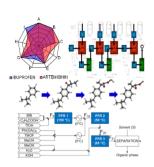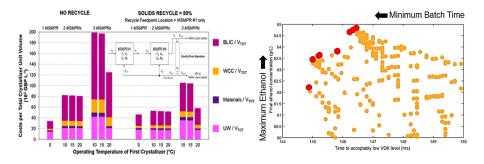# Rigorous Design & Optimisation of Pharma and Drink Manufacturing for Industry 4.0

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Abstract

In an era of ever-increasing pressure on global material and energy resources, Advanced Manufacturing can only remain relevant by sustainably fostering its agility and affordability of products for large populations. The prospect of Digital Manufacturing is a grassroots design target (rather than a retrofit option): in pharma, this is featured by new organic synthesis routes paving the way for Continuous Manufacturing (CM). Comparative economic analyses explicitly illustrate advantages, securing the strong interest of pharma corporations and regulatory (eg. FDA) bodies. Remarkable corporate investments in production-scale CM facilities illustrate the value of this novel paradigm. Similar trends in the Food & Drink sector are due to fierce competition, and/or niche (e.g. microbrewery) high quality.

This seminar lecture will focus on our successful applications of process systems engineering methodologies (process synthesis, parameter estimation, simulation, deterministic optimisation, and design space visualisation) towards evaluating technical efficiency, environmental impact and economic viability of new continuous processes for Active Pharmaceutical Ingredients (APIs) and beverage batch manufacturing, based on lab and/or industrial recipe precedents. Detailed environmental impact comparisons and technoeconomic results will also be presented.

Biosketch

Dr. Dimitrios Gerogiorgis is a Reader (eff. 08/22) and Director of the IChemE-accredited MSc in Adv. Chem. Eng., and Royal Society Industrial Fellow at the School of Engineering of the University of Edinburgh, focusing on process systems modelling, design and optimisation. He holds a Diploma in Chemical Engineering (Aristotle University of Thessaloniki, Greece), an MSc in Electrical and Computer Engineering and a PhD in Chemical Engineering (Carnegie Mellon University, USA). His research portfolio includes the model-based development of the Alcoa ARP carbothermic aluminium reactor (Pittsburgh, PA), the NTUA vertical perlite expansion furnace (Athens, GR), the optimisation of investment planning for efficient polygeneration energy systems (Imperial College London), the systematic methodology for interval arithmetic evaluation of candidate flowsheets, the first comparative economic evaluation of batch vs. continuous pharmaceutical manufacturing strategies (Novartis-MIT Center for Continuous Manufacturing), and significant advances in systematic multi-objective dynamic optimisation of beer fermentation (WestBeer, MolsonCoors). He also held a Royal Academy of Engineering (RAEng) Industry Fellowship, and has authored over 100 peer-reviewed publications in journals and book series. He has been recognized with the Academy of Athens L. Mousoulos Research Excellence Prize (2015), a High Commendation for the IChemE Global Food and Drink Award (2017), the Best Oral Presentation Award of the 3rd CSIRO International CFD Conference (Australia), and an RSE Scottish Crucible membership (2015). He has delivered invited lectures at McGill University (Canada), Univ. Rovira i Virgili (Spain), the Max Planck Institute (Potsdam, Germany) the Universities of Maribor (Slovenia) and Budapest/BUTE (Hungary), and many in the UK. The course on Oil & Gas Systems Engineering he has developed in collaboration with Atkins/SNC Lavalin (now Kent, Aberdeen) has been shortlisted for the IChemE Global Education & Training Award (2015).