AI leadership and the future of corporate governance: Changing demands for board competence

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Changing demands for board competence

Fernanda Torre, Robin Teigland and Liselotte Engstam

1. Introduction

When discussing digitalization and its impact on the future of labor, much of the practitioner and academic literature tends to focus on labor in general. However, this chapter takes a different approach and focuses on one subset of labor that to date has attracted considerably less attention in the literature: corporate boards. Corporate boards may be the organizational unit that has the most influence on firm performance and behavior as they influence decision-making and are involved throughout the different phases of a firm's strategic process (Huse, 2007). Leblanc and Gillies (2005, p. 6) even argued, "Nothing is more important to the well-being of a corporation than its board of directors". This should not be too surprising as corporate boards and executives are responsible for major strategic decisions such as mergers and acquisitions, new product launches, and digital transformation (Libert, Beck and Bonchek, 2017). Today, however, corporate boards are increasingly struggling with taking the right decisions. For example, a 2015 McKinsey study found that only 16% of board directors said they fully understood how technological advances were changing their company's trajectory and how the dynamics of their industry were changing (Sarrazin and Willmott, 2016).

Due to this increasing complexity of board tasks, it is expected then that digitalization will not lead to the automation or obsolescence of board directors within the foreseeable future (Bankewitz, Åberg and Teuchert, 2016; Libert, Beck and Bonchek, 2017). Rather, research and industry both point to the need to continuously develop the competence of boards to successfully tackle the many challenges brought by digitalization, especially as the external environment continues to become more volatile and uncertain due to digital technologies. For example, a recent study by MIT found that firms whose boards of directors were *digitally savvy*, i.e., members had "an understanding, developed through experience and education, of the impact that emerging technologies will have on businesses' success over the next decade" (Weill et al., 2019, p. 17), significantly outperformed other firms on key metrics – such as revenue growth, return on assets and market cap growth (Weill et al., 2019).

Of all the various digital technologies, artificial intelligence (AI) has been predicted by global leaders across industries to have a greater impact on the world than the internet (PWC, 2019). Indeed, it has even been predicted that AI will become the basis of essential competitive advantage when employed for strategic and operational decision-making, similar to electricity in the Industrial Revolution and enterprise resource planning software (ERP) in the information age (Libert, Beck and Bonchek, 2017). However, AI is still poorly understood by firms and their leaders, and the majority are still unsure as to when and how AI should be implemented (EY, 2018).

To date, the majority of activities by researchers and practitioners alike have focused on the implementation of AI at the operational level of firms (Acemoglu and Restrepo, 2019). Few are investigating what impact AI will have on the governance of organizations and how corporate boards may need to develop their competence to successfully lead their organization in this new evolving AI-based era. This seems surprising as the governance of AI, and the "big data" on which AI is based, is predicted to become one of the greatest board issues in the next ten years (Featherstone, 2017).

In order to address this research gap, we embarked on a two-year study investigating how boards will govern and leverage AI. This chapter presents some of the preliminary results from this study based on a literature review and a series of interviews with leading global experts in corporate governance and AI as well as with chairmen, board directors and top management in some of Sweden's largest multinationals. In particular, we limit our discussion in this chapter primarily to two competence areas that we propose corporate boards need to develop in order to successfully govern in a world where AI is increasingly the basis of competitive advantage: (1) guiding AI operational capability and (2) supervising AI governance capability. We also present the *Boards 4 AI Leadership Matrix*, a tool that we suggest boards may use to facilitate the development of these competence areas. In addition, we touch briefly on how AI may change the future of board work such as new board processes and augmenting board tasks (Libert, Beck and Bonchek, 2017).

The structure of this chapter is as follows. The next section presents the background for this chapter. Section 3 presents the first competence area – Guiding AI operational capability – while Section 4 presents the second competence area – Supervising AI governance capability. Section 5 then introduces our *Boards 4 AI Leadership Matrix*. Section 6 presents a reflection on how AI may influence board work in the future, followed by our concluding remarks in Section 7. Again, it is important to note that the aim of this book chapter is not to focus on the future of labor in general, even though boards will themselves have a major impact on organizations and the future of work. Rather, the primary focus is on labor at the board level and how the implementation of AI in industry will require boards to develop new competence areas to successfully govern. Furthermore, we should note that while there are different models of corporate governance based on a number of factors, e.g., ownership models, development stages, jurisdictions, this study takes a more generalist approach and applies a broad view on the competence areas that boards need to develop to ensure AI leadership.

2. Background

Corporate boards and top management are ultimately responsible for a firm's success as they are the ones taking strategic decisions and thereby putting the firm at risk. Today's competitive environment is becoming increasingly more volatile and uncertain, leading boards to take on even more strategic risk. The challenge arises when board members lack the necessary competence to take such strategic decisions, in what has been labeled "ungoverned incompetence" (Cebon, 2017). In other words, ungoverned incompetence occurs when the board tries to make the right decision, yet it ends up making the wrong one due to a lack of competence by board members (Cebon, 2017). One of the most well-known examples is Lehman Brothers during the global financial crisis when the board took the decision to invest in a product that it did not understand (Cebon, 2017). Since then many boards have failed to take the right decisions for their firms, especially when it comes to digitalization and new digital business models. For example, more than 50% of the firms that were on the Fortune 500 list in the year 2000 have disappeared from this list due to digital disruption (Nanterme, 2016). Furthermore, MIT research in 2018 on more than 1000 multinationals with over USD1 billion in revenues showed that firms with boards with a relatively low level of digital competence had significantly lower revenue growth, lower ROA, and lower market growth than those firms with digitally competent boards (Weill et al., 2019).

One of the authors of this report, under the auspices of Digoshen AB, investigated further how firms and their boards are meeting changing competitive environments due to digitalization. Building on research on digital transformation by organizations such as MIT, Institute of the Future, and the Centre for Creative Leadership and Altimeter as well as their own research and work with clients, Digoshen AB found that those firms that are digital leaders in their industry have relatively high capabilities in two areas: "digital *business* capability" and "digital *leadership* capability" (Engstam and Caroan, 2016; Pagano, 2017). In other words, as the risks continue to rise due to an increasingly complex and uncertain environment, it is not enough for a firm to merely have a high level of *digital business capability*, i.e., the use of digital technologies in areas such as local and global marketing efforts as a means to enable collaboration across firm boundaries, as the basis for a new customer value proposition or business model, and as a driver of rethinking the firm. Rather, the firm must also have a strong *digital leadership capability* to ensure successful digital transformation, i.e., digital competence at the board level, participation by the board in the identification of digital opportunities, the board's monitoring of risks related to digital transformation, and the board's use of social media and other digital technologies to share knowledge, listen to customers and increase visibility of their company.

To learn more about firms' digital business and digital leadership capabilities, Digoshen administered a survey to board directors within the European Confederation of Directors Association (ecoDa) and the Swedish Academy of Board Directors during 2016. Approximately 400 board members answered the survey with

the majority of respondents from ten European countries and others from the US, Australia, China and Africa. A second survey was then conducted with approximately 400 board members from 2017 to 2019, including participants from the Swedish Academy of Board Directors Chairman Program and members of the INSEAD Directors Network, a global network.

Comparing the Digital Business Capabilities results from the surveys revealed that digital transformation was predominantly at the functional level, with only some firms starting to have their strategy influenced by digital trends. While only 30% initially had a digitally influenced vision, this more than doubled to 73% in the second survey. As for using digital technologies to understand customers better, this increased from 40% to 58%. Another interesting change was that the percent of firms launching new business models rose from 40% to 58%, with 47% starting to sacrifice existing revenue – up from 25%. While only 14% had started to look into the next wave of digital opportunities, such as AI, robotics and 3D printing, this only increased to 19% in the second.

Looking at digital leadership capabilities, more than 50% responded in 2016 that their CEOs had been leading key strategic digital business initiatives, and this number climbed to 73% in the second survey. While initially 25% had clarity in roles and responsibilities in governing digital initiatives, this only improved to 36% in the second round. One area that surfaced as critical for success was the monitoring by boards of the risks related to digital technologies and digital transformation. However, 60% of the companies were not clear about, nor did they monitor, their digitally related risks, and this number remained the same in the second set of results, even though the digital risks for most organizations had increased. A notable change was that 66% of board members claimed in the second survey to be listening via social media to customers, employees, partners, competitors and industry experts, up from 50% in 2016.

This research and these surveys revealed that digital transformation is affecting not only firms but also the work of boards. Boards are adapting their focus, changing their behavior and increasing their competence. However, the focus by boards has been primarily on understanding digitalization's influence on a firm's operations and less on how to lead digital transformation.

In our current research project, 4boards.ai, we built on the previously mentioned findings to further investigate the impact of digitalization on corporate governance by narrowing our focus to AI. We have chosen this specific focus since AI is the digital technology that is expected to have the greatest impact on firm competitiveness, and as previously noted, AI governance, and the "big data" on which AI is based, is predicted to become one of the greatest board issues in the next ten years (Featherstone, 2017). Thus, one of our underlying research aims is to examine the competence that board directors need to develop in order to successfully govern their firms in a world where AI is increasingly the basis of competitive advantage.[1]

To fulfill this aim, we present the preliminary results from our research based on extensive firsthand board work experience by one of the team members, a systematic review of academic and practitioner literature on corporate governance

and AI implementation in industry, and a series of interviews with board members of leading multinationals and with global AI experts. In short, we found that while boards are aware of the importance of AI implementation as a key competitive advantage, they do not yet have sufficient competence in two key areas to best steward their companies within AI Leadership: (1) guiding AI operational capability and (2) supervising AI governance capability. Next we discuss each of these competence areas in depth, basing our discussion on our preliminary findings from our research.

3. Guiding AI operational capability

As representatives of shareholders and stakeholders, boards cannot ignore the extraordinary value-creation opportunities that AI is enabling in today's digital era characterized by a constantly changing strategic context, short-term strategizing, availability of large amounts of data and crowd-approaches to knowledge sharing (Bankewitz, Åberg and Teuchert, 2016). Through applications such as recommendations, live translations, facial recognition, autonomous vehicles and smart cities, AI offers tremendous opportunities and already is changing how value is created by firms and delivered to end users. By 2025, some 75.4 billion devices will be connected globally, compared with 26.6 in 2019 (Statista, 2019). This hyper-connectedness will generate unique innovation opportunities as well as completely new relationships between customers, suppliers, stakeholders, regulators and the greater ecosystem. Looking into the future, these relations will manifest themselves in the dissolving borders of traditional pipeline-based firms toward multi-sided business models and collaborative platforms, which will, in turn, enable new business structures in the form of networked ecosystems (Ringel et al., 2019).

Digitalization in general, and AI in particular, creates a unique context for sensing and seizing new opportunities, i.e., both the process of identifying opportunities before they arise and the process of responding to these same opportunities (Bankewitz, Åberg and Teuchert, 2016). In order to both sense and seize opportunities, boards need to have sufficient competence to guide AI operational capability, which we discuss next.

3.1. Guiding the gathering, harvesting and analysis of big data

Data are a new type of asset that organizations need to consider since our digitized society has brought to light a key aspect of technology: the connectedness between different nodes in the system. The 2018 New Vantage Partners annual executive survey shows that today, for the first time, large corporations report that they have direct "access to meaningful volumes and sources of data which are providing AI solutions with sufficient meaningful data to detect patterns and understand behaviors" (NewVantage Partners, 2018, p. 7). This is probably because it is now widely accepted that the size of available data sets represents a competitive advantage (Lauterbach and Bonime-Blanc, 2018). Indeed, data sources are numerous and

include publicly available open data sets (external), data created by a company's customers, suppliers and other partners (and collected by the company within the ecosystem) and data created by the company itself (internal). Additionally, firms are beginning to take note of "alternative data", an expression developed by investment companies to label data from non-financial and non-traditional sources to improve investment decisions (Kolanovic and Krishnamachari, 2017). Big and alternative data can come from individuals (e.g., social media, news, reviews, web searches/personal data), business processes (e.g., transaction data, corporate data, government agency data), and sensors (e.g., satellites geolocation, other sensors) (Kolanovic and Krishnamachari, 2017).

Gathering quality data and building a reliable data-lake to train algorithms is no easy task. In fact, one of the most challenging tasks of building an AI program is the cleaning, preparing and labeling (tagging) of data (Lauterbach and Bonime-Blanc, 2018). Accenture suggested in a report that the firm's reluctance of investing in AI is largely driven by data concerns, as 48% of surveyed companies reported data quality issues, while 36% reported a lack of sufficient data for training and 35% reported data existing in silos (Sinclair, Brashear and Shacklady, 2018). Thus, boards need to develop an understanding of not only the gathering but also of the harvesting and analyzing of data. To address this challenge, boards can learn from the *Data Management Life Cycle* as proposed by the World Economic Forum/Accenture (WEF, 2018) that consists of four steps:

1 Data origination: Strong data infrastructure to enable data harvesting
2 Data storage: Robust data warehousing to enable storage (combination of on-premise, cloud and hybrid models)
3 Data structure and analysis: Capabilities to structure and analyze data (data quality over data quantity)
4 Communication and action: Tools and assets to communicate and take action on insights

Furthermore, our research revealed that the timely collection and harvesting of data will become increasingly critical as boards will need faster and more transparent indicators of the status of the business and industry in order to gain insights relative to strategic decisions.

Finally, our research finds that there will be a need for boards to acquire a deeper understanding of the complexities of data ownership and data access rights issues. Boards need to make balanced decision regarding their company's usage of data and who they should protect among their stakeholders.

3.2. Guiding AI-driven innovation

AI presents organizations with the opportunity to innovate their businesses in a multitude of ways, ranging from incremental improvement to complete reinvention (McWaters, 2018). Table 7.1 provides an overview of the innovation that AI enables as well as some examples provided by the World Economic Forum:

Table 7.1 From core to radical innovations with AI.

Leaner, faster operations	AI allows operational enhancements, such as improving efficiency, decreasing costs and freeing capacity. Example: Using automation and pattern detection to improve core business processes.
Tailored services, products and advice	AI resolves traditional trade-offs between cost and customization, enabling tailored products at near-zero marginal cost. Example: Big data analytics for personalization.
Ubiquitous presence	AI expands reach by enabling better self-serve applications that allow more services to be delivered digitally. Example: A suite of offerings that capture new market share by using AI to offer a seamless experience automating the purchasing process.
Smarter decision-making	AI enhances decision-making capabilities, unlocking novel insights that drive improved performance. Example: Identification of unexplored patterns to outperform markets.
New value propositions	AI redefines core offerings, unlocking untapped segments and revenue opportunities through new products and services. Example: Big data analytics to identify new areas of customer demand.

Source: (Adapted from McWaters [2018] and WEF [2018])

In order for firms to take advantage of AI opportunities, corporate boards need to be able to implement a portfolio approach addressing a range of AI opportunities. From exploiting AI for leaner, faster operations to exploring AI for new value propositions, a portfolio approach is important since some projects will generate quick wins while others will focus on transforming end-to-end workflows (Lauterbach and Bonime-Blanc, 2018). It is important not to mistake the mere launch of a few isolated use cases as complete AI deployment. McKinsey & Company has noted that if an AI strategy is not implemented beyond a few use cases, then this is a warning signal of AI program failure (Fleming et al., 2018). Additionally, corporate boards need to understand the strong relationship between successful innovation management in general and AI innovation capabilities, i.e., a firm that is successful at innovation generally is successful at AI deployment (Ringel et al., 2019).

Some of the capabilities common to innovation management and AI implementation are the following:

- Cross-functional, diverse teams working on AI and algorithmic development are a "must-have in the adoption of safe and beneficial technology" (Lauterbach and Bonime-Blanc, 2018, p. 145).
- Strong feedback loops in an iterative development process in close connection with business development are required because "the best algorithms will

not succeed in delivering results if they do not improve a product or a service experience for a customer" (Lauterbach and Bonime-Blanc, 2018, p. 145).
- Clear top-management buy-in since if the "executive leadership team is not ready to redesign business models and end-to-end processes across the whole organization, a company may never benefit from the full potential of AI" (Lauterbach and Bonime-Blanc, 2018, p. 147).
- An innovation culture that embraces both a "succeed fast" approach to innovation and that focuses on finding unmet real needs (Main, McCormak and Lamm, 2018).
- Training and hiring programs with innovation at the core is a key enabler for digital transformation: "whichever strategy it pursues, an organization must offer its workforce an engaging work environment that enhances the employee experience, incubates ideas and encourages creative thinking" (WEF, 2018, p. 15).

Of note is that some of the most urgent opportunities for AI-driven innovation are related to the 2030 Agenda for Sustainable Development adopted by all UN Member States in 2015 (Rolnick et al., 2019). Due to the complexity of social-ecological systems, AI presents specific opportunities within big data analysis and the management and optimization of the global technological infrastructure that extracts and develops natural resources such as minerals, food, fossil fuels and living marine resources. Furthermore, algorithms facilitate global trade flows that form the basis of environmental monitoring technologies (Galaz and Moberg, 2015).

Even though there are strong arguments to use AI in the context of enabling innovation, our research shows, however, that the level of AI implementation varies greatly across organizations. This represents an additional area for board consideration since looking into the future, we see that while organizations struggle to invest in their dynamic capabilities for innovation and AI implementation, the "first-mover" advantage might be of key importance in this innovation game. AI is a technology that lends itself to a "winner-takes-all" strategy due to either potential networks effects of the solutions presented or due to the nature of the technology itself. AI does not allow a "plug-and-play" approach, which generates a performance gap between AI "pioneers" that appear to be "pulling further away" from organizations that are still lagging behind (Ringel et al., 2019, p. 8). The performance gap between AI performers and non-performers might be of particular concern for corporate boards since it might require a more ambitious AI deployment strategy, which also increases the pressure for leadership contributing to a distinct "bandwagon" effect. This effect can be described as "a psychological phenomenon in which people do something primarily because other people are doing it, regardless of their own beliefs, which they may ignore or override (Kenton, 2018). The "bandwagon" effect is known to contribute to speculative bubbles; therefore, corporate boards should be considerate of this bias and aim toward a meaningful implementation of AI according to best practices.

To better guide AI-driven innovation in the firm, boards will, however, need to strike the right balance between development and control activities. Our research has revealed to date that currently, most companies spend the majority of their board meetings discussing control issues, thereby greatly limiting time spent on innovation. A better practice would be to develop processes for control outside the larger board meetings either in committees or through online fora and instead devote more board time to discussing development activities while considering the right KPIs (key performance indicators) to reflect this balance. As a consequence, a bigger focus by boards on innovation will require the development of new competences in the board and capabilities in the firm. In order to develop their companies' businesses, boards will need to better understand innovation, technology and sustainability, and their impact on opportunities, threats and new business models.

3.3. Guiding the growth of a digital business ecosystem

As mentioned previously, there is a strong correlation between companies that consider themselves strong innovators and those that see themselves as being strong at AI (Ringel et al., 2019). One would expect this to be primarily true for technology firms; however, a closer look at a BCG report reveals that the most innovative firms are not all technology firms. Rather the most innovative firms are those that develop not only AI but also platforms and ecosystems across their industry regardless of industry (Ringel et al., 2019). While a platform structure is nothing new per se, for example, newspapers have connected subscribers and advertisers for many years, the enhanced ability to capture, analyze and exchange huge amounts of data will increase a platform's value to all (Van Alstyne, Parker and Choudary, 2016). Furthermore, the usage of digital platforms, APIs, IoT technology and new tools for data collection and analysis will allow for new products and services that go beyond the boundaries of traditional business (Fuller, Jacobides and Reeves, 2019). This is a shift that is predicted to have a significant impact in the near future. For example, a McKinsey study showed that an emerging set of digital ecosystems could account for more than USD60 trillion in revenues by 2025, or more than 30% of global corporate revenues (Bughin et al., 2018).

A platform is a specific kind of ecosystem, i.e., all platforms are ecosystems but not all ecosystems are platforms. A platform leverages "networked technologies to facilitate economic exchange, transfer information, connect people, and make predictions . . . thus a platform drives value from its role as an intermediary" (Fenwick, McCahery and Vermeulen, 2019, p. 3). Currently, seven of the 12 largest companies by market capitalization – Alibaba, Alphabet (Google), Amazon, Apple, Facebook, Microsoft and Tencent – are ecosystem orchestrators (Bughin et al., 2018) that use platforms to create value by facilitating exchanges between different yet interdependent groups (Fenwick, McCahery and Vermeulen, 2019). For example, developers of voice-recognition-based smart-home platforms, such

as Amazon's Alexa or Google's Home, make it easy for others to create new consumer services that use their AI-enabled platforms – and in the process to attract the critical mass of applications needed to make their platform and thus their ecosystem a clear leader (Ringel et al., 2019).

For most firms, the relation between the implementation of AI and operating in a business ecosystem becomes increasingly relevant as it will be extremely difficult for a firm to implement an advanced AI program completely alone. Currently, the costs of implementing AI and finding the appropriate data scientists are extremely high, especially as AI technology is becoming increasingly relevant for all business sectors, not only within tech firms. As a result, the search for recruiting and retaining AI talent is also becoming more competitive (Perisic, 2018), in what has been called a war on AI talent (Kelnar, 2019). Boards need to develop an understanding of how organizations collaborate in digital business ecosystems to hasten the pace of implementation of an AI program, reduce costs and to potentially tap into value from ecosystem partners. As identified in Accenture Technology Vision 2017, "The competitive advantage of tomorrow won't be determined by one company alone, but by the strength of the ecosystems chosen, and the company's plans to help the ecosystems grow" (Accenture, 2017, p. 39).

Moving forward, corporate boards must develop their understanding of complex adaptive systems. To implement AI through a platform and even to orchestrate a digital ecosystem can be described as the management of a complex adaptive system, i.e., an understanding of the individual parts does not automatically convey an understanding of the whole system's behavior. The management of a complex adaptive system requires what could be called "competing on the edge" that requires "adaptation to current change and evolution over time, resilience in the face of setbacks, and the ability to locate the constantly changing sources of advantage . . . engaging in continual reinvention" (Brown and Eisenhardt, 1998, p. 19). The goal is flexibility, requiring the board to be able to shape strategy where the organization both influences and is influenced by ecosystem stakeholders, while evolving the ecosystem for mutual benefit (Fuller, Jacobides and Reeves, 2019). In other words, corporate boards will need to support the development of an organization's adaptive capabilities so they can provide real-time responses to strategic issues and opportunities provided by AI (Bankewitz, Åberg and Teuchert, 2016).

An implication of digital business ecosystem participation is that boards will need to be more dynamic in their work. Today many companies have four to seven board meetings a year, which, given the complexities of governing a digital business ecosystem, will probably need to be complemented with more flexible options. For example, board work can be complemented with full or temporary committees for areas such as innovation and technology. Additionally, board meetings could be both physical and virtual, thereby enabling the ability to react more quickly to changing conditions. For example, virtual meetings could occur in between the traditional face-to-face board meetings to discuss upcoming opportunities or threats.

4. Supervising AI governance capability

While AI offers considerable innovation opportunities in both strategic and operational areas (Vinnova, 2018), we have found that corporate boards must also develop the competence to supervise AI governance capability in order to successfully govern and mitigate the risks that go hand-in-hand with implementing AI within an organization. Next we discuss three areas in which boards need to develop their competence in order to supervise AI governance capability.

4.1. Supervising data management, ethics and black box decision-making

Currently, few companies perceive data as a valuable asset, and thus they do not devote sufficient attention to how they manage their data. As a result, they lag behind in implementing clear rules and policies to ensure data are trustworthy, clean and usable (Protiviti, 2019). Accenture found that 79% of executives responded that their organizations were basing their most critical systems and strategies on data, yet many had not invested in the capabilities to verify the truth within (Accenture, 2018). This is a basis for concern for boards because if an AI system is based on incomplete or poor data quality, it could lead to the wrong training of the algorithms, opening concerns for the trustworthiness of the AI decisions.

Besides data quality, algorithms that are programmed by humans may be subject to bias, leading to ethical conflicts. Programmers might inject their judgments into the code and train algorithms with biased data, leading to machines being even more untrustworthy or incapable of delivering neutral results. A recent report by Microsoft identified five areas for potential bias: dataset bias, associations bias, automation bias, interaction bias and confirmation bias (Chou, Murillo and Ibars, 2017). Dataset bias occurs when algorithms are trained on data with low diversity, leading to a generalization that will underrepresent certain elements. Association bias takes place when the data used to train an AI model reinforces and multiplies a cultural bias. In the same way, the automation of decisions might override social and cultural considerations and automate goals that go against human diversity. Interaction bias takes place when the bias comes from humans that have distinctively tampered with the AI in order to make it biased. And finally, confirmation bias takes place when AI algorithms serve up content that matches what other people have already chosen, thereby confirming preconceptions.

The best way to address possible biases is to have algorithms developed in a context of diversity, in terms of disciplines, demographics, experience and knowledge, as this will be the best way to anticipate ethical failures and minimize the risks of unintended AI harm (Pauwels, 2018). Regrettably, we live in what can be called a diversity crisis. For example, it took a group of engineers who call themselves "black in AI" to uncover the scandal of how facial recognition technologies failed to trace the features of individuals with darker skin tones (Snow, 2018).

Furthermore, there are also concerns with what is called AI black box decision-making, which can create a liability minefield. Black box decision-making refers to machine learning and the fact that it might not be possible to trace back to why certain decisions were taken by a firm's AI system, making it nearly impossible for a firm to explain its AI actions to stakeholders, the general public or regulators. AI's black box decision-making can result in considerable accountability challenges since responsibility for a decision or action taken may be difficult to pinpoint – was it the programmer who wrote the initial algorithm, the machine that learned the wrong thing due to improper data, or perhaps the company's processes that led to a failure to update the algorithm? Moving forward, as AI applications are highly complex and many managers do not completely understand how they work, regulators may be reluctant to approve AI systems if they cannot be thoroughly explained in how and why decisions are made (Protiviti, 2019). To avoid this, boards need to ensure that the firm strives for the "explainability" of its AI systems in order to be transparent and provide an explanation for decisions and actions made (AI HLEG, 2019).

Furthermore, in our interviews we have found that boards tend ***not*** to be aware of the current applications of AI in their organization, especially when it comes to off-the-shelf solutions. For appropriate AI governance, corporate boards will need to stay informed of the individual AI application uses in their companies as well as the model reviews done for those algorithms.

In a context of clouded accountability and relatively low expert understanding, AI raises risks of reputational damage and ethical concerns. Major AI leaders, such as Microsoft, Intel, Alphabet Inc./Google and IBM, have recently published social responsibility principles, showing an interest in self-regulation and taking on real-world problems. These documents provide a look into potential foreseeable troubles. For example, Microsoft, in its annual Securities and Exchange Commission (SEC) report filed in June 2018 and referent to the previous year, has put it very clearly:

> Issues in the use of artificial intelligence in our offerings may result in reputational harm or liability . . . AI algorithms may be flawed. Datasets may be insufficient or contain biased information. Inappropriate or controversial data practices by Microsoft or others could impair the acceptance of AI solutions. These deficiencies could undermine the decisions, predictions, or analysis AI applications produce, subjecting us to competitive harm, legal liability, and brand or reputational harm.
>
> (Microsoft, 2018, p. 28)

Following suit also Alphabet Inc. (holding company of Google) has also reported the risks of AI:

> New products and services, including those that incorporate or utilize artificial intelligence and machine learning, can raise new or exacerbate existing ethical, technological, legal, and other challenges, which may negatively

> affect our brands and demand for our products and services and adversely affect our revenues and operating results.
>
> (Alphabet, 2018, p. 7)

Even if some IT multinationals today show concern by showing interest in self-regulation and publishing social responsibility principles, it is unclear as to how regulators will act in the future. Perhaps a set of principles may materialize into standard practices within industry that are sufficient for regulators or perhaps strict regulations may be developed. Looking into the future, even prior to potential regulation, corporate boards will have to take a stance on the ethical implementation and regulation of AI. For example, Microsoft recently announced that it had decided to decline the sale of its facial recognition technology to both a California law enforcement agency and to an unnamed capital city because of human rights concerns (Menn, 2019).

In this context, it seems clear that boards should raise their competence in this area. For example, boards should be able to supervise the creation and monitoring of a data governance framework for the firm. This framework should focus on ensuring that the firm's data and processes are developed with a clear purpose and fulfilling ethical obligations. This is distinguishable from the current practices of many firms that aim to merely fulfill legal obligations. Currently, there is not an established and mature model that is consensual among industry, policy makers and academics, although several models are being tested (Micheli et al., 2018). This is relevant for boards because, in the words of Anastassia Lauterbach, "A visionary board should ask how the company thinks about data to solve strategic and operational problems, whether there is a solid data governance framework in place, and if and when the business considers providing wide access to data, allowing as many people as possible to find valuable insights" (Lauterbach, 2018, para.7). Additionally, the data governance framework should be linked to the firm's regulatory actions and cybersecurity activities, the subject of the next section.

4.2. Supervising AI security

Not only must boards develop the competence to ensure they can adequately supervise data governance, but they must also develop significant competence related to understanding how to best ensure data and AI system security and protection from hackers and similar ransomware activities (Else and Pileggi, 2019).

There are different kinds of cybersecurity threats, and one of the most commonly discussed is hacks, i.e., an unauthorized intrusion into a computer or a network, such as malware, phishing, man-in-the-middle attack, denial-of-service attack, SQL injection, among others (Cisco, 2018). This action can be perpetrated with different intentions, from stealing corporate secrets to executing ransomware attacks such as the 2017 WannaCry that led to losses estimated to reach USD4 billion (Berr, 2017). Robert Mueller, during his time as Director of the FBI, explained this increasing threat in an RSA Cyber Security Conference, "I am convinced that

there are only two types of companies: those that have been hacked and those that will be. And even they are converging into one category: companies that have been hacked and will be hacked again" (Mueller, 2012, para.63).

Hacks are not always conducted by external malicious software. They can also be conducted through social engineering, which relates to the action of using psychological manipulation to trick targeted users into making security mistakes or giving away sensitive information. As corporations devote more resources to IT departments and vamp up firewalls, hackers are increasing their social engineering efforts to bypass these defenses, by going further beyond technology and targeting the aspect of a corporation where security has been the weakest – its employees.

An example of this practice is *phishing*, which can be defined as email scams that use social engineering to attempt to trick the recipient into providing confidential information or unintentionally installing malware through the use of links or attachments (Proofpoint, 2019). According to the enterprise security company, Proofpoint, 83% of global info-security respondents experienced phishing attacks in 2018, which is up from 76% the previous year (Proofpoint, 2019).

To ensure AI security, boards should understand the relevant talent issues. Questions arise such as which talent should be outsourced, when, and how versus whether talent should be employed in house? While conventional security principles are about keeping the bad guys out, social engineering raises another type of question: what to do when the "bad" guys are already inside (Gregersen, 2018)? Thus, one area of discussion for boards is how to ensure employee education as employees who feel they have sufficient training and support to deal with technology at work will be better at their jobs and save the company from hacking attacks along the way. In fact, according to Proofpoint's 2018 report, security awareness training had a significant impact on preventing attacks, and nearly 60% of organizations saw an increase in employee detection once their staff was better trained to identify possible attacks (Spadafora, 2019). Looking forward, one suggestion is that boards understand how to drive AI security implementation by applying the same friendly customer-centric experience that companies have with clients on their own employees (Gregersen, 2018), addressing both cybersecurity and talent retention.

Moreover, AI systems are particularly susceptible to attacks (Mitchell, 2019) for two main reasons: 1) machines are being used to train other machines – which scales the exposure of compromised pieces of code, and 2) machines can be fooled by adversarial examples, i.e., inputs optimized by an adversary to produce an incorrect model classification (Elsayed et al., 2018; Lauterbach, 2018). Image classification systems could be attacked by adding a layer of noise distortion, e.g., fool an algorithm to identify a school bus as an ostrich (Szegedy et al., 2013). Autonomous driving systems could be attacked by, for example, placing stickers on a STOP sign to fool the self-driving car to interpret the sign as a "Speed Limit 80" sign (Eykholt et al., 2018). Finally, speech recognition systems could be attacked by, for example, an audio signal changed so that it is white noise to a human but is, in fact, a command to a machine (Carlini et al., 2016). Thus, corporate boards should be extra vigilant and cognizant that such attacks on their AI

systems can occur. Corporate boards need to develop the competence to develop and reevaluate a routine to foresee where such attacks may occur and how to both monitor and sufficiently respond if and when an attack occurs.

Finally, besides training employees to avoid attacks, boards need to be ready to handle worst-case-scenario situations that might happen anyway. The board should have a clear process on how to deal with AI security breaches, such as how to handle reputation issues in the media or even how to run offline since "pen-and-paper" operations might be necessary in the case of extensive attacks.

All these different aspects related to governing AI as a black box that is susceptible to cyberattacks will require firms to take an intelligent, proactive and multi-layered attitude toward cyberattacks (Grasso, 2019). The implication for how board work may change is that in the future boards will need to better balance the company's focus on long-term strategies that will have to be clearly communicated with all stakeholders, shifting away from more traditional short-termism.

4.3. Supervising business ecosystem leadership

As AI businesses move into ecosystem configurations and platform models, boards will need to learn to "govern" all the stakeholders and the organization's relation to them. Traditionally, as firms grew, they would develop increasingly hierarchical structures as a way to manage the complexities of scale. Although this system might have been useful in the past, in today's dynamic and uncertain business reality, it raises challenges related to the bureaucratization of firm culture (Fenwick, McCahery and Vermeulen, 2019). Today's reality demands the creation of flat, open and inclusive organizations that take advantage of stakeholder talent. Together with live data drawn from the ecosystem, a flexible organization raises the opportunity to automate decisions in what, for example, Alibaba calls the "self-tuning enterprise" (Fuller, Jacobides and Reeves, 2019). As such, AI ecosystems and platforms should be built around the idea of delivering constant innovation via open and inclusive processes of collaboration and co-creation (Fenwick, McCahery and Vermeulen, 2019). For boards this means a flexible and holistic approach to stakeholder governance, which boards can develop following the three-step strategy (Fenwick, McCahery and Vermeulen, 2019):

(A) Leveraging current and near-future digital technologies to create more "community-driven" forms of organization
(B) Building an "open and accessible platform culture"
(C) Facilitating the creation, curation and consumption of meaningful "content"

Besides governing stakeholders to harvest their talents, boards need to learn to govern specific aspects related to data usage and data rights throughout the ecosystem, similar to what many firms have implemented when it comes to sustainability and supply-chain management. Boards will need to ensure that all participants conform to local regulations for the jurisdictions in which the organization exists (WEF, 2018). This represents a big shift in boards' focus. It will no longer be

enough to guarantee a firm's own governance, but it will be increasingly relevant to apply all aspects of governance and risk management to the different partners and stakeholders of the ecosystem.

When addressing stakeholder governance, an extra point for boards to understand is the asymmetry of power between the tech-leaders and the tech-takers. Together with the powerful network effects from digital platforms, this lends itself to a "winner-takes-all" scenario (Lauterbach and Bonime-Blanc, 2018), as addressed in Section 3.2. In this context, boards should be sure to evaluate the benefits and drawbacks when choosing or joining an ecosystem or choosing an AI technology vendor.

Finally, boards should also develop the competence required to enable complex ecosystems. As mentioned previously, the management of a complex adaptive system requires adaptation and indirect shaping in what is called a *shaping strategy*. This still feels counterintuitive to many boards and leadership teams more used to a traditional "plan and execute" controlling approach. A BCG Henderson Institute study found in a strategy simulation game that only 18% of managers succeeded in ecosystem strategy versus an AI opponent, while they would succeed 71% in a classical strategy simulation (Fuller, Jacobides and Reeves, 2019). As a consequence, boards will need to increase their focus on stakeholders from a primary focus on shareholders.

5. Boards 4 AI leadership matrix – a tool for developing board competence

As previously discussed, AI warrants the close attention of the board because firms that successfully implement and govern AI can disrupt the market, drive growth and manage their risk. To support boards to develop the two competence areas necessary to successfully steward the firm to leverage AI, we have developed the tool presented in Figure 7.1, based on the preliminary findings from our research.

To apply this tool, we suggest that a firm's board members should *individually* evaluate where the board is in terms of its competence in the two areas: (1) guiding AI operational capability and (2) supervising AI governance capability. The board can then use the results as a basis for discussion on how the board can improve its two sets of AI capabilities in the firm. For example, a board may not know where or how AI is being implemented in their firm. If such is the case, the board could use this opportunity to address this gap and develop a critical opinion about how the board should develop its competence in order to guide the firm's AI operations and supervise its AI governance. It is also important for boards to relate themselves to others in their industry as there may be differences across industries. For example, the boards of dominant companies such as Facebook, Amazon, Alibaba, Tencent and Google seem to be building their guiding AI operational capability faster than their supervising AI governance capability. However, in the medical service industry with strict regulations concerning patient data, boards may have a very strong supervising AI governance capability but still a rather low

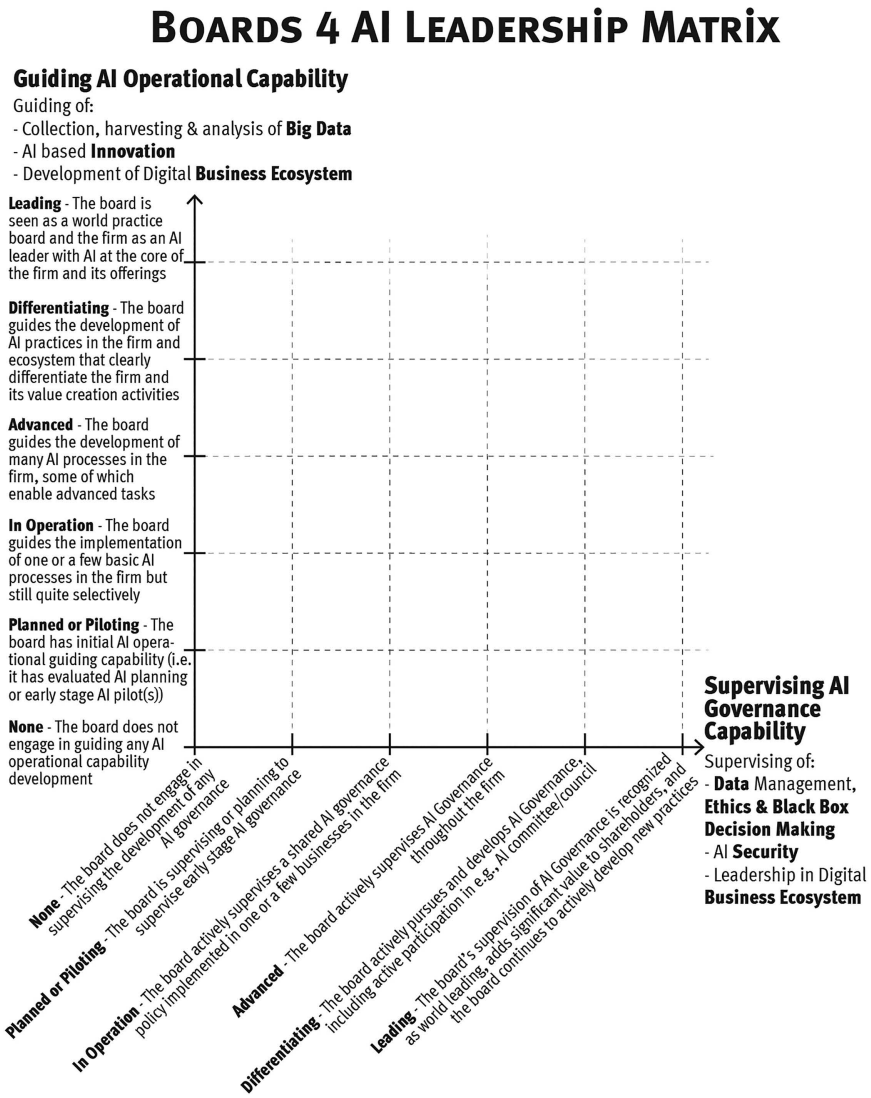

Figure 7.1 Boards for AI leadership matrix.

guiding AI operational capability. Firms in either of these categories would need to leapfrog if they want to become complete AI leaders and need to consider how to fast forward implementation to become the AI benchmark. In this context, as explained in the ecosystem section, it may be faster and more efficient to partner with relevant actors in the firm's ecosystem and build synergies beneficial to all partners. Finally, it is important to note that when a firm's board is a benchmark in both guiding AI operational capability and supervising AI governance capability, then it has the ability to shape the regulatory context, which may prove beneficial in continuing the development of its competitive advantage.

To help boards acquire a better understanding of where they are in terms of the development of their competence, we created a set of questions following the themes addressed in this study. Table 7.2 presents the questions relevant for guiding AI operational capability, following the sections: (3.1) guiding the gathering, harvesting and analysis of big data; (3.2) guiding AI-driven innovation; and (3.3) guiding the growth of a digital business ecosystem.

As mentioned previously, boards need to develop competence not only in regard to guiding AI operational capability but also to supervising AI governance. Table 7.3 presents a set of questions to support boards addressing sections: (4.1) supervising data management, ethics and black box decision-making, (4.2) supervising AI security and (4.3) supervising digital business ecosystem leadership.

6. Beyond competence to the future of board work

Not only will boards need to guide and supervise their firm's AI capabilities, but they will also need to rethink and redesign themselves and their tasks in the context of managing their business to meet the challenges brought on by digitalization (Bankewitz, Åberg and Teuchert, 2016). Through our research, we have identified several areas for board consideration.

One action for boards is to reflect on is how they themselves can become better resources for their organization. For example, should the board focus on personal development or should the board implement specific technical committees that will support the board's digitalization work? In the context of the implementation of an AI program by management, a subset of the board in a technology committee could have a role overseeing and supervising the implementation framework (Lauterbach and Bonime-Blanc, 2018).

Another action is to rethink how to best transition the workforce. One of the biggest issues with AI implementation in firms is job automation in society and the potential rise of unemployment and social unrest (Shewan, 2017). Boards will have an important role in guiding their organization through this important transition. Boards will need to monitor and oversee the decisions regarding the appropriate balance between the automation of processes and jobs versus the augmentation of job tasks, potentially reskilling workers and creating new jobs. Boards should think more broadly about automation and its displacement effect and propose how to create new tasks with AI, thereby engendering a *reinstatement effect* (Acemoglu and Restrepo, 2019).

Table 7.2 Guiding AI operational capability.

Guiding AI operational capability		
Capability level	*Area*	*Questions*
1. None: The board does not engage in guiding any AI operational capability development.	**Data**	How does the board evaluate the firm's internal data collection strategy? How does the board evaluate the firm's routines for exploring data sources?
	Innovation	How does the board assess the relationship between the firm's business strategy, innovation strategy and its data? How does the board challenge itself and management to learn about AI and its implications for the future of work?
	Ecosystem	How does the board rethink the firm's value chain? How does the board evaluate which partners may enable the firm to more quickly ramp up its AI operational capability for faster and more value creating operations and offerings?
2. Planned or piloting: The board has initial AI operational guiding capability (i.e., it has evaluated AI planning or early stage AI pilot[s]).	**Data**	How does the board monitor that the firm identifies and prioritizes both internal and external data to increase value for customers and the firm? How does the board ensure that the firm has the necessary competence to harvest, process and analyze data?
	Innovation	How does the board guide and challenge management to identify use cases to improve offerings or operations through AI in the firm? How does the board evaluate and guide which use cases to further explore?
	Ecosystem	How does the board monitor the exploration of possible partners with which the firm could collaborate within its value chain? How does the board monitor the exploration of possible partners with which the firm could collaborate beyond in the greater ecosystem?
3. In Operation: The board guides the active implementation of one or a few basic AI processes in the firm but still quite selectively.	**Data**	How does the board evaluate the use of third-party data sources by the firm, e.g., external data from an open third party, from the greater ecosystem? How does the board evaluate the firm's data storage, usage strategy and consider data as an asset?
	Innovation	How does the board continuously develop an understanding of the potential impact of AI on the firm's industry, offerings, business operations and business model? How does the board consider which aspects of the business could benefit from increased automation or machine-learning innovation?

	Ecosystem	How does the board ensure alignment with the firm's partners on shared values and communication standards?
		How does the board consider how AI might fit with other emerging technologies in the ecosystem?
4. Advanced: The board guides the development of many AI processes in the firm, some of which enable advanced tasks.	**Data**	How does the board ensure that the firm has a complete data management life cycle and comprehensive data strategy?
	Innovation	How does the board evaluate the firm's use of AI for incremental innovation in its operations?
	Ecosystem	How does the board ensure that the firm allows for all voices to be heard, including all stakeholders?
		How does the board monitor and guide which skills and talents to acquire/develop internally vs externally?
5. Differentiating: The board guides the development of AI practices in the firm and ecosystem that clearly differentiate the firm and its value-creation activities.	**Data**	How does the board work with guiding the development of the firm's data management strategy?
	Innovation	How does the board ensure that it continues to improve its guidance of the firm's data-driven innovation strategy and to evaluate how AI can help transform the firm's products or services?
		How does the board monitor and discourage AI silos and promote collaboration across the firm through policies, processes and systems?
	Ecosystem	How does the board guide the firm to ensure that the hierarchy (competence, titles, reporting lines, goals setting) and agility is compatible with the firm's ecosystem to ensure continued data-driven innovation?
		How does the board guide the firm to continuously explore partners in the ecosystem to move forward faster or better?
6. Leading: The board is seen as a world practice board and the firm as an AI leader with AI at the core of the firm and its offerings.	**Data**	How does the board guide and ensure that the data framework is applied to all aspects of the firm consistently and systematically?
		How does the board guide the work with data science talent management?
	Innovation	How does the board guide and ensure that the firm has a leading AI innovation portfolio?
		How does the board guide and ensure that the firm has the necessary innovation management capabilities to be harvesting both short- and long-term opportunities?
	Ecosystem	How does the board guide and ensure that the firm has the organizational muscle to manage complex relationships across an ecosystem (competing on the edge)?

Table 7.3 Supervising AI governance capability.

Supervising AI governance capability		
Capability level	*Area*	*Questions*
1. None: The board does not engage in supervising the development of any AI governance.	**Data governance**	How does the board learn about data and black box governance and introduce discussions in the board room and with management?
		How does the board supervise awareness of where AI and algorithms are used in the firm?
		How does the board supervise the alignment with GDPR?
	AI security	How does the board supervise AI security for the firm, and how is AI security reviewed and reported to the board?
	Ecosystem leadership	How does the board learn about the impact AI will have on different stakeholders and their expectations?
2. Planned or piloting: The board is supervising or planning to supervise early stage AI governance.	**Data governance**	How does the board keep pace of how the firm is registering where AI and algorithms are used in the organization?
		How does the board keep up-to-date on and supervise what the prioritized use cases and pilots are?
		How does the board define and agree on relevant data and AI governance to better prepare the firm for the future?
	AI security	How does the board ensure that the cyber risks and data privacy issues related to AI implementation are evaluated and monitored?
		How does the board review if the implications of a data breach have been fully understood and costed?
		How does the board encourage the firm to expedite learning related to AI security risks in the broader organization?
	Ecosystem leadership	How does the board continuously evaluate the impact AI will have on customers, employees and society?
		What are the expectations from shareholders on the board's insights and actions?
		How does the board discuss and agree on data governance priorities and policies for the firm?
3. In Operation: The board actively supervises a shared AI governance policy implemented in one or a few businesses in the firm.	**Data governance**	How does the board review which data and bias governance policy is relevant for the broader organization?
		How does the board ensure that the learnings are incorporated in the broader risk and governance system of the firm?
		How does the board ensure that the algorithms and models used are transparent and reviewed by an independent party?

	AI security	How does the board challenge management to respond strategically to risks associated with AI, including cyber risks?
		How does the board monitor that the agreed AI governance policy is implemented throughout the firm?
	Ecosystem leadership	How does the board ensure the firm continues to build stakeholder trust as the firm implements AI?
4. Advanced: The board actively supervises AI governance throughout the firm.	**Data governance**	How does the board remain updated on developments related to data governance, AI bias and ethics?
		How does the board ensure that the firm matures its data practices and runs them in the most effective way?
	AI security	How does the board monitor and supervise that the workforce is sufficiently and continuously equipped to exercise the emotional and ethical judgement required of them?
	Ecosystem leadership	How does the board ensure that the firm lives up to stakeholder expectations in its AI governance activities?
		How does the board supervise how stakeholders manage compliance with AI policies across the ecosystem?
5. Differentiating: The board actively pursues and develops AI governance, including active participation in e.g., AI committee/ council.	**Data governance**	How does the board ensure that the firm uses state-of-the-art AI, bias and ethics governance practices to create further differentiation for the firm?
	AI security	How does the board evaluate the firm's engagement in industry consortia to further learn and share its insights to increase society protection?
		How does the board monitor and supervise that the employees are engaged with continuous feedback?
	Ecosystem leadership	How does the board ensure collaboration and increased engagement with stakeholders on AI governance issues?
6. Leading: The board's supervision of AI governance is recognized as world leading, adds significant value to shareholders, and the board continues to actively develop new practices.	**Data governance**	How does the board ensure that the firm takes the lead and helps promote improved data, AI bias and ethical governance and research in the society?
	AI security	How does the board ensure the firm takes the lead and helps promote an intelligent, proactive and multilayered attitude toward research in society toward cyberattacks?
	Ecosystem leadership	How does the board ensure that the firm collaborates and leads the ecosystem in its understanding of AI governance?
		How does the board work with regulators regarding the shaping of AI governance policies and regulations?

A final point to consider when stewarding an organization is the importance for boards to maintain a focus on diversity. One growing challenge is that women might be at a disadvantage in the future due to higher barriers to transition in terms of time to reskill and due to their lower participation in the STEM fields (science, technology, engineering and mathematics) (Madgavkar et al., 2019). While entirely new occupations will be created, approximately 60% of the new US occupations created to date have been in male-dominated fields (Madgavkar et al., 2019). Boards need to bear this in mind and work even harder to ensure diversity in these emerging positions.

Moving forward, corporate boards will also need to develop the capability to work with AI at the board level. One of the biggest promises of AI is that it can be used to augment human intelligence, thereby changing how we work together, make decisions and manage organizations – from cognitive overload to intelligence augmentation (Rometty, 2016). Several large firms such as IBM and EY are working on digital boardroom solutions to improve board decision-making and time management. One interesting current development is the use of AI by recruiters to support nomination committees, to both assess the board's talent and to search for new board members (Biswas, 2019). Furthermore, at the board level, AI will be able to enable simpler tasks such as automatic speech transcription of board meetings. In the future, AI should be able to facilitate more complex strategic decision-making processes, such as track capital allocation patterns and highlight concerns, review and process press releases to identify potential new competitors, improve operational decision-making by analyzing internal communication to assess employee morale and predicting churn, and to identify subtle changes in customer preference or demographics impact on product development (Libert, Beck and Bonchek, 2017). Other areas include advice on board-relevant topics, such as acquisition candidates aligned with business strategy (Simonite, 2014).

Besides augmenting board members, AI may also augment the board itself by contributing in the role of a board member (Libert, Beck and Bonchek, 2017). As noted by Jeanne Ross, principal research scientist at the MIT Center for Information Systems Research, "companies are succeeding with AI by partnering smart machines with smart people who are learning to take advantage of what these machines can do" (Ross, 2018, p. 11). Already in 2014 an algorithm named Vital (validating investment tool for advancing life sciences) became the "world's first artificial intelligence company director" at Deep Knowledge Venture*s*, a Hong Kong-based venture capital firm (Zolfagharifard, 2014, para.1). Another example is the Finnish IT service and consulting company, Tieto, that appointed a bot called Alicia T. to be part of the leadership team and went so far to grant Alicia T. voting rights (Suni, 2016).

Boards will furthermore be under increased scrutiny from shareholders and the greater circle of stakeholders, using AI tools to monitor their performance. Investors are increasingly using AI to support their identification of investment objects, and both private and public investors are increasing their use of AI to analyze their portfolio companies in terms of both financial and sustainability performance. Examples such as digital AI analysts that leverage natural language processing

and psycholinguistics to analyze nuanced speaking patterns of board members on earnings calls boards will be subject to increased transparency, and boards will need to learn how to act in such an AI world (Sansani, 2018). At this moment the efficiency of these examples could be debated and some even labeled as marketing and communication stunts, but they are still good examples of how AI could support in the creation of insights that will allow more efficient decision-making processes. Indeed, the World Economic Forum reported that 45% of the more than 800 global executives surveyed believed that the first AI machine would be part of a corporate board of directors. However, this would need a change in legal frameworks as the role as board member currently is reserved for natural persons (WEF, 2015).

In summarizing our findings, it becomes clear that boards will need to not only develop their competence to guide AI operational capabilities and supervise AI governance, but they will also need to challenge and adapt their traditional board processes to successfully steward their organizations into an AI future. Next we would like to highlight six additional areas that have emerged from our research to date:

1 Boards will need to better balance their time between development and control activities. Currently, the majority of board work is spent on control, but we foresee a need to move toward a more balanced commitment between development and control as well as the need to develop KPIs accordingly.
2 Boards will need to be more dynamic in their work. Traditional board work will need to be complemented with more flexible options that will allow faster pivoting and strategy adjustments.
3 Boards will need to ensure faster and more transparent insights based on indicators from the business and industry, allowing for better data-led decision-making.
4 Boards will need to expand their focus to include all stakeholders from a narrow focus on shareholders.
5 Boards will need to develop a clearer higher purpose for the firms, raising their ethical standards, versus the status quo of merely fulfilling the lowest legal threshold.
6 Boards will need to better balance the company's focus on the long term with the short term, combining scenario thinking with strategy development and implementation.

7. Conclusion

In this chapter, our purpose was to address one subset of labor – corporate boards – and discuss how one particular digital technology – AI – will influence this subset of labor in the future. More specifically, through extensive board work experience, a systematic review of academic and practitioner literature on corporate governance and AI implementation in firms and a series of interviews with board members of leading multinationals and global AI experts, we found that

boards are aware of the importance of AI implementation as a key competitive advantage and that they do not see AI as replacing jobs in the boardroom. Furthermore, we found that boards need to develop two competence areas related to AI to best steward their companies within AI Leadership: (1) guiding AI operational capability – (a) guiding the gathering, harvesting and analysis of big data, (b) guiding AI innovation and (c) guiding the growth of a digital business ecosystem; and (2) supervising AI governance capability – (a) supervising data management, ethics and black box decision-making, (b) supervising AI security and (c) supervising business ecosystem leadership.

In order to facilitate a fruitful discussion among board directors to move toward developing these competence areas, we then proposed our *Boards 4 AI Leadership Matrix*. This tool supports the finding that if a board is only guiding a firm's AI operational capability, while not supervising AI governance, the firm will likely face high risk and strong regulatory headwinds in the future. We recognize that our approach is very general and does not address specific aspects of AI implementation, such as industry-specific questions or in-depth technology issues. Rather, we aim to contribute with a more general understanding of how boards can better develop their competence within guiding and stewarding AI implementation with the hope of further developing modern corporate governance.

Lastly, AI technology and implementation is an extremely dynamic field of research in which there are exciting developments nearly every day. For the next steps, the *Boards 4 AI Leadership Matrix* will be continuously tested and iterated under the project 4boards.ai. For example, it is likely that companies can learn from highly regulated industries, such as financial services or health care. Thus, testing the *Boards 4 AI Leadership Matrix* in these industries could be an interesting point of departure to establish an actionable strategy for AI implementation as supervising AI governance capability may be the preferable starting point. A further area for research is to test the *Boards 4 AI Leadership Matrix* across different governance models as these differ for ownership models, development stages and jurisdictions while keeping in mind specific national legislation and policies.

We conclude by inviting other scholars and practitioners to use the framework presented as well as to build insights and research on the propositions made in this chapter. We believe that the challenges put forward by AI are worthy of a societal discussion that should go beyond the boardroom.

Conflict of interest

The authors have received funding from Sweden's Innovation Agency, Vinnova, for their research project, "4boards.ai", under the coordination of Chalmers University of Technology. The 4boards.ai project aims to identify, codify and disseminate a set of best practices to enable corporate boards to more successfully leverage and govern AI and other exponential technologies in their innovation and sustainability efforts. The project's funding terms require a number of deliverables. This chapter, which summarizes the principal findings from the project's first phase, constitutes one of the deliverables of 4boards.ai.

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Note

1 A note on terminology. We use the term "competence" at the board level to be in line with previous research looking at board competence and incompetence, e.g., (Cebon, 2017). Competence is defined as "the quality or state of having sufficient knowledge, judgment, skill, or strength (as for a particular duty or in a particular respect)" (Merriam-Webster, 2019), and competence is generally used in the context of leadership. Capability, however, is generally used to describe the collaborative processes in a firm, e.g., "the ability of an organization to perform a coordinated set of tasks, utilizing organizational resources, for the purpose of achieving a particular end result" (Helfat and Peteraf, 2003, p. 999).

References

Accenture, 2017. *Technology Vision 2017 – Amplify You*. [online] Available at: <www.accenture.com/_acnmedia/Accenture/next-gen-4/tech-vision-2017/pdf/Accenture-TV17-Full.pdf> [Accessed 24 Jun. 2019].

Accenture, 2018. *Accenture Technology Vision 2018 – Data Veracity*. [online] Available at: <www.accenture.com/us-en/insight-data-integrity-veracity> [Accessed 22 Jun. 2019].

Acemoglu, D. and Restrepo, P., 2019. Artificial Intelligence, Automation, and work. In: A. Agrawal, J. Gans and A. Goldfarb, eds. *The Economics of Artificial Intelligence An Agenda*. Chicago, IL: National Bureau of Economic Research. pp. 197–237.

AI HLEG, 2019. *A Definition of AI: Main Capabilities and Disciplines – EU High-Level Expert Group on Artificial Intelligence*. [online] European Commission. Available at: <https://ec.europa.eu/digital-single-market/en/news/definition-artificial-intelligence-main-capabilities-and-scientific-disciplines> [Accessed 26 Jun. 2019].

Alphabet, 2018. *United States Securities and Exchange Commission – Alphabet Inc*. [online] United States Securities and Exchange Commission – FORM 10-K. Available at: <www.sec.gov/Archives/edgar/data/1652044/000165204419000004/goog10-kq42018.htm> [Accessed 14 Jun. 2019].

Bankewitz, M., Åberg, C. and Teuchert, C., 2016. Digitalization and Boards of Directors: A New Era of Corporate Governance? *Business and Management Research*, 5(2), pp. 58–69.

Berr, J., 2017. *WannaCry ransomware attack losses could reach $4 billion – CBS News*. [online] CBS News. Available at: <www.cbsnews.com/news/wannacry-ransomware-attacks-wannacry-virus-losses> [Accessed 16 Apr. 2019].

Biswas, S., 2019. *3 Use-Cases of AI in Recruitment*. [online] HR Technologist. Available at: <www.hrtechnologist.com/articles/digital-transformation/3-usecases-of-ai-in-recruitment> [Accessed 24 Jun. 2019].

Brown, S.L. and Eisenhardt, K.M., 1998. *Competing on the Edge – Strategy as Structured Chaos*. Boston, MA: Harvard Business School Press.

Bughin, J., Catlin, T., Hirt, M. and Willmott, P., 2018. *Why Digital Strategies Fail*. [online] McKinsey Quarterly. Available at: <www.mckinsey.com/business-functions/digital-mckinsey/our-insights/why-digital-strategies-fail> [Accessed 17 Apr. 2019].

Carlini, N., Mishra, P., Vaidya, T., Zhang, Y., Sherr, M., Shields, C., Wagner, D. and Zhou, W., 2016. Hidden Voice Commands. In: *SEC'16 Proceedings of the 25th USENIX Conference on Security Symposium*. pp. 513–530.

Cebon, P., 2017. *The 3 Company Crises Boards Should Watch For*. [online] Harvard Business Review. Available at: <https://hbr.org/2017/01/the-3-company-crises-boards-should-watch-for> [Accessed 21 Jun. 2019].

Chou, J., Murillo, O. and Ibars, R., 2017. *How to Recognize Exclusion in AI*. [online] Medium. Available at: <https://medium.com/microsoft-design/how-to-recognize-exclusion-in-ai-ec2d6d89f850> [Accessed 14 Jun. 2019].

Cisco, 2018. *What Are the Most Common Cyberattacks?* [online] Cisco. Available at: <www.cisco.com/c/en/us/products/security/common-cyberattacks.html> [Accessed 10 May 2019].

Elsayed, G.F., Shankar, S., Cheung, B., Papernot, N., Kurakin, A., Goodfellow, I. and Sohl-Dickenstein, J., 2018. Adversarial examples that fool both computer vision and time-limited humans. In: *NIPS'18 Proceedings of the 32nd International Conference on Neural Information Processing Systems, December 2–8*. Montréal, Canada, pp. 3914–3924.

Else, S.R. and Pileggi, F.G.X., 2019. *Corporate Directors Must Consider Impact of Artificial Intelligence for Effective Corporate Governance*. [online] Business Law Today from ABA. Available at: <https://businesslawtoday.org/2019/02/corporate-directors-must-consider-impact-artificial-intelligence-effective-corporate-governance> [Accessed 16 Apr. 2019].

Engstam, L.H. and Caroan, K., 2016. *Digital Business & Board Leadership Progress Report*. Stockholm, Sweden: Digoshen.

EY, 2018. *When Boards Look to AI, What Should They See?* [online] Available at: <www.ey.com/Publication/vwLUAssets/ey-when-boards-look-to-ai-what-should-they-see/$FILE/ey-when-boards-look-to-ai-what-should-they-see.pdf> [Accessed 26 Jun. 2019].

Eykholt, K., Evtimov, I., Fernandes, E., Li, B., Rahmati, A., Xiao, C., Prakash, A., Kohno, T. and Song, D., 2018. Robust physical-world attacks on deep learning visual classification. In: *CVPR conference*. Salt Lake City, UT, June 18–22. pp. 1625–1634.

Featherstone, T., 2017. *Preparing Directors for Artificial Intelligence Whirlwind*. [online] Australian Institute of Company Directors. Available at: <https://aicd.companydirectors.com.au/advocacy/governance-leadership-centre/external-environment/preparing-directors-for-artificial-intelligence-whirlwind> [Accessed 24 Jun. 2019].

Fenwick, M., McCahery, J.A. and Vermeulen, E.P.M., 2019. The end of 'Corporate' governance (Hello 'Platform' Governance). *European Business Organization Law Review*, 20(1), pp. 171–199.

Fleming, O., Fountaine, T., Henke, N. and Saleh, T., 2018. *Ten Red Flags Signaling Your Analytics Program Will Fail*. [online] McKinsey Analytics. Available at: <www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/ten-red-flags-signaling-your-analytics-program-will-fail> [Accessed 8 May 2019].

Fuller, J., Jacobides, M. and Reeves, M., 2019. The Myths and Realities of Business Ecosystems. *MIT Sloan Management Review Digital*, 60(3), pp. 1–9.

Galaz, V. and Moberg, F., 2015. *The Biosphere Code*. [online] The Biosphere Code. Available at: <http://thebiospherecode.com/> [Accessed 24 Jun. 2019].

Grasso, A., 2019. *Cybersecurity Challenges in a Digitally Transforming World*. [online] Ericsson Blog. Available at: <www.ericsson.com/en/blog/2019/2/cybersecurity-challenges-in-a-digitally-transforming-world> [Accessed 26 Jun. 2019].

Gregersen, H., 2018. *Digital Transformation Opens New Questions – and New Problems to Solve*. [online] MIT Sloan Management Review. Available at: <https://sloanreview.mit.edu/article/digital-transformation-opens-new-questions-and-new-problems-to-solve> [Accessed 26 Jun. 2019].

Helfat, C.E. and Peteraf, M.A., 2003. The dynamic resource-based view: Capability lifecycles. *Strategic Management Journal*, 24(10), pp. 997–1010.

Huse, M., 2007. *Boards, Governance and Value Creation: The Human Side of Corporate Governance*. Cambridge, UK: Cambridge University Press.

Kelnar, D., 2019. *The State of AI 2019: Divergence*. [online] Available at: <www.stateofai2019.com/introduction/> [Accessed 26 Jun. 2019].

Kenton, W., 2018. *Investiopedia – Bandwagon Effect*. [online] Available at: <www.investopedia.com/terms/b/bandwagon-effect.asp> [Accessed 9 May 2019].

Kolanovic, M. and Krishnamachari, R.T., 2017. *Big Data and AI Strategies Machine Learning and Alternative Data Approach to Investing*. [online] Available at: <https://faculty.sites.uci.edu/pjorion/files/2018/05/JPM-2017-MachineLearningInvestments.pdf> [Accessed 26 Jun. 2019].

Lauterbach, A., 2018. *Salzburg Questions for Corporate Governance – What Questions Should Boards Be Asking About AI?* [online] Salzburg Questions for Corporate Governance. Available at: <www.salzburgglobal.org/news/publications/article/anastassia-lauterbach-what-questions-should-boards-be-asking-about-ai.html> [Accessed 24 Jun. 2019].

Lauterbach, A. and Bonime-Blanc, A., 2018. *The Artificial Intelligence Imperative A Practical Roadmap for Business*. Santa Barbara, CA: ABC-CLIO, LLC.

Leblanc, R. and Gillies, J., 2005. *Inside the Boardroom: How Boards Really Work and the Coming Revolution in Corporate Governance*. New York, NY: John Wiley & Sons.

Libert, B., Beck, M. and Bonchek, M., 2017. AI in the Boardroom – The Next Realm of Corporate Governance. *MIT Sloan Management Review Blog*. [online] Available at: <https://sloanreview.mit.edu/article/ai-in-the-boardroom-the-next-realm-of-corporate-governance> [Accessed 26 Jun. 2019].

Madgavkar, A., Manyika, J., Krishnan, M., Ellingrud, K., Yee, L., Woetzel, J., Chui, M., Hunt, V. and Balakrishnan, S., 2019. *The Future of Women at Work – Transitions in the Age of Automation*. [online] Available at: <https://mckinsey.com/featured-insights/gender-equality/the-future-of-women-at-work-transitions-in-the-age-of-automation> [Accessed 22 Sep. 2019].

Main, A., McCormak, D. and Lamm, B., 2018. *On the Board's Agenda US – Not If, But How: Evaluating the Soundness of Your Digital Transformation Strategy*. [online] Available at: <https://www2.deloitte.com/us/en/pages/center-for-board-effectiveness/articles/on-the-boards-agenda.html> [Accessed 26 Jun. 2019].

McWaters, J., 2018. *The New Physics of Financial Services – Understanding How Artificial Intelligence Is Transforming the Financial Ecosystem*. [online] World Economic Forum. Available at: <www.weforum.org/reports/the-new-physics-of-financial-services-how-artificial-intelligence-is-transforming-the-financial-ecosystem> [Accessed 26 Jun. 2019].

Menn, J., 2019. *Microsoft Turned Down Facial-Recognition Sales on Human Rights Concerns*. [online] Reuters. Available at: <www.reuters.com/article/us-microsoft-ai-idUSKCN1RS2FV> [Accessed 10 May 2019].

Merriam-Webster, 2019. *Merriam Webster Dictionary*. [online] Available at: <www.merriam-webster.com/dictionary/competence> [Accessed 25 Jun. 2019].

Micheli, M., Blakemore, M., Ponti, M., Scholten, H. and Craglia, M., 2018. *The Governance of Data in a Digitally Transformed European Society. Second Workshop of the DigiTranScope Project*. [online] Available at: <https://ec.europa.eu/jrc/communities/en/community/digitranscope-digital-transformation-and-governance-human-society/document/digitranscope-0> [Accessed 26 Jun. 2019].

Microsoft, 2018. *United States Securities and Exchange Commission – Microsoft Corporation*. [online] United States Securities and Exchange Commission – FORM 10-K. Available at: <www.sec.gov/Archives/edgar/data/789019/000156459018019062/msft-10k_20180630.htm> [Accessed 10 May 2019].

Mitchell, M., 2019. *The Collapse of Artificial Intelligence*. [online] 2019 Science Board and Trustees Symposium – The End of Everything. Available at: <www.youtube.com/watch?v=4QBvSVYotVc> [Accessed 18 Jun. 2019].

Mueller, R.S., 2012. *Speech Robert S. Mueller*. [online] The FBI Federal Bureau of Investigation. Available at: <https://archives.fbi.gov/archives/news/speeches/combating-threats-in-the-cyber-world-outsmarting-terrorists-hackers-and-spies> [Accessed 10 May 2019].

Nanterme, P., 2016. *Digital Disruption has Only Just Begun*. [online] World Economic Forum. Available at: <www.weforum.org/agenda/2016/01/digital-disruption-has-only-just-begun> [Accessed 24 Jun. 2019].

NewVantage Partners, 2018. *Big Data Executive Survey 2018*. [online] Available at: <http://newvantage.com/wp-content/uploads/2018/01/Big-Data-Executive-Survey-2018-Findings.pdf> [Accessed 26 Jun. 2019].

Pagano, M., 2017. *Strategic Thinking in the Age of Digital Transformation*. [online] Board Agenda. Available at: <https://boardagenda.com/2017/09/11/strategic-thinking-digital-transformation> [Accessed 21 Jun. 2019].

Pauwels, E., 2018. *The Ethical Anatomy of Artificial Intelligence – Centre for Policy Research at United Nations University*. [online] Centre for Policy Research at United Nations University. Available at: <https://cpr.unu.edu/cpr-voices-the-ethical-anatomy-of-artificial-intelligence.html> [Accessed 18 Apr. 2019].

Perisic, I., 2018. *How Artificial Intelligence Is Shaking Up the Job Market*. [online] World Economic Forum. Available at: <www.weforum.org/agenda/2018/09/artificial-intelligence-shaking-up-job-market> [Accessed 15 Apr. 2019].

Proofpoint, 2019. *State of Phish*. [online] Proofpoint. Available at: <www.proofpoint.com/au/threat-reference/phishing> [Accessed 26 Jun. 2019].

Protiviti, 2019. *Competing in the Cognitive Age – How companies Will Transform Their Businesses and Drive Value Through Advanced AI*. [online] Available at: <www.protiviti.com/sites/default/files/united_states/insights/ai-ml-global-study-protiviti.pdf> [Accessed 21 May 2019].

PWC, 2019. *22nd Annual Global CEO Survey – CEO's Curbed Confidence Spells Caution*. [online] Available at: <www.pwc.com/gx/en/ceo-survey/2019/report/pwc-22nd-annual-global-ceo-survey.pdf> [Accessed 26 Jun. 2019].

Ringel, M., Grassl, F., Baeza, R., Kennedy, D., Spira, M. and Manly, J., 2019. *BCG The Most Innovative Companies 2019*. [online] Available at: <http://image-src.bcg.

com/Images/BCG-Most-Innovative-Companies-Mar-2019-R2_tcm9-215836.pdf> [Accessed 26 Jun. 2019].

Rolnick, D., Donti, P.L., Kaack, L.H., Kochanski, K., Lacoste, A., Sankaran, K., Ross, A.S., Milojevic-Dupont, N., Jaques, N., Waldman-Brown, A., Luccioni, A., Maharaj, T., Sherwin, E.D., Mukkavilli, S.K., Kording, K.P., Gomes, C., Ng, A.Y., Hassabis, D., Platt, J.C., Creutzig, F., Chayes, J. and Bengio, Y., 2019. *Tackling Climate Change With Machine Learning*. [online] arXiv.org. Available at: <http://arxiv.org/abs/1906.05433> [Accessed 26 Jun. 2019].

Rometty, G., 2016. *Digital Today, Cognitive Tomorrow*. [online] MIT Sloan Management Review. Available at: <https://sloanreview.mit.edu/article/digital-today-cognitive-tomorrow/> [Accessed 26 Jun. 2019].

Ross, J., 2018. The fundamental flaw in AI implementation. *MIT Sloan Management Review*, 59(2), pp. 10–11.

Sansani, T., 2018. *Brave New World: Equity Investing in the Age of Artificial Intelligence*. [online] American Century Investments. Available at: <https://institutional.americancentury.com/content/institutional/en/insights/asset/equity/meet-your-new-robo-analyst.html> [Accessed 24 Jun. 2019].

Sarrazin, H. and Willmott, P., 2016. *Adapting Your Board to the Digital Age*. [online] McKinsey Quarterly. Available at: <www.mckinsey.com/business-functions/digital-mckinsey/our-insights/adapting-your-board-to-the-digital-age> [Accessed 24 Jun. 2019].

Shewan, D., 2017. *Robots Will Destroy Our Jobs – And We're Not Ready for It*. [online] The Guardian. Available at: <www.theguardian.com/technology/2017/jan/11/robots-jobs-employees-artificial-intelligence> [Accessed 16 Apr. 2019].

Simonite, T., 2014. *The Room Where Executives Go to Get Help from IBM's Watson*. [online] MIT Technology Review. Available at: <www.technologyreview.com/s/529606/a-room-where-executives-go-to-get-help-from-ibms-watson> [Accessed 24 Jun. 2019].

Sinclair, A., Brashear, J. and Shacklady, J., 2018. *The Momentum Mindset*. [online] Available at: <www.accenture.com/_acnmedia/PDF-73/Accenture-Strategy-AI-Momentum-mindset-Exec-Summary-POV.pdf> [Accessed 26 Jun. 2019].

Snow, J., 2018. *"We're in a diversity crisis": Cofounder of Black in AI on What's Poisoning Algorithms in Our Lives – MIT Technology Review*. [online] MIT Technology Review. Available at: <www.technologyreview.com/s/610192/were-in-a-diversity-crisis-black-in-ais-founder-on-whats-poisoning-the-algorithms-in-our> [Accessed 18 Apr. 2019].

Spadafora, A., 2019. *Phishing Attacks on the Rise in 2018*. [online] TechRadar Pro. Available at: <www.techradar.com/news/phishing-attacks-on-the-rise-in-2018> [Accessed 16 Apr. 2019].

Statista, 2019. *Statista*. [online] Available at: <www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide> [Accessed 26 Jun. 2019].

Suni, A., 2016. *It-konsulten Tieto har valt en artificiell intelligens, Alicia T, i ledningsgruppen för enheten för datadrivet beslutsfattande [IT Consultant Company Tieto has Chosen an Artificial Intelligence, Alicia T, to Join the Management Team for the Unit for Data]*. [online] Dagens Industri. Available at: <www.di.se/nyheter/it-bolag-valjer-ai-i-ledningsgrupp> [Accessed 26 Jun. 2019].

Szegedy, C., Zaremba, W., Sutskever, I., Bruna, J., Erhan, D., Goodfellow, I. and Fergus, R., 2013. *Intriguing Properties of Neural Networks*. [online] arXiv.org. Available at: <https://arxiv.org/abs/1312.6199>.

Van Alstyne, M.W., Parker, G.G. and Choudary, S.P., 2016. Pipelines, Platforms, and the New Rules of Strategy. *Harvard Business Review*, 94(4), pp. 54–62.

Vinnova, 2018. *Artificial Intelligence in Swedish Business and Society – Analysis of Development and Potential*. [online] Available at: <www.vinnova.se/contentassets/29cd313d690e4be3a8d861ad05a4ee48/vr_18_09.pdf> [Accessed 26 Jun. 2019].

WEF, 2015. *Deep Shift Technology Tipping Points and Societal Impact – Survey Report*. [online] World Economic Forum. Available at: <http://www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf> [Accessed 26 Jun. 2019].

WEF, 2018. *Digital Transformation Initiative – Maximizing the Return on Digital Investments*. [online] World Economic Forum. Available at: <http://reports.weforum.org/digital-transformation/files/2018/05/201805-DTI-Maximizing-the-Return-on-Digital-Investments.pdf> [Accessed 26 Jun. 2019].

Weill, P., Apel, T., Woerner, S.L. and Banner, J.S., 2019. It pays to have a digitally savvy board. *MIT Sloan Management Review*, 60(3), pp. 41–45.

Zolfagharifard, E., 2014. *Would You Take Orders from a ROBOT? An Artificial Intelligence Becomes the World's First Company Director*. [online] Daily Mail. Available at: <www.dailymail.co.uk/sciencetech/article-2632920/Would-orders-ROBOT-Artificial-intelligence-world-s-company-director-Japan.html> [Accessed 26 Jun. 2019].