Syed Babar Ali
School of Science and Engineering

INNOVATE ENTERPRISE SERIES 3

OPTIMISING INDUSTRIAL CHEMICAL PROCESSES

Dr. Rofice Dickson is striving to provide innovative and sustainable solutions for the design and operation of chemical plants and emerging technologies. His research focuses on developing models, algorithms, and computer-aided tools to solve complex challenges. Using mathematical industry driven techniques, he developed generic models that can be used to find economically feasible and environmentally acceptable solutions for process synthesis, product design, retrofit, supply chain optimisation, resource optimisation, and renewable energy systems.

Specialised Areas

- Process systems engineering
- Process design and optimisation
- Process integration and circular economy
- Techno-economic and lifecycle analysis
- Biomass-to-fuels/chemicals and hydrogen economy

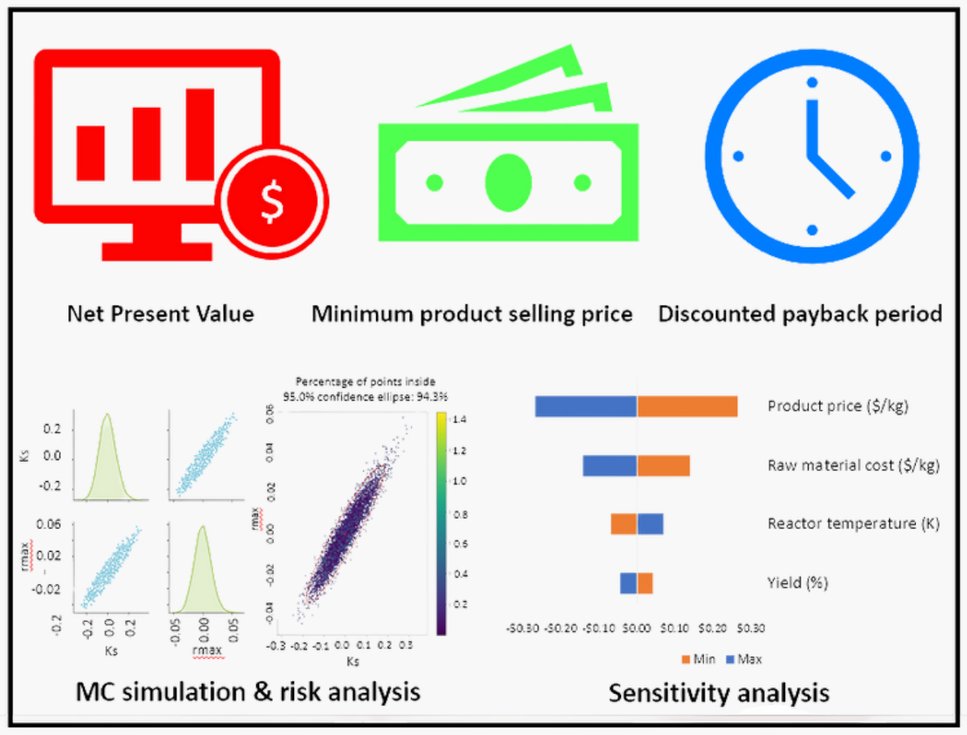
Computational Tools

- Aspen Plus
- GAMS
- MATLAB
- SimaPro

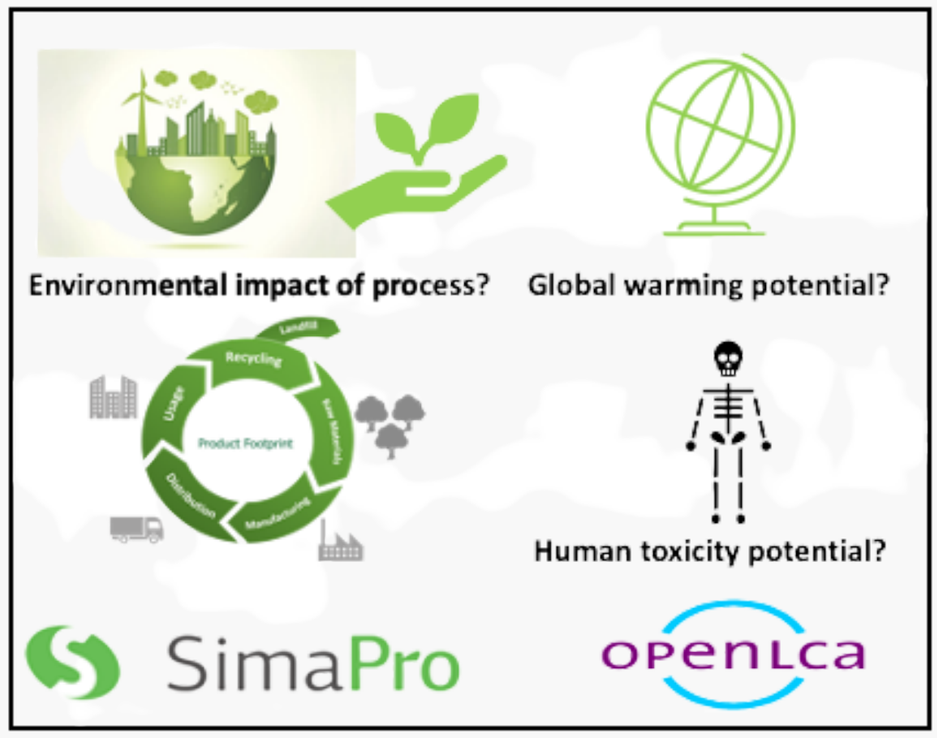
PROCESS SYNTHESIS & OPTIMISATION

A fundamental problem in chemical engineering is process design. The selection of unit operations, their interconnections, and operational conditions to generate an optimal flowsheet is a challenging problem due to a large number of processing alternatives. A conventional approach to addressing the aforementioned challenge is to decompose complex design problem into manageable subsystems to be solved independently. However, the disadvantage is that interactions among the subsystems are not considered, and thus optimal solution may be excluded. Process synthesis through superstructure is an optimisation approach that systematically finds an optimal flowsheet and its operating conditions based on the proposed design space for the optimal configuration and defined objective function such as maximisation of economics or environmental performance. The goal of our research is to develop optimisation models and methods to provide decision-making support for a range of problems related to **(1)** the design and operation of chemical process industries, **(2)** research and development of product design, and **(3)** process scale-up of emerging technologies.

TECHNO-ECONOMIC ANALYSIS



LIFE CYCLE ANALYSIS



TO THIS END, WE CAN ASSIST IN FINDING:

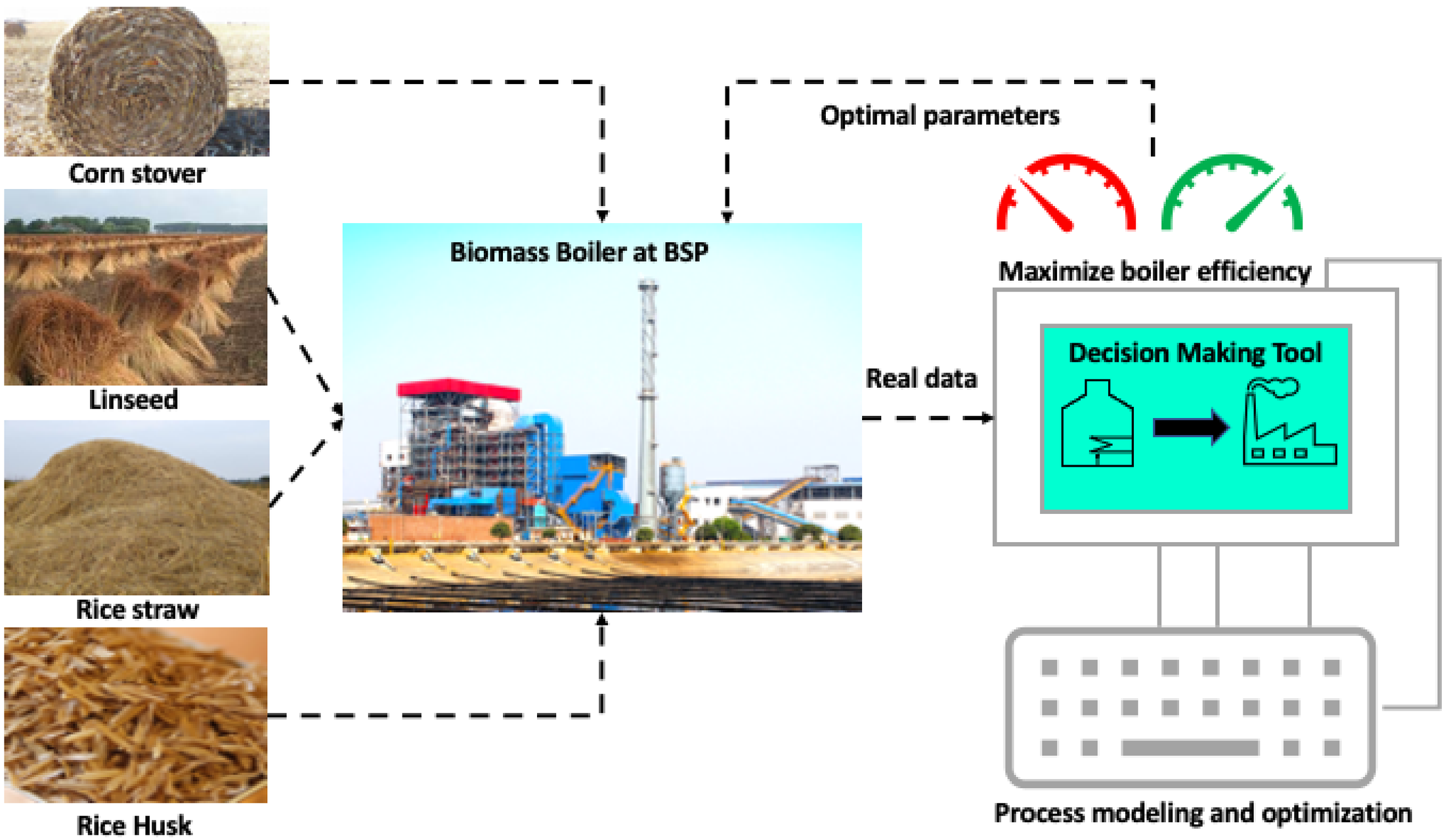
- Optimal flowsheet for a given product or raw material
- Optimisation of operating conditions to minimise utility consumption or maximise resource utilisation, etc.
- Rigorous mass and energy balance for a conceptual or physical process
- Opportunities for maximising process economics
- Environmental impact of a given process
- Bottlenecks in process economics and/or environmental sustainability

EXAMPLE PROJECT

INDUSTRY PARTNER

BULLEH SHAH PACKAGING PVT LIMITED.

The high (40–70 wt%) and constantly varying moisture content in the feedstock is an inherent problem in biomass boiler operation, which not only reduces the boiler steam production capacity, but it also reduces the furnace temperature, making it more difficult to sustain the fire and burn wet material. These problems lead to compromised thermal conversion efficiency, ash slagging and fouling as well as decreased lifetime of combustion equipment. Towards these challenges, Dr. Rofice is performing detailed process simulation and optimisation for industrial scale boiler powered by multiple biomass at Bulleh Shah Packaging Pvt Limited. The main objective of this project is to maximise boiler efficiency by optimising key operating parameters, such as **(1)** air temperature in the combustion chamber, **(2)** feed water temperature, **(3)** air to fuel ratio, **(4**) biomass moisture content, etc. In addition, he is also investigating the impact of biomass shredding and dehydration on boiler efficiency.



ABOUT

Dr. Rofice Dickson currently serves as an Assistant Professor at the Department of Chemistry and Chemical Engineering, Syed Babar Ali School of Science and Engineering at LUMS. He has more than 9 years of R&D experience in academia and industry. He received his B.Sc. and M.Sc. Chemical Engineering degree from the University of Punjab and a Ph.D. in Chemical Engineering from the Pukyong National University, South Korea.

During his graduate studies, he worked with the PROSYS research facility at The Technical University of Denmark, where he developed novel models and tools for superstructure optimisation of bio-chemical synthesis from 1st to 3rd generation biomasses. To date, Dr. Rofice has published 25 peer-reviewed papers on process optimisation, techno-economic analysis, and life cycle assessment in top-tier journals (Energy and Environmental Sciences, Renewable & Sustainable Energy Reviews, Green Chemistry, etc).

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