Research Support Office

Radioactive Waste Management

RSO Discipline Update: Advanced Manufacturing

Name: Steve Jones - DL and Richard Hardy - SME

Introduction

Steve Jones, PhD CEng, FWeldI: was formerly Rolls-Royce plc's Global Engineering Specialist for joining RD&I between 2005 to 2015, and formerly Professor of Advanced Manufacturing and Joining Sciences between Feb 2015 and Sept 2017 for Coventry University. He is now the CTO for the Nuclear AMRC and Professor of Joining Sciences and Advanced Manufacturing Systems with the University of Sheffield. Alumni of the Open University with over 40 years of welding and fabrication experience, he is a UK delegated expert into the International Institute of Welding (IIW) and UK contributing committee member into ASME BPVC Sections III and Section IX.

Appointed to the role of Discipline Lead for the Advanced Manufacturing theme - April 2020

Richard Hardy, CEng, MIMechE: is a mechanical engineer with 14 years' experience in nuclear engineering. He joined RWM in 2016 with responsibility for GDF mechanical systems and ventilation, as well as being the lead for waste container design. Previously, as an engineer for Nuvia employed on Sellafield and AWE projects, he finalised the design and manufacture of a self-climbing platform linked to the B204 Stack Demolition Project at Sellafield, which resulted in its successful demolition. Richard is the Secretary of the Stores Operations Forum (group for managing the interim storage of radioactive waste) for NDA.

Appointed to the role of Subject Matter Expert (SME) for the Advanced Manufacturing theme - September 2020

Updates

Progress over the last year / ongoing projects already in this area

Listening to those concerns

From last year's annual conference we listened to those constructive comments associated with the challenges faced within the engineering and manufacturing theme.

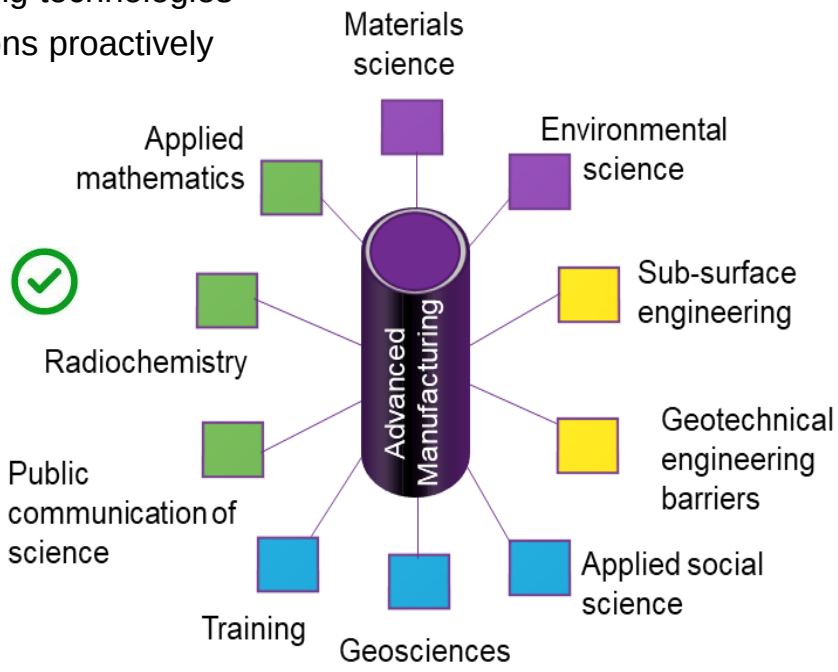
- No engineering disciplines in the current call for academic leads
- The RWM could benefit significantly from adopting emerging technologies
- The RWM could benefit from the design of bespoke solutions proactively

Areas that should be considered:

- Automation ✓
- Control and instrumentation ●
- Geotechnics/rock mechanics and drilling technologies ✓
- Barrier materials and their manufacturing ✓
- Inspection ✓
- Packaging and handling systems ●

Key: ✓ = actioned / programme started

● = being developed



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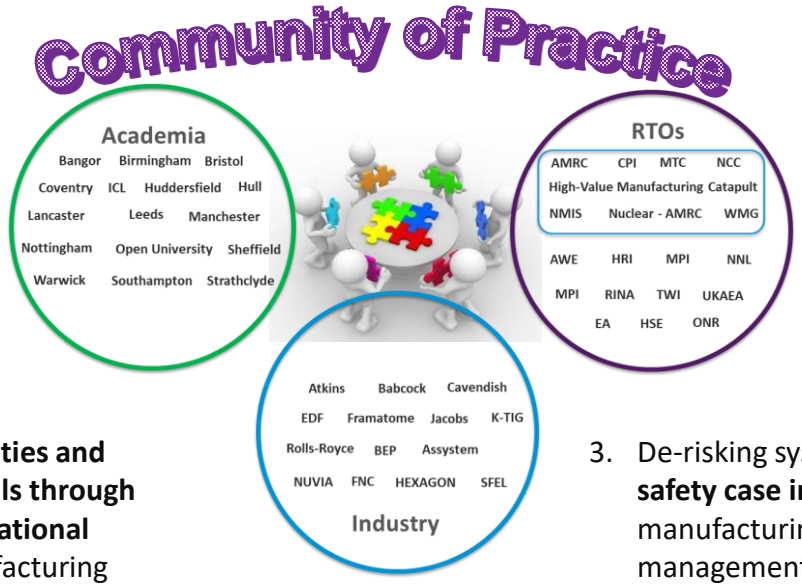
Forward vision

SMART objectives developed with CSFs linked to describing PhD projects

Acceleration of applicable research linked to industrial challenges

1. **Optioneering** high-heat generation waste (HHGW) disposal containers **cost effectively, facilitating a reduced disposal footprint and interim storage periods**.

2. Establishing a **standardised RWM infrastructural asset management system**



4. To **facilitate funding opportunities and development of grant proposals through leveraging national and international support** associated with manufacturing and construction.

3. De-risking systems failure through **improving safety case integration** between design, manufacturing and construction, asset management, decommissioning and long-term safety throughout the GDF lifetime

Upcoming opportunities

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Advanced Manufacturing research themes

Level 1	Level 2	Level 3
Architecture	Intelligent infrastructures Ventilation designs Filtration & systems designs Passive & natural ventilation Gas recapture and recovery Diagnostic systems	CFD and simulation C&I Modularisation C, S & Regulations DTs & mechatronics HEPA filter analytics
Autonomous Technologies	Functional based architecture Autonomous safety systems AI/ML/DT for maintenance Sorting and segregation Autonomous construction UGVs – motion & reconnaissance	Sensor development Surrogate dynamics Advanced navigation Fusion – real and virtual frameworks Manufacturing models
Asset Management & Security	Asset life cycle functions Sustainable management Network and systems design Cyber security systems Predictive maintenance Servicing and replacement	AI-Machine learning BIM systems Digital platforms Domain ontologies Product DNA efficacy Grid data systems
Waste Container Performance	Design optioneering Resilient transfer designs Fabrication technologies S-I performance Condition monitoring systems Safety Case Models	Reconfigurable design analysis Forming – post properties SCC/Irradiation resilience Safety performance Advanced sensors Transfer system technologies Hot zone welding & inspection

Proposed PhD subjects aligned to objectives
Chosen PhD subject: Remote inspection of high integrity welds in high radiation environments
Planned promotion of a Community of Practice (COP)

CTO (DL and SME) proposed advanced manufacturing (PhD) research topics

1. Advanced condition-monitoring techniques applied to reconfigurable waste containers.
2. Application of machine learning as a quantitative predictor / acceptance classifier of high-integrity welds completed in hot-cell environments. (Excellent opportunity to use NNUF)
3. DED-Hybrid AM/SM systems as a performance and monitoring enabler for waste container fabrications.
4. Composite structures using FGMs created by DED-AM for improved condition monitoring of waste containment systems.
5. Robotic electroplating (EP) combined with subtractive manufacturing (SM) systems generating through-life leak detector systems capability.

Aligned to SMART objectives 1 and 3

- Share best practice and updates across RWM-RSO
- RWM-RSO point of reference for advanced manufacturing area and communications
- Generate Adv Man research roadmap
- Scope and seek external project funding – e.g. made smarter, IUK-Industrial transformation etc.
- Connect and collaborate with academia, RTOs and industry
- Central recognition and support for information share, communications and events pertaining to Adv -Man

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Thank you