Decision Making in the Boardroom: Towards a new Understanding of Corporate Governance in the Age of Artificial Intelligence

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1. Introduction

The potential of big data and artificial intelligence (AI) to fundamentally disrupt the practices of corporate governance and the decision making processes of the board of directors (BoD) has recently attracted considerable attention.[1] Some experts argue that, in today's increasingly complex and dynamic business environment, the BoD should no longer make critical decisions without the support of intelligent systems.[2] In the past, board decisions were often made with limited data availability and an emphasis on gut feeling. But with the emergence of big data and AI, board decisions can be based on the analysis of underlying patterns and anticipated trends. Just as AI is helping doctors improve their diagnoses, it is also able to generate valuable insights for the BoD. This potential motivates an analysis of how humans and AI can work together in the boardroom and, in particular, what role AI can play in the decision making of the BoD.

2. Human and Artificial Intelligence

In order to understand the AI's potential contribution to decision making at board level, we must first deconstruct the broad meaning of the term «artificial intelligence» and understand how it compares to human intelligence.[3]

Human intelligence describes the mental quality that consists of the ability to learn from experience, adapt to new situations, understand abstract concepts, and use knowledge to manipulate the environment.[4] Over time, researchers have emphasized different aspects of intelligence in their definitions such as the ability to think abstractly or the ability to learn and give good responses.

1 E.g., Evans, G. (2017). Disruptive technology and the board: The tip of the iceberg. Economics and Business Review, 3(1), 205-223; Merendino, A., et al. (2018). Big data, big decisions: The impact of big data on board level decision making. Journal of Business Research, 93(1), 67-78.

2 Libert, B., Beck, M. & Bonchek, M. (2017). AI in the boardroom: The next realm of corporate governance. MIT Sloan Management Review. Retrieved on 02 May 2020 from: https://sloanreview.mit.edu/article/ai-in-the-boardroom-the-next-realm-of-corporate-governance/

3 For a more detailed analysis, see: Hilb, M. (2020). Toward artificial governance? The role of artificial intelligence in shaping the future of corporate governance. Journal of Management and Governance, 24(4), 851-870.

4 Sternberg, R. (1998). Human Intelligence. In Encyclopedia Britannica Online. Retrieved from https:// www.britannica.com/science/human-intelligence-psychology.

More recently, however, psychologists have agreed that adaption to the environment is key to understanding what intelligence is and what it does. Effective adaption draws upon several cognitive processes such as perception, learning, memory, reasoning, and problem solving. Thus, the main emphasis in a definition of intelligence is that it is not a cognitive process per se but rather a «selective combination of these processes that is purposively directed toward effective adaption».[5]

Artificial intelligence, on the other hand, is an umbrella term for both AI terminology, such as «machine intelligence», «computer intelligence» or «intelligent behavior», as well as for AI technologies, such as machine or deep learning, which are used to develop AI applications.[6] For this article, I employ Poole & Mackworth's definition of AI as «computational agents that act intelligently»[7] and perceive their environments in order to take actions that maximize the chances of success. This understanding of AI is a notable departure from previous views that emphasized AI displaying humanlike intelligence, and it may alleviate some of the concerns regarding the replacement of humans through AI.

To discuss the potential and limitations of the two approaches with regard to board decision making, I rely on Hilb's decision process model, as illustrated in Figure 1:

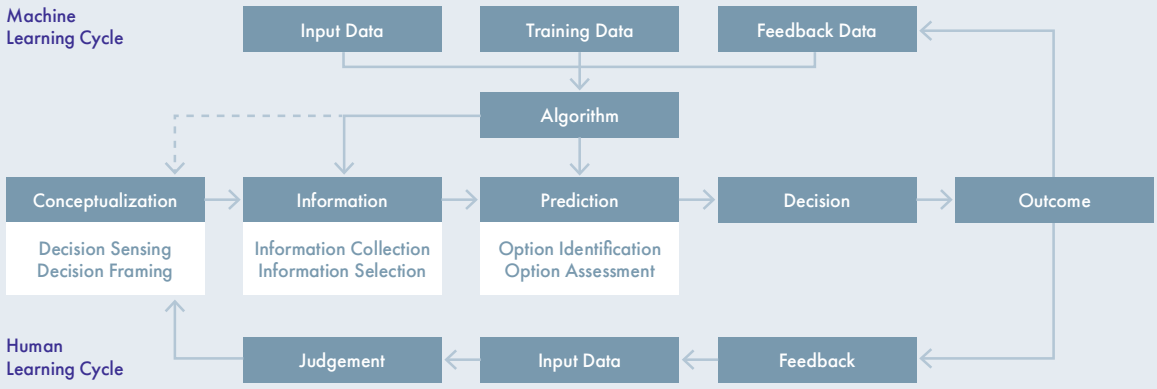

Figure 1: Human and machine decision making (based on Hilb, 2020, p. 858)

Figure 1 illustrates that both approaches – human and machine – to decision making assume that decisions are based on predictions of possible outcomes. In both approaches, predictions are based on some sort of input data which are then further processed to generate an output, i.e., the final decision outcome.

With regard to the machine decision process, Figure 1 shows that AI (or more specifically, machine learning, ML) assumes three types of data: (i) input data, i.e., the direct input to the algorithm leading to predictions, (ii) training data, used primarily to generate the algorithm, and (iii) feedback data, used to improve the algorithm over time. Technically speaking, these three types of data play a different role for different ML applications such as supervised learning, reinforcement learning and unsupervised learning. Hence, it is crucial to discuss which learning approach is best suited for the specific type of decision in order to judge its effectiveness. Additional complications from AI-based decision making arise from the lack of transparency or transferability, referred to as «the black box» character of AI, the inherent inability to distinguish between causality and correlation, as well as the inefficiency in terms of the data required for valid predictions of possible outcomes.[8]

5 Idem.
6 Alsheiabni, S., Cheung, Y. & Messom, C. (2019). Towards an artificial intelligence maturity model: From science fiction to business facts. Pacific Asia Conference on Information Systems (PACIS) 2019 Proceedings. 46.
7 Poole, D. L. & Mackworth, A. K. (2010). Artificial Intelligence: Foundations of Computational Agents. Cambridge, UK: Cambridge University Press, p. 3.
8 For a more detailed discussion of the different approaches and their limitations, see Hilb, M. (2020). Toward artificial governance? The role of artificial intelligence in shaping the future of corporate governance. Journal of Management and Governance, 24(4), p. 858.

With regard to the human decision process, I note that the decision process is based not only on input data and feedback from previous outcomes but also on human judgement. The role of human judgement in decision making has been extensively studied and is often considered as one of the key concerns when it comes to automating decision making. For the purpose of this article, judgement is understood in a more encompassing view of the term than intuition or gut feeling. It describes the synthesis of data, facts, and processes that go into decisions from which we have learned in the past. Human judgement thus seems particularly relevant in situations in which information is lacking, ambiguous, or even conflicting, as it is often the case in the real-world settings that the BoD is dealing with.

3. Delineating the Typology

In what follows, I develop a typology that provides insights into different types of human and machine interaction forms available for boardroom decision making. My main argument is that, by combining human and artificial intelligence, boards can enhance overall board intelligence and exploit different forms of decision making that contribute to a more effective and efficient corporate governance. The scope of this article is limited to decision making by the BoD and focuses primarily on decisions derived from the non-transferable statutory duties of the board as stated in article 716a of the Swiss Code of Obligations. To determine which types of decisions benefit most from being supported by AI, it is key to recognize the main features of decision making. I therefore present different approaches to decision making, as proposed by Hilb, in order to illustrate how the processes of human and machine decision making are compared (Figure 1). Based on this model, I derive two dimensions that serve to characterize human and machine interactions in boardroom decision making: (I.) domain-level maturity, and (II.) cognitive capabilities.

Domain-level maturity refers to the maturity level of AI in the respective area in which it is employed. The dimension refers to the machine-learning life cycle in Hilb's model and focuses on the technical feasibility of the AI-based systems for decision making in the respective domain. Domains with high AI maturity levels include corporate finance, controlling, and the legal practice. In other domains, such as human resource management, the application of AI remains at the «potential» level as of today and is therefore generally met with skepticism.[9]

Cognitive capabilities are brain-based skills that are needed for acquiring knowledge, processing information, and for reasoning. In general, they relate to mechanisms of how humans learn, remember, and solve problems, thus encompassing the domains of perception, attention, memory, learning, and decision making.[10] The dimension refers to the human learning cycle in Hilb's model and draws upon the cognitive capabilities that are involved in human judgement and high-level strategic decision making. For the purpose of this article, I thus define board decisions that involve ethical dilemmas, value judgements, trade-off considerations and / or paradoxical thinking as decisions that require high cognitive capabilities.

Combining these two dimensions in a 2 x 2 matrix, a typology emerges in which each of the four categories designates a particular interaction form between humans and machines in the context of boardroom decision making, as illustrated in Figure 2:

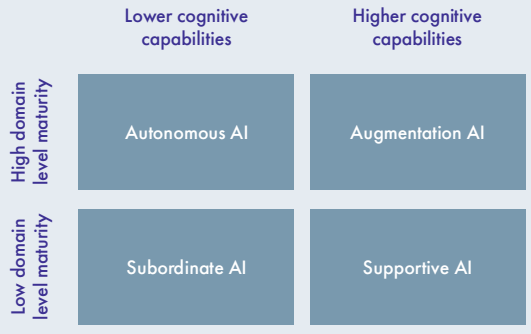

Figure 2: A typology of human and machine interactions for board decision making (own illustration)

9 Duan, Y., Edwards, J. S. & Dwivedi, Y. K. (2019). Artificial intelligence for decision making in the era of Big Data – evolution, challenges and research agenda. International Journal of Information Management, 48(1), 63-71.

10 Kiely, K. (2014). «Cognitive function». In Michalos, Kim M. (Ed.). Encyclopedia of Quality of Life and Well-Being Research (pp. 974-978). Dodrecht: Springer.

4. The four Interaction Forms

As the typology proposes different interaction forms between humans and machines in board decision making, my intention is to clarify the role of AI related to each interaction form. Based on this idea, I label the four categories as follows: autonomous AI, augmentation AI, supportive AI, and subordinate AI. Figure 2 depicts the typology with the four interaction forms.

Subordinate AI: In the case of subordinate AI, it exhibits low domain-level maturity in the field that it is supposed to be applied to. The low maturity is either because the ML approach is not well suited for the context of the decision or because AI systems have not yet been developed for or proven to be successful in the respective domains. In addition, the decision requires a lower level of cognitive capabilities in the sense that there is available information and little uncertainty, complexity, and ambiguity. In this setting, humans are the decision makers who may or may not use AI to provide additional insights to certain aspects of their decision process.

Supportive AI: In the case of supportive AI, the AI still exhibits a low domain-level maturity, while the board decision requires higher cognitive capabilities due to increased uncertainty, complexity, and / or ambiguity. In this setting, humans clearly are still the clear decision makers who rely on selective decision support systems. Examples in the context of boardroom decision making include supporting the BoD by gathering and analyzing information, identifying and diagnosing problems, proposing possible courses of action, and evaluating such proposed actions.

Augmentation AI: In this setting, AI exhibits a high domain-level maturity, and its usage and application are generally accepted and usually well-regulated in the respective field. While humans remain the clear decision makers, the AI-based solutions are more sophisticated and allow the decision maker to use the technology in a way that surpasses human intelligence, e.g., by identifying outliers in large amounts of data or automated reporting.[11] The aim of using intelligent systems is thus to enable such tasks to be performed by a computer while emulating human capabilities as closely as possible. It is important to note, however, that in this setting, AI is not meant to replace board members or to automate governance. It serves to augment overall board intelligence by combining the learning cycles of humans and AI, as shown in Figure 1.

Autonomous AI: With autonomous intelligence, AI is theoretically able to make decisions independently and to operate within a predefined range without human decision input. These are settings in which AI exhibits a high domain-level maturity and in which its machine-learning approaches are well suited for the decision context. In addition, these decision types typically require lower cognitive capabilities, given that data is readily available, the decision context is less uncertain and ambiguous, and the decision does not require complex considerations or moral judgements. However, even though the AI is theoretically able to decide autonomously in these situations, it is important to note that current accountability and liability standards still require the BoD to hold formal decision authority over the final decision outcome.

11 For a more detailed discussion: Hilb, M. (2020). Toward artificial governance? The role of artificial intelligence in shaping the future of corporate governance. Journal of Management and Governance, 24(4), p. 861.

5. Empirical Examples

Having developed a conceptual typology, I now focus on adding empirical examples of board decisions to my framework. In order to better understand the potential contribution of AI to the decision making of the BoD, I follow Hilb's taxonomy of board decisions and identify three generic key roles of BoD that are acknowledged across jurisdictions:[12]

- **Control:** As a supervisory body, one of the key responsibilities of the BoD is to control the top management team (TMT) and to ensure full compliance with the law, accounting standards, and the company's statutory rules, particularly with regard to the firm's finances and risk management. The key decision types in this category thus involve decisions on target achievements, meeting accounting standards, and legal compliance.

- **Co-direction:** The BoD is also responsible for strategic leadership, for developing the corporate strategy with the TMT, and for ensuring its implementation by setting objectives and monitoring its achievements. Key decisions thus involve decisions on innovation, optimization, transformation, diversification or concentration, and internationalization.

- **Coaching:** The BoD is also responsible for appointing and coaching the TMT to ensure effective leadership. By adding the role of a supporter and coach to the BoD, we extend the traditional dualistic perspective of direction and control and include decisions on executive and board appointments, development, and compensation.

Based on the typology presented in Figure 2 and Hilb's taxonomy of board decisions described above, I draw on typical board decisions as derived from the non-transferable statutory duties of the board stated in article 716a of the Swiss Code of Obligations and assign them to the four types of human and machine interactions in board decision making:

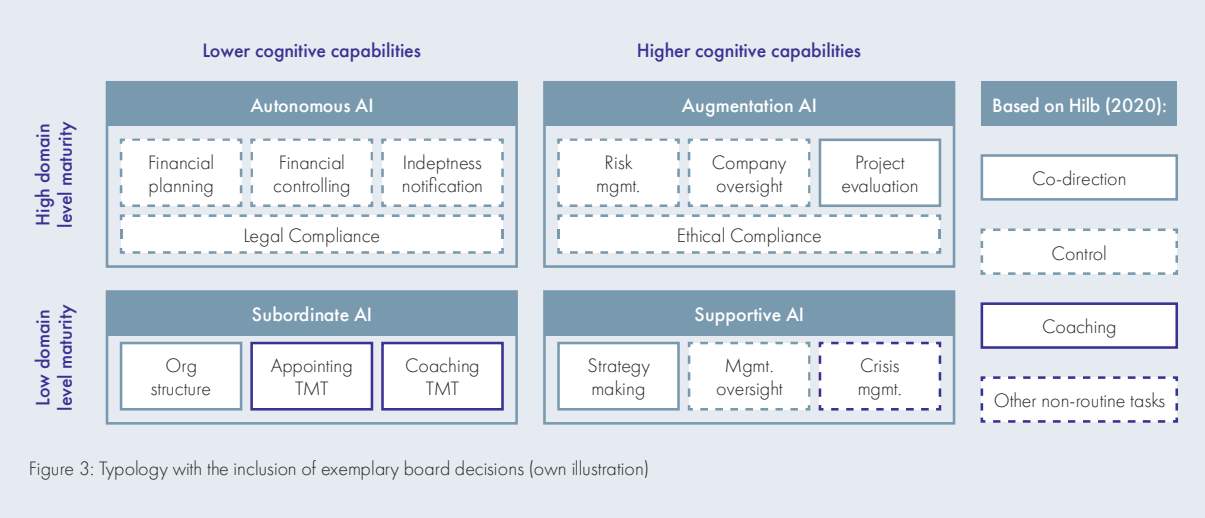

Figure 3: Typology with the inclusion of exemplary board decisions (own illustration)

Figure 3 systematizes different forms of human-machine interactions in decision making and assigns specific examples of board decisions to each interaction type. Even though these decisions are to be understood as generic examples, the aim is to help the BoD decide whether and how to incorporate AI-based systems to support and guide their decision making. It can be noted that AI is predominantly suitable for control and command functions of the BoD such as financial planning and controlling or risk oversight and compliance.

12 Hilb, M. (2020). Toward artificial governance? The role of artificial intelligence in shaping the future of corporate governance. Journal of Management and Governance, 24(4), p. 852 – 853.

In addition, AI is also quite advanced in the field of project evaluations, given that data availability is guaranteed. In other areas such as strategy making, management oversight, or non-routine tasks, such as crisis management, AI can play a supportive role in board decision making. These are typically areas in which AI is not yet capable of automating decisions due to limited data availability or the complex and conflicting nature of the decision. Finally, in some areas, such as drafting organizational structures or appointing and coaching the TMT, AI only plays a subordinate role as of today. These are areas in which, even though the context may not be overly complex or ambiguous, AI is still at an early stage, and there are many other factors apart from quantifiable data that play an important role in supporting the BoD fulfil its direction and support roles.

6. Conclusions

This article contributes to the theoretical underpinnings of human and machine interactions in decision making at the board level. In terms of practical implications, this article argues that AI systems can introduce profound and pervasive changes to the board's decision making and thus fundamentally alter existing corporate governance structures. However, board members should also take into account the technical limitations of AI-supported decision systems.[13] First, in addition to the considerable time and cost required for AI implementation, decision makers need to consider its interoperability with other existing information systems and platforms. Second, they need to carefully examine the quality of data used as input to train AI systems. Moreover, there are also important legal considerations for the board's decision to incorporate AI into its decision making processes, in particular with regard to the accountability and liability rules related to the BoD. Legally, the business judgement rule states that any key decision taken at the level of the board must be based on the best available information and must be documented accordingly. This rule may lead to conflicting interpretations though: it could either mean that companies could be forced to resort to AI for certain decisions where AI-based decision support systems promise better results than human predictions or that it could lead to its rejection due to the fear of legal disputes that may arise from the usage of such systems.[14]

Notwithstanding these limitations, AI can be used as a powerful decision support system that can help the BoD make faster, more accurate, and unbiased decisions. However, boards eager to benefit from the potential that AI offers in this realm first need to understand the different interaction forms between humans and machines in decision making. Unfortunately, AI adoption is still often equated with automation, whereby humans are thought to be replaced by machines in decision making. In practice, however, AI is much more commonly used to augment human activity.[15] This augmentation view is particularly true for the strategic decision making of the BoD. This generally involves considerations that are difficult to digitize or where prior knowledge and experience is important for anticipating outcomes in novel or unusual circumstances. In this context, the human and machine relationship should therefore no longer be considered dichotomous but evolving into a «machine augmentation» of human capabilities.

Overall, I believe that the question is not whether AI will play an increasingly important role in decision making and corporate governance but how well we are able to use and adapt such systems in order to complement and enhance the existing capabilities of the board. This is why I believe that it is paramount to understand the underlying features of the technology and how it can affect reasoning and decision making. Only when we truly grasp the fundamentals of these processes, we can reap the full potential of what AI has to offer in these areas. The result could be a whole range of new governance mechanisms and systems that are powered by the advantages of both human and machine learning cycles. Today's boards of directors can play a central role in this process if they are willing and open to engage in the social dialogue that is necessary for taking a step forward in human and AI governance.

13 For a more elaborate discussion of limitations, see: Paschen, U., Pitt, C. & Kietzmann, J. (2020). Artificial intelligence: Building blocks and an innovation typology. Business Horizons, 63(2), 147-155.

14 Hilb, M. (2020). Toward artificial governance? The role of artificial intelligence in shaping the future of corporate governance. Journal of Management and Governance, 24(4), p. 859.

15 See also: Athey, S., Bryan, K. & Gans, J. (2020). The allocation of decision authority to human and artificial intelligence. AEA Papers and Proceedings, 110(1), 80-84; Raisch, S. & Krakowski, S. (2020). Artificial intelligence and management: The automation-augmentation paradox. Academy of Management Review, forthcoming (pre-print version).