NATIONAL DIGITAL TWIN PROGRAMME

HM Government

NDTP Ethics Strategy

Introduction

As we embark on the ambitious journey of developing and implementing a National Digital Twin, it is imperative to ground the efforts in a robust ethical framework. The advent of digital twins—a dynamic, virtual representation of physical systems across various sectors—holds the promise of transformative benefits for society. However, it also introduces complex ethical considerations that must be addressed to ensure these technologies serve the public good, respect human rights, and promote a fair and inclusive society.

Drawing upon the foundational principles adapted from the Organisation for Economic Co-operation and Development (OECD) Digital Economy papers, Artificial Intelligence papers, and Good Practice Principles for Data Ethics, the ethics strategy is designed to navigate the multifaceted challenges posed by the lifecycle of digital twins. This strategy sets out, at a high level, an approach to inclusivity, human-centred values, transparency, robustness, and accountability, to ensure that the development, deployment, and operation of digital twins can contribute positively to inclusive growth, sustainable development, and the well-being of citizens.

The final part of the strategy sets out the next steps which the National Digital Twin Programme will be taking to develop a more comprehensive strategy to support those engaged in the creation, maintenance and operation of digital twins in ensuring these technologies and processes are developed and used in a way that is ethical.

Ethical principles guiding the strategy

The strategy is based on five key principles:

0.1

Inclusive growth, sustainable development, and well-being:

a broad spectrum of actors and stakeholders should be involved in the creation of digital twins aimed at fostering socioeconomic inclusivity, environmental sustainability, and the overall well-being of society.

0.2

Human-centred values and fairness:

democratic values should be upheld across all stages of the digital twin lifecycle, allowing the technologies to reflect the diversity and dignity of the individuals they serve.

0.3

Transparency and explainability:

recognising the crucial role of stakeholder trust, high standards of transparency and explainability in operations should be maintained. This includes clear communication about how digital twins function and are deployed, as well as providing mechanisms for affected individuals to understand and, if necessary, challenge decisions made by or with the assistance of digital twins.

0.4

Robustness, security, and safety:

comprehensive risk management strategies to address potential threats should be implemented to maintain the safety, security, reliability and traceability of digital twins throughout their lifecycle.

0.5

Accountability:

all actors involved in the digital twin ecosystem must be accountable for the systems' integrity and adherence to ethical principles. This accountability is contingent upon each actor's role and the context of their involvement, guided by the latest advancements and best practices in the field.

In summary, the ethics strategy is guided by an evidence based principled approach to technology development and deployment. By adhering to these ethical foundations, it will be possible to harness the potential of digital twins to enhance the nation's economic, social, and environmental well-being, while navigating the ethical complexities inherent in such a transformative technology.

Defining digital twin actors

A diverse ecosystem of actors will be engaged in the creation, maintenance and operation of a digital twin. These actors are not mutually exclusive and will have interconnected roles and contributions. These actors can be broadly placed into four groups:

- **Actors directly involved in digital twin infrastructure:** this group encompasses the technical backbone of a digital twin, including developers, engineers, and domain experts responsible for the foundational infrastructure.
- **Actors directly involved over digital twin lifecycle:** including organisations and individuals across the planning, design, deployment, and operational phases.
- **Users of digital twins:** the end-users, whether individuals or groups, who interact with and derive value from the digital twin applications for specific purposes.
- **Affected stakeholders:** recognising the broader impact of digital twins, this includes all individuals and organisations, directly or indirectly affected by the deployment and operation of these systems.

Table 1. The actions required by the different digital twin actor groups in the creation, maintenance and operation of a digital twin

	ETHICAL PRINCIPLES				
DIGITAL TWIN ACTORS	**Inclusive growth, sustainable development, and well-being**	**Human-centred values and fairness**	**Transparency and explainability**	**Robustness, security, and safety**	**Accountability**
Actors directly involved in digital twin infrastructure	▪ Steer development, deployment, and use in a way that empowers members of society. ▪ Consolidate research networks and collaborative platforms for data reduction. ▪ Enable, guide, and foster access to, use and re-use of, data and evidence.	▪ Undertake human rights impact assessments. ▪ Implement measures to reduce bias. ▪ Embed human-centred values.	▪ Conduct early sharing, testing and evaluation of prototypes with expected end-users. ▪ Be transparent about the use of systems, while not comprising the security of the digital twin or its physical counterpart.	▪ Maintain records of data characteristics for traceability. ▪ Adopt and uniformly apply relevant standards and guidance. ▪ Perform regular and random data audits to assess data quality, compliance with standards (where relevant), evaluate fitness for purpose and ensure its use is proportionate and legitimate.	▪ Identify individuals who are responsible and accountable for the digital twin infrastructure and maintain records of these.
Actors directly involved over digital twin lifecycle	▪ Reduce the potential environmental impact of digital and data infrastructure by avoiding the proliferation of unnecessary, redundant or overlapping data infrastructure.	▪ Ensure the availability of multi-faceted and diverse teams working on or collaborating around a specific project to help to mitigate biases. ▪ Publish data governance and management policies, practices, and procedures, especially around the use of personal data.	▪ Be specific about requirements in procurement processes to increase efficiency and sustain objectives.	▪ Identify and assess and manage risks through risk management approaches. ▪ Maintain a record of residual risks, near misses and incidents. ▪ Establish compliance measures where appropriate. ▪ Identify and assess adverse impacts in operations, supply chains and business relationships. ▪ Agree on trustworthy data management practices that adhere to shared values, at both operational and strategic levels.	▪ Maintain documentation of the proper functioning of the system throughout it's lifecycle. ▪ Implement tools and processes to document system decisions and to ensure accountability.
Users of digital twins	▪ Monitor and control the quality, suitability, sustainability and impartiality of data inputs by defining and deploying data management rules and practices.	▪ Ensure any decisions that require unique human insight into the specific individual, social and economic context of impacted individuals or groups do not rely solely on automated processes. ▪ Be user-driven and place users' needs and their concerns at the core of project design, implementation and monitoring. ▪ Communicate to relevant stakeholders, or their representatives, in a clear and understandable way about the role of data and its primary purpose.	▪ Establish frameworks or criteria to decide on and guide the assessment of sources and quality of data inputs. ▪ Define a timely and formal process to allow relevant parties to challenge the use or output of a system. ▪ Be transparent, open and clear about data inputs and machine and/or human processes that led to final determinations.	▪ Identify and assess and manage risks through risk management approaches. ▪ Identify clear accountabilities and responsibilities to ensure overall co-ordination of implementation. ▪ Capture evidence and data over the course of implementation to monitor system performance. ▪ Identify users, intended use and reasonably foreseeable misuse (hazard identification). ▪ Adopt impact mitigation planning (IMP). ▪ Track implementation of efforts to address risk.	▪ Develop and implement a code of ethical conduct.

Table Notes: The guideposts identified within table cells are adapted from the following source documents: OECD, "Good Practice Principles for Data Ethics in the Public Sector", (2020); OECD, "The State of Implementation of the OECD AI Principles Four Years On", October (2023); OECD, "Common Guideposts to Promote Interoperability in AI Risk Management", November (2023); OECD, "Recommendation of the Council on Digital Government Strategies", (2014).

Further work

While the strategy offers a solid foundation for ethical considerations in deploying and utilising digital twins, further work is required to improve the comprehensiveness and effectiveness of the ethical guidelines, ensuring they address the complexities and nuances of digital twin technologies adequately. This includes practical guidance for implementing the framework outlined in Table 1 to enhance its usability.

Other areas where the need for further guidance is likely to be required include:

- **Early design and development:** integrating ethical considerations during the early design and development phases of digital twins to ensure these systems can be ethically aligned from the outset.
- **Cross organisational working:** ethical implications of data sharing between different entities in complex ecosystems involving multiple stakeholders.
- **International considerations:** taking into consideration the global nature of digital technologies, more explicit considerations on how to address and respect cultural differences and international norms in the deployment of digital twins.
- **Sustainability:** assessing and mitigating the overall environmental footprint of digital twins throughout their lifecycle through work on a sustainability framework.
- **Risks around assumptions:** ensuring transparency and traceability of assumptions made, and the risks attached, especially with regard to carrying out simulations.
- **Future-proofing and evolution:** future-proofing ethical considerations in the face of rapid technological advancements and the evolving nature of digital twins.

Next steps

The strategy's formulation marks the initial phase for the programme.

The second phase will involve a development of further practical guidance and supporting tools, in particular addressing the areas identified above.

This will be done alongside testing implementation in use cases to assess the framework's efficacy and refining the guidance through iterative feedback. This process ensures that the framework evolves to meet the dynamic needs of stakeholders while maintaining its effectiveness and usability.

References

- OECD, “The State of Implementation of the OECD AI Principles Four Years On”, October (2023).
- OECD, “Common Guideposts to Promote Interoperability in AI Risk Management”, November (2023)
- OECD, “Recommendation of the Council on Open Government”, (2023).
- OECD, “Good Practice Principles for Data Ethics in the Public Sector”, (2020).
- OECD, “Recommendation of the Council on Digital Government Strategies”, (2014).