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THE USE OF ARTIFICIAL INTELLIGENCE IN CORPORATE DECISION-MAKING AT BOARD LEVEL: A PRELIMINARY LEGAL ANALYSIS

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Floris Mertens

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Abstract

Praised popular applications of artificial intelligence (AI) such as ChatGPT are merely a demonstration of AI's potential in the business world. AI is on the verge of assuming a common role in the management of companies, since its steady emergence as a support tool for the administrative and judgement work of directors and managers. While only a handful of companies worldwide have attempted to appoint a robo-director, the general use of AI in corporate governance has proven to rationalize board decision-making, challenge groupthink and strengthen the independence of directors. Contrastingly, company law frameworks around the world remain rooted in exclusively human decision-making and deny the role of technology in corporate governance, resulting in inefficient regulatory strategies with regard to AI systems bestowed with governance powers. As a result, uncertainty exists about the legal permissibility and legal consequences of the implementation of AI in the corporate realm, which could discourage corporations from adopting AI, in spite of the technology being likely to enhance the business judgement of directors.

Therefore, this paper attempts to highlight the growing importance of AI in corporate governance by classifying its gradual levels of autonomy vis-à-vis the board of directors. Then, this paper proceeds to make a preliminary legal analysis of the potential roles of AI in the management of memberless entities, leaderless entities and traditional corporations. The strongest focus of this paper lies on fundamental questions of corporate law pertaining to the delegation of decision rights to AI, the full replacement of human directors by AI, the required human supervision of AI and the attribution of liability for algorithmic failure.

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The use of artificial intelligence in corporate decision-making at board level: A preliminary legal analysis

Floris Mertens[1]

I. INTRODUCTION

1. Emergence of AI. In times when conversational chatbots such as ChatGPT are hailed as game-changers for the era of artificial intelligence (hereafter: AI),[2] many maintain that AI is bound to be the central engine of a fourth industrial revolution, which will have a considerable impact on the lives of individuals and organizations in our society.[3] Since new powerful foundation models[4] are making their entrance into the real world, palpable excitement about the corporate use of AI is emerging as it is no longer inconceivable that AI will become indispensable to many aspects of the corporate realm.[5] In fact, AI is on the verge of playing a crucial role in the management of companies. There is a growing recognition in the business world that AI systems can usefully assist human directors in their decision-making at management level, while only a handful of corporations worldwide have already attempted to grant AI true decision-making powers akin to those of human directors. However, the use of so-called "(artificial) governance intelligence"[6], even as a mere support tool to directors, generates unprecedented issues of corporate law, which call for a thorough legal analysis.

2. Use cases of AI in the corporate realm. Governance bodies such as the board of directors increasingly deploy AI to assist the decision-making on their corporate strategy, personnel selection, procurement, sales, marketing and even movie greenlighting.[7] In fact, assisting algorithms are already used in the management models proposed by McKinsey, Bain and BCG

[1] Doctoral researcher at the Financial Law Institute, Ghent University; Fellow of the Flemish Research Foundation (FWO). The author would like to express his sincere gratitude to Hans De Wulf for his valuable comments and contributions. Thank you to Julie Goetghebuer, Sergio Gramitto Ricci, Julie Kerckaert, Sinan Vanden Eynde and Francis Wyffels for the helpful remarks and suggestions. My appreciation also goes to John Armour, Florian Möslein and Eva Lievens for the valuable remarks on the general research project.

[2] Open AI's ChatGPT dialogue-based AI chatbot has gained a great deal of attention, as it is capable of understanding natural human language and generating impressively detailed human-like written text; see S. LOCK, "What is AI chatbot phenomenon ChatGPT and could it replace humans?", *The Guardian* 2022, www.theguardian.com/technology/2022/dec/05/what-is-ai-chatbot-phenomenon-chatgpt-and-could-it-replace-humans; S. MURPHY KELLY, "This AI chatbot is dominating social media with its frighteningly good essays", *CNN Business* 2022, edition.cnn.com/2022/12/05/tech/chatgpt-trnd/index.html.

[3] R. GIRASA and G.J. SCALABRINI, *Regulation of Innovative Technologies – Blockchain, Artificial Intelligence and Quantum Computing*, New York, Palgrave Macmillan, 2022, 2-3.

[4] A foundation model is an AI model trained on a large amount of unlabelled data, resulting in a model that can be adapted (*e.g.* finetuned) to various downstream cognitive tasks; R. BOMMASANI *et al.*, "On the Opportunities and Risks of Foundation Models", 2021, arxiv.org/abs/2108.07258, 3.

[5] X, "Artificial intelligence is permeating business at last", *The Economist* 2022, www.economist.com/business/2022/12/06/artificial-intelligence-is-permeating-business-at-last.

[6] The term "artificial governance intelligence" or "corporate AI" is already used in the literature. See *inter alia* M. HILB, "Toward artificial governance? The role of artificial intelligence in shaping the future of corporate governance", *Journal of Management and Governance* 2020, vol. 24 (4), 851-870; E. HICKMAN and M. PETRIN, "Trustworthy AI and Corporate Governance: The EU's Ethics Guidelines for Trustworthy Artificial Intelligence from a Company Law Perspective", *EBOR* 2021, vol. 22, 593-625; M.A. TOKMAKOV, "Artificial Intelligence in Corporate Governance" in S.I. ASHMARINA and V.V. MANTULENKO (eds.), *Digital Economy and the New Labor Market: Jobs, Competences and Innovative HR Technologies*, Cham, Springer, 2021, 667-674.

[7] For example, Warner Bros. deploys an algorithm from Cinelytic to predict the box office results of movie projects before being greenlit; CINELYTIC, "Data Driver Cinelytic Engages Warner Bros. Pictures International to Utilize Their Revolutionary AI-Driven Content and Talent Valuation System", *Business Wire* 2020, www.businesswire.com/news/home/20200108005856/en/Data-Driver-Cinelytic-Engages-Warner-Bros.-Pictures-International-to-Utilize-Their-Revolutionary-AI-Driven-Content-and-Talent-Valuation-System.

as strategic advisors for investments.[8] The use of algorithmic trading, where an algorithm decides to buy financial products on behalf of the company, is also on the rise.[9] Relatedly, one of the most popular applications of governance intelligence today is its support for the discovery and due diligence process of mergers and acquisitions.[10] Both processes are essential steps for the eventual board decision of the acquirer, which involve a highly coordinated effort among experts such as company personnel, accountants, lawyers and investment bankers.[11] When these processes are assisted by AI, there is an increased likelihood that the board will be able to negotiate an accurate price and an appropriately tailored deal structure.[12] In addition, AI systems are deployed by directors to profile investors, audit annual reports,[13] review the risk of financial instruments and determine optimal market supply and demand.[14]

Back in 2014, the Hong Kong-based venture capital group Deep Knowledge Ventures took this further by allegedly appointing an algorithm named "VITAL" to its board of directors.[15] This AI system was purportedly given the right to vote on whether the firm were to invest in a specific company or not, similar to the other – human – directors of the corporation.[16] Consequently, VITAL has been widely acknowledged as the world's first robot-director.[17] After successes stemming from VITAL's decisions (such as investments in biotech start-ups Insilico Medecine and Pathway Pharmaceuticals[18]), other companies also factually implemented AI systems as board members (such as Tietoevry and Salesforce).[19] Yet, most legal systems do not allow the appointment of a robo-director.[20] While only a handful of companies have chosen this untrodden path of robot-directors, many have already assigned a supportive role to AI in its corporate decision-making process.[21]

3. Prospects. One can therefore ascertain that AI is steadily emerging in the boardrooms of innovative companies, which is supported by the recent EY-study ordered by the European

[8] M. SCHRAGE, "4 Models for Using AI to Make Decisions", *Harvard Business Review* 2017, hbr.org/2017/01/4-models-for-using-ai-to-make-decisions.
[9] See M.J. MCGOWAN, "The Rise of Computerized High Frequency Trading: Use and Controversy", *Duke Law & Technology Review* 2010, vol. 9, 2; T.C.W. LIN, "The New Investor", *UCLA Law Review* 2013, vol. 60, 689-691.
[10] M.R. SIEBECKER, "Making Corporations More Humane Through Artificial Intelligence", *The Journal of Corporation Law* 2019, vol. 45, 107.
[11] *Ibid*, 108.
[12] S. ZADEH, "Better, Faster, Stronger: Revamping the M&A Due Diligence Process with Artificial Intelligence Platforms", *Deal Law Wire* 2018, www.deallawwire.com/2018/03/27/better-faster-stronger-revamping-the-ma-due-diligence-process-with-artificial-intelligence-platforms/.
[13] G. HERTIG, "Use of AI by Financial Players: The Emerging Evidence", 2022, ssrn.com/abstract_id=4013559, 15-16.
[14] J.B.S. HIJINK, "Robots in de boardroom", *Ondernemingsrecht* 2019, 11.
[15] R. WILE, "A Venture Capital Firm Just Named An Algorithm To Its Board Of Directors — Here's What It Actually Does", *Business Insider* 2014, www.businessinsider.com/vital-named-to-board-2014-5?international=true&r=US&IR=T.
[16] *Ibid*, Y.N. HARARI, *Homo Deus: A Brief History of Tomorrow*, London, Harvill Secker, 2015, 322.
[17] E. ZOLFAGHARIFARD, "Would you take orders from a ROBOT? An artificial intelligence becomes the world's first company director", *Daily Mail* 2014, www.dailymail.co.uk/sciencetech/article-2632920/Would-orders-ROBOT-Artificial-intelligence-world-s-company-director-Japan.html.
[18] BIOGERONTOLOGY RESEARCH FOUNDATION, "Deep Knowledge Ventures announces new investment fund for life sciences and aging research", *EurekAlert!* 2015, www.eurekalert.org/news-releases/831727.
[19] TIETO, "Tieto the First Nordic Company to Appoint Artificial Intelligence to the Leadership Team of the New Data-Driven Businesses Unit", *Business Wire* 2016, www.businesswire.com/news/home/20161016005092/en/Tieto-the-First-Nordic-Company-to-Appoint-Artificial-Intelligence-to-the-Leadership-Team-of-the-New-Data-Driven-Businesses-Unit; J. BORT, "How Salesforce CEO Marc Benioff uses artificial intelligence to end internal politics at meetings", *Business Insider* 2017, www.businessinsider.in/How-Salesforce-CEO-Marc-Benioff-uses-artificial-intelligence-to-end-internal-politics-at-meetings/articleshow/58743024.cms.
[20] See no. 20.
[21] Collective investment undertakings, asset managers and other large companies such as BlackRock, EQT Ventures, Quantum Light Capital and NN Investment Partners strongly rely on their AI platforms for core financial decision-making.

Commission, claiming that 13% of the respondent EU-companies already use governance intelligence, and an additional 26% plan to do so in the future.[22] A 2023 McKinsey-study highlights that 8% of C-suite executive respondents regularly uses generative AI for work, while 16% of respondents regularly uses generative AI for both professional and non-professional purposes.[23] In respect of M&A, a 2022 study suggested that over 69% of its respondents (executives from large US public corporations and private equity funds) are utilizing AI tools for the due diligence process.[24] On top of that, in a survey report, the World Economic Forum made the claim that by 2026, corporate governance will have faced a robotization process of a massive scale, with the result that human directors sharing their decision-making powers with artificial directors will become the new normal.[25] Even though this claim was made back in 2015, the corporate sector of today shows an increasingly notable interest in AI.[26] Momentum in computational power, breakthroughs in AI technology, and advanced digitalisation will therefore inevitably lead to a more established support of directors by AI, if not their full replacement by autonomous systems.[27]

4. Corporate law. The rise of AI in corporate governance is contrasted by static company law, which has not kept pace at all with governance-relevant advances at the technological front. A good illustration is VITAL, which may have been widely acknowledged as the world's first robo-director,[28] but from a legal point of view, Hong Kong corporate law did not recognize the AI system as such.[29] To bypass the law, VITAL was treated as a member of the board with "observer status".[30] On a more general note, corporate law is not adapted to governance

[22] The pool of respondents consisted of 402 companies from all 27 EU Member States, except Poland. ERNST & YOUNG, "Study on the relevance and impact of artificial intelligence for company law and corporate governance – Final report", 2021, op.europa.eu/en/publication-detail/-/publication/13e6a212-6181-11ec-9c6c-01aa75ed71a1/language-en, 13-14.
[23] The pool of respondents consisted of 541 C-suite executives from companies all over the world. M. CHUI, B. HALL, A. SINGLA and A. SUKHAREVSKY, "The state of AI in 2023: Generative AI's breakout year", *McKinsey Global Survey* 2023, www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai-in-2023-generative-ais-breakout-year#/, 3.
[24] DELOITTE, "2022 M&A Trends Survey: The future of M&A – Dealmaking trends to help you pivot on M&A's fast-changing playing field", 2022, www2.deloitte.com/us/en/pages/mergers-and-acquisitions/articles/m-a-trends-report.html?mod=article_inline.
[25] WORLD ECONOMIC FORUM, "Survey Report: Deep Shift - Technology Tipping Points and Societal Impact", *Global Agenda Council on the Future of Software & Society* 2015, www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf, 21.
[26] *Inter alia* M. CHUI, R. ROBERTS and L. YEE, "Generative AI is here: How tools like ChatGPT could change your business", 2022, www.mckinsey.com/capabilities/quantumblack/our-insights/generative-ai-is-here-how-tools-like-chatgpt-could-change-your-business (retrieved on 27 March 2023); X, "Artificial intelligence is permeating business at last", *The Economist* 2022, www.economist.com/business/2022/12/06/artificial-intelligence-is-permeating-business-at-last; S. EARLEY and S. ZIVIN, "The Rise of the AI CEO: A Revolution in Corporate Governance", *Teneo* 2023, www.teneo.com/the-rise-of-the-ai-ceo-a-revolution-in-corporate-governance/; D. STRAUSS, "Generative AI set to affect 300mn jobs across major economies", *Financial Times* 2023, www.ft.com/content/7dec4483-ad34-4007-bb3a-7ac925643999.
[27] The overall desirability and economic necessity of autonomous systems entering the boardroom is debated, but will be discarded for this paper. It is a fact that AI is already being used in corporate boardrooms today, which prompts an inquiry into its legal implications regardless of its desirability.
[28] R. WILE, "A Venture Capital Firm Just Named An Algorithm To Its Board Of Directors — Here's What It Actually Does", *Business Insider* 2014, www.businessinsider.com/vital-named-to-board-2014-5?international=true&r=US&IR=T.
[29] S. SHARWOOD, "Software 'appointed to board' of venture capital firm", *The Register* 2014, www.theregister.com/2014/05/18/software_appointed_to_board_of_venture_capital_firm/. According to S. 456 (2) Hong Kong Companies Ordinance, a "body corporate" may not be appointed as a director of the majority of corporate forms. Based on the method of exclusion, only natural persons can consequently be appointed as a director of these Hong Kong incorporated companies.
[30] N. BURRIDGE, "Artificial intelligence gets a seat in the boardroom", *Nikkei Asia* 2017, asia.nikkei.com/Business/Artificial-intelligence-gets-a-seat-in-the-boardroom.

intelligence, since it is rooted in *human* decision-making.[31] Therefore, corporate law will have to cope with novel legal questions, once the use of AI as a support tool or replacement of human directors becomes more common.

It is the purpose of this paper to create awareness of the legal uncertainty arising from governance intelligence, and to signal its legal issues from a company law perspective. To attain this, Part II articulates the reasons for introducing AI in the boardroom, along with a taxonomy of governance intelligence on the basis of its autonomy level, which could serve as a benchmark for future differentiated rules. Then, Part III maps the current state of the legal art, identifies corporate law issues arising from AI under current legal frameworks and makes suggestions on where the law should be headed to tackle or at least alleviate these legal issues.

II. USE OF ARTIFICIAL INTELLIGENCE IN CORPORATE DECISION-MAKING

a. Concept of artificial intelligence for this paper

5. Definition and capabilities. Since AI is an intangible and emerging core concept for this paper, a clear and convenient working definition is necessary to facilitate the development of arguments in this regard. There is no predominant definition of AI available yet.[32] The literature offers many diverging definitions, often prompted by the needs of a particular research project.[33] For this study, the AI definition of the OECD (now transposed to the EU Draft AI Act) serves as working definition. The OECD's Expert Group of Artificial Intelligence defines AI as "*a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments. Different AI systems vary in their levels of autonomy and adaptiveness after deployment*".[34] The fact that the machine-based system pursues a given set of objectives and influences the environment in doing so, implies that its actions and output generation are not determined by pre-programmed rules, but they are the result of a learning and training process of the machine itself (of which the foundation is indeed coded in advance). This definition refrains from using anthropomorphic terms that resemble human traits (*i.e.* anthropocentrism[35]), which is discarded in the literature.[36] At the same time, the technology-

[31] One may argue that the legal permissibility (in some jurisdictions) to appoint a corporate director (*i.e.* a legal person as director) impedes the argument that corporate law is rooted in human decision-making. However, corporate directors have always been factually represented by one or more natural persons at the board of the subject company, whether this is mandated by statute or not. Therefore, traditional corporate law assumes that all decision-making at the level of the subject company is performed by humans.

[32] S. LUCCI and D. KOPEC, *Artificial Intelligence in the 21st Century: A Living Introduction*, Dulles, Mercury Learning and Information, 2016, 4; S. SAMOILI, M. LÓPEZ COBO, E. GÓMEZ, G. DE PRATO, F. MARTÍNEZ-PLUMED, and B. DELIPETREV, "AI Watch. Defining Artificial Intelligence. Towards an operational definition and taxonomy of artificial intelligence", 2020, publications.jrc.ec.europa.eu/repository/handle/JRC118163, 7.

[33] P. WANG, "On the Working Definition of Intelligence", 1995, www.researchgate.net/publication/2339604_On_the_Working_Definition_of_Intelligence, 3.

[34] See L. BERTUZZI, "OECD updates definition of Artificial Intelligence 'to inform EU's AI Act'", *EUROACTIV* 2023, www.euractiv.com/section/artificial-intelligence/news/oecd-updates-definition-of-artificial-intelligence-to-inform-eus-ai-act/. Compare with the original OECD definition in OECD, "Scoping the OECD AI Principles – Deliberations of the Expert Group on Artificial Intelligence at the OECD (AIGO)", 2019, www.oecd-ilibrary.org/science-and-technology/scoping-the-oecd-ai-principles_d62f618a-en, 7.

[35] Anthropocentrism refers to the viewpoint that human beings are the central or most important entity in the universe; see BRITANNICA, "Anthropocentrism", www.britannica.com/topic/anthropocentrism (retrieved on 5 September 2023).

[36] The outcomes of today's AI appear to be increasingly human, while the underlying processes do not necessarily resemble human intelligence. For that reason, any tendencies of anthropocentrism in defining AI are misplaced. See *inter alia* D.M. KATZ, "Quantitative Legal Prediction - Or - How I Learned to Stop Worrying and Start Preparing for the Data-Driven Future of the Legal Services Industry", *Emory Law Journal* 2013, vol. 62, 918; I. GIUFFRIDA, F. LEDERER and N.

neutral nature of the definition makes it flexible and future-proof. To make clear AI does not capture simple and traditional computer programs such as spreadsheets, it stresses that AI systems produce output *autonomously*,[37] as mentioned by the definition enshrined in the latest version of the EU Draft AI Act.[38]

AI systems can either use symbolic rules (knowledge-based systems) or learn a numeric model (data-based or machine learning systems).[39] Machine learning is the most popular method, as it enables AI to learn ("train") from examples by deriving a decision from large sets of data, improving its model each decision cycle.[40] Hence, the system is not given instructions on how to perform a task (*i.e.* there are no pre-programmed rules about how to solve a specific problem), but it is programmed to elaborate its own instructions by a complex learning procedure. There are various types of machine learning. In case of supervised learning, the algorithm learns to associate labelled output data with input data. By contrast, unsupervised learning allows the algorithm to discover patterns and structures in unlabelled data on its own.[41] Alternative forms of machine learning include semi-supervised, self-supervised and reinforcement learning.[42]

Another useful distinction can be made on the basis of the system's goals. Most AI systems existing today are narrow, as they model intelligent behaviour for narrowly defined specific tasks and fail to operate outside of their programmed domain of use cases. In spite of being designed to fulfil limited tasks, even narrow systems can display autonomous capabilities by operating under limited human supervision within the boundaries of their application field.[43]

VERMEYST, "A Legal Perspective on the Trials and Tribulations of AI: How Artificial Intelligence, the Internet of Things, Smart Contracts, and Other Technologies Will Affect the Law", *Case Western Reserve Law Review* 2018, vol. 68, 755; H. SURDEN, "Artificial Intelligence and Law: An Overview", *Georgia State University Law Review* 2019, vol. 35, 1315; M. HERBOSCH, *Intelligent contracteren – Het precontractueel gebruik van systemen op basis van artificiële intelligentie*, doctoral thesis at Koninklijke Universiteit Leuven, 2023, 14-16, no. 17-19. There are, however, authors who still defend a definition of AI in terms of human intelligence. See *inter alia* D. WECHSLER, *The measurement of adult intelligence*, Baltimore, Williams & Wilkins, 1944, vii + 258 p.; T. BESOLD, J. HERNÁNDEZ-ORALLO and U. SCHMID, "Can Machine Intelligence be Measured in the Same Way as Human intelligence?", *KI – Künstliche Intelligenz* 2015, vol. 29, 292-293, where intelligence is defined as "*the aggregate or global capacity of the individual to act purposefully, to think rationally, and to deal effectively with the environment*". For a comprehensive overview of the viewpoints on what contributes to intelligence, see C. PENNACHIN and B. GOERTZEL, "Contemporary Approaches to Artificial General Intelligence" in B. GOERTZEL and C. PENNACHIN (eds.), *Artificial General Intelligence*, Berlin Heidelberg, Springer, 2007, 6-11; S. LEGG, *Machine Super Intelligence*, doctoral thesis at the University of Lugano, 2008, 3-11; S. RUSSELL and P. NORVIG, *Artificial Intelligence – A Modern Approach*, Harlow, Pearson, 2022, 19-23. For a general definition of "intelligence", see L.S. GOTTFREDSON, "Mainstream Science on Intelligence: An Editorial With 52 Signatories, History, and Bibliography", *Intelligence* 1997, vol. 24, 13. There is high controversy about the so-called "theories of intelligence", which elaborate a different taxonomic structure of abilities associated to intelligence; see R.J. STERNBERG, *The Cambridge Handbook of Intelligence*, Cambridge, Cambridge University Press, 2020, xxii + 1250 p.

[37] AI systems may exhibit several gradual degrees of autonomy. See T. LASAR, *Künstliche Intelligenz in der GmbH*, Frankfurt am Main, Fachmedien Recht und Wirtschaft, 2023, 4.

[38] See EUROPEAN PARLIAMENT, Draft Compromise Amendments on the Draft Report – Proposal for a regulation of the European Parliament and of the Council on harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union Legislative Acts, COM(2021)0206 – C9 0146/2021 – 2021/0106(COD), 16 May 2023, 137.

[39] See HIGH-LEVEL EXPERT GROUP ON ARTIFICIAL INTELLIGENCE, "A Definition of AI: Main Capabilities and Disciplines. Definition developed for the purpose of the AI HLEG's deliverables", 2019, digital-strategy.ec.europa.eu/en/library/definition-artificial-intelligence-main-capabilities-and-scientific-disciplines, 6.

[40] E. ALPAYDIN, *Introduction to Machine Learning*, Cambridge, Massachusetts Institute of Technology, 2014, 1-4.

[41] See *inter alia* T.M. MITCHELL, *Machine learning*, New York, McGraw-Hill, 1997, 414 p; K.P. MURPHY, *Machine Learning: A Probabilistic Perspective*, Cambridge – London, MIT Press, 2012, 3; D. LEHR and P. OHM, "Playing with the Data: What Legal Scholars Should Learn About Machine Learning", *UC Davis Law Review* 2017, vol. 53, 673.

[42] S. RUSSELL and P. NORVIG, *Artificial Intelligence – A Modern Approach*, Harlow, Pearson, 2022, 671.

[43] G. LUSARDI and A. ANGILLETTA, "The interplay between the new Machinery Regulation and Artificial Intelligence, IoT, cybersecurity and the human-machine relationship", 2022, www.technologyslegaledge.com/2022/04/the-interplay-

A popular narrow AI application is ChatGPT (even though it has an *a priori* general purpose). Also in the business world, the majority of AI systems is narrow. AI systems such as autonomous vehicles are considered broad, as they are designed to handle a variety of tasks.[44] Finally, some scholars contend that it will not be long until AI displays human-like intelligence with an unlimited operational domain, therefore achieving general intelligence.[45]

6. Critical evaluation of the technological state of the art. In reality, artificial general intelligence might still be a decade or even a century away.[46] In addition, critics highlight that AI has been handicapped by an incomplete understanding of "intelligence", as it is only able to detect hidden correlations in large datasets and does not comprehend causal relationships.[47] While AI may outperform humans on average for certain well-defined tasks, it sometimes produces erroneous results of which it is unlikely that a human would make the same mistake.[48] Furthermore, the use of foundation models and artificial neural networks for "deep learning" (a subset of supervised machine learning) may pose transparency challenges, as these models may embody "black box" characteristics causing the underlying reasons and the logic of their decisions to be hard to comprehend, even for the developers of the system.[49] The opacity issue is combatted by the explainable AI movement ("XAI"), which strives for the decisions and predictions of AI to become understandable in the eye of human beings.[50] Finally, while AI

between-the-new-machinery-regulation-and-artificial-intelligence-iot-cybersecurity-and-the-human-machine-relationship/#page=1.

[44] Both narrow and broad AI belong to the category of weak AI, *i.e.* intelligent systems with limited goals. Computer science has not managed to develop an AI system of which the intelligence goes beyond the "weak" attribute yet; H. SHEVLIN, K. VOLD, M. CROSBY and M. HALINA, "The limits of machine intelligence – Despite progress in machine intelligence, artificial general intelligence is still a major challenge", *EMBO reports* 2019, vol. 20 (49177), 1-5.

[45] For an overview of currents standpoints in the literature, see *inter alia* C. PENNACHIN and B. GOERTZEL, "Contemporary Approaches to Artificial General Intelligence" in B. GOERTZEL and C. PENNACHIN (eds.), *Artificial General Intelligence*, Berlin Heidelberg, Springer, 2007, 1 *ff.*; B. GOERTZEL, "Artificial General Intelligence: Concept, State of the Art, and Future Prospects", *Journal of Artificial General Intelligence* 2014, vol. 5, 1-46; A.M. BARRETT and S.D. BAUM, "A model of pathways to artificial superintelligence catastrophe for risk and decision analysis", *Journal of Experimental & Theoretical Artificial Intelligence* 2017, vol. 29, 397; K. GRACE, J. SALVATIER, A. DAFOE, B. ZHANG, and O. EVANS, "When Will AI Exceed Human Performance? Evidence from AI Experts", *Journal of Artificial Intelligence Research* 2018, vol. 62, 729-754; H. SHEVLIN, K. VOLD, M. CROSBY and M. HALINA, "The limits of machine intelligence – Despite progress in machine intelligence, artificial general intelligence is still a major challenge", *EMBO Reports* 2019, vol. 20, art. e49177; S. RUSSELL and P. NORVIG, *Artificial Intelligence – A Modern Approach*, Harlow, Pearson, 2022, 50-52; H. HIRSCH-KREINSEN, "Artificial intelligence: a "promising technology"", *AI & SOCIETY* 2023, doi.org/10.1007/s00146-023-01629-w; S. MCLEAN, G.J.M. READ, J. THOMPSON, C. BABER, N.A. STANTON and P.M. SALMON, "The risks associated with Artificial General Intelligence: A systematic review", *Journal of Experimental & Theoretical Artificial Intelligence* 2023, vol. 35, 649-650.

[46] This claim is made by Geoffrey HINTON with regard to AI passing the Turing test in M. FORD, *Architects of Intelligence – the truth about AI from the people building it*, Birmingham, Packt Publishing, 2018, 89. As of now, computer engineering is far away from the dystopian scenario that philosopher Nick BOSTROM envisaged, in which general AI ("superintelligence") assigned with producing paperclips would sacrifice all of the planet's resources to achieve its final goal and ultimately convert the entire universe into paperclips; N. BOSTROM, *Superintelligence: Paths, dangers, strategies*, Oxford, Oxford University Press, 2014, 122-125.

[47] J. PEARL and D. MACKENZIE, *The Book of Why: The New Science of Cause and Effect*, New York, Basic Books, 2018, 418 p.

[48] See for instance A. NGUYEN, J. YOSINSKI and J. CLUNE, "Deep Neural Networks are Easily Fooled: High Confidence Predictions for Unrecognizable Images", *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, Boston, IEEE, 2015, 427-436.

[49] R.T. KREUTZER and M. SIRRENBERG, *Understanding Artificial Intelligence – Fundamentals, Use Cases and Methods for a Corporate AI Journey*, Cham, Springer, 2020, 11-12.

[50] See *inter alia* Y. BATHAEE, "The Artificial Intelligence Black Box and the Failure of Intent and Causation", *Harvard Journal of Law & Technology* 2018, vol. 31, 889-938; A. PREECE, "Asking 'Why' in AI: Explainability of intelligent systems – perspectives and challenges", *Intelligent Systems in Accounting, Finance and Management* 2018, vol. 25, 63–72; P. HACKER, R. KRESTEL, S. GRUNDMANN and F. NAUMANN, "Explainable AI under contract and tort law: legal incentives and technical challenges", *Artificial Intelligence and Law* 2020, vol. 28, 415-439; S. LU, "Algorithmic Opacity, Private Accountability, and Corporate Social Disclosure in the Age of Artificial Intelligence", *Vanderbilt Journal of Entertainment & Technology Law* 2020, vol. 23, 99-159; A. BIBAL, M. LOGNOUL, A. DE STREEL and B. FRÉNAY, "Legal requirements on explainability

can help to reduce direct human biases, there is a risk that its model is trained and tested with biased data, reflecting the financial interests of its deployer or developer.

b. Reasons for the use of artificial governance intelligence

7. Growing popularity of AI in the corporate realm. In spite of the aforementioned criticism on the current capabilities of AI, this paper signals that a growing number of companies adopts AI for corporate decision-making. The concept of corporate decision-making refers to the decision-making processes relating to the core functions of the board of directors and top management (*i.e.* monitoring, strategy formulation and daily management). Of course, computer systems have been deployed in support of corporate decision-making for decades now, ranging from early decision support systems to executive support systems.[51] But today, the techniques and functionalities of AI enable useful and advanced applications for corporate governance, such as retrieving relevant information, coordinating real-time data delivery, analysing data trends, providing financial and other forecasts, monitoring financial transactions, optimizing logistics flows and making useful predictions and scenario analyses for potential courses of action in the decision-making process.[52]

8. Advantages of AI for corporate decision-making. On a more general level, AI support rationalizes board decisions, some of which typically call for large amounts of data. The more complex a decision is, the greater the amount of data that the board needs to consider in order for it to make a rational and well-informed decision.[53] The processing of a plethora of factors to reach an optimal market-based decision is difficult for human directors, since they are often unfamiliar with analytics. Because of this, board decisions are frequently made with little data analysis and an emphasis on sheer gut feelings.[54] Here, the main advantage of AI comes down to the rapid analysis of large data arrays. Today's best AI programmes are at heart statistical (analytical) models,[55] which can detect hidden correlations and patterns in large datasets.[56] Thus, AI is able to complement the broad capabilities and knowledge of the human board members by providing them with a clear analysis of intangible mountains of data, and therefore increase the pace at which difficult decisions are taken. Furthermore, boards could use AI

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in machine learning", *Artificial Intelligence and Law* 2021, vol. 29, 149-169; G. VILONE and L. LONGO, "Notions of explainability and evaluation approaches for explainable artificial intelligence", *Information Fusion* 2021, vol. 76, 89-106; G. DEL GAMBA, "Machine Learning Decision-Making: When Algorithms Can Make Decisions According to the GDPR" in G. BORGES and C. SORGE (eds.), *Law and Technology in a Global Digital Society – Autonomous Systems, Big Data, IT Security and Legal Tech*, Cham, Springer, 2022, 75-87.

[51] R.H. SPRAGUE and E.D. CARLSON, *Building Effective Decision Support Systems*, Englewood Cliffs, Prentice-Hall, 1982, xx + 329 p; D.L. OLSON and J.F. COURTNEY, *Decision Support Models and Expert Systems*, New York, Macmillan, 1992, xiii + 418 p; D.L. OLSON and G. LAUHOFF, *Descriptive Data Mining*, Singapore, Springer, 2019, 2.

[52] P. BHATTACHARYA, "Artificial Intelligence in the Boardroom: Enabling 'Machines' to 'Learn' to Make Strategic Business Decisions" in *Fifth HCT Information Technology Trends (ITT)*, Dubai, IEEE Computer Society, 2018, 170-171; H. DRUKARCH and E. FOSCH-VILLARONGA, "The Role and Legal Implications of Autonomy in AI-Driven Boardrooms" in B. CUSTERS and E. FOSCH-VILLARONGA (eds.), *Law and Artificial Intelligence – Regulating AI and Applying AI in Legal Practice,* Den Haag, Asser Press, 2022, 352.

[53] T.A. LIEDONG, T. RAJWANI and T.C. LAWTON, "Information and nonmarket strategy: Conceptualizing the interrelationship between big data and corporate political activity", *Technological Forecasting & Social Change* 2020, vol. 157, 1-12; Z. LIPAI, X. XIQIANG and L. MENGYUAN, "Corporate governance reform in the era of artificial intelligence: research overview and prospects based on knowledge graph", *Annals of Operations Research* 2021, separate online issue, 12.

[54] M.R. SIEBECKER, "Making Corporations More Humane Through Artificial Intelligence", *The Journal of Corporation Law* 2019, vol. 45, 144.

[55] M. BROUSSARD, *Artificial Unintelligence – How Computers Misunderstand the World*, Cambridge, MIT Press, 2018, 87-119.

[56] For a critical account on the lack of causal "intelligence" of AI, see J. PEARL and D. MACKENZIE, *The Book of Why: The New Science of Cause and Effect*, New York, Basic Books, 2018, 418p.

simulation tools (to generate *e.g.* Monte Carlo Simulations[57]) to design and test scenarios. This enables board decisions to be based on a rational and objective analysis of corporate patterns and industry trends instead of gut feelings.[58]

Additionally, some authors insist that governance intelligence, in addition to traditional solutions such as a required form of diversity and independence of board members, is useful to counteract groupthink.[59] The latter is a psychological mode of thinking in highly cohesive groups such as boards of directors, where the desire to reach consensus (or majority) by the group members overrides critical thinking and correct judgment.[60] In a scenario where the board of directors has failed to consider alternate courses of action (either because there was no time to process all relevant information or because it was hesitant to challenge the management), the board will have to evaluate the output of the implemented AI system, which is normally uninfluenced by groupthink as this cognitive tendency is inherently human (unless when the system's training data is biased). Thus, the board will be able to consider aspects of a situation or courses of action that might have been missed because of blind spots caused by groupthink.[61]

The theorical and technological neutrality[62] of AI may also strengthen the independence of the board for two reasons (under the condition that its training data is unbiased). First, AI support gives the independent board members more leverage to protest each other's opinions in board meetings.[63] Since AI machines are in principle impartial and free of conflict of interest, their output is not influenced by any friendship and ensures bolstered independence of decision-

[57] Monte Carlo simulations, as most types of regressive analyses today, constitute AI when they are rendered autonomously. See for instance T. VODOPIVEC, S. SAMOTHRAKIS and B. STER, "On Monte Carlo Tree Search and Reinforcement Learning", *Journal of Artificial Intelligence Research* 2017, vol. 60, 881-936; S. RUSSELL and P. NORVIG, *Artificial Intelligence – A Modern Approach*, Harlow, Pearson, 2022, 207-210.

[58] A. HAMDANI, N. HASHAI, E. KANDEL and Y. YAFEH, "Technological progress and the future of the corporation", *Journal of the British Academy* 2018, vol. 6, 219-220.

[59] A. KAMALNATH, "The Perennial Quest for Board Independence - Artificial Intelligence to the Rescue?", *Albany Law Review* 2019-20, vol. 83, 52; M.A. TOKMAKOV, "Artificial Intelligence in Corporate Governance" in S.I. ASHMARINA and V.V. MANTULENKO (eds.), *Digital Economy and the New Labor Market: Jobs, Competences and Innovative HR Technologies*, Cham, Springer, 2021, 669.

[60] I.L. JANIS, "Groupthink", *Psychology Today* 1971, vol. 5, 43-46. The phenomenon of groupthink is often blamed in the literature for the failures at Enron, Worldcom and the financial crisis of 2007-2008, see *inter alia* M.A. O'CONNOR, "The Enron Board: The Perils of Groupthink", *Corporate Law Symposium* 2003, vol. 71, 1233-1320; S. ALLEN, "The Death of Groupthink", *Bloomberg* 2008, www.bloomberg.com/news/articles/2008-02-05/the-death-of-groupthinkbusinessweek-business-news-stock-market-and-financial-advice; M. SKAPINKER, "Diversity fails to end boardroom groupthink", *Financial Times* 2009, www.ft.com/content/433ed210-4954-11de-9e19-00144feabdc0; P. SCHRANK, "A better black-swan repellent", *The Economist* 2010, www.economist.com/leaders/2010/02/11/a-better-black-swan-repellent.

[61] R.J. THOMAS, R. FUCHS and Y. SILVERSTONE, "A machine in the C-suite", 2016, ecgi.global/sites/default/files/documents/accenture-strategy-wotf-machine-csuite11.pdf, 5; A. KAMALNATH, "The Perennial Quest for Board Independence - Artificial Intelligence to the Rescue?", *Albany Law Review* 2019-20, vol. 83, 52; A. LAI, "Artificial Intelligence, LLC: Corporate Personhood As Tort Reform", *Michigan State Law Review* 2021, 620-621.

[62] AI is claimed to be unbiased as opposed to humans, albeit in the limited sense that the technology does not follow an own agenda different from its programmed goals. However, it is possible that human subjectivity, perhaps even previous instances of groupthink, emerges through its test data and training data and is thus incorporated in the system's learning process. These human biases reflect the financial interests of human actors involved, and can even be exacerbated by the system. In addition, algorithmic biases may also emerge from the system's learning process. See *e.g.* S. BAROCAS and A.D. SELBST, "Big Data's Disparate Impact", *California Law Review* 2016, vol. 104, 692-693 regarding the risk of human decision-makers masking their intentions by using biased data; A.H. RAYMOND, E. ARRINGTON STONE YOUNG and S.J. SHACKELFORD, "Building a Better Hal 9000: Algorithms, the Market, and the Need to Prevent the Engraining of Bias", *Northwestern Journal of Technology and Intellectual Property* 2018, vol. 15, 222-232 regarding algorithmic biases.

[63] A. KAMALNATH, "The Perennial Quest for Board Independence - Artificial Intelligence to the Rescue?", *Albany Law Review* 2019-20, vol. 83, 50-51.

making,[64] as long as the human directors do not feel pressured to put a blind faith in the AI output.[65] The neutral outcomes of the machine can challenge strong interpersonal relationships that may have grown between directors over the years, which led to a holdback of protesting friends on the board.[66] In other words, the board dynamics, including interpersonal relationships, could shift considerably when AI is granted a dominant or even a mere assisted role in the board. Second, AI augmentation will help directors to process data in a shorter period of time. Independent directors are known to hold positions in multiple boards, where decisions sometimes need to be taken on a short notice. Being outsiders to the company, they are unable to digest all decision-relevant data in this brief timespan. Governance intelligence can aid them in quickly distilling the crucial information,[67] which may lead to an increased board activity.[68]

c. Classification of artificial governance intelligence in terms of the level of autonomy

9. Importance of classification. There are, to this day, no universal standards defining different kinds of AI systems used in the corporate realm. However, for the purpose of a legal analysis of governance intelligence, it is imperative to first discover the potential use cases of AI for corporate decision-making. A taxonomy offers a clear overview of how boards of directors and top managements may use AI to their benefit, irrespective of its lawfulness or legal impact. In a second step, a taxonomy could also allow the legislator, should he be so inclined, to use its categories as a benchmark for issuing AI-specific differentiated corporate rules. Such a method would diminish legal uncertainty, as it enables companies to precisely determine the applicable rules to a certain type of governance intelligence they would like to implement.

10. The level of autonomy as demarcation criterium. Within the corporate realm, the various agency conflicts and corresponding corporate rules are closely connected to the decision-making power of agents in the corporation. Therefore, it makes sense to develop a governance intelligence continuum that distinguishes categories on the basis of the allocation of decision rights between man and machine. In other words, the level of autonomy of the AI system serves as a benchmark here. Autonomy, not to be confused with automation,[69] refers to the ability to perform specific (narrow) tasks (based on the system's utility functions)

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[64] Z. LIPAI, X. XIQIANG and L. MENGYUAN, "Corporate governance reform in the era of artificial intelligence: research overview and prospects based on knowledge graph", *Annals of Operations Research* 2021, separate online issue, 12; M. EROĞLU and M.K. KAYA, "Impact of Artificial Intelligence on Corporate Board Diversity Policies and Regulations", *EBOR* 2022, vol. 23, forthcoming.

[65] S.A GRAMITTO RICCI, "Artificial Agents in Corporate Boardrooms", *Cornell Law Review* 2020, vol. 105, 899 (arguing that human directors may feel overly compelled to conform to AI output. Should board members disagree with the system, they might feel compelled to explain why they chose to disregard entirely, or deviate from, the output of the system. As a result, the alleged pressure for human directors to explain why they disagree with AI could ultimately affect the directors' ability to exercise independent judgment when making a decision).

[66] A. KAMALNATH, "The Perennial Quest for Board Independence - Artificial Intelligence to the Rescue?", *Albany Law Review* 2019-20, vol. 83, 50-51.

[67] *Ibid*, 49-51.

[68] ERNST & YOUNG, "Study on the relevance and impact of artificial intelligence for company law and corporate governance", 2021, 28-29.

[69] Automation should be defined as the ability of a system (not necessarily an AI system) to perform a limited set of programmed supervised tasks on behalf of the user, most often executed in a repeating pattern; F. GALDON, A. HALL, and S.J. WANG, "Designing trust in highly automated virtual assistants: A taxonomy of levels of autonomy" in A. DINGLI, F. HADDOD and C. KLÜVER (eds.), *Artificial Intelligence in Industry 4.0 – A Collection of Innovative Research Case-studies that are Reworking the Way We Look at Industry 4.0 Thanks to Artificial Intelligence*, Cham, Springer, 2021, 200.

independently from human guidance or intervention.[70] Besides the allocation of decision rights, the classification of governance intelligence in this paper also takes into account the decision type of the board, the task that is assigned to the AI system[71] and the scope of the goals of both the implemented AI system and the company as a whole (narrow or broad), which all have an impact on the autonomy level of the AI system – and likewise the required oversight by human directors.[72]

11. Levels of autonomy for artificial governance intelligence. As a starting point for this classification, one should consider traditional board practices where human directors are the sole decision-makers within the board. They are potentially supported by simple technology applications without AI capabilities such as calculators and spreadsheets. These systems are purely practical, task-specific and lack any form of autonomy in the corporate governance process. However, from the moment that AI is deployed in the corporate realm, it is possible that traditional board practices will fade in a gradual manner. According to the respective level of autonomy and corresponding decision rights granted to the AI system, a distinction can be made between assisted, augmented and autonomous governance intelligence.[73]

Assisted Governance Intelligence. In the assisted form of AI, human directors are still the sole decision-makers within the board of directors, but they rely on selective support from narrow AI systems for mostly practical and administrative tasks. These AI applications are task-specific and their output is restricted to an assisted nature that does not enhance the human decision-making or touch upon the core judgement work of directors. Assisted governance intelligence is occasionally assimilated with the intelligent (*i.e.* AI-driven) "automation" of business processes in management literature.[74] Examples include business virtual assistants,[75]

[70] W. XU, "From Automation to Autonomy and Autonomous Vehicles – Challenges and Opportunities for Human-Computer Interaction", *Interactions* 2021, vol. 28, 50.

[71] For example, the difference between assisted and augmented intelligence might not necessarily stem from the respective capabilities of the technology. Instead, the demarcation between both categories depends on the enhancing nature of the output of the AI system, as well as the role definition of the system, *i.e.* the task that is *ad hoc* entrusted to it, see K. WALCH, "Is There A Difference Between Assisted Intelligence Vs. Augmented Intelligence?", *Forbes* 2020, www.forbes.com/sites/cognitiveworld/2020/01/12/is-there-a-difference-between-assisted-intelligence-vs-augmented-intelligence/?sh=2322431526ab.

[72] The general "AAAI"-classification of RAO and its equivalents, as well as the SAE standard J3016 for autonomous vehicles, are two AI classifications built on a similar notion. See A. RAO, "AI: Everywhere and Nowhere (Part 3)", 2016, www.insurancethoughtleadership.com/ai-machine-learning/ai-everywhere-and-nowhere-part-3; SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL, "Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles", 2021, www.sae.org/standards/content/j3016_202104/, 41 p. Therefore, these taxonomies could be transposed to the corporate realm, which has been attempted before by other scholars, such as *inter alia* F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 657; M. PETRIN, "Corporate Management in the Age of AI", *Columbia Business Law Review* 2019, vol. 3, 980-983; S.A GRAMITTO RICCI, "Artificial Agents in Corporate Boardrooms", *Cornell Law Review* 2020, vol. 105, 895-904; M. HILB, "Toward artificial governance? The role of artificial intelligence in shaping the future of corporate governance", *Journal of Management and Governance* 2020, vol. 24 (4), 861-862; H. DRUKARCH and E. FOSCH-VILLARONGA, "The Role and Legal Implications of Autonomy in AI-Driven Boardrooms" in B. CUSTERS and E. FOSCH-VILLARONGA (eds.), *Law and Artificial Intelligence – Regulating AI and Applying AI in Legal Practice,* Den Haag, Asser Press, 2022, 355-356; J. ZHAO and B. GÓMEZ FARIÑAS, "Artificial Intelligence and Sustainable Decisions", *EBOR* 2023, vol. 24, 13-15.

[73] As originally defined in a general manner by A. RAO, "AI: Everywhere and Nowhere (Part 3)", 2016, www.insurancethoughtleadership.com/ai-machine-learning/ai-everywhere-and-nowhere-part-3.

[74] *E.g.* J. NALDER, "Future-U A3 Model: How to understand the impact of tech on work, society & education", 2017, static1.squarespace.com/static/52946d89e4b0f601b40f39a4/t/58ec53789de4bb1ee3bf3bc5/1491882887958/FUTURE-U+A3+MODEL+v2.pdf.

[75] *E.g.* the (now discontinued) application Amy Ingram of the now-acquired company X.ai, which was developed to schedule meetings by reading and writing e-mails, coordinating with participants and managing calendar invites.

intelligent document and material processing,[76] in addition to accounting and reporting robotics.[77]

Augmented Governance Intelligence. At the augmented level, human directors are still the final decision-makers within the board of directors, who rely on the sustained support from AI systems for certain specific decisions, in a manner that enhances or improves human intelligence or decision-making. The human directors use AI output to improve the informative basis of governance decisions for which they have a certain amount of policy freedom (decisions pertaining to their "business judgement"). AI augmentation allows for the analysis of large amounts of data, and the reduction of uncertainties essential to the decision-making with predictive analyses.[78] Therefore, the human board members and AI systems perform decision-making tasks *jointly*, but the AI system itself does not enjoy standalone decision rights as it is exclusively entrusted with the preparation of decisions (there is human-in-the-loop[79] oversight). Augmented governance intelligence can serve multiple purposes, such as searching for information (*i.e.* intelligent search or enterprise search), classifying information (a form of supervised learning), clustering information (a form of unsupervised learning) and rendering precise recommendations and/or predictions (such as Monte Carlo scenario analyses). Currently, AI systems of this autonomy level are used to support M&A transactions and strategic decision-making of the management. The predictive and prescriptive analytics of this level also allow for cutting-edge forecasting applications in the field of finance and creative fields such as the film industry (by predicting box office results for movie projects).[80]

Autonomous Governance Intelligence. At the final autonomous stage, AI systems are bestowed with their own standalone decision rights for governance decisions, as they operate virtually independently from the guidance and control of human directors – if there are any. Such an autonomous level can be achieved through the delegation of core corporate governance powers to the AI system or through the appointment of an AI system as a member of the board. The delegation or appointment does not need to be legally recognised and may constitute a matter of facts – as directors could factually put blind faith in AI for certain decisions. The AI systems of this category vary in the scope of the so-called "operational domain"[81] for which

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[76] Specialised AI platforms such as Automation Anywhere IQ Bot, docBrain, Kofax TotalAgility, Metamaze, Super.ai and UiPath Document Understanding are using this process to automate complex document-based workflows of enterprises in general.

[77] As part of the so-called Robotic Process Automation (RPA) within businesses, see INSTITUTE FOR ROBOTIC PROCESS AUTOMATION, "Introduction to Robotic Process Automation – A Primer", 2015, irpaai.com/introduction-to-robotic-process-automation-a-primer/.

[78] M.H. JARRAHI, "Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making", *Business Horizons* 2018, vol. 61, 580; S. FRIEDRICH, G. ANTES, S. BEHR, H. BINDER, W. BRANNATH, F. DUMPERT, K. ICKSTADT, H.A. KESTLER, J. LEDERER, H. LEITGÖB, M. PAULY, A. STELAND, A. WILHELM and T. FRIEDE, "Is there a role for statistics in artificial intelligence?", *Advances in Data Analysis and Classification* 2021, doi.org/10.1007/s11634-021-00455-6.

[79] *Cf.* the AI oversight models defined in HIGH-LEVEL EXPERT GROUP ON ARTIFICIAL INTELLIGENCE, "Ethics Guidelines for Trustworthy AI", 2019, op.europa.eu/en/publication-detail/-/publication/d3988569-0434-11ea-8c1f-01aa75ed71a1. See also R. KOULU, "Human Control over Automation: EU Policy and AI Ethics", *European Journal of Legal Studies* 2020, vol. 12, 31-32; E. HICKMAN and M. PETRIN, "Trustworthy AI and Corporate Governance: The EU's Ethics Guidelines for Trustworthy Artificial Intelligence from a Company Law Perspective", *EBOR* 2021, vol. 22, 600-603.

[80] See no. 7.

[81] The operational (design) domain of an autonomous system encompasses "*the operating conditions under which* [the system] *or feature thereof is specifically designed to function*". Compare with the used terminology in the SAE-taxonomy for connected and autonomous vehicles: SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL, "Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles", 2021, www.sae.org/standards/content/j3016_202104/, 32-33, no. 6.

they are designed and consequently implemented. In case of a core power delegation to AI or an appointment of AI among other human directors (a *hybrid board*), the AI system operates within a limited domain of the decision-making process. Human directors are still present to monitor the overall operations and decisions of the AI system where desirable (called human-in-command oversight). For instance, regardless of its lawfulness, a human director may delegate part of its monitoring duty to an AI system, or a robo-director may be appointed as additional board member. Another possibility entails the situation where the factual board of a company exclusively consists of one AI system (a *fused board*) or multiple artificial directors (an *artificial board*). Then, human directors are completely absent (human-out-of-the-loop), as the AI system operates independently from any human intervention. A scenario of fused or artificial boards is currently only possible (from a mere technological perspective) when the goals of the AI system and the company are restricted to a narrow operational domain, in addition to being closely connected and intertwined. Examples include algorithmic trading (for long-term investments), robo-taxi and vending machine companies, where a limited purpose naturally facilitates the technological conceivability of the autonomous system. Self-driving subsidiaries with narrow goals, as defined by leading scholars,[82] also fall in this category. In order for AI systems to be able to govern corporations with broad goals (*i.e.* with an unlimited number of operational domains), the achievement of strong or general intelligence is required, which remains science fiction at this point in time. If ever accomplished, the upward potential of AI decision-making in corporate governance rises to a superhuman level for all domains.

III. HUMAN-TAILORED CORPORATE LAW, UNPREPARED FOR THE INTRODUCTION OF ARTIFICIAL GOVERNANCE INTELLIGENCE

a. Artificial governance intelligence: the legal state of the art

12. Static company law. The classification of governance intelligence represents a continuum of power that is handed over from human directors to AI systems. It starts with trivial and mundane AI systems that do not have a real say in corporate decision-making and evolves towards the delegation of core powers to AI or even the full replacement of one or more human directors by AI. As mentioned before, corporate law has not evolved at all to reflect the potential role of AI in the corporate realm. The latter may not immediately impede the legal permissibility of the assisted autonomy level of governance intelligence, as it does not intrude on the basic principles of board practice.[83] Greater legal uncertainty does arise for higher AI autonomy levels, where the decision-making process is to a large extent influenced by AI output, with autonomous intelligence as an extreme as it might remove humans completely out of the loop for some decision types.

13. *Prima facie* incompatibility of corporate legal frameworks. The unpreparedness of corporate legal frameworks is due to the fact that traditional corporate law has the general

[82] J. ARMOUR and H. EIDENMÜLLER, "Self-Driving Corporations?" in H. EIDENMÜLLER and G. WAGNER (eds.), *Law by Algorithm*, Tübingen, Mohr Siebeck, 2021, 176-177.
[83] M. HILB, "Toward artificial governance? The role of artificial intelligence in shaping the future of corporate governance", *Journal of Management and Governance* 2020, vol. 24 (4), 862-863.

function of mediating or at least controlling specific human agency conflicts.[84] Not all of these conflicts necessarily occur in the same fashion if decision-making is conducted or supported by AI, which is wired differently than human intelligence. From a mere technological point of view, an AI system cannot choose its ultimate goal or utility function (as this has been programmed from the outset by its developer[85]), it operates without other self-interests than maximising its utility function and it is unfamiliar with the corporate concept of stakeholder interests (unless when it is programmed and trained to take such interests into account[86]). On top of this, AI cannot pursue anyone's interests in good faith or bad faith, insofar the system optimises its objective utility function[87] in alignment with the subjective goals of its programmer.[88] The system's "intentions", if any, should be attributed to its human coding, training data and learning process.[89] AI is thus claimed to be unbiased as opposed to humans, albeit in the limited sense that the technology does not follow an own agenda that deviates from the objectives set by its programmer.[90] However, human biases may be reflected in the algorithm and/or the data, and algorithmic biases may emerge from the learning process.[91] The *ex post* remedies of corporate law are inefficient to counter these biases or to encourage rule-compliant behaviour from governance intelligence,[92] as these dissuasive methods are not appropriate for systems of which the learning process is pre-programmed. Finally, the broad standards of conduct that directors should adhere to when fulfilling their core functions, such as the fiduciary duty of

[84] For an account on the three agency problems within the corporation, see J. ARMOUR, H. HANSMANN and R. KRAAKMAN, "What Is Corporate Law?" in R. KRAAKMAN, J. ARMOUR, P. DAVIES, L. ENRIQUES, H. HANSMANN, G. HERTIG, K.J. HOPT, H. KANDA, M. PARGENDLER, W.-G. RINGE and E. ROCK (eds.), *The Anatomy of Corporate Law: A Comparative and Functional Approach*, Oxford, Oxford University Press, 2017, 29-31.

[85] S.M. OMOHUNDRO, "The Nature of Self-Improving Artificial Intelligence", 2008, selfawaresystems.files.wordpress.com/2008/01/nature_of_self_improving_ai.pdf, 17-28; N. BOSTROM, *Superintelligence: Paths, dangers, strategies*, Oxford, Oxford University Press, 2014, 109-111;

[86] See *inter alia* T. AHMED and A. SRIVASTAVA, "Predicting Human Interest: An Application of Artificial Intelligence and Uncertainty Quantification", *Journal of Uncertainty Analysis and Applications* 2016, vol. 4, 1-21; B.D. MITTELSTADT, P. ALLO, M. TADDEO, S. WACHTER and L. FLORIDI, "The ethics of algorithms: Mapping the debate", *Big Data & Society* 2016, vol. 3, 1-21.

[87] F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 666; J. ARMOUR and H. EIDENMÜLLER, "Self-Driving Corporations?" in H. EIDENMÜLLER and G. WAGNER (eds.), *Law by Algorithm*, Tübingen, Mohr Siebeck, 2021, 177; C. PICCIAU, "The (Un)Predictable Impact of Technology on Corporate Governance", *Hastings Business Law Journal* 2021, vol. 17, 119.

[88] An AI system may pursue its objective function in a manner that is incompatible with the intended (subjective) goals that its programmer wishes the system to accomplish. One could argue that in case of goal-misalignment, the AI system acts in bad faith. An example of this is so-called "reward hacking" or "specification gaming", where a reinforcement system finds loopholes that helps it accomplish the specified objective efficiently but in unintended, possibly harmful ways. See *inter alia* D. MANHEIM and S. GARRABRANT, "Categorizing Variants of Goodhart's Law", 2018, doi.org/10.48550/arXiv.1803.04585; V. KRAKOVNA, J. UESATO, V. MIKULIK, M. RAHTZ, T. EVERITT, R. KUMAR, Z. KENTON, J. LEIKE and S. LEGG, "Specification gaming: the flip side of AI ingenuity", *DeepMind* 2020, www.deepmind.com/blog/specification-gaming-the-flip-side-of-ai-ingenuity.

[89] In respect of the possibility of AI forming intent, see *e.g.* L.B. ELIOT, "On The Beguiling Question Of Whether AI Can Form Intent, Including The Case Of Self-Driving Cars", *Forbes* 2020, www.forbes.com/sites/lanceeliot/2020/06/06/on-the-beguiling-question-of-whether-ai-can-form-intent-including-the-case-of-self-driving-cars/?sh=2f28a81c448d.

[90] S. DHANRAJANI, "Board Rooms Strategies Redefined By Algorithms: AI For CXO Decision Making", *Forbes* 2019, www.forbes.com/sites/cognitiveworld/2019/03/31/board-rooms-strategies-redefined-by-algorithms-ai-for-cxo-decision-making/?sh=4861ddee3154; S.A GRAMITTO RICCI, "Artificial Agents in Corporate Boardrooms", *Cornell Law Review* 2020, vol. 105, 901 and 903; M. PETRIN, "Corporate Management in the Age of AI", *Columbia Business Law Review* 2019, vol. 3, 1006.

[91] See no. 8.

[92] F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 666-667; M. PETRIN, "Corporate Management in the Age of AI", *Columbia Business Law Review* 2019, vol. 3, 1013-1018.

loyalty and care, are hardly intelligible for AI and cannot be coded into the algorithm,[93] since they are subject to interpretation and often ambiguously shaped by case law.

Generally, the absence of specific corporate rules for artificial governance intelligence creates legal uncertainty about whether it is lawful at all to "enhance" human governance decisions with the help of AI, and how liability should be attributed when a decision based on AI output causes harm to third parties. As mentioned earlier, Hong Kong corporate law did not recognize VITAL as a director, since the legal status of a corporate director is reserved for natural persons in most forms of Hong Kong companies.[94] In this respect, its "appointment" was exaggerated, as no true legal decision rights could be granted to the system. This renders the question to what extent a director is legally allowed to hand over (*i.e.* delegate) core decision-making powers to AI from a corporate governance perspective, and if allowed, which level of supervision by humans is required.[95] A full replacement of corporate bodies by AI encounters even greater legal issues, although prominent scholars acknowledge the possibility of creating algorithmic entities in the US and the EU.[96] Interestingly, the previously mentioned EY-study ordered by the European Commission purports that the use of AI as a support tool for decision-making is regarded as permissible under the current corporate frameworks, in absence of specific statutory provisions or case law.[97] While the use of technological auxiliaries by directors may be allowed, uncertainty exists about its potential legal (liability) consequences. In fact, the study itself signals the complex legal questions arising from the use of assisted and augmented intelligence.[98] In addition, leading scholars in the field have expressed the opinion that existing corporate law frameworks as a whole are currently unfit for the adoption of governance intelligence with higher autonomy levels.[99] Beyond corporate law, it is also unclear if the worldwide initiatives to regulate AI may impose legal obligations on companies adopting governance intelligence, besides the many specific rules concerning data and financial transactions.[100] As a result of this legal uncertainty from a company law and technology law perspective, companies could be discouraged to adopt AI at a governance level, even when its implementation would likely improve the quality of decision-making.

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[93] M. PETRIN, "Corporate Management in the Age of AI", *Columbia Business Law Review* 2019, vol. 3, 1013; A. KAMAL-NATH, "The Perennial Quest for Board Independence - Artificial Intelligence to the Rescue?", *Albany Law Review* 2019-20, vol. 83, 55; C. PICCIAU, "The (Un)Predictable Impact of Technology on Corporate Governance", *Hastings Business Law Journal* 2021, vol. 17, 119.

[94] See no. 4.

[95] See no. 18 on corporate power delegation and no. 21 on the required supervision of the delegated powers.

[96] See no. 14.

[97] ERNST & YOUNG, "Study on the relevance and impact of artificial intelligence for company law and corporate governance", 2021, 48-51.

[98] While the study views AI support tools for corporate decision-making as permissible under the current laws, it paradoxically attaches two broad and ambiguous conditions to this permissibility: "(i) that duties and decisions laying at the heart of the management function (*e.g.* definition and supervision of corporate strategy) remain with human directors, and (ii) that directors oversee the selection and activities of AI tools, which in turn requires them to have at least some basic understanding of how the specific AI tools operate". In respect of autonomous intelligence, the study concludes that AI cannot legally replace corporate bodies under the existing frameworks; see ERNST & YOUNG, "Study on the relevance and impact of artificial intelligence for company law and corporate governance", 2021, 48-51.

[99] F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 666-667; M. PETRIN, "Corporate Management in the Age of AI", *Columbia Business Law Review* 2019, vol. 3, 1015-1022; J. ARMOUR and H. EIDENMÜLLER, "Self-Driving Corporations?" in H. EIDENMÜLLER and G. WAGNER (eds.), *Law by Algorithm*, Tübingen, Mohr Siebeck, 2021, 175-182.

[100] See no. 21 for an illustration on specific rules of data protection law and financial law.

14. Memberless and leaderless entities. Before legal literature started paying attention to the emerging potential of AI entering the boardroom of existing corporations, some scholars depicted the creation of entirely new businesses without any ongoing human involvement. This idea was first put forward by BAYERN, who asserted that one can factually confer legal personhood on an autonomous computer by putting it in control of a US limited liability company (LLC's), thus creating a memberless or algorithmic entity exclusively governed by an algorithm.[101] According to BAYERN, the default corporate governance rules do not prevent so-called algorithmic management, and state law allegedly allows LLC's to continue their operations after becoming shareholderless over time under the exclusive control of an AI system.[102] Even if state law would not allow the foregoing, circular ownership and "vetogates" could achieve a comparable result.[103] Other scholars contend that a similar result can be reached with other corporate forms and in different jurisdictions, such as EU Member States.[104] The latter could be achieved by establishing algorithmic entities in countries with flexible regulatory standards, and then invoking the principle of Freedom of Establishment in order to conduct business in other EU Member States.[105] However, the absence of any type of human control creates a risk of undesirable activities and liability attribution problems. Algorithmic entities incorporated in the EU will need to refrain from taking certain decisions autonomously, as the AI Act will require human oversight of AI systems with high-risk applications such as evaluating the creditworthiness of natural persons or assessing the recruitment of natural persons.[106] In addition, the technological conceivability and utility of memberless entities is rightfully criticized,[107] as they have no legitimate or serious *raison d'être*, let alone a for-profit purpose.[108] More generally, the necessity of granting legal personhood to AI, whether or not under the corporate veil or via special types of citizenship, is hotly debated.[109]

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[101] S. BAYERN, "Of Bitcoins, Independently Wealthy Software, and the Zero-Member LLC", *Northwestern University Law Review* 2014, vol. 108, 1495-1500; S. BAYERN, "The Implications of Modern Business-Entity Law for the Regulation of Autonomous Systems", *Stanford Technology Law Review* 2015, vol. 19, 93-112; S. BAYERN, "Are Autonomous Entities Possible?", *Northwestern University Law Review* 2019, vol. 114, 23-47.

[102] S. BAYERN, "Of Bitcoins, Independently Wealthy Software, and the Zero-Member LLC", *Northwestern University Law Review* 2014, vol. 108, 1496-1497; S. BAYERN, "The Implications of Modern Business-Entity Law for the Regulation of Autonomous Systems", *Stanford Technology Law Review* 2015, vol. 19, 101-104.

[103] For these techniques, see S. BAYERN, "Are Autonomous Entities Possible?", *Northwestern University Law Review* 2019, vol. 114, 28-33; L.M. LOPUCKI, "Algorithmic Entities", *Washington University Law Review* 2018, vol. 95, 919-924.

[104] S. BAYERN, T. BURRI, T.D. GRANT, D.M. HÄUSERMANN, F. MÖSLEIN, and R. WILLIAMS, "Company Law and Autonomous Systems: A Blueprint for Lawyers, Entrepreneurs, and Regulators", *Hastings Science and Technology Law Journal* 2017, vol. 9, 139-153; L.M. LOPUCKI, "Algorithmic Entities", *Washington University Law Review* 2018, vol. 95, 907-912.

[105] T. BURRI, "Free Movement of Algorithms: Artificially Intelligent Persons Conquer the European Union's Internal Market" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 543-549; L.M. LOPUCKI, "Algorithmic Entities", *Washington University Law Review* 2018, vol. 95, 927-928.

[106] Art. 14 (1) *juncto* Annex III Draft AI Act. See also art. 22 (1) GDPR.

[107] See *inter alia* D.M. HÄUSERMANN, "Memberless Legal Entities Operated by Autonomous Systems – Some Thoughts on Shawn Bayern's Article "The Implications of Modern Business-Entity Law for the Regulation of Autonomous Systems" from a Swiss Law Perspective", ssrn.com/abstract=2827504, 10-12; M.U. SCHERER, "Of Wild Beasts and Digital Analogues: The Legal Status of Autonomous Systems", *Nevada Law Journal* 2019, vol. 19, 264-279.

[108] *Contra* L.M. LOPUCKI, "Algorithmic Entities", *Washington University Law Review* 2018, vol. 95, 900-901.

[109] *E.g.* L. SOLUM, "Legal Personhood for Artificial Intelligences", *North Carolina Law Review* 1992, vol. 70, 1231-1287; F.P. HUBBARD, "Do Androids Dream? Personhood and Intelligent Artifacts", *Temple Law Review* 2010, vol. 83, 405-474; R. DOWELL, "Fundamental Protections for Non-Biological Intelligences or: How We Learn to Stop Worrying and Love Our Robot Brethren", *Minnesota Journal of Law Science & Technology* 2018, vol. 19, 305-336; G. TEUBNER, "Digitale Rechtssubjekte? Zum privatrechtlichen Status autonomer Softwareagenten", *Ancilla Iuris* 2018, 36-78; V. A.J. KURKI, *A Theory of Legal Personhood*, Oxford, Oxford University Press, 2019, 175-189; T.L. JAYNES, "Legal personhood for artificial intelligence: citizenship as the exception to the rule", *AI & Society* 2020, vol. 35, 343-354; N. BANTEKA, "Artificially Intelligent Persons", *Houston Law Review* 2021, vol. 58, 537-596; A. LAI, "Artificial Intelligence, LLC: Corporate Personhood As

On the other end of the spectrum, one should be wary of AI-driven leaderless entities, namely Decentralized Autonomous Organizations (DAOs). DAOs belong to the broader family of decentralized organizations. The latter are computer programs without a distinct governance body, running on a peer-to-peer network, which involves a set of users interacting with each other, in accordance with a coded protocol, enforced on a blockchain.[110] DAOs are designed to run "autonomously"[111] on this blockchain since they are solely controlled by code,[112] whereas traditional decentralized organizations require heavy involvement from humans on each end of various transactions.[113] Put another way, DAOs have a structure that does not entail directors or managers, since it is directly controlled by its members through an autonomous and decentralized system.[114] The utility functions of DAOs span greater lengths than those of memberless entities, as they originated in the world of Decentralized Finance (DeFi). However, the DAO is faced with numerous legal hurdles in light of its lacking legal recognition, which may result in courts qualifying it as an unincorporated partnership to impose personal liability on its members.[115] Other legal risks include the unclear attribution of corporate fiduciary duties,[116] in addition to the debatable security law qualification of initial offerings of tokens and coins.[117] Aside from the foregoing legal aspects, the spectacular failure of Ethereum-based "The DAO"[118] underpins the general risks and shortcomings of a business entity without centralized management.

15. Artificial management of traditional corporations – legal state of the art. The far-fetched ideas of both memberless and leaderless corporations eventually drew attention to the more realistic hypothesis of AI playing a role in the boardroom of traditional and already established corporations. Over the past few years, a vast number of research papers have been

Tort Reform", *Michigan State Law Review* 2021, 597-653; E. MIK, "AI as a Legal Person?" in J.-A. LEE, R.M. HILTY, K.-C. LIU (eds.), *Artificial Intelligence and Intellectual Property*, Oxford, Oxford University Press, 2021, 419-439.

[110] This definition is, with minor alterations, adopted from L. METJAHIC, "Deconstructing The DAO: The Need for Legal Recognition and the Application of Securities Laws to Decentralized Organizations", *Cardozo Law Review* 2018, vol. 39, 1541-1542.

[111] While DAOs come in many different varieties, they tend to have in common that they use smart contracts enabling investors to directly participate in its decision-making. The term "autonomous" in DAO refers to that use of smart contracts, which do not constitute AI as they merely automate the execution of past party promises that are translated into code. Therefore, it seems inappropriate to refer to DAOs as truly "autonomous". On smart contracts, see H. SURDEN, "Computable Contracts", *University of California, Davis Law Review* 2012, vol. 46, 695.

[112] Blockchain networks (or other Distributed Ledger Technologies) serve as an interoperable layer for AI to interact and potentially coordinate themselves with other code-based systems through a set of smart contracts; P. DE FILIPPI and A. WRIGHT, *Blockchain and the Law: The Rule of Code*, Cambridge – London, Harvard University Press, 2018, 147-150.

[113] *Ibid*, 148.

[114] V. BUTERIN, "DAOs, DACs, DAs and More: An Incomplete Terminology Guide", *Ethereum Foundation Blog* 2014, blog.ethereum.org/2014/05/06/daos-dacs-das-and-more-an-incomplete-terminology-guide.

[115] S. PALLEY, "How to Sue a DAO", 2016, www.linkedin.com/pulse/how-sue-dao-stephen-palley; L. METJAHIC, "Deconstructing The DAO: The Need for Legal Recognition and the Application of Securities Laws to Decentralized Organizations", *Cardozo Law Review* 2018, vol. 39, 1553-1558; C.L. REYES, "If Rockefeller Were a Coder", *The George Washington Law Review* 2019, vol. 87, 398-400; W.A. KAAL, "Decentralized Autonomous Organizations – Internal Governance and External Legal Design", *Annals of Corporate Governance* 2021, vol. 5, 24. *E.g.* District Court Southern District Of California (US) May 2, 2022, Sarcuni et al v. bZx DAO et al., www.classaction.org/media/sarcuni-et-al-v-bzx-dao-et-al.pdf.

[116] W.A. KAAL, "Decentralized Autonomous Organizations – Internal Governance and External Legal Design", *Annals of Corporate Governance* 2021, vol. 5, 26; B. MIENERT, *Dezentrale autonome Organisationen (DAOs) und Gesellschaftsrecht – Zum Spannungsverhältnis Blockchain-basierter und juristischer Regeln*, Tübingen, Mohr Siebeck, 2022, 189-192.

[117] The US SEC published a report in 2017 about the qualification of DAO tokens as securities, which is a fact-based analysis; US SECURITIES AND EXCHANGE COMMISSION, "SEC Issues Investigative Report Concluding DAO Tokens, a Digital Asset, Were Securities", 2017, www.sec.gov/news/press-release/2017-131.

[118] *E.g.* U. RODRIGUES, "Law and the Blockchain", *Iowa Law Review* 2019, vol. 104, 697-706.

written about the legal status of governance intelligence in various jurisdictions.[119] This research wave was sparked by the original work of MÖSLEIN,[120] in addition to the paper of ARMOUR and EIDENMÜLLER.[121] Prompted by the growing attention paid to governance intelligence in the literature, the European Commission ordered a study report from EY on its impact for corporate law and corporate governance. However, as mentioned earlier, this EY-study claimed categorically that AI support for directors is permissible in absence of specific cases and statutory law (even though the study confirms that legal problems and uncertainty exist), while AI replacing corporate bodies is legally impossible in the EU.[122] In 2021 and 2022, the Commission proposed a criticized AI Act,[123] AI Liability Directive[124] and revised Product Liability Directive[125] without any rules tailored to governance intelligence, as the EY-study advised to await further developments in the field. It goes without saying that this is a missed opportunity, as the Commission had the chance to anticipate potential AI developments and reflect about their impact on legal rules of corporate governance today, in order to prevent developments at the technological front simply dictating the evolution of legal rules in the future. Rule-makers should make up their minds today about how to regulate future AI

[119] See *inter alia* A. KAMALNATH, "The Perennial Quest for Board Independence - Artificial Intelligence to the Rescue?", *Albany Law Review* 2019-20, vol. 83, 43-60; M. PETRIN, "Corporate Management in the Age of AI", *Columbia Business Law Review* 2019, vol. 3, 965-1030; Y.R. SHRESTHA, S.M. BEN-MENAHEM and G. VON KROGH, "Organizational Decision-Making Structures in the Age of AI", *California Management Review* 2019, vol. 61, 66-83; M.R. SIEBECKER, "Making Corporations More Humane Through Artificial Intelligence", *The Journal of Corporation Law* 2019, vol. 45, 95-149; M.E. DIAMANTIS, "The Extended Corporate Mind: When Corporations Use AI to Break the Law", *North Carolina Law Review* 2020, vol. 98, 893-931; L. ENRIQUES and D.A. ZETZSCHE, "Corporate Technologies and the Tech Nirvana Fallacy", *Hastings Law Journal* 2020, vol. 72, 55-98; S.A GRAMITTO RICCI, "Artificial Agents in Corporate Boardrooms", *Cornell Law Review* 2020, vol. 105, 869-908; N. LOCKE and H. BIRD, "Perspectives on the current and imagined role of artificial intelligence and technology in corporate governance practice and regulation", 2020, ssrn.com/abstract=3534898; G.D. MOSCO, "AI and the Board Within Italian Corporate Law: Preliminary Notes", *European Company Law Journal* 2020, vol. 17, 87-96; U. NOACK, "Künstliche Intelligenz und die Unternehmensleitung" in G. BACHMANN, S. GRUNDMANN, A. MENGEL and K. KROLOP (eds.), *Festschrift für Christine Windbichler zum 70. Geburtstag am 8. Dezember 2020*, Berlin, De Gruyter, 2020, 947-962; C.M. BRUNER, "Artificially Intelligent Boards and the Future of Delaware Corporate Law", 2021, ssrn.com/abstract=3928237; J. LEE and P. UNDERWOOD, "AI in the boardroom: let the law be in the driving seat", ssrn.com/abstract=3874588; C. PICCIAU, "The (Un)Predictable Impact of Technology on Corporate Governance", *Hastings Business Law Journal* 2021, vol. 17, 67-136; J. LEE and P. UNDERWOOD, "AI in the boardroom: let the law be in the driving seat", 2021, ssrn.com/abstract=3874588; M.A. TOKMAKOV, "Artificial Intelligence in Corporate Governance" in S.I. ASHMARINA and V.V. MANTULENKO (eds.), *Digital Economy and the New Labor Market: Jobs, Competences and Innovative HR Technologies*, Cham, Springer, 2021, 667-674; S. WEI, "When FinTech meets corporate governance: opportunities and challenges of using blockchain and artificial intelligence in corporate optimisation", *Journal of International Banking Law and Regulation* 2021, vol. 36, 53-68; H. DRUKARCH and E. FOSCH-VILLARONGA, "The Role and Legal Implications of Autonomy in AI-Driven Boardrooms" in B. CUSTERS and E. FOSCH-VILLARONGA (eds.), *Law and Artificial Intelligence – Regulating AI and Applying AI in Legal Practice,* The Hague, Asser Press, 2022, 345-364; A. KAMALNATH and U. VAROTTIL, "A Disclosure-Based Approach to Regulating AI in Corporate Governance", 2022, ssrn.com/abstract =4002876; T. LASAR, *Künstliche Intelligenz in der GmbH*, Frankfurt am Main, Fachmedien Recht und Wirtschaft, 2023, xviii + 240 p; M.M. RAHIM and P. DEY, "Directors in Artificial Intelligence-Based Corporate Governance – an Australian Perspective" in I. DUBE (ed.), *Corporate Governance and Artificial Intelligence – a Conflicting or Complementary Approach*, Cheltenham, Edward Elgar, forthcoming; J. ZHAO and B. GÓMEZ FARIÑAS, "Artificial Intelligence and Sustainable Decisions", *EBOR* 2023, vol. 24, 1-39.

[120] F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 649-670.

[121] J. ARMOUR and H. EIDENMÜLLER, "Self-Driving Corporations?" in H. EIDENMÜLLER and G. WAGNER (eds.), *Law by Algorithm*, Tübingen, Mohr Siebeck, 2021, 157-186.

[122] ERNST & YOUNG, "Study on the relevance and impact of artificial intelligence for company law and corporate governance", 2021, 45-51.

[123] Proposal for a Regulation Laying Down Harmonised Rules On Artificial Intelligence and Amending Certain Union Legislative Acts, 21 April 2021, COM(2021)206 final – 2021/0106 (COD) (hereafter: Draft AI Act).

[124] Proposal for a Directive on Adapting Non-Contractual Civil Liability Rules to Artificial Intelligence, 28 September 2022, COM(2022)496 final – 2022/0303 (COD) (hereafter: Draft AI Liability Directive).

[125] Proposal for a Directive on Liability for Defective Products, 28 September 2022, COM(2022)495 final – 2022/0302 (COD) (hereafter: Draft Revised Product Liability Directive).

developments for the corporate realm, to ensure they are ready to react on the basis of calm analysis when technology progresses, instead of then improvising rule changes on the hoof.[126] As long as no adapted rules are introduced, the literature (and the judicial system) ought to bring legal clarity for the legal questions arising from governance intelligence, of which the most prominent are identified in Part III.

16. A legal research agenda. The increasing use of governance intelligence, in conjunction with its speedy development, has led researchers to the consensus that AI will soon enter stages of autonomous intelligence where it is bestowed with core board powers with a limited role for humans. As controversy exists about the legal status of higher autonomy levels of governance intelligence, the purpose of this paper is twofold. First, the legal issues raised by the several autonomy levels of governance intelligence are identified from a corporate law perspective (*de lege lata*). Second, it is the goal to suggest changes to current corporate law frameworks, in order to solve or at least alleviate the identified problems (*de lege ferenda*).

b. Current legal problems arising from artificial governance intelligence

17. General. The continuum of artificial governance intelligence, ranging from assisted intelligence to autonomous intelligence,[127] provokes three research questions in the field of corporate law.[128] In case of assisted intelligence, no true decision rights are granted to the machine. From a corporate governance perspective, the use of AI in an assisted form therefore seems permissible, but may still impose liability questions if the system contributes to negligence of the company. From augmented intelligence and onwards, however, AI plays a more crucial role in the judgment work of the board, where greater legal uncertainty comes into play. Here, the question arises if directors have the legal *right* to rely on AI output and/or delegate governance powers to AI. This question may also be inverted, by wondering if directors could, for some decisions, have the *duty* to rely on the narrow but superhuman capabilities of AI. Finally, autonomous AI systems may in the future also be able to fully replace human directors and obtain all governance powers,[129] which introduces more existential challenges for company law as we know it today. The goal of these research questions is to diminish legal uncertainty and ease the legal concerns of companies eager to adopt governance intelligence.

18. The *right* of a director to rely on the output of AI and/or delegate decision rights to AI (core power delegation). As mentioned earlier, company directors already use AI output to improve the informative basis of their decisions. The latter is most often the case when pure data analysis is at the heart of the decision, which occurs in the asset management industry for instance.[130] At a higher autonomy level, AI could also be bestowed with certain tasks, decision

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[126] For example, the rushed EU regulation of crypto exchanges was partly dictated by common established practices on the market, see *e.g.* S. STEIN SMITH, "Crypto Regulation Needs Clarity, But Rushing It Is A Bad Idea", *Forbes* 2021, www.forbes.com/sites/seansteinsmith/2021/08/03/crypto-regulation-needs-clarity-but-rushing-it-is-a-bad-idea/.

[127] See no. 11.

[128] As first identified by F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 657-666.

[129] According to MÖSLEIN, this may happen either because humans increasingly trust the machines' abilities to decide or because decisions have to be taken so quickly or require so many data that humans are simply unable to decide; F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 657.

[130] Investment firms whose sole goal is to maximize financial returns, have already to a large extent handed over share and bond-trading to algorithms.

rights or core powers, such as monitoring the management and the overall performance of the company. However, no clarity exists about the legality of such delegations in many corporate frameworks. For example, UK company law provides the option for directors to delegate their powers to a *person or committee* if foreseen in the articles of incorporation,[131] but it is doubtful whether AI can be considered as one of both.[132] Italian law, on the other hand, completely forbids delegation to other agents than board members,[133] while Belgian law contains no statutory rules on board power delegation. Even if the delegation would be legally permitted, restrictions to the delegation authority of directors still need to be taken into account. To illustrate, Delaware courts insist that the "heart of the management" remains with the board of directors.[134] In other jurisdictions such as Belgium, directors are endowed with a mandate that is *intuitu personae*, which limits their ability to outsource fundamental governance decisions.[135] In fact, most corporate laws do not allow the delegation of core management decisions,[136] although it is usually unclear what these decisions include. The ambiguity of the existing legal framework could be clarified by comparing AI task delegations to the established literature concerning a director's right to seek help from an (independent) auditor or expert, in addition to literature on outsourcing board tasks.[137]

19. The *duty* of a director to rely on the output of AI and/or delegate decision rights to AI (core power delegation). Most corporate laws expect the board to make governance decisions on a well-informed basis.[138] Some systems even impose minimum requirements for the gathering of information.[139] Considering that the capabilities of AI may be superior to those of humans for a number of specific tasks, the ubiquitous expectation for directors to act on a well-informed basis may very well evolve into the duty to rely on the output of AI.[140] The duty of a director to rely on AI is most probable to emerge when data analysis is at the basis of a decision, as merely following gut feelings may be considered uncareful in this case. With regard to the board's oversight function, Delaware case law already facilitates a potential duty

[131] Art. 5 (1) UK Model Articles.
[132] F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 658.
[133] Art. 2381 Codice Civile (IT); G.D. MOSCO, "AI and the Board Within Italian Corporate Law: Preliminary Notes", *European Company Law Journal* 2020, vol. 17, 92.
[134] Delaware Court of Chancery (US) July 2, 1992, Canal Capital Corp. v. French, 1992 *Del. Ch. Lexis* 133; C.M. BRUNER, "Artificially Intelligent Boards and the Future of Delaware Corporate Law", 2021, ssrn.com/abstract=3928237, 9.
[135] L. FRÉDÉRICQ, *Traité de droit commercial belge*, Gent, Fecheyr, 1950, 340, no. 209; H. BRAECKMANS and R. HOUBEN, *Handboek vennootschapsrecht*, Antwerpen, Intersentia, 2021, 219-220, no. 468.
[136] Such as Swiss and Spanish company law; see art. 716b, par. 1 Obligationenrecht (CH) and art. 249bis and 529ter Ley de Sociedades de Capital (ES). Dutch company law, on the other hand, does not impose limitations on a director's delegation authority; K.H.M. DE ROO, "Delegatie van bestuursbevoegdheden", *WPNR* 2019, vol. 150, 473.
[137] See *inter alia* for an account on internal corporate governance structures in Europe: H. DE WULF, *Taak en loyauteitsplicht van het bestuur in de naamloze vennootschap*, Antwerpen, Intersentia, 2002, 235-361; K.J. HOPT and P.C. LEYENS, "Board Models in Europe. Recent Developments of Internal Corporate Governance Structures in Germany, the United Kingdom, France, and Italy", *European Company and Financial Law Review* 2004, vol. 1, 135-168; S. DE GEYTER, *Organisatieaansprakelijkheid: bestuurdersaansprakelijkheid, corporate governance en risicomanagement*, Antwerpen, Intersentia, 2012, 289-478. See also S.M BAINBRIDGE and M.T. HENDERSON, *Outsourcing the board: how board service providers can improve corporate governance*, Cambridge – New York, Cambridge University Press, 2018, xiii + 234 p.
[138] F. MÖSLEIN, *Grenzen unternehmerischer Leitungsmacht im marktoffenen Verband: Aktien- und Übernahmerecht, Rechtsvergleich und europäischer Rahmen*, Berlin, De Gruyter, 2007, 131-134.
[139] Such as US, UK, French and Italian law, see F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 661-663.
[140] *Ibid*, 660-662; U. NOACK, "Künstliche Intelligenz und die Unternehmensleitung" in G. BACHMANN, S. GRUNDMANN, A. MENGEL and K. KROLOP (eds.), *Festschrift für Christine Windbichler zum 70. Geburtstag am 8. Dezember 2020*, Berlin, De Gruyter, 2020, 953-955.

of AI delegation, as the reasonable use of formal monitoring systems in corporate governance has been interpreted to follow from a director's duty of loyalty.[141] As of now, however, the costs of data governance and the AI system's operation do not justify the establishment of any obligation to use AI. The latter may change in the near future, because AI technology advances rapidly.

20. The replacement of one or more human directors by AI (hybrid or artificial board). A more distant prospect is the potential replacement of human directors by AI-driven robo-directors, resulting in autonomous governance intelligence. It is possible that human directors will soon share seats in the boardroom with one or more computers (a *hybrid board*[142]), that a single algorithm will replace all human directors (a *fused board*[143]) or that the board will be composed by multiple robo-directors, originating from differing manufacturers (an *artificial board*). To discover whether AI can ever replace human directors in conformity with the existing corporate laws, two preliminary questions must first be answered. First, from a technological point of view, the type of tasks that are suited for AI replacement must be clarified. In this respect, management literature acknowledges that, on the one hand, administrative work could be placed in the hands of AI, going further down the road of time.[144] Judgement work, on the other hand, requires creative, analytical and strategic skills[145] of which it is debated if AI will ever achieve them.[146] It is also uncertain whether AI will be able to balance stakeholder interests,[147] or make ethical decisions. Second, most corporate laws presuppose that only natural and/or legal persons may be appointed as directors,[148] while AI is neither of those. Even if AI would be endowed with personhood and thus be eligible as director, some jurisdictions such as Belgium, France and Spain require the designation of a natural person as permanent representative of that non-natural director (*i.e.* corporate director).[149] In spite of the apparent

[141] See *inter alia* Delaware Supreme Court (US) January 24, 1963, Graham v. Allis-Chalmers Manufacturing Company, 1963 *Del.* 188 A.2d, 125; Delaware Supreme Court (US) September 27, 2018, Marchand v. Barnhill, 2018 *Del. Ch. Lexis* 316; Delaware Court of Chancery (US), September 25, 1996, In re Caremark International Inc. Derivative Litigation, 1996 *Del. Ch.* 698 A.2d, 959. See for an account on the evolving case law on the board's discretion regarding the design of compliance monitoring systems: C.M. BRUNER, "Artificially Intelligent Boards and the Future of Delaware Corporate Law", 2021, ssrn.com/abstract=3928237, 11-19.

[142] S.A GRAMITTO RICCI, "Artificial Agents in Corporate Boardrooms", *Cornell Law Review* 2020, vol. 105, 900-903.

[143] M. PETRIN, "Corporate Management in the Age of AI", *Columbia Business Law Review* 2019, vol. 3, 1002-1003.

[144] See *inter alia* T.H. DAVENPORT and R. RONANKI, "Artificial Intelligence for the Real World - Don't start with moon shots", *Harvard Business Review* 2018, hbr.org/2018/01/artificial-intelligence-for-the-real-world; M. PETRIN, "Corporate Management in the Age of AI", *Columbia Business Law Review* 2019, vol. 3, 985; J.B. BULLOCK, "Artificial Intelligence, Discretion, and Bureaucracy", *American Review of Public Administration* 2019, vol. 49, 4-7; R.T. KREUTZER and M. SIRRENBERG, *Understanding Artificial Intelligence – Fundamentals, Use Cases and Methods for a Corporate AI Journey*, Cham, Springer, 2020, 276; P. BUŁA and B. NIEDZIELSKI, *Management, Organisations and Artificial Intelligence – Where Theory Meets Practice*, New York, Routledge, 2022, 77.

[145] A director's judgement work typically pertains to problem solving, collaboration, strategy, innovation and relations with individuals and shareholders; see A. AGRAWAL, J. GANS and A. GOLDFARB, "What to Expect From Artificial Intelligence", *MIT Sloan Management Review* 2017, vol. 58, 24.

[146] For an overview of the predominant views in the literature, see S. MAKRIDAKIS, "The forthcoming Artificial Intelligence (AI) revolution: Its impact on society and firms", *Futures* 2017, vol. 90, 50-53; M. PETRIN, "Corporate Management in the Age of AI", *Columbia Business Law Review* 2019, vol. 3, 986-993. See also IBM, "The quest for AI creativity", www.ibm.com/watson/advantage-reports/future-of-artificial-intelligence/ai-creativity.html (retrieved on 31 October 2022).

[147] See no. 13.

[148] For example, corporations whose registered office is located in Belgium and the Netherlands are permitted to appoint both natural and legal persons as a director; *cf.* art. 7:85, par. 1 WVV (BE) and art. 2:11 BW (NL). Contrastingly, UK company law requires at least one director to be a natural person, while German law totally forbids a legal person from attaining the status of board member; *cf.* S. 155 (1) Companies Act (UK), S. 6 (2) GmbHG (DE) and S. 76 (3) AktG (DE).

[149] In respect of Belgian corporate law, see art. 2:55, §1, first sentence WVV (BE). In respect of French corporate law, see art. L.225-20 Code de commerce (FR) from which it is implicitly derived that the permanent representative must be a

impossibility to appoint AI as director or its representative, a number of prominent scholars believe that algorithmic entities can be created in countries with flexible standards.[150] Moreover, it is interesting to explore what the legal implications would be if human directors could hypothetically be replaced by AI machines.

In this respect, it seems that current corporate frameworks are unfit for the adoption of autonomous AI. As mentioned above, existing corporate governance best practices are predominantly based on agency conflicts between human directors and shareholders, which will not necessarily occur when an AI system is deployed in a governance setting.[151] Various AI applications can have different normative implications or goals, and thus do not necessarily translate to either greater shareholder-centrism, primacy of the board or progressive policies.[152] Moreover, robo-directors earn no money nor work towards the objective of doing so, with the consequence that pay-for-performance regimes will be of no use to make AI pursue the corporate interest.[153] Fiduciary duties such as the duty of loyalty and care are hardly intelligible for algorithms,[154] while the business judgement rule (*e.g.* in the US, UK, Italy and Germany) seems impossible to apply to AI for various reasons.[155] In addition, some authors argue that the potential black box characteristic of *inter alia* neural networks hinders the collegiality of the board,[156] even though the thought process of human directors may be equally opaque.[157] All of the foregoing demonstrates that the introduction of robo-directors would prompt fundamental – if not existential – challenges for traditional corporate law.

21. The required human supervision and control of governance AI. As a first control question to the foregoing research questions, one must verify the extent to which human directors should supervise the various levels of governance intelligence in accordance with existing laws. Naturally, in most jurisdictions, the power of delegation does not relieve a director

natural person; *cf.* e.g. P. LE CANNU, *La société anonyme à directoire*, Paris, LGDJ, 1979, 224. In respect of Spanish corporate law, see art. 212*bis* (1) Ley de Sociedades de Capital (ES). See also P. DEL VAL TALENS, "Corporate Directors: In Search of a European Normative Model for Legal Persons as Board Members", *European Company and Financial Law Review* 2017, vol. 14, 631-632.

[150] S. BAYERN *et al.*, "Company Law and Autonomous Systems: A Blueprint for Lawyers, Entrepreneurs, and Regulators", *Hastings Science and Technology Law Journal* 2017, vol. 9, 139-153.

[151] See no. 13.

[152] See C.M. BRUNER, "Distributed Ledgers, Artificial Intelligence and the Purpose of the Corporation", *The Cambridge Law Journal* 2020, vol. 79, 450-453.

[153] F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 666-667.

[154] See no. 13.

[155] The business judgement rule essentially comes down to the rebuttable presumption that directors pursue the corporation's interests in good faith when their actions are being challenged. As a prerequisite for this rule, most legal systems require that the director must have had a certain amount of policy freedom, which seems to be absent when a decision is delegated to AI, since AI reasons linear in pursuance of its set goals. Moreover, the contribution of AI to the decision-making process is sometimes not exactly traceable and ascertainable, whilst this is also a common requirement for the protection of the business judgement rule. See in this respect A. KAMALNATH, "The Perennial Quest for Board Independence - Artificial Intelligence to the Rescue?", *Albany Law Review* 2019-20, vol. 83, 55-56; G.D. MOSCO, "AI and the Board Within Italian Corporate Law: Preliminary Notes", *European Company Law Journal* 2020, vol. 17, 95; U. NOACK, "Künstliche Intelligenz und die Unternehmensleitung" in G. BACHMANN, S. GRUNDMANN, A. MENGEL and K. KROLOP (eds.), *Festschrift für Christine Windbichler zum 70. Geburtstag am 8. Dezember 2020*, Berlin, De Gruyter, 2020, 955.

[156] A.-G. KLECZEWSKI, "L'intelligence artificielle au service des administrateurs: une mise à l'épreuve de la collégialité?", *TRV-RPS* 2020, 520-521, no. 43.

[157] For an interesting study on the opaque thought process of human judges, see J.Z. LIU and X. LI, "Legal Techniques for Rationalizing Biased Judicial Decisions: Evidence from Experiments with Real Judges", *Journal of Empirical Legal Studies* 2019, vol. 16, 630–670.

from its duty to supervise the exercise of delegated rights,[158] but the supervision duty differs from jurisdiction to jurisdiction and is often vaguely defined. Some authors argue that directors must at least generally oversee the selection and activities of governance intelligence, which requires the board members to have a basic understanding of how these devices operate.[159] An oversight model where humans are expected to intervene in each decision cycle is undesirable as it will diminish all efficiency gains.[160]

Besides the case law on corporate delegation, there are other rules that may require supervision of governance intelligence. For example, it is principally prohibited in the EU to entrust AI with a decision that produces legal effects or similarly significantly effects for a natural person, when the decision is based on personal data of that person (*e.g.* the selection and dismissal of a CEO).[161] Surprisingly, the EU Draft AI Act does not require special oversight duties for governance intelligence, since it does not qualify as high-risk in the current draft. However, existing regimes on directors' conflicts of interests may be invoked by shareholders to challenge AI's decision, when its training data, test data or algorithm reflects the financial interests of its human "controllers" – the directors. For financial decisions, specific rules may come into play as well, such as the German financial regulation that requires substantial oversight of algorithmic trading on securities markets.[162] Even if the law does not demand human directors to supervise governance AI, they may be financially inclined to do so, if they or the company could be held liable for damage caused by the system.

22. Liability for algorithmic failure. The second control question pertains to the liability attribution for (un)lawful decisions made by governance intelligence that harm business partners of the company and/or third parties.[163] It remains an open question to what extent current statutory and case law on product liability, general tort law and specifically director's liability can be applied to AI failures in governance context. Clearly, the AI system itself cannot be held liable for its faulty predictions or decisions, as it cannot pay damages or make amends.[164] Because of this liability gap,[165] the law is required to turn to legal entities or natural persons in order to enforce a liquidation of damages. In this respect, general tort law in most jurisdictions

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[158] *E.g.* A.N. MOHD-SULAIMAN, "Directors' Oversight Responsibility and the Impact of Specialist Skill", 2010, ssrn.com/abstract =1635154.

[159] F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 660.

[160] E. HICKMAN and M. PETRIN, "Trustworthy AI and Corporate Governance: The EU's Ethics Guidelines for Trustworthy Artificial Intelligence from a Company Law Perspective", *EBOR* 2021, vol. 22, 602.

[161] The right of the individual *ex* art. 22 GDPR to oppose automated decision-making is widely interpreted as a general prohibition for the data processor; see ARTICLE 29 DATA PROTECTION WORKING PARTY, "Guidelines on Automated individual decision-making and Profiling for the purposes of Regulation 2016/679", edpb.europa.eu/our-work-tools/our-documents/guidelines/automated-decision-making-and-profiling_en, 19-20; J. GOETGHEBUER, "De invloed van artikel 22 AVG op het gebruik van robo-advies binnen de beleggingssector. Met de rug tegen de muur?", *TBH-RDC* 2020, 146-147, no. 21.

[162] S. 80, par. 2 Wertpapierhandelsgesetz (DE); A. FLECKNER, "Regulating Trading Practices" in N. MOLONEY, E. FERRAN, and J. PAYNE (eds.), *The Oxford Handbook of Financial Regulation*, Oxford, Oxford University Press, 2015, 619-623.

[163] In my opinion, governance intelligence may be able to cause harm at any given autonomy level. Therefore, the current ambiguity of liability regimes applies to assisted, augmented and autonomous governance intelligence.

[164] AI systems have "*no soul to be damned, and no body to be kicked*", as they do not own assets or bear liabilities. Neither do they have a social reputation or professional persona to protect. See S.A GRAMITTO RICCI, "Artificial Agents in Corporate Boardrooms", *Cornell Law Review* 2020, vol. 105, 886; C. PICCIAU, "The (Un)Predictable Impact of Technology on Corporate Governance", *Hastings Business Law Journal* 2021, vol. 17, 120.

[165] *E.g.* S. DE CONCA, "Bridging the Liability Gaps: Why AI Challenges the Existing Rules on Liability and How to Design Human-empowering Solutions", in B. CUSTERS and E. FOSCH-VILLARONGA (eds.), *Law and Artificial Intelligence*, The Hague, Asser, 2022, 239-258.

seems to hold the owner of the AI system liable for algorithmic failure, which is mostly the company using it. The same result is achieved by applying the agency theory, whereby the AI system is considered an agent of the company (which is usually the case for directors), making its actions attributable to the company.[166] Therefore, one can assume *prima facie* that judges will be inclined to rely on fault liability of the company in case of governance AI failures. The latter does not exclude the personal liability of (human) directors who have contributed to the failure. Current fault liability regimes, however, put a great burden of proof on the shoulders of victims, as they are required to prove the faulty AI supervision of the company or its directors – an issue that the European Commission tries to resolve with its Draft AI Liability Directive.[167] Of course, special liability regimes may also be invoked, such as the one imposed by the EU's GDPR, in case personal data is processed by governance intelligence without human intervention[168] or when the potential black box embedded in *inter alia* neural networks makes the system's reasoning opaque for decisions with significant or legal effects.[169]

c. Potential solutions to the legal problems arising from artificial governance intelligence

23. **General**. The identified corporate law problems should be solved or at least alleviated for the instances in which it is shown that AI support can lead to more informed board decisions or that for a certain type of board decision, the decision-quality of AI is clearly superior to that of human intelligence. The latter is in my view the case when a board decision is based on large amounts of data – considering that AI is able to translate incomprehensible mountains of data into consolidated chunks of information, which are easily managed and understandable for human directors. AI is also superior to human intelligence if it could be proven to make decisions faster than humans under the condition that the speed of decision-making is crucial for a specific board decision. Both normative criteria presuppose a reasonable exercise of system benchmarking, to achieve a negligible chance of erroneous output generation (*i.e.* reasonable accuracy). That being said, limitations to AI power transfers may be needed as well, especially if biases, the black box nature of the system or other technological flaws hinder the transparency or independence of the system. In addition, if high risks to the fundamental rights of individuals are involved (for example in case of a sensitive decision on the company's personal data policy), the allowed degree of AI autonomy should be reduced or even prohibited.

24. **Shifting foundations of corporate law.** It is clear that rule-makers should provide legal frameworks that enable AI board appointments and AI task delegations on a decision-specific basis, *i.e.* only with regard to decisions for which the normative assumption explained above

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[166] On the agency or "organ" theory, see *e.g.* A. AVIRAM, "Officers' Fiduciary Duties and The Nature of Corporate Organs", *University of Illinois Law Review* 2013, 763-784.
[167] See no. 25.
[168] See no. 21.
[169] The required transparency or "explainability" of AI under art. 22 GDPR remains controversial. See *inter alia* B. GOODMAN and S. FLAXMAN, "EU regulations on algorithmic decision-making and a right to explanation", *AI Magazine* 2017, 50-57; P. HACKER, R. KRESTEL, S. GRUNDMANN and F. NAUMANN, "Explainable AI under contract and tort law: legal incentives and technical challenges", *Artificial Intelligence and Law* 2020, vol. 28, 415-439; A. BIBAL, M. LOGNOUL, A. DE STREEL and B. FRÉNAY, "Legal requirements on explainability in machine learning", *Artificial Intelligence and Law* 2021, vol. 29, 149-169. Art 52 (1) Draft AI Act does not require a form of transparency of low-risk AI systems towards individuals subject to its decisions. The provision solely requires natural persons interacting with the system to be aware of its artificial nature, while these persons are the directors in this case.

is fulfilled. However, for all cases where AI delegation or replacement would be legally permitted, due respect for the regulatory concerns on maintaining human control of AI ought to be considered. In this respect, a form of obligatory oversight for each decision cycle of the system must be rejected, or should at least remain a last resort if the decision-making entails certain risks for the rights of individuals, as efficiency gains and incentives for innovation are stifled otherwise.

In respect of *autonomous* governance intelligence specifically, its legal recognition will require rule-makers to introduce profound changes to the fundamentals of corporate law. Existing *ex post* remedies in corporate law such as the fiduciary duties and liability of directors, designed to control human agency conflicts and director's behaviour, must be reimagined for the hypothesis of AI entering the boardroom. As elaborated on before, an AI system cannot be held liable and does not have its own interests, although inherent biases of its controllers may be reflected as AI is only as good as its inputs and programming.[170] For this reason, robo-directors will be less inclined to abuse corporate assets for personal gains. On the other hand, whilst the system can be programmed to pursue the interests of its principals, there is no guarantee that it will follow the programmed goals, follow all applicable legal rules and have a reasonable aversion to risks and losses. When AI is trusted with a crucial role in board decision-making, rule-compliant behaviour will therefore need to be embedded in the algorithm's code. The latter calls for cutting-edge *ex-ante* regulatory strategies,[171] such as abstract coding requirements for appointed robo-directors, which will implicate far-reaching "surgeries" to the anatomy of corporate law. After positioning the algorithm in the corporate structure, its abstract oversight will require technological know-how, which can neither be expected from shareholders, human directors, nor specialized courts. Therefore, some contemplate the need for direct governmental control of governance intelligence,[172] which might collide with fundamental principles such as private autonomy and entrepreneurial freedom.

One particular *ex ante* strategy, proposed by prominent scholars, is the regulation or calibration of corporate objectives.[173] As elaborated on before, algorithms pursue set goals. These goals reflect the exact content of the interests AI should pursue, which are, assumedly, aligned with the (best) interests of the company. Therefore, it may be more efficient for the legislator to regulate corporate goals, *i.e.* the AI system's goals. As a result, human biases embedded in the algorithm and data, in addition to algorithmic biases generated by the learning process, may be reduced to a minimum. However, it will require a hard balancing exercise to regulate corporate goals or purposes in general while also leaving ample scope for firm-specific goals, as the aforementioned fundamental principles must not be endangered.

Overall, however, if the implementation of autonomous governance intelligence would be

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[170] *E.g.* A.H. RAYMOND, E. ARRINGTON STONE YOUNG and S.J. SHACKELFORD, "Building a Better Hal 9000: Algorithms, the Market, and the Need to Prevent the Engraining of Bias", *Northwestern Journal of Technology and Intellectual Property* 2018, vol. 15, 222-232.

[171] F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 666-667.

[172] A form of control by state agencies on governance intelligence could endanger the fundamental principles of private autonomy and entrepreneurial flexibility; see F. MÖSLEIN, "Robots in the Boardroom: Artificial Intelligence and Corporate Law" in W. BARFIELD and U. PAGALLO (eds.), *Research Handbook on the Law of Artificial Intelligence*, Cheltenham, Edward Elgar, 2018, 667.

[173] J. ARMOUR and H. EIDENMÜLLER, "Self-Driving Corporations?" in H. EIDENMÜLLER and G. WAGNER (eds.), *Law by Algorithm*, Tübingen, Mohr Siebeck, 2021, 177-179.

permitted, AI could allow the company to benefit from the separation of ownership and control, while protecting the shareholders with a smart decision-maker that is loyal and careful to them.[174] To achieve this, the option of shareholder "say-on-manufacturer" rights in respect of robo-directors could be considered by lawmakers, as a complement to the traditional say-on-pay rights regarding human executives.

25. Liability for algorithmic failure *de lege ferenda.* Whilst current regimes point towards the liability of the company deploying the AI system for harm caused by the system's decisions, it is not my opinion that the primary result of these regimes should be altered. The company using governance intelligence exclusively decides on the design and deployment of the system, as opposed to the third-party developer, vendor, provider or operator of the platform. In this respect, the company is the "least-cost avoider" of algorithmic failure and thus its liability is most justifiable.[175] What matters, and should be up for debate, is the type of liability that the company should face, *i.e.* fault liability or strict liability? On the one hand, fault liability puts the difficult task of proving negligence or faulty supervision in the hands of victims, often resulting in no compensation.[176] If one were to prefer fault liability, then rebuttable presumptions of fault and/or causal link are necessary to alleviate the burden of proof for injured parties, as the company itself has the best access to information on its AI system. On the other hand, a strict liability regime would stifle the company's incentive to innovate and requires it to have sufficient funds to compensate all victims.[177] The latter could be countered by imposing a liability cap,[178] or a mandatory liability insurance with minimum amount of coverage, as is suggested before in the literature on self-driving cars.[179] Some authors contend that companies should be liable for harms of their "employed" algorithms just like they currently are for harms of their human employees,[180] but this idea is not appropriate for jurisdictions where directors – likewise robo-directors – are not considered as employees.

In the literature, a plethora of alternative liability approaches can be found for artificial governance intelligence. Regarding self-driving subsidiaries, for instance, a general liability of the controlling shareholder for corporate debts (*i.e.* piercing of the corporate veil) seems well founded vis-à-vis tort creditors.[181] Others argue that actions against the AI system itself should be made possible, which purportedly necessitates its bestowment with legal personality.[182] The latter condition ought to be discarded, however, as legal personhood is not a prerequisite

[174] S.A GRAMITTO RICCI, "Artificial Agents in Corporate Boardrooms", *Cornell Law Review* 2020, vol. 105, 872.
[175] J. ARMOUR and H. EIDENMÜLLER, "Self-Driving Corporations?" in H. EIDENMÜLLER and G. WAGNER (eds.), *Law by Algorithm*, Tübingen, Mohr Siebeck, 2021, 180-182.
[176] For a general account on fault liability versus strict liability, see S. SHAVELL, "Strict Liability versus Negligence", *The Journal of Legal Studies* 1980, vol. 9, 1-25.
[177] J. ARMOUR and H. EIDENMÜLLER, "Self-Driving Corporations?" in H. EIDENMÜLLER and G. WAGNER (eds.), *Law by Algorithm*, Tübingen, Mohr Siebeck, 2021, 182.
[178] As the liability risk of AI is temporary and inherent to all new technologies, and because AI does not have a catastrophic potential, a liability cap may not be justified; see *e.g.* M. CHATZIPANAGIOTIS and G. LELOUDAS, "Automated Vehicles and Third-Party Liability: A European Perspective", *University of Illinois Journal of Law, Technology & Policy* 2020, 192-193.
[179] H. EIDENMÜLLER, "The Rise of Robots and the Law of Humans", in H. EIDENMÜLLER and G. WAGNER (eds.), *Law by Algorithm*, Tübingen, Mohr Siebeck, 2021, 15-16.
[180] M.E. DIAMANTIS, "Employed Algorithms: A Labor Model of Corporate Liability for AI", *Duke Law Journal* 2023, vol. 72, 844-848.
[181] J. ARMOUR and H. EIDENMÜLLER, "Self-Driving Corporations?" in H. EIDENMÜLLER and G. WAGNER (eds.), *Law by Algorithm*, Tübingen, Mohr Siebeck, 2021, 182. See more generally on piercing of the corporate veil: H. HANSMANN and R. KRAAKMAN, "Toward Unlimited Shareholder Liability for Corporate Torts", *The Yale Law Journal* 1991, vol. 100, 1879-1934.
[182] M. PETRIN, "Corporate Management in the Age of AI", *Columbia Business Law Review* 2019, vol. 3, 1015-1016.

for states to grant rights or duties to an entity.[183] On the contrary, legal personhood is merely a linguistic symbol or heuristic formula to conveniently label a set of legal capacities designated by the state,[184] of which the suitability for AI is disputed.[185] It seems more appropriate to give AI systems limited rights and duties that enable actions against them, instead of granting these systems the full package that legal personhood entails. This hypothesis prompts new questions pertaining to these entities' lack of financial resources and the applicable standards of behaviour.[186]

Recently, the European Commission proposed a differentiated approach of fault and strict liability for damage caused by AI. For material damage (including data losses) suffered by natural persons, a strict liability regime for defective AI is suggested, which results in liability of the manufacturer for defects in the algorithm – instead of the company using AI.[187] For all other damage in a non-contractual environment, the Commission did not opt for a strict liability regime. Instead, a (limited and conditional) rebuttable presumption of causal link between fault and AI output (or lack thereof) was put on the table, whilst maintaining the Member States' own regimes of fault liability.[188] These proposals came after years of discussion on the application field of the 1985 Product Liability Directive.[189] The result, however, has little significance for governance intelligence systems. Moreover, harm caused by AI in a contractual and commercial context (B2B-contracts) will be of a greater magnitude, but is not covered by any of the proposed regulatory measures in the EU as of now.[190] Therefore, Member States should opt for a broader application field of its transposition laws, which has been allowed by the ECJ in other contexts.[191]

IV. Conclusion

26. This research paper underpinned that corporate law is about to embark on a new era, that is, the era of artificial governance intelligence. As a matter of fact, this paper has shown that AI is increasingly deployed as a support tool for the core functions of the board of directors and the management of corporations, such as monitoring, corporate strategy setting and daily management. Since AI is said to rationalize decision-making, reduce the risk of

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[183] For instance, in a number of jurisdictions, the general partnership is endowed with certain rights and duties, in spite of its lacking legal personality. See M. BLACKETT-ORD and S. HAREN, *Partnership law: the modern law of firms, limited partnerships and LLPs*, Haywards Heath, Bloomsbury Professional, 2020, 9, no. 1.13. See also in respect of the Belgian unlimited partnership (the "*maatschap*"): S. LANDUYT, F. DESMYTTERE and L. MAES, "De maatschap: van contract naar instituut?" in J. BAEL (ed.), *Rechtskroniek voor het notariaat deel 35*, Herentals, KnopsPublishing, 2019, 62-65, no. 71-77.

[184] J. ARMOUR, H. HANSMANN and R. KRAAKMAN, "What Is Corporate Law?" in R. KRAAKMAN *et al.* (eds.), *The Anatomy of Corporate Law: A Comparative and Functional Approach*, Oxford, Oxford University Press, 2017, 8; S.A GRAMITTO RICCI, "Artificial Agents in Corporate Boardrooms", *Cornell Law Review* 2020, vol. 105, 892-893.

[185] See no. 14.

[186] M. PETRIN, "Corporate Management in the Age of AI", *Columbia Business Law Review* 2019, vol. 3, 1016.

[187] See the Draft Revised Product Liability Directive.

[188] Art. 4 Draft AI Liability Directive. See also V. SCHOLLAERT and J. DE BRUYNE, "Voorstel Richtlijn AI-aansprakelijkheid – Verkennende analyse vanuit Belgisch perspectief", *NJW* 2023, 582-587, no. 17-25.

[189] *E.g.* G. WAGNER, "Robot Liability", 2018, ssrn.com/abstract=3198764; M. CHATZIPANAGIOTIS and G. LELOUDAS, "Automated Vehicles and Third-Party Liability: A European Perspective", *University of Illinois Journal of Law, Technology & Policy* 2020, 118-131; J. DE BRUYNE, E. VAN GOOL and T. GILS, "Tort Law and Damage Caused by AI Systems" in J. DE BRUYNE, and C. VANLEENHOVE (eds.), *Artificial Intelligence and the Law*, Antwerpen, Intersentia, 2021, 359-403.

[190] See for a critical account on both the Draft AI Liability Directive and the Draft Revised Product Liability Directive: P. HACKER, "The European AI Liability Directives – Critique of a Half-Hearted Approach and Lessons for the Future", *Computer Law & Security Review* 2023, vol. 51, art. 105871..

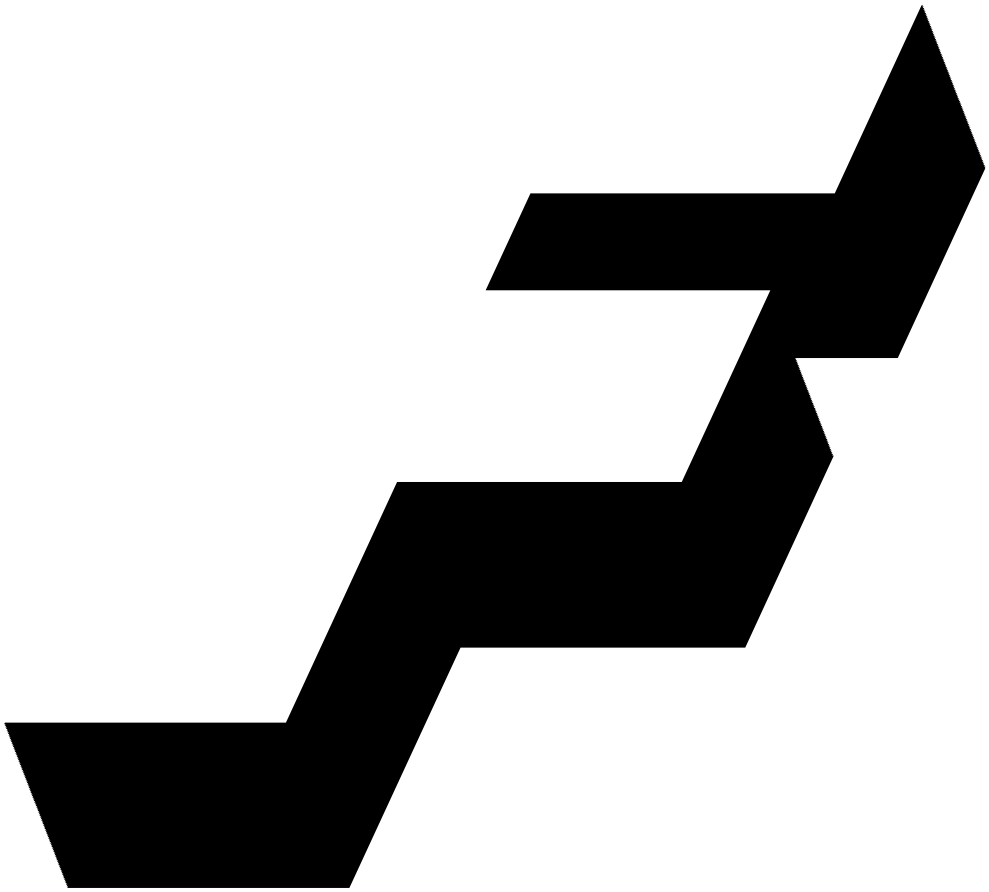
[191] *E.g.* ECJ July 12, 2012, C-602/10, SC Volksbank România SA v. Autoritatea Națională pentru Protecția Consumatorilor – Comisariatul Județean pentru Protecția Consumatorilor Călărași (CJPC).

groupthink and boost the independence of board members, it is expected that the assisted role of AI in corporate governance will soon transform into a leading one, as more corporations are attempting to appoint algorithms as directors. Consequently, the World Economic Forum made the claim that by 2026, human directors sharing their decision-making powers with AI will become the new normal.[192]

Systems of artificial governance intelligence can be classified into several categories on the basis of their level of autonomy, which determines the allocation of decision rights between the AI system vis-à-vis the board of directors. In case of assisted intelligence, human directors selectively rely on AI for administrative tasks. At the augmented stage, human directors use AI output to enhance the informative basis of their decisions. Here, AI contributes to core decision-making or judgement work of the board, but it does not enjoy standalone decision rights. In its final autonomous stage, AI is bestowed with independent decision-rights through a delegation of core governance powers or through its appointment as director. Here, a hybrid board of humans and machines is possible, or all human members could be replaced by one or more AI systems, resulting in a fused or artificial boardroom. Unless when the goals of the corporation are very narrow, the latter remains science fiction today.

The emergence of AI in the corporate realm raises many questions of corporate law, which is tailored to human decision-makers. While assisted intelligence seems permissible under current corporate frameworks, human directors do not have the right to delegate core governance tasks to AI. However, it is uncertain which decisions belong to this category. Even when delegation is permitted, it seems likely that humans should still supervise artificial governance intelligence to a certain extent that does not diminish efficiency gains. As boards are generally expected to make decisions on an informed basis, the right of a director to delegate limited decision rights to AI could evolve into a duty, considering the superior capabilities of AI for certain well-defined tasks. An outright appointment of AI as director seems impossible under the current regimes, but via a detour, algorithmic entities seem plausible. The latter poses major challenges to the foundations of corporate law, which is focused on controlling human agency conflicts through director's fiduciary duties and liability. Instead, AI pursues set goals, operates without other self-interests than maximising its utility function, does not act in good or bad faith in the same way that humans do, but may still reflect or even exacerbate biases of its human controllers. Therefore, regulatory strategies should be revised to *ex ante* remedies, such as regulating corporate purposes and imposing the embedding of rule-compliant behaviour into the code of robo-directors. The liability for algorithmic failure will likely be attributed to the corporation itself, but policy debates on the burden of proof should determine the very nature of this liability regime. New phenomena such as entities without leaders (DAOs) or without members (algorithmic entities) will undoubtedly challenge corporate systems even more than robo-directors do. It is clear that further research on the shifting anatomy of corporate law is needed, to ensure that novel corporate rules are not dictated by the quickly evolving AI technology, but based on calm reasoning instead.

[192] WORLD ECONOMIC FORUM, "Survey Report: Deep Shift - Technology Tipping Points and Societal Impact", *Global Agenda Council on the Future of Software & Society* 2015, www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf, 21.



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