QUB - Mechanical and Aerospace Engineering PhD Project 2019-2020

Title: Increasing Manufacturing Efficiency by Reducing Downtime through Advanced Data Analytics, Simulation, and Experimentation

Project description:

Manufacturing downtime is defined as any time a process is stopped. While this most often occurs because of tool or machine breakage, downtime can also be caused by planned maintenance, equipment adjustments, or even operator comfort breaks. Downtime is considered one of the biggest and most challenging problems in manufacturing. *OneServe*, working with industry in 2017, calculated that downtime costs British manufacturers in excess of £180bn per year. Reducing downtime makes UK industry significantly more competitive, leading to an increase in economic growth. But the advantages are not only economic. Reduced downtime significantly reduces the environmental impact of the industry, and decreases its energy use, enhancing UK industrial sustainability.

Understanding what disrupts machine uptime is critical to preventing machine downtime and improving lean manufacturing processes. The core innovation of the research will be to leverage advanced data analytics techniques in order to operate on underutilized real-time manufacturing data. Further, this analysis will be coupled with advanced physics-based simulations and high risk/ high value experimentation in an actual mass production environment. The result will be a comprehensive analytic framework that operates on actual real-time data, and will be used to identify trends, predict the likelihood of downtime in real-, near-, and far-time, as well as quantify the resulting impact, including quantification of risk and reliability. Further, the research will be used to minimize production disruption, optimize resource allocation and cash flow, and identify and implement clear strategies to minimize and/or prevent downtime.

This research offers the unique opportunity to access large quantities of actual mass production data produced in a working industrial environment. The successful candidate will work side by side with a full time research professional, and will be fully integrated into the research team. There will be further opportunity to undertake experimental research in a mass production environment. The research will involve international travel as well as industry-related company visits and interactions.

Aims and Objectives:

The aims and objectives of the research are:

- To develop an extensive understanding of failure physics in high pressure die casting
- Comprehensive identification of sources of downtime and their complex interactions
- The creation of verifiable equations and prediction metrics for production components to estimate when maintenance and failure are most likely to occur
- A simulation- and data- powered analytics dashboard to explore ‘what-if’ scenarios and conduct current and future trade studies to minimise downtime
- A comprehensive strategic roadmap for long-term optimization of manufacturing efficiency

Key skills required for the post:

- A minimum degree of a first or a high 2:1 (or equivalent) in one of the following areas is required: Engineering, Science, IT, Mathematics, or a closely related subject area. Candidates with other primary degree areas may be considered if they can demonstrate a high level of suitable relevance and experience to the scope of the project in their primary degree area.

- Knowledge of mathematical modelling and simulation.
- Strong computer skills are essential.
- Data analysis skills or experience would be highly desirable.
- Strong oral and written technical communication skills.

Key transferable skills that will be developed during the PhD:

- Simulation and modelling techniques
- Advanced data analytics techniques
- Effective dissemination of research findings through presentation at international conferences and publication in high quality technical journals.
- Industrial engagement and technology transfer
- Interpersonal skills within a multidisciplinary team including academics and industrialists
- Project and time management training to ensure milestones of the project are delivered

Lead supervisor:	Dr. Danielle Soban +44 (0)2890 974181; d.soban@qub.ac.uk
Other supervisor(s):	Dr. Dave Thornhill +44 (0) 2890 975533; d.thornhill@qub.ac.uk
Guaranteed stipend:	UK/EU applicants: Full stipend award of £15,009 per annum (index linked and payable over 3 years) plus full University registration fees for 3 years. International applicants will be considered at the above stipend, provided they can cover the additional cost of international fees.
Conditional top-up available:	A top-up of up to £10k total over the three year period may be available to exceptional candidates.

PhD students in the School have the opportunity to apply to be demonstrators on undergraduate modules. Compensation for this can amount to in excess of £2,400 per year.

Queens University Belfast is a diverse and international institution which is strongly committed to equality and diversity, and to selection on merit. Currently women are under-represented in research positions in the School and accordingly applications from women are particularly welcome.