Beyond Technology - A Transdisciplinary Approach to Accelerating Value Retention Adoption in High-Integrity Sectors

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Achieving circularity in high-integrity sectors—such as aerospace, wind energy, and power generation—requires more than technological innovation alone. The University of Strathclyde's National Manufacturing Institute Scotland (NMIS), in partnership with the UK Government, is leading two major projects: ReMake Glasgow (£4.5 million) and the ReMake Value Retention Centre (£10.5 million). These projects recognise that maximising the circular opportunity for high-integrity sector products demands a system-wide, transdisciplinary approach and cross-sector learning.

One use case within the projects, focused on energy compressor systems, where technology development was integrated with a supportive business model and a Digital Product Passport (DPP) system to enable a new remanufactured product. This approach has created the conditions necessary to accelerate circularity in this high-value sector, where durability, safety, and performance are paramount. It also provided an opportunity for other sectors to learn from this success.

High-pressure cold spray, laser cladding, and high-velocity oxygen fuel (HVOF) thermal spray were extensively trialled using new material compositions, of WC-CoCr and a Nickel binder matrix. These trials delivered a 9-fold improvement in wear resistance, a 3-to-4-fold increase in low-cycle fatigue life, and a 17% reduction in manufacturing costs. While these innovations enhance product lifecycles, technology alone did not drive the systemic change required for circularity.

To support and scale these advancements, a servitisation business model is now considered. Due to the increased performance of the materials, it has been demonstrated that the current business model can shift from traditional product sales to service-based offerings, where the compressor manufacturer retains ownership of assets and provides maintenance, remanufacturing, and repair services throughout the product's lifecycle. This model can incentivise sustainable practices by aligning revenue streams with product longevity and embedding circularity into business operations, creating cross-sector adoption pathways.

Additionally, a Digital Product Passport (DPP) system was developed to enhance traceability and lifecycle management by consolidating product data—such as repair history, spare parts availability, in-process remanufacturing data, and compliance records—into a centralised digital record. The DPP enables suppliers and customers to make informed decisions about product history. This transparency and data accessibility were crucial for supporting regulatory compliance, quality assurance, and seamless cross-industry collaboration.

Skills, policy and other disciplines were also included to ensure a transdisciplinary approach. This paper highlights how a holistic, system-driven approach is essential to transforming the future of high-integrity manufacturing towards circularity.

Abstract requirements include:

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