Appendix 1: Knowledge assessment tool

This tool can be used by individual directors or as a board exercise. When asking the following questions, consider whether the board:

- Possesses the knowledge needed for independent judgement about AI and AI-related issues.
- Has access to this knowledge from inside the company, from other sources or through free access to experts.

The tool also suggests related modules for additional analysis.

External environment	Area of knowledge	Board knowledge (more than sufficient, sufficient, insufficient)	Access to knowledge by board (more than sufficient, sufficient, insufficient)	Related modules
How AI is changing sustainability in our industry and markets				
Climate Change[1]	**Clean power** • Optimised energy system forecasting. • Smart grids for electrical use. • Optimised decentralised & peer-to-peer renewable energy systems. **Smart cities and homes** • Smart traffic lights & parking systems for urban mobility management. • Optimised sustainable building design. • Energy-efficient building management systems. • Analytics & automation for smart urban planning. **Sustainable land-use** • Early crop yield prediction. • Precision agriculture & nutrition. • Monitoring health & well-being in livestock farming. **Sustainable production and consumption** • Supply chain monitoring and transparency. • Active optimization of industrial machinery & manufacturing. • Digital twins for lifespan performance optimization • Smart recycling programs. • Integrated municipal & industrial waste management. **Smart transport systems** • On-demand shared transport mobility. • AI-enabled electric cars. • Autonomous vehicles for efficient transport. • Optimised traffic flows.			• Operations • Technology • Ethics • Risk
Biodiversity and conservation[1]	**Habitat protection and restoration** • Precision monitoring of ecosystems. • Bird habitat and migration pattern prediction. • Simulation of animal and habitat interaction. • Habitat loss detection and monitoring. • Micro drones for pollination. • Optimised breeding of plants. **Realising natural capital** • Register & trading of biological & biomimetic assets. • Plant species identification. • Machine-automated land-use detection linked to ecosystem payments. **Invasive species and disease control** • Machine-automated biodiversity analysis. • Smart mosquito traps. • Plant disease identification & detection.			• Operations • Technology • Ethics • Risk

External environment	Area of knowledge	Board knowledge (more than sufficient, sufficient, insufficient)	Access to knowledge by board (more than sufficient, sufficient, insufficient)	Related modules
How AI is changing sustainability in our industry and markets				
Biodiversity and conservation[1]	**Pollution Control** • Pollutant dispersal prediction and tracking. • Analysis of urban runoff quality issues. **Sustainable Trade** • Food value chain optimization. • Supply-chain monitoring & origin tracking. • Detection of unauthorised animal capture and trade. • Poacher route prediction and high risk animal tracking.			• Operations • Technology • Ethics • Risk
Healthy oceans[1]	**Fishing sustainably** • Overfishing prevention and control. • Insights for fishermen. • Aquaculture monitoring. • Monitoring & detection of illegal fishing activities. • Optimising patrol schedules. **Impact from climate change (including acidification)** • Real-time monitoring of ocean temperature and pH. • Phytoplankton distribution detection and prediction. • Monitoring of ocean currents. • Monitoring of coral reef ecosystems. **Protecting species** • Monitoring location and quantities of ocean species. • Predicting the spread of invasive species. • Monitoring & prevention of illegal trafficking of marine wildlife. • Drones & AI to analyse whale health. **Protecting habitats** • Monitoring marine habitats for change (e.g. marine dead zones). • Habitat conservation assessments. • Coral reef mapping. • Autonomous vehicle deep sea assessments. **Preventing pollution** • Marine litter prediction. • Robotic fish to fight pollution. • Real-time monitoring of pollution levels.			• Operations • Technology • Ethics • Risk
Water security[1]	**Water supply** • Water supply monitoring and management. • Water quality simulation & data alerts. **Drought planning** • Drought prediction. • Simulations of drought planning. • Drought impact assessments. **Adequate sanitation** • Drones and AI for real-time monitoring of river quality. • Ensuring adequate sanitation of water reserves. • Real-time monitoring and management of household water supply. **Water efficiency** • Residential water use monitoring and management. • Optimisation of industrial water use. • Predictive maintenance of water plants. • Early warning system for water infrastructure. • Smart meters in homes. **Catchment control** • Harmful algal blooms detection and monitoring. • Streamflow forecasting. • Automated flood centered infrastructure.			• Operations • Technology • Ethics • Risk

External environment	Area of knowledge	Board knowledge (more than sufficient, sufficient, insufficient)	Access to knowledge by board (more than sufficient, sufficient, insufficient)	Related modules
How AI is changing sustainability in our industry and markets				
Clean air[1]	**Monitoring and prevention** • Real-time air pollution monitoring and simulations **Filtering and capture** • Optimised sensor-based air purifying systems • Carbon capture, sequestration and use **Clean fuels** • Advanced battery and fuel-cell design • Advanced battery components • Pollution forecasting for transport management **Early warning** • Air quality alerts • 2-10 day pollution level forecasting			• Operations • Technology • Ethics • Risk
Weather and disaster resilience[1]	**Prediction and forecasting** • Extreme weather event modelling and prediction • Weather-forecast-informed flight paths • Climate informatics for enhanced climate modelling **Resilience planning** • Impact & risk mitigation analytics • Emergency risk communication • Real-time disaster risk mapping • Real-time disaster response coordination **Financial instruments** • Rapid, multi-source risk analysis • Analytics for financial parametric risk instruments • Analytics for claims analysis **Resilient infrastructure** • Automated mitigation of flood risk • Building-specific earthquake damage prediction • Disaster-ready urban infrastructure and buildings **Early warning systems** • Natural catastrophe early warning • Real-time enabled communication of natural disasters • Social media enabled disaster response			• Operations • Technology • Ethics • Risk
Global commitments to the 17 Sustainable Development Goals (SDGs)	**Opportunities for AI to accelerate the achievement of the SDGS:** • In value chain productivity evaluation and enhancement • To accelerate research and development • To solve previously unsolvable business problems • Create entirely new business capabilities			• Ethics • Risk • Governance • Operations
Emergence of Environment, Social, Governance (ESG) standards	• A framework focusing investors and financial analysts on Environmental, Social and Governance factors. • Investors may avoid companies that pose a financial risk due to their environmental or other practices. • Brokerage firms and mutual funds are offering ETFs and other financial products that support ESG standards.			• Ethics • Risk • Governance • Operations • Customer
Internet of things	Mass data gathering in a sensor-driven world.			• Ethics • Governance • Responsibility • Technology

External environment	Area of knowledge	Board knowledge (more than sufficient, sufficient, insufficient)	Access to knowledge by board (more than sufficient, sufficient, insufficient)	Related modules
How AI is changing sustainability in our industry and markets				
Reporting impact and performance + metrics	**Sustainability and impact reporting initiatives:** • GRI • Carbon Disclosure Project (CDP) • IRIS+ • Impact Management Project (IMP) • SDG Compass			• Ethics • Audit
Ethical, legal and other AI responsibilities	The rapid expansion of AI is already outpacing the development and deployment of legal and regulatory frameworks and the mechanisms that are designed to govern it.			• Ethics • Risk
Digitization of Education	Massive Open Online Courses (MOOCs) • edX • KhanAcademy AI can be used to transform the structure of formal and information education, placing AI in the role of the teacher on the internet. As machines carry out an ever-growing number of routine tasks, learning that stimulates conceptual and creative capacities appears increasingly relevant. This could imply an education system shifting from a focus on mathematics and reading to a different set of personal and intellectual skills that facilitate working in tandem with intelligent machines (Brinjolfsson & McAfee, 2014). "The global education system is still based on the assumption that people are indispensable ... It is essential to be able to adapt to changes in society and the environment, and that we must develop an education that supports that" (Teramachi, 2018, para. 7) Young children interact with AI through educational software like Leapfrog, use of smartphones, and reactive virtual assistants: Siri, Alexa, Ok Google, etc. Students are not utilizing libraries to find information when they have that capability at their fingertips. Management education must keep pace with the emerging AI revolution.			• Ethics • Audit • Cybersecurity
Other questions	Variance in national AI policies. There are significant disparities among countries in their readiness for the AI revolution, and hence their capacity to capture the potential benefits. Rate of tech obsolescence. Leapfrog strategies. Developing countries need systematic assistance and sustained development aid to strengthen their education systems, business enterprises and governance to be able to leapfrog into the green technologies and new energy future promised by AI. Greening of IT Vs. Greening through IT. Jevons paradox. Environmental costs of AI? Life cycle assessments. Sustainability-oriented innovation (SOI). Sustainability Indexes (e.g. Dow Jones Sustainability Index (DJSI)). Furthering the understanding of climate change, and modelling of its possible impact.			

External environment	Area of knowledge	Board knowledge (more than sufficient, sufficient, insufficient)	Access to knowledge by board (more than sufficient, sufficient, insufficient)	Related modules
Competitors', customers' and partners' use of AI in Sustainability				
Competitors	**How traditional competitors compare on:** • Use of AI to improve on their GHG emissions and transform processes . • Instituting new low-carbon operating models using AI-enabled productivity enhancing processes. • Investments in AI ecosystem development. • Innovation programmes and incentives for sustainability-orientated innovation. • Vendors and partners engaged, and results obtained. • AI talent. • Intellectual property (patents, unique data etc.) • Results of benchmark comparisons against competitors.			• Competitive • Customer • People and culture • Risk • Technology
Partners	Whether partners follow responsible AI practices. Our partners' readiness to share data and use shared AI learnings for the collective. Open-source software and data community: • Open source algorithms and machine learning standards • Accelerating the democratization of AI AI implementation as a third-party service. Adopting data science and artificial intelligence by expressing business needs into technical solutions. AI-enabled sharing and circular economies. Emergence of satellite imagery and data analytics as a service. Global Reporting Initiative (GRI) helps companies find the value in sustainability reporting.			• Competitive • Risk

Internal response	Area of knowledge	Board knowledge (more than sufficient, sufficient, insufficient)	Access to knowledge by board (more than sufficient, sufficient, insufficient)	Related modules
Coordination of AI-enabled sustainability initiatives				
Identification of new transformation and improvement opportunities	Sustainability-Orientated Innovation (SOI): *Deliberate changes to products, processes, services, organizations or wider systems to deliver environmental and social as well as economic value.* How management is targeting AI to support sustainability driven business models for a better world. What management is learning from other companies' sustainable development strategies? Does AI have a role? Why or why not? Whether management is focused on growth or just cost reduction. How management uses AI to find new opportunities and balances trade-offs. How management judges initiatives' value, risks, compliance with core mission and values, and the responsibilities and legal requirements to be met. The prize of aligning business strategies with AI and sustainable development. How much will be doing nothing cost? Risks and responsibilities of committing to SDGs. Whether establishing a task force or committee will help the board review the company's AI activities. Benefits of providing an educational programme on AI to board members (either internally or externally).			• Governance • Ethics • Risk • Technology • Brand and strategy • Competitive • People and culture • Operations

Internal response	Area of knowledge	Board knowledge (more than sufficient, sufficient, insufficient)	Access to knowledge by board (more than sufficient, sufficient, insufficient)	Related modules
Coordination of AI-enabled sustainability initiatives				
Identification of risk	Guiding AI to mitigate against risk: **Performance risks** • Risk of errors • Risk of bias • Risk of opaqueness or "black box" risk • Risk of explainability • Risk of stability for performance **Security risks** • Cyber-intrusion risks • Privacy risks • Open-source software risk **Control risks** • Risk of AI going "rogue" • Inability to control malevolent AI **Ethical risks** • "Lack of values" risk • Value alignment risk • Goal alignment risk **Economic risks** • Job displacement risks • "Winner-takes-all" concentration of power risk • AI-based developments may not be accessible to small firms, driving the gap with respect to larger ones. • Liability risk • Reputational risk **Societal risks** • Risk of autonomous weapons proliferation • Risk of "intelligence divide			• Risk • Ethics • Cybersecurity • Technology
Investment in AI	Expenditures in AI to support the company's strategy. Expenditures in AI for process retrofit and improvements. Developing needed skills and retaining vital talent. Striking a balance between short- and long-term investment horizons with the rate of AI's advancement.			• Competitive • Risk • Governance • Technology
Identification of implementation requirements	Responsibly operating and developing AI; recruiting and retaining AI talent; obtaining, managing and protecting data. Companies with AI process improvement capabilities that are potential acquisition targets. Action taken to ensure data quality, and that it is collected, used and stored responsibly. Integrating deep life-cycle analyses into our design phases. Renewable energy sources and providers.			• Competitive • Brand • People and culture • Technology • Cybersecurity

References

1. Pwc, "Harnessing AI for the Earth", 2018