

10-year anniversary of the successful collaboration between IHI and Queen's University Belfast

The starting point was a lunchtime meeting between IHI engineers and Prof Stephen Spence of Queen's University Belfast (QUB) during the ASME Turbo Expo 2008 conference in Berlin, Germany. Prof Stephen Spence is one of the world's most prominent researchers in radial turbomachinery aerodynamics, with strong connections in the turbocharger sector. He has served the technical community as a past chair of the ASME Turbomachinery Committee and also as an Associate Editor of the prestigious ASME Journal of Turbomachinery. He continues to be involved in the organising committees of the IMechE Turbocharger Conference and the European Turbomachinery Conference. Given his international reputation in the field of turbomachinery, it is no surprise that the turbocharger performance team in Heidelberg, Germany, easily identified common areas of interest with Prof Spence's research group. That first meeting in Berlin in 2008 was followed by further meetings in Belfast and Heidelberg, which led to the signing of the first research project in March 2009.

That first project addressed leakage flows in VGS turbines and the benefits of splitter blades in turbine rotors. A sustained and fruitful research collaboration developed over the following years covering many topics relating to turbine and compressor performance. The combined capabilities at QUB of computational modelling, prototyping of turbomachinery components and advanced performance test rigs have yielded deeper understanding and insight in the performance of turbocharger compressors and turbines.

The projects have been conducted with the close collaboration of engineers at IHI under the lead of Andre Starke, team leader performance in Heidelberg, to ensure effective knowledge transfer and impact from the research. Five PhD students have successfully defended their theses and graduated with a Doctorate degree, with three of those students taking positions in IHI Charging engineering careers. Besides those, there are students at various stages of their work. The projects directly with the IHI engineering Dr Takahiro Bamba. Each PhD student has either in Heidelberg or Yokohama, which helps the knowledge transfer has worked both ways when a senior IHI engineer gave a guest lecture to Masters engineering students at QUB.



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Systems Intl, Heidelberg, to begin their now other current projects and more PhD collaboration has expanded to include headquarters in Yokohama under the lead of undertaken a period of industrial placement ensure close working with IHI engineers. The

The results of the various research projects have been publicised in 26 technical papers in the leading journals in the field and at technical conferences in Europe, China, Japan and the Americas. All of these publications have been co-authored in conjunction with IHI engineers, earning worldwide recognition and credibility for the technical work and building the company's reputation as a leading innovator in turbocharging. Most importantly, the findings from these research programs have been utilized within IHI's engineering team to improve the company's turbocharger products; products designed to maximize vehicular engine power and efficiency; products that are installed in vehicles from Audi, Mercedes Benz, VW, Porsche and others.

Detailed analysis and insight into flow phenomena contributed to new highly efficient compressor stages for Diesel and Gasoline passenger car applications. Understanding of flow losses helped to optimize fixed and variable geometry turbine stages within IHI's vehicular range of turbochargers. Two of the current PhD projects in progress are steered by Dr Thomas Leonard, who received his PhD from QUB working on an IHI funded project. He is now a member of IHI Charging Systems Intl GmbH performance team in Heidelberg. This is another important way that IHI receives value from this collaboration – "Know how transfer via heads".