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TRANSFORMING GLOBAL HEALTH THROUGH COMPUTATIONAL COOKSTOVE DESIGN

Lead partner: Dr Ratna Kishore Velamati, Amrita Vishwa Vidyaapeetham University, India

THE PEOPLE

Dr Ratna Kishore Velamati , Amrita Vishwa Vidyaapeetham University, India

Dr Srikrishnan A R, Associate Professor Amrita Vishwa Vidyapeetham

Dr Srikrishna Sahu Assistant Professor Indian Institute of Technology Madras

Professor Satyanarayanan R. Chakravarthy, Professor Indian Institute of Technology Madras

Professor Omar Kamal Matar Professor Imperial College London

Dr Christopher Tighe Assistant Professor, Imperial College London

Dr Aditya Karnik Post-doc research assistant, Imperial College London

Dr Moushine Serrar, CEO, Prakti

Ian Waters, Lead Research Engineer, Prakati, Imperial College London

THE CHALLENGE

Millions of families in India use traditional cookstoves due to their low cost, burning efficiency and useful lifetime. However, these conventional wood-fired cookstoves create a lot of smoke which causes several health problems such as cancer, stroke and pneumonia, especially for women who are particularly exposed to the air pollution from cooking. Cookstoves also emit pollutants, such as methane and black carbon that contribute to climate change. This makes their use and replacement a global challenge. Supported with funding from the Royal Academy of Engineering, Dr Ratna Kishore Velamati embarked on the 'Transforming global health through computational cookstove design' project.

THE PROJECT

The main objective of the project was to improve the design of conventional wood-fired stoves by developing a computational simulation of a cookstove using cutting-edge computational fluid mechanical software with advanced modelling capabilities. Computational simulation is the process of using mathematical modelling to predict the outcome of a physical system, such as the safety of a new car design. This method would enable the optimisation of cookstove efficiency and reduce emissions without costly prototyping and emissions testing. The goal of the project in the long term was to transform global health though computational cookstove design.

The 18-month project was led by Dr Ratna Kishore Velamati of Amrita Vishwa Vidyaapeetham University, with partners at the National Centre for Combustion R&D (NCCRD) at IT Madras, Imperial College London and Prakti, an Indian social enterprise designing cookstoves.

The main project activities were the development of a new computational fluid dynamics (CFD) model of a cook stove, incorporating heat transfer, combustion kinetics and particulate formation and emission. This enabled the team to predict the burning efficiency and emissions of toxic and carcinogenic components and particulates in the cookstove design. This provided data for designing the stoves for efficient operation and minimum pollutant emission. The project also organised a free hands-on two-week CFD Summer School to teach mechanical, aeronautical and chemical engineering undergraduate students at IT Madras how to solve problems with fluid simulation software and gain hands-on experience.

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IMPACTS

The project has led to the development of a CFD Summer School entitled 'Transforming Computational Cookstove Design' held at Amrita Vishwa Vidyaapeetham which was attended by 26 engineering students. The summer school included lectures on basics of CFD, reaction kinetics and challenges in modelling of cook stove.

As part of the CFD Summer School, the students visited the industry partner, Prakti, where they saw how to build and optimise cookstoves using the simple emissions testing facility. The students also gained knowledge on how to conduct modelling and CFD analysis. During the second week of the workshop, a cookstove design competition was organised for the students. With some help from Dr Kishore and his team the students used the **skills and knowledge gained** during the CFD Summer School to develop nine computational cookstove designs.

"Normally when you work on a problem, it is more theoretical, or for more industrial application, nothing is actually useful for people on ground. This [project] is where we have worked on something actually useful for rural people."

Dr Ratna Kishore Velamati

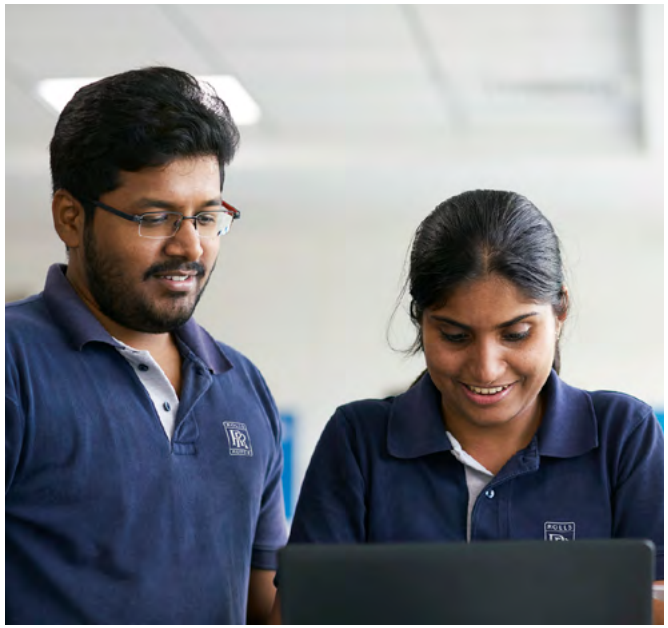
Prakti selected three computational cookstoves designed by students. These three designs were developed into prototypes by Prakti and tested at the Indian Institute of Technology Madras .

"It is amazing that students are very interested in technology, and day to day applications. … It's very encouraging to see that students are coming forward and it has helped me to move forward in that direction"

Dr Ratna Kishore Velamati

The project results were presented at the 27th International Colloquium on the Dynamics of Explosions and Reactive Systems (ICDERS) in 2019.

Dr Velamati highlighted that without the funding from the Royal Academy of Engineering the team would have not worked with the UK partner and the project would have progressed at a slower pace.



THE FUTURE

There is the potential for the innovation to be scaled up and adopted to improve the design of larger cookstoves used in India.

SOURCES

The case study was developed using an interview with Dr Ratna Kishore Velamati, the application form and progress reports from the project.

- Project: IAPP1R2\100209 application
- Industry Academia Partnership Programme six-month report (June 2018)
- Interview with Dr Ratna Kishore Velamati

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Royal Academy of Engineering
Prince Philip House, 3 Carlton House Terrace, London SW1Y 5DG
For more information: https://engineeringx.raeng.org.uk/tsp