SOCIETAL DRIVERS
(Net Zero & Sustainability, Low Carbon Places & Systems, Renewable Energy, Clean Growth, Green Infrastructure, Digitalisation)

PRODUCT
(Output)

DESIGN
(product definition)

VERIFICATION

INTEGRATION

IMPLEMENTATION
(Manufacturing)

A **digital thread** definition
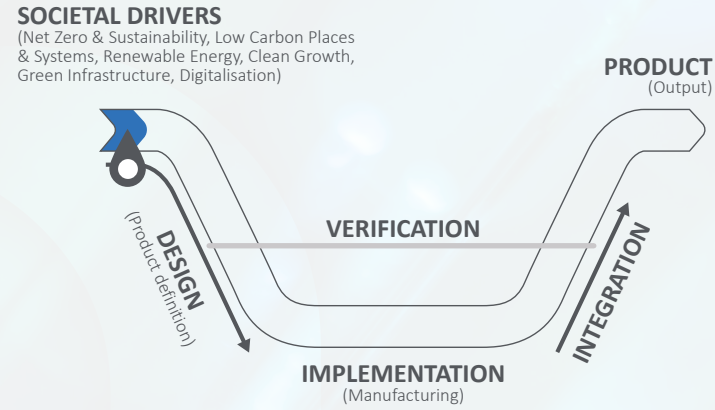
RESULTS AND THE DIGITAL OPPORTUNITY

Definition → Current Practice → Capability and Knowledge → Digital Thread Demonstrator

CFMS have reviewed academic literature to determine a consistent definition of the term "Digital Thread" which was determined to be:

"Data and/or information flow between systems and/or people that is systematic, consistent and auditable delivering the right information at the right time to the right people through the right mechanism."

Through this review, seven types of Digital Thread were identified for engineering organisations:

1. **Internet-of-Things.** The sensing and translation of physical information into the digital. Examples include sensing a manufacturing facility (e.g., humidity and temperature), manufacturing processes (e.g., tolerances, production rates), the product (e.g., inertial measurement units, temperature, GPS), and decommissioning processes.

2. **Twinning.** The data and information flows that enable synchronicity between digital and physical assets and inform the Digital Twin, a virtual representation of a physical process or object.

3. **Operational.** The data and information flows that serve to enhance productivity and efficacy of an organisations' operations.

4. **Exposing Digital Assets.** The data and information flows that provide the ability to interrogate and query across an organisation's digital assets.

5. **Business Intelligence / Data Science.** The data and information flows that enable exploration and interrogation of data to provide insights that can add value to a business through re-shaping and optimising their processes.

6. **Lessons Learned.** The data and information flows that feedback information to improve future engineering processes.

7. **Inter-Organisational.** Exposing data and information for other organisations to query and use within their processes.
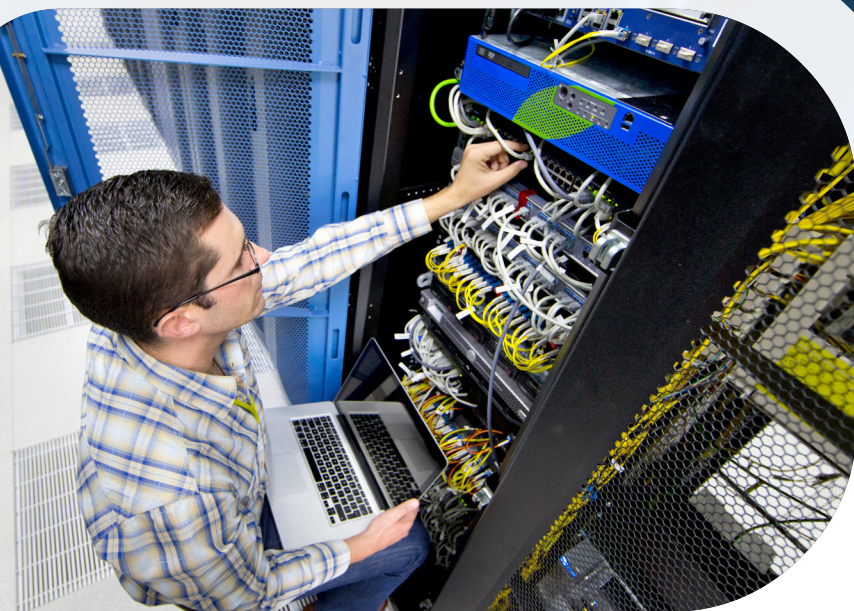
and uptake of digital engineering technology. The Digital Threads will connect data and information flows across digital engineering workflows and tools such that the full potential of digital transformation can be exploited in support of the next generation of products and meet the pressing challenges of net zero and sustainability.

With the definition of Digital Thread determined, the research continues with a review of current Digital Thread implementations in industry, with the goal of identifying the typical tools, skills, and management practices required for the successful application of the Digital Thread.

Results indicate that while the necessary technologies and tools exist, it is the management practices, roles within an organisation, how one architects the Digital Thread for an organisation, and the up-skilling of the engineers that require further support and development. Future focus and development of this research will result in a Digital Thread demonstrator, which will showcase the connection of the threads of data across an organisation, driving efficiency and reduced time to market in developing sustainable products and processes.

CHALLENGE

The past decade has seen an explosion in digital engineering technology and capability with industry quickly exploiting and adopting it into their practice. This is referred to as the "Digital Transformation" of industry, often known as "Industry 4.0". However, the rapid update has led to an heterogenous digital engineering landscape with no one organisation featuring the same

IT infrastructure and architecture as another. The result is digital engineering silos and constrained workflows that do not exploit the full capabilities digital engineering has to offer in terms of design and manufacturing optimisation, traceability of information, decision making, engineering process improvement and business intelligence.

'Digital Thread' is the term given to the activities, tools and practices that will address the challenges brought about by the rapid democratisation

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