

Technology, Strategy and Security Team
Department for Business, Energy and
Industrial Strategy
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11 May 2022

Dear Sir,

Consultation reference: Enabling a National Cyber-Physical Infrastructure to Catalyse Innovation

Questions this response addresses:

- 3. Opportunities for cyber-physical systems
- 4. Barriers and risks to developing and adopting cyber-physical systems
- 5a. Value in shared building blocks
- 5b. Role of government, industry, academia etc in developing shared building blocks
- 6a. Skills requirements
- 6b. Skills accessibility
- 11. Connected cyber-physical systems
- 12. Value and risks of data sharing
- 13a. Barriers to interoperability
- 13b. Data access needs
- 13c. Role of government, industry and academia in connection/interoperability

This response describes **The Apollo Protocol** project and how it does or will address these consultation questions in a cross-sector way.

Project Introduction and summary

The Apollo Protocol Project is a collaborative project between the following stakeholders representing the manufacturing, built environment and technology sectors:

- The Institution of Engineering and Technology (IET)
- The Construction Leadership Council (CLC)
- The University of Sheffield Advanced Manufacturing Research Centre (AMRC)
- The Digital Twin Hub (supported by the Connected Places Catapult)
- Cambridge Centre for Digital Built Britain (CDBB)
- techUK
- The Alan Turing Institute, the UK's national institute for data science and artificial intelligence

At present, the manufacturing and built environment sectors are developing their concepts of digital twins separately. When it comes to innovation, different sectors carry out similar processes in different ways. New products and services generally focus on sectoral specific issues, resulting in path dependent behaviours, including increasingly unfit codes of practice with recurring issues and an inability to successfully scale. Without change, the sectors will remain prone to these behaviours, will fail to meet interconnectivity and operability, and fail to meet today's key challenges of poor performance and climate change.

Our respective sectors face increasing challenges, not least Net Zero and sustainability goals, but by working in silos we risk overlap, risk and inefficiency. Working together with a shared strategic direction we can establish the infrastructure required to meet these challenges.

There are two key outcomes such collaboration can achieve:

- **Understanding true performance:** Clarity of our respective performance will reduce the environmental impact of our products and services.
- **Opening up sustainable growth:** Building a single value chain for data and information management will open up new market opportunities and business models.

The aim of the Apollo Project Protocol is to demonstrate the benefits of connecting the **manufacturing** and the **built environment** sectors, supported by the **technology** sector. We also aim to feed our collective influence into the ongoing development of the cyber-physical systems and National Digital Twin policies, enabling wider governmental initiatives.

The Apollo Protocol

How can the built environment and manufacturing, supported by the technology sector, break the sectoral divide, and unlock the benefits of digital twins? Our goal is The Apollo Protocol, a mechanism of formalising communication between sectors.

The Apollo mission was NASA's moon-shot and a follow on from their own Gemini Programme. Alongside the ambition of the National Digital Twin and the Gemini Principles¹, we are establishing a prototype mechanism for developing cross sector digital twins built from the Gemini Principles, the IET's Digital Twins for the Built Environment², Vision for the Built Environment³, HVMC's Untangling the Requirements of a Digital Twin⁴ and techUK's Unlocking Value Across the UK's Digital Twin Ecosystem⁵. Our goal is The Apollo Protocol, a mechanism of formalising communication between sectors.

The Apollo Protocol will be available for use by any cross-sector initiative.

¹ The Gemini Principles, Cambridge Centre for Digital Built Britain, 2018
<https://www.cdbb.cam.ac.uk/news/2018GeminiPrinciples>

² Digital Twins for the Built Environment, The Institution of Engineering and Technology, 2019
<https://www.theiet.org/impact-society/sectors/built-environment/built-environment-news/2019-news/digital-twins-for-the-built-environment/>

³ Our Vision for the Built Environment, Construction Innovation Hub, 2021
<https://constructioninnovationhub.org.uk/news/vision-for-the-built-environment/>

⁴ Untangling the Requirements of a Digital Twin, HVMC/AMRC, 2021
<https://www.amrc.co.uk/pages/digital-twin-report>

⁵ Unlocking Value Across the UK's Digital Twin Ecosystem, techUK, 2021
<https://www.techuk.org/resource/techuk-launches-landmark-report-on-the-future-of-the-uk-s-digital-twin-ecosystem.html>

Context – Comparing Sectors

Each industry is investing in data and information management systems. Recent innovations in digital twins are enabling some understanding of the true performance of products and services. However, maintaining a siloed approach will miss an opportunity to accelerate the change we need to meet our sustainability and performance goals. Cross sectoral challenges require cross-sectoral collaboration.

Manufacturers produce specific products at different scales and are not obliged to make their products digitally interoperable with competitor solutions. Built environment actors generally install assemblies of products. This can lead to a mosaic of different products in a built asset which fail to integrate into a coherent system that enables measurement of performance. Construction professionals are limited by the lack of product integration and the ability to acquire and share data to enable a 'system of systems' view of asset performance.

Manufacturers iterate development, focusing on the specific product performance of the provided system. It is not currently in their remit to consider the performance of their product once integrated into a broader system of systems (for example, a pump in a heating system). This missing factor in the design process for manufactured products is demonstrated by the performance gap of buildings, the gap between the intended performance in design and actual performance in operations.

This disconnect is exacerbated by the language barrier between the two sectors creating a fragmented set of perceived value chains between the two and preventing a line of view from the product development in manufacturing through to its performance 'in the wild' of the built environment sector. Addressing the language of digital twins can help to standardise the digitalisation of manufactured digital assets, allowing for cross market interoperability, and reducing the performance gap when these assets are added to the built environment.

The technology sector supports both the manufacturing and built environment sectors providing technology for enterprise solutions and connected systems such as the Internet of Things (IoT) and Supervisory Control and Data Acquisition (SCADA). By making the technology sector the foundation for our engagement, we can produce common ground for integrating platforms. There are also opportunities for smaller technology suppliers that have developed solutions in a specific sector and may have value in being applied in the adjacent sector, for example a Product Lifecycle Management system in manufacturing could be applied as a Common Data Environment for BIM Management Systems.

The Apollo Themes

Digitally, each stakeholder is a leader in their respective area. The key to progress is to bridge the language gap, allowing sectors to communicate. To establish the Protocol, we propose these focal points for achieving cross sector digital twins will be investigated by working groups::

- **A single value chain** for information and data services and requirements, enabling a new paradigm for policy makers responsible across the lifecycle of product life cycles.
- **Circular supply chains** through the alignment of standards and processes, turning the built environment sector's waste and latent material into a resource for the manufacturing sector through effective, integrated digitisation.

Optimised performance throughout the product lifecycle, enabled through robust and interoperable data with technology enabled information sharing.

Managed human capital between the sectors to ensure resources are optimally utilised and have the right learning and reskilling environments for achieving the above themes.

The Apollo Forum

The Apollo Forum will be at the the template for establishing collaborative working groups focused on cross sectoral digital twin interfaces. Their mission is to create and define the Apollo Protocol to bridge sectors, untangling and aligning cultural, process and technological differences resolving the challenges of the Apollo Themes. Stakeholder organisations will act as sponsors of the Forum and publishers of its content, including the Apollo Protocol. The Forum’s principles will include open, collaborative management, vendor-neutral governance and open-source publishing.

Conclusion

This submission is a high-level summary of the Apollo Protocol, a detailed version of which will be published in a few months’ time. We will make a re-publication copy available to you as soon as we have signed off final draft.

The IET would welcome the opportunity to discuss any aspect of this work. If you would like to know more please contact rhartwig@theiet.org

About the Institution of Engineering and Technology (IET)

The IET is one of the world’s largest engineering institutions with over 158,000 members in 150 countries. Our aim is to inspire, inform and influence the global engineering community to engineer a better world. We are a diverse home across engineering and technology and share knowledge to engineer solutions to global challenges like climate change. With our roots in electrical engineering, we have been championing engineering solutions and the people who deliver them for 150 years.

The IET provides independent, impartial, and expert advice, spanning multiple sectors including Energy, the Built Environment, Transport, Manufacturing and Digital. On behalf of the profession, the IET strives to inform and influence government on a wide range of engineering and technological issues. The organisation’s membership spans a broad range of professional knowledge, and regularly offers unbiased, independent, evidence-based advice to policymakers via several channels. We believe that professional guidance, especially in highly technological areas, is critical to good policymaking

Yours Faithfully



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