has been said to lead 'to the simple, guiding principle of quantum morality that itself mirrors the Golden Rule: When in any relationship, do onto others as you would have them do onto you—because those "others" are you'.[341] If this moral rule were fostered by a scientific observation and implemented through new technologies, would it not drastically change the world and the laws governing it? Perhaps, although it sounds like science fiction, these scientific observations were already made more than a century ago in what we are now celebrating the first quantum revolution. With the advent of the second quantum revolution, law and policymakers, as well as other stakeholders, now have both the chance and the responsibility to make sure that the development of the technologies issuing from these theories will be met by an adequate human understanding of human nature and social relations.

VI. CONCLUSION

The path which opens immediately before us in the future is that of applying the conception of four-dimensional space to the phenomena of nature, and of investigating what can be found out by this new means of apprehension. [342]

At the dawn of the second quantum revolution, which is witnessing an accelerated pace of development of quantum technologies, many new and exciting possibilities are arising. As usual, however, so are serious challenges, risks and dangers, as was recently also experienced with the global hype about the recent advent of AI technologies. The regulatory debates centred around AI brought to light important features. Nonetheless, they were also deeply flawed, as can be seen from the dominant narrative of a 'global race or battle to regulate AI'. This is not the first time in history that, in dealing with new technologies, humans have fallen victim to hype and a false belief that a new technology will automatically improve everyone's life, solve all problems and determine humanity's destiny. The misjudgement of technology seems to derive from a one-sided perspective that regards technologies merely as tools to shape the external world. This perspective is oblivious to the deeper purpose of technologies, which is their function as a window onto the internal world

[340] Dana Zohar, *Zero Distance: Management in the Quantum Age* (Palgrave Macmillan 2022) 107.

[341] ibid.

[342] Charles Howard Hinton, *A New Era of Thought* (Swan Sonnenschein 1888) 7.

of humans.[343] Such a one-sided perspective is also aided by outdated forms of thinking, such as dualistic or dichotomous thinking, as is expressed in the views on technologies contested by technophiles and technophobes.[344]

Against the backdrop of the rapid rise of quantum technologies as the next big thing and concrete proposals to regulate them through specific laws, such as a future EU Quantum Act, this article has argued for the need to learn from the shortcomings inherent in the global AI governance debate and especially warned about the negative effects of its dominant narrative as a global race to regulate AI. It also aimed to show that the regulation of quantum technologies based on existing legal instruments will not suffice, or that efforts to copy laws from one legal field to another or from the national or regional to the global level will fail. In contrast, the article stresses the need for a better integration of the latest scientific discoveries into the sphere of law and policymaking, which in the case of quantum technologies resides in the development of adequate levels of human 'quantum intelligence'. In the present context, this term is to be understood as a mandate for developing a new cognitive mind-set, one capable of producing the regulatory instruments for new technologies that are commensurate with the dangers that these threaten to bear, to paraphrase an important way of critical thinking expressed both in the constitution of UNESCO and in one of the founding treaties of the EU.[345] Quantum intelligence is also considered essential for the future development of 'quantum law', which not only refers to regulatory acts focusing on quantum technologies but applies to all laws and all legal systems in the coming quantum age.

In an allusion to the scientific description of reality as a 'four-dimensional space-time continuum', the new cognitive mind-set underlying quantum intelligence has been called 'four-dimensional thinking'. This is based on the ability to transcend dualistic thinking by complementing binary logic with polyvalent or fuzzy logic, which is supported both by linguistic trends, in the rise of oxymora and paradoxes, and by the parallel trends of technological convergence. It also means enhancing the human ability to make forecasts as an essential feature of planning. In law, it is deemed essential for the future-proofness or 'time consistency' of future laws that

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[343] Norm Friesen, 'Mind and Machine: Ethical and Epistemological Implications for Research' (2010) 25 AI & Society 83, 83 <https://doi.org/10.1007/s00146-009-0264-8>.

[344] Maria-Elena Osiceanu, 'Psychological Implications of Modern Technologies: "Technophobia" Versus "Technophilia"' (2015) 180 Procedia–Social and Behavioral Sciences 1137 <https://doi.org/10.1016/j.sbspro.2015.02.229>.

[345] Treaty Establishing the European Coal and Steel Community (signed 18 April 1951) 261 UNTS 140, recital 1.

they are based on the integration of time as the fourth dimension into the known three dimensions of space. Moreover, four-dimensional thinking may open the door to the perception of a higher dimension of reality, behind which further miraculous scientific discoveries may loom.

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