Supplementary material 1 – Illustrative data excerpts

Supplementary Table 1. Illustrative excerpts of the Environmental sustainability principle

Author	Excerpt
Avanade	…claims of environmental responsibility might translate into low-energy and low-waste technologies. …implications for people, society and the environment (such as energy, materials, pollution, waste, etc.).
AI Ethics Impact Group	Environmental sustainability is a form of intergenerational justice and describes the obligation towards future generations to ensure and preserve their living conditions. This obligation is typically geared towards a careful use of natural resources, e.g., to combat pollution and to preserve biodiversity as well as mitigate the worst effects of climate change. Within the field of AI, this includes setting up resource-saving infrastructures for information technology, primarily through building power-efficient data centres as well as developing less power consuming machine learning models. So far, the more computational resources AI models have at their disposal and the more training data they process, the more powerful and accurate the systems are. Increase in computation, however, means an increase in energy consumption, which brings with it increased carbon footprints. In this field, certification processes are especially useful for end-users to evaluate the carbon footprint of a given AI application. An important criterion to arrive at environment-friendly AI applications is the transparency regarding power consumption and the provision of sustainability data in general.
Deloitte	The solution should take actions to reduce negative environmental impact.
European Commission (Ethics guidelines)	Sustainable and environmentally friendly AI: AI systems promise to help tackling some of the most pressing societal concerns, yet it must be ensured that this occurs in the most environmentally friendly way possible. The system's development, deployment and use process, as well as its entire supply chain, should be assessed in this regard, e.g. via a critical examination of the resource usage and energy consumption during training, opting for less harmful choices. Measures securing the environmental friendliness of AI systems' entire supply chain should be encouraged. …Did you establish mechanisms to measure the environmental impact of the AI system's development, deployment and use (for example the type of energy used by the data centres)? Did you ensure measures to reduce the environmental impact of your AI system's life cycle?
European Commission (Assessment List)	Sustainability and ecological responsibility of AI systems should be encouraged, and research should be fostered into AI solutions addressing areas of global concern, for instance the Sustainable Development Goals. … This subsection helps to self-assess the (potential) positive and negative impacts of the AI system on the environment. AI systems, even if they promise to help tackle some of the most pressing societal concerns, e.g. climate change, must work in the most environmentally friendly way possible. The AI system's development, deployment and use process, as well as its entire supply chain, should be assessed in this regard (e.g. via a critical examination of the resource usage and energy consumption during training, opting for less net negative choices). Measures to secure the

	environmental friendliness of an AI system's entire supply chain should be encouraged. • Are there potential negative impacts of the AI system on the environment? -Which potential impact(s) do you identify? • Where possible, did you establish mechanisms to evaluate the environmental impact of the AI system's development, deployment and/or use (for example, the amount of energy used and carbon emissions)? -Did you define measures to reduce the environmental impact of the AI system throughout its lifecycle?
ECP	Sustainability: AI must not have a harmful effect on the environment
Institute and Faculty of Actuaries	Considering the impact on the environment and its resources. … Evaluating the energy-cost of storing and processing large volumes of data, and considering different options such as cloud computing, aggregating data and regularly reviewing the need for data.
Leslie	Think big-picture about the wider impacts of the AI technologies you are conceiving and developing. Think about the ramifications of their effects and externalities for others around the globe, for future generations, and for the biosphere as a whole.
Machine Intelligence Garage	• Has the environmental impact of development/deployment of the technology been considered? • Is environmental impact considered when choosing suppliers? Have less energy-intensive options been considered?
UK Government Digital Service	What are the environmental implications of the project? How could they be mitigated?
Syntec numérique	Does the evaluation of the IT system's environmental impacts cover primary energy, greenhouse gas emissions, water, the depletion of abiotic resources, paper and WEEE (waste electrical and electronic equipment)? Conduct a regular assessment of the environmental footprint of the IT system (at least every two years), based on recognised and auditable indicators (Green IT or WWF France)

Supplementary Table 2. Illustrative excerpts of the Organisational responsibility principle

Author	Excerpt
Accenture Labs – Building digital trust	New vectors of risk are scattered throughout the data supply chain. How businesses, governments, and NGOs address this risk, within and beyond the four walls of the enterprise, is critical to their ability to operate. As ethical data concerns continue to proliferate, organizations need to find a new way forward, and should embrace the opportunity: this new ethical frontier offers a way to engender trust and provide vital differentiation in a crowded marketplace. Governance practices should be robust, known to all team members and regularly reviewed. Data ethics poses organizational challenges that cannot be resolved by compliance regimes alone. Because the regulatory, social, and engineering terrains are in flux, organizations engaged in data analytics need collaborative, routine and transparent practices for ethical governance. Organizations should begin taking steps now to reduce their exposure to digital risk by integrating a wide array of data ethics practices throughout their data supply chains. In doing so, they'll gain the trust of stakeholders, reap business benefits, and position themselves for prolonged success in the digital economy.

Accenture Labs – Facilitating ethical decisions	But data analytics in general, and data sharing in particular, pose unique and largely unfamiliar ethical and governance challenges. While there are good ethical reasons to share in the long-run, the consequences of sharing in any given case are unpredictable and possibly harmful. Navigating such challenges requires the development of flexible, collaborative governance structures that enable organizations to make consistent, actionable decisions about uncertain outcomes. Those that succeed in this objective stand to gain significant advantages – both in business benefits and in securing and sustaining building public trust. *Risk management approach to data sharing and privacy considerations.* Executives have long used risk management to make strategic and operational decisions that positively impact the long- and short-term success of their organization. Risk management has become part of compliance law and is recognized as a standard practice; it is also increasingly applied to questions of data privacy, protection, and sharing. Organizations are thus well-advised to incorporate data sharing into their existing risk management frameworks. *Develop ethical review procedures between partners*. Partners should determine in advance how ethics concerns can be escalated and resolved both within their own organizations and between their organizations. Everyone handling and interpreting the data should be aware of these procedures.
AMCR	Once again deriving from the special nature of AMRC [Association of Medical Research Charities] members as charities working with partners, the ethical principle of sustainability requires that creators of digital health projects consider potential harms to users and beneficiaries if projects are created and then collapse due to a lack of financial or operational sustainability. Creating a project without a plan for how it can scale and survive can be seen as ethically irresponsible. When working with corporate partners, this principle therefore leads to questions about their business model. In the UK specifically, a hypothesis for how the project can be funded in the context of the NHS and social care systems is also seen as important. Possible questions: • How does your business model ensure that this project will be financially sustainable?; • Does your model involve providing free or below-cost services in exchange for user data?; • What restrictions are in place around how data will be used, including any future linking or sale of the data?; • How are you ensuring interoperability with UK-wide NHS systems – both now and in the future?; • If you go bankrupt or are acquired, what happens to collected data; to an AI model; to the app or technology platform?; • How are you funding ongoing storage, security and cleansing of data and any training of AI models?; • What is your distribution model should this solution scale?; • Have you considered what would happen if this solution becomes pervasive in the future (e.g. for health system costs, training of a larger user base and support network, public health management)?
Avanade	So far, companies' efforts to practice good digital behavior have aligned almost entirely to rules and regulations. But with regulatory oversight so far behind, it's much too easy for companies to follow the law and still act unethically, intentionally or unintentionally. More mature organizations might even go a step further with efforts to reduce operational, brand and strategic risks, not just legal ones. But these are merely strategies for protecting shareholder value; they don't foster a culture of good behavior. If we want to build value for shareholders and other stakeholders, we have to follow ethical principles; because more than ever, people want to work for, invest in, buy from and live near companies that behave ethically. Rules and regulations initially motivate most companies to practice good digital behaviour. More mature organizations are motivated to reduce the risk that poor ethical behavior might be costly. But ultimately, leaders realize that good digital ethics practices can create value as well. … Explain how these values should manifest in the culture. To accomplish the objectives you've defined, you need participation from across the organization. Tell designers, developers, implementers and operators the behavior you

	expect from them, and give them the necessary tools and training to make it happen. Review goals during Scrum sessions, track performance after implementation, and provide a channel for every stakeholder involved – including users and customers – to raise questions and concerns along the way. …Your organization should already have a written set of values; your job is to translate these into digital ethics guiding principles. Specifically, a company that values transparency will likely prioritize explainable AI; a corporate value of inclusion would suggest investments in digital accessibility; and claims of environmental responsibility might translate into low-energy and low-waste technologies.
Deloitte	Whereas previous principles focus on the technical aspects of the product, the company and the product are also assessed for ethical and environmental aspects like fairness, sustainability, accountability and transparency. This includes aspects like gender or racial bias, environmental effects and transparency on the design, development and maintenance process.
IBM	• Make company policies clear and accessible to design and development teams from day one so that no one is confused about issues of responsibility or accountability. As an AI designer or developer, it is your responsibility to know. • Understand where the responsibility of the company/software ends. You may not have control over how data or a tool will be used by a user, client, or other external source.
Institute and Faculty of Actuaries	*Educating the workforce to recognise the risks for harm and/or unfairness* • Communicating to others what data science can and cannot do; • Helping non-technical individuals understand the ethical, professional and technical issues relevant to a project; • Leaders ensuring that their organisation as a whole understands the ethical principles and policies surrounding data science *Engaging with appropriate ethical bodies* • Leaders in this area may wish to communicate with ethical bodies and the public about how data is used and handled in relation to data science work *Ensuring the business's ethics policies, procedures and governance are applied to data science work* • Providing executive staff with enough information on the advantages and limitations of the work to make decisions about the use of models; • Understanding and communicating to stakeholders and decision-makers the ethical risks of the project, such as bias, uncertainty, quality issues, individual/commercial harm, methodology assumptions, disadvantages of chosen methods; • Leaders setting clear lines of responsibility; • Educating the workforce appropriately about relevant policies and procedures *Following best practice for data analysis* • Using appropriate statistical and algorithmic methods for the question being addressed; • Leaders taking the level of uncertainty in work into account when using data science in any decision making
Institute of Business Ethics	Accountability is central to the definition of good practice in corporate governance. It implies that there should always be a line of responsibility for business actions to establish who has to answer for the consequences. AI systems introduce an additional strand of complexity: who is responsible for the outcome of the decision-making process of an artificial agent? This is compounded by AI development being largely outsourced by companies rather than developed in-house. Companies need to ensure that the AI systems they use produce correct, precise and reliable results. To do so algorithms need to be free from biases and systematic errors deriving, for example, from an unfair sampling of a population, or from an estimation process that does not give accurate results.

Machine Intelligence Garage	Consider the business model Integrity and fair dealing should be an integral part of organisational culture. Companies should consider what structures and processes are being employed to drive revenue or other material value to the organisation as certain business models or pricing strategies can result in discrimination. Where possible and appropriate, companies should consider whether part of the product, service or data can be made available to the public. • What kind of corporate structure best meets the company's needs? As well as the traditional company limited by shares, there are a variety of 'social enterprise' alternatives, including community interest company, co-operative, B-Corp and company limited by guarantee. Are any of these of interest?; • Data exchange: are free services in exchange for user data provided? Are there any ethical implications for this? Do users have a clear idea of how the data will be used, including any future inking/sale of the data?; • What happens if the company is acquired? For example, what happens to its data and software?; • Pricing: have differential prices been considered? Are there any ethical considerations regarding the pricing strategy? Are there any vulnerable groups to which lower prices may be offered?; • Data philanthropy: is there data that others could (e.g. charities, researchers) use for public purpose benefits?; • Is integrity and fair dealing embedded in the organisational culture?; • Has the environmental impact of development/deployment of the technology been considered?; • Is environmental impact considered when choosing suppliers? Have less energy-intensive options been considered?
New South Wales Gvt	*Organisation principles*: • Management of data repositories so there is a single source of truth, and data is easy to find, access, use, and share; • Compliance with published metadata including data dictionary, business rules and guide for use *Data Sponsor*: Data Sponsors are generally high-level executives with control over strategic direction, who undertake duties of ownership on behalf of the organisation.
Open Data Institute	• What is your primary purpose for collecting and using data in this project?; • What are your main use cases?; • What is your business model?; • Are you making things better for society?; • How and for whom?; • Are you replacing another product or service as a result of this project?
SG	*Auditability:* Auditability refers to the readiness of an AI system to undergo an assessment of its algorithms, data and design processes. The evaluation of the AI system by internal or external auditors (and the availability of evaluation reports) can contribute to the trustworthiness of the AI system as it demonstrates the responsibility of design and practices and the justifiability of outcomes. It should, however, be noted that auditability does not necessarily entail making information about business models or intellectual property related to the AI system publicly available. Implementing auditability not only entails the involvement of external parties but requires disclosure of commercially sensitive information to the auditors, who may be external. Organisations can take a risk-based approach towards identifying the subset of AI-powered features in their products or services for which implementing auditability is necessary, or where implementing auditability is necessary for an organisation to align itself with regulatory requirements or industry practice. To facilitate auditability, organisations can consider keeping a comprehensive record of data provenance, procurement, pre-processing, lineage, storage and security. The record could also include qualitative input about data representations, data sufficiency, source integrity, data timelines, data relevance, and unforeseen data issues encountered across the workflow. Organisations may also wish to centralise such information digitally in a process log. This would enable the organisation to make available, in one place, information that may assist in demonstrating to concerned parties and affected decision subjects both the responsibility of design and practices and the justifiability of the outcomes of your system's processing behaviour. Such a log would also enable better organisation of the accessibility and presentation of information yielded, assist

	in the curation and protection of data that should be kept unavailable from public view, and increase the organisation's capacity to cater the presentation of results to different tiers of stakeholders with different interests and levels of expertise.
Syntec numérique	*Are ethics-related issues addressed on a cross-functional basis within the company?* • Put in place an awareness-raising programme for all employees (information and examples of best practice); • Appoint a Chief Digital Ethics Officer tasked with ensuring the overall coherence of the company's "ethics and digital" policy *Is an assessment carried out of the impact of innovations on jobs in the company, especially when automation occurs?* • Forecast, with the help of teams specialising in forward-planning and strategy, the impacts of technological change on the company's jobs and activities.; • Include the impacts of automation and more broadly of digital technology in strategic workforce planning … Has an approach designed to improve the environmental footprint of the IT system been introduced? Identify a manager and draw up an action plan including raising the awareness of all IT department staff and users, building on recognised standards Factor in environmental impact when entering into any contract that has consequences for the environmental footprint of the IT system.
The MITRE Corporation	The organization should identify the department(s) and/or person(s) directly responsible for CGD [consumer-generated data in healthcare]-based analytics, including predictive modeling, machine learning, and other AI within the organization. How will the department(s) or person(s) promote good practices to ALL groups that need them? How will the department(s) or person(s) promote transparency? What mechanisms need to be in place to hold the department(s) or person(s) accountable? The organization should foster a culture of data ethics. What cultural changes are needed to foster a culture of ethics? Consider data ethics and integrity training. Consider regular data ethics roundtables (or grand rounds) to address issues surrounding CGD (or other data use), machine learning implemented within the organization, and/or vulnerabilities of decision-making surrounding application of outputs. With regard to organizations' use of CGD, promoting transparency requires that both internal and external stakeholders have access to information about how and why an organization uses CGD, and resources to help them understand how the use of CGD might affect decisions or outcomes. This may include, but is not limited to, information about the details on which a decision using CGD is based (e.g., who made the decision, what procedures/processes were applied, what data was used, what was the data quality), or information about the outputs/consequences of CGD use (e.g., errors, outcomes, biases). Transparency does not require organizations to share all information with all stakeholders, but rather that they restrict information (only when necessary) by considering the following: (1) cost, risk, and benefits of transparency; (2) governance and oversight responsibilities; and (3) options to help stakeholders understand a process, outcome, or decision, and how it is meaningful to them, even when it is based on proprietary information. … The organization should ensure ethics expertise is available within the organization, to provide support to staff in aligning their technical choices with ethical decisions, for issues surrounding CGD-based analytics, machine learning, and other AI. What ethics expertise is available within the organization? Consider contracting with external experts if expertise is not available within the organization. This may include collaboration with ethics consensus groups, centers, or organizations. Organizations should establish and foster a culture of accountability, such that all decision makers are aware of the expectation that they are answerable for their actions and decisions. This culture of accountability should promote system accountability to cultivate a supportive environment wherein individuals involved in the data-algorithm-model pipeline are motivated to report and discuss errors to address root causes and develop

	effective solutions. However, organizations also must develop accountability policies and standards for all individuals involved in CGD use and its associated algorithms, wherein certain standards for individuals are inviolable, and all individuals who violate those standards are held accountable.
UK Gvt Digital Service	An important aspect of complying with data protection law, is being able to demonstrate what measures you are taking to ensure everything is documented, as seen in Article 5(2) of the GDPR (the accountability principle) and Article 30 on keeping records of processing activities. Your organisation and information assurance teams will be responsible for this at a high level including ensuring policies and training are in place. However, it is essential to show how you are doing this at an individual level, through thorough documentation of things like Data Protection Impact Assessments.
WEF – Companion model to AI governance framework	*Objectives of deploying AI* – To guide organizations on how to include ethical considerations in developing their business case to deploy AI • Has your organization considered conducting an assessment on whether the expected benefits of implementing the identified AI solution in a responsible manner (as described in the Model Framework) outweighs the expected costs?; • Did your organization consider whether the decision to use AI for a specific application/use case is consistent with its core values and/or societal expectations? *Internal governance structures and measures* – To guide organizations to develop appropriate internal governance structures • Does your organization have an existing governance structure that can be leveraged to oversee the organization's use of AI?; • Are the relevant staff dealing with AI systems properly trained to interpret AI model output and decisions as well as to detect and manage bias in data?; • Are the other staff who interact with the AI system aware of and sensitive to the relevant risks when using AI? Do they know who to raise such issues to when they spot them (e.g. subject-matter experts within their organizations)?; • Does your organization have an existing risk management system that can be expanded to include AI-related risks? *Determining the level of human involvement in AI-augmented decision-making* – To help organizations determine the appropriate extent of human oversight in their AI-augmented decision-making process • After deployment, did your organization continually identify, review and mitigate risks of using the identified AI solution? *Operations management* – To help organizations adopt responsible measures in the operations aspect of their AI adoption process • Did your organization implement accountability-based practices in data management and protection (e.g., the PDPA and OECD Privacy Principles)?; • If your organization obtained datasets from a third party, did your organization assess and manage the risks of using such datasets?; • Is your organization able to verify the accuracy of the dataset in terms of how well the values in the dataset match the true characteristics of the entity described by the dataset?; • If any human has filtered, applied labels, or edited the data, did your organization implement measures to ensure the quality of dataset used?; • Did your organization take steps to mitigate unintended biases in the dataset used for the AI model, especially omission bias and stereotype bias?; • Did your organization periodically review and update datasets to ensure its accuracy, quality, currency, relevance and reliability?; • Did your organization perform active monitoring, review and regular model tuning when appropriate (e.g. changes to customer behaviour, commercial objectives, risks and corporate values)? *Stakeholder interaction and communication* – To help organizations implement good communication practices to inspire trust and confidence among their stakeholders when deploying AI

	• Did your organization inform relevant stakeholders that AI is used in your products and/or services?; • Did your organization offer the option to opt out of the identified AI solution by default or only on request?
WEF – Guidelines for AI procurement	Create the conditions for a level and fair playing field among AI solution providers. Why is this important? Government spending can be used to create a fair, competitive market, which leads to better AI systems. In addition, early engagement with AI vendors can result in more relevant responses, increasing the probability of success for the procurement and the subsequent project. Create the conditions for a level and fair playing field among AI solution providers. A. Reach out in various ways to a wide variety of AI solution providers. B. Engage vendors early and frequently throughout the process. C. Ensure interoperability of AI solutions and require open licensing terms to avoid vendor lock-in.