How philosophers contribute to research for sustainable technologies

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How can we avoid scientific findings that meet academic standards but do not in practice contribute to solving societal challenges? Including philosophers in your research consortium can be one solution, argue philosophers of science Henk-Jan van den Brink and Mieke Boon of the University of Twente.

Written by: Henk-Jan van den Brink and Mieke Boon

Sustainability is one of the greatest challenges facing our society. One of the key concepts is the 'transition to circularity'. Engineering sciences plays an important role in the research and development of sustainable technological innovations. In practice, however, the balance between scientific merit and the applicability of research results remains challenging.

In the DREAM project, which aims to achieve circularity through chemical process development, this is one of the main research questions. The central case study in this project is biomass-based waste streams from the paper industry, which are typically incinerated for energy. The aim of DREAM is to convert this biomass into valuable chemicals such as flavours and fragrances through membrane separation and catalytic conversion. This is not easy due to the complex and varying composition of these biomass streams. As a result, research to develop such industrial processes is time-consuming and expensive. The innovative aim of DREAM is to develop methods to carry out this research in an efficient and effective way.

Strangers

The research is carried out by chemists and chemical engineers, and we, as philosophers of science, are also part of the consortium. We may appear to be strangers, but our personal research experience in chemical engineering facilitates communication and mutual trust. Our role is not ethical, but to ensure that this research contributes to the development of technological breakthroughs for circularity and material transition. This is important because this research is often guided by scientific logic, i.e. the established norms of academic research. However, in order to effectively contribute to technological breakthroughs, one needs not only to be guided by the scientific perspective, but also by an application logic, i.e. an 'outside-in' perspective. This means asking which approach is appropriate to achieve the practical goals of the project. In philosophy we call this an 'epistemological' question.

One of the things that strikes us is that in this chemical-technological research, decisions are often made automatically. In these cases, the scientific logic is guiding, whereas the application logic might be more appropriate, especially since this kind of research is time-consuming and expensive. It is therefore important that such choices are made wisely in order to strike a balance between scientific quality and practical applicability.

Work packages

An example of a choice is the chemical-physical regime under which the rates of chemical reactions

are measured. The balance between scientific quality and practical applicability is, for example, the choice between 'ideal' conditions, i.e. those that are reproducible, and realistic experimental conditions. The overarching research logic is also important for the integration of the different scientific fields that come together in this consortium. In this case, catalysis, analytical chemistry and chemical engineering with mathematical modelling and process simulation and design. Each of these is part of a work package with its own research logic and objectives. The challenge is to integrate them so that together they contribute to the overall goal.

Our philosophical research is descriptive, as we want to describe the overarching methodology and approach and understand its logic. We do this by conducting interviews with researchers, asking them to explain in detail how they do their research, what their expectations are, and what intellectual and technological challenges they face. On the other hand, our research is also normative, in that we want to understand which overarching methodology can help in making integral research choices. We do this by discussing potential research strategies with project partners, while also looking at whether we can learn from approaches used in other fields that investigate complex problems, such as climate science.

Moral ambition

Typically, philosophers are only involved when scientific research is applied, i.e. when a certain level of technological readiness (TRL3 or 4) has been reached. At this stage they are involved for ethical reflection. In this research, however, we already work intensively with the chemists and chemical engineers in the actual research phase to think together critically and creatively. This collaboration is mutually stimulating and informative. For example, the researchers really appreciate the interviews, which provide an opportunity to discuss their research in detail. This shows that it is enriching to work together across disciplines that are usually separate.

Many scientists and engineers are morally driven and want to contribute to sustainability. However, there is often a gap between these high ideals and concrete research practice. As philosophers, we want to bridge this gap by concretely investigating established methodologies and developing effective alternatives. We look forward to the coming years of research and collaboration in the DREAM project and hope to share our findings and results in the future.

The DREAM-project 'Processing Complex Matrices: Description, Reaction-Separation, Modelling (DREAM, dream.cnrs.fr)' is the project in which Henk-Jan van den Brink is doing his PhD. Mieke Boon is the supervising professor. Both are part of the Philosophy section of the University of Twente, The Netherlands.