

EPSRC Centre for Doctoral Training in Sustainable Materials and Manufacturing

Title: Developing optimised remanufacturing using digital twins

Research Supervisor at Cranfield: Dr. John Erkoyuncu

Supporting Company: Siemens Industrial Turbomachinery Ltd

Cranfield University and Siemens Industrial Turbomachinery Ltd are seeking a top class candidate to undertake research leading to the award of an International Engineering Doctorate awarded jointly by the Universities of Warwick, Exeter and Cranfield.

As a 'research engineer' on our International Doctorate programme you will have unrivalled access to some of the best teaching and industrial expertise in the world, across three universities. While you will be based at Cranfield University and Siemens Industrial Turbomachinery Ltd, you will also spend time at Warwick and Exeter Universities to give you the broadest possible experience. You will emerge from the four-year programme more confident and better equipped to make a difference to the industrial sponsor and the global marketplace.

This opportunity also provides a substantial tax free stipend equivalent to many graduate jobs.

Project

The project is designed in collaboration with Siemens. With over 160 years of engineering history, the Siemens gas turbine business in Lincoln is at the forefront of energy sustainability - supplying efficient power and lifetime product service to the global oil and gas industry, power generation and mechanical drive applications. Gas turbine manufacturing is a complex process that requires multiple functions/departments to cooperate in the design, build and delivery of products to customers. A major challenge in this process is to meet customer demands with on time delivery for all the requested quantity. In order to achieve this, organisations need to pay due attention to configuration management and establish integration across functions in the manufacturing processes. Whilst traditionally, the gas turbine manufacturing process has been dependent on manual handling, the growing opportunities in digital technologies is opening up new avenues to explore prospects to improve with on time delivery. In this project, Siemens is focusing on how the remanufacturing processes can be optimised.

Re-manufacturing is a process in which worn-out parts/products are restored to like-new conditions through a series of disassembly, clean, refurbishment and assembly processes with the infusion of new/refurbished parts, as necessary, in a factory environment. Literature focuses especially on repair problems, however it does not sufficiently address the relationship between demand and returns of items, which sets the focus for this project. In a hybrid system, such as the gas turbine context at Siemens, the interaction and coordination between remanufacturing and manufacturing is the main issue, the literature that focuses on repair models are not sufficient.

Accordingly, this EngD aims to increase sustainable manufacturing by implementing digital twin concepts. A Digital Twin is a computational representation of a physical product or process. Through improved connectivity and integration of data it can enable improved decision making capability. The hypothesis for this EngD project is: digital twins can enhance robust estimates for parts requirements in overhaul shops within a remanufacturing context. The digital twin will focus on integrating artificial intelligence, complex systems, remote monitoring, engine BOM / sales, operations forecast, with the procurement process. The research will be challenging and holistic in a variety of topics such as supply chain management, engineering and engine build. The EngD will focus on developing innovative models and algorithms to predict the dynamic behaviours for parts movements in the remanufacturing processes. The project is highly complex and innovative as it

combines big data analysis, and remote data collection to monitor critical components and predict requirements in an optimised manner for sustainable manufacturing.

At Cranfield, the candidate will be based at the Through-life Engineering Services Centre, which hosts cutting-edge simulation and visualisation facilities. The student will have access to high-end computers for simulating the complex nature of part movements.

Business Need and Opportunity

The project is considered to be highly strategic for Siemens. The research will contribute to sustainable manufacturing by addressing a number of key challenges by the combination, integration and analysis of data sources from across the product lifecycle and across remanufacturing phases. The DT can offer new and brave applications in:

- Tailored overhaul delivered specific to a component serial number.
- Better informed decision making capability to future-proof the implications of proactive actions.
- Just in Time (JIT) spares provisioning from the supplier reducing customer requirements to warehouse and administer spares, and reduced maintenance burden on spares with a 'shelf life'.
- Potential to reduce costly range of test equipment, user manuals, spares, calibration requirements, and facilities.

The proposed research is part of a long-term research agenda to develop high value manufacturing products with optimised functional life and whole life cost, circular economy and sustainable manufacturing. The research aligns well with the recently published 'Industrial Strategy', particularly in terms of 'productivity'.

Entry Requirements

Qualifications

Candidates should have a minimum of an upper second (2.1) honours degree (or equivalent) preferably in Mechanical Engineering / Industrial Engineering / Mathematics / Operations Research but candidates in other degrees related to Engineering or related quantitative fields would be considered. Candidates with an MSc degree in these disciplines will be desirable.

Attributes

- High levels of innovative thought and lateral thinking
- Excellent analytical and reporting skills
- Excellent communication skills
- Strong computer skills and the ability to learn new software quickly
- Self-motivated, capable of working with minimal guidance and supervision, and within a team.
- Enthusiasm for the subject

Due to funding regulations this project is open to Home/EU students only.

The Studentship

Qualifying students an attractive enhanced stipend which could be tax and NI free depending on your personal circumstances, paid by the Centre and topped up by a contribution from Siemens Industrial Turbomachinery. Throughout the EngD this will be approximately £20,000 tax free per annum.

The funding is for four years and will also cover University tuition fees and all course fees as well as a travel allowance to attend courses as well as a period of time at a foreign placement not being the sponsor company.

Apply: To apply please complete our [online enquiry form](#).