

UK Fluids Network (UKFN): Pathways to impact

Summary

Increasing the impact of fluid dynamics research is the central reason for the establishment of the UK Fluids Network. Since this is a network proposal, the pathways to impact and their beneficiaries are described to a great extent in the **Activities** section of the Case for Support. Here, we have expanded on these activities to describe specific pathways to impact for *Knowledge, People, Economy and Society*. In each of these categories the full range of network activities will play a part.

1. Knowledge

A major goal of the network is to bring about research and applications of knowledge in fluid mechanics that would not otherwise occur. The network will facilitate the initiation and growth of new research areas in fluid mechanics, new developments and advances in new and existing experimental and numerical methodologies, and their application to real-world problems. Future emerging areas, particularly those across disciplines, may fail to be captured by current funding models and the UK could therefore miss the opportunity to benefit from them. These areas are impossible to predict with a top-down approach to research. Nurturing them requires instead a bottom-up approach in which researchers propose ideas and are empowered to propagate those ideas within the community, refine them amongst a group of like-minded academic and industrial peers, and then propose carefully-planned research projects to industry and to funding bodies. The network must be agile and responsive. We have not, therefore, pre-defined the areas of research activity that the network will support. However, we have laid out focused objectives and clearly-defined activities, which will apply to all areas of research activity, in order to maximize the impact of the network.

Action. The SIGs and short research visits will play the major roles in the creation of new research areas, with SIGs bringing together researchers around particular research topics and methodologies. Research visits will allow new connections to be made, equipment and expertise to be shared, and allow the implications of new ideas to be explored. SIGs involving industrial researchers will raise new questions and industrial applications of fluid mechanics. SIGs will be tasked with refining these ideas, propagating them within the community, critically reviewing joint proposals, and roadmapping their pathways to impact. This will lead to well-coordinated funding proposals to research councils and industry, leveraging the most relevant academic and industrial partners in the UK.

2. People

The network will provide resources to help train PDRAs and PhD students in all three aspects of fluid dynamics research: theory, computation and experimentation. This training will be enhanced by increased contact with the wider academic community, and by increased interactions with industry. The network will provide opportunities for researchers to develop leadership skills, to keep up to date with the latest developments in the subject and to participate in the early stages of new and innovative developments. A number of universities have stated that they see the network as providing a mechanism for improving their own internal communication and training.

Action. Resources will be collated on the website in order to share best practice and high quality pedagogical material across the whole community. Participation in the SIGs will provide access to industrial research and the wider UK research community beyond an individual's institution. The encouragement of academic researchers at all levels to initiate and organise a SIG will provide opportunities to develop organisational and leadership capabilities. PDRAs and PhD students will be encouraged to play active roles in SIGs and to leverage this to apply for individual fellowships (Marie Curie, EPSRC). The network will provide resources for this, such as exemplar applications.

3. Economy

It is difficult to overstate the importance of fluid mechanics to the economy. It underpins much of the mechanical, aerospace and chemical engineering industries, the oil industry, aspects of the

high-tech industry, such as 3D printing, the food and drink industry and increasingly pharmaceuticals. It is also critical to environmental issues such as watershed and flood management, weather forecasting, the causes and impacts of climate change, and air pollution. The role of fluid mechanics in applications to biology and medicine are major growth areas. The network will keep the UK at the forefront of research in these areas to the benefit of the UK economy.

Action. Most SIGs will contain industrial partners who already collaborate with universities. The SIGs will expand the range of academic researchers that these industrial partners meet (e.g. letter of support from BP Formulated Products). These SIGs will be structured to provide a forum for deep discussion of industrial problems and opportunities, a sharing of new research ideas with industry, and roadmapping for particular research ideas. They will meet every six months.

Other SIGs will be set up around new industrial partners. The network has an initial set of industrial partners selected as a sample from a number of different sectors and sizes. We will expand this number many times over during the lifetime of the network and particularly aim for SMEs who do not have significant in-house research capabilities. We will include a designated section of the website where a company can register an interest, a list of SIGs categorised by industrial sector, and no initial joining fee. An important role for the facilitator will be to initiate contact with companies and invite them to relevant networks events. The list of researchers and facilities on the website will allow industry to find the relevant expertise and the facilitator will ensure that enquiries will be followed through

4. Society

The air we breathe and the water we drink sustain human life and are common to all. Life on the planet relies on the atmosphere, the oceans, rivers, and rainfall, all governed by the laws of fluid dynamics. And as we mention above, fluid flow underpins many critical industries, and human health and well-being. Despite this permeation throughout our whole existence and of life on the planet, fluid dynamics has failed to capture the public imagination in the way say astronomy or cosmology has. Perhaps this is because, by and large, we cannot see the air we breathe and water is a bit mundane. We want to change this perception and make the public aware of the beauty of fluid flow, understand the intellectual challenges associated with the subject, and see its importance to our lives.

Action. We will use the network to establish new and closer links with the media, to provide arresting images and stories about fluid mechanics, and to report on success stories of new breakthroughs and applications. The website will play the major role in providing news items, and a searchable catalogue of images and movies. We will make science correspondents aware of the network and send them regular information. We will encourage members to write popular articles and the network will support the developments of public exhibits, sharing of outputs from departmental open days, and encourage members to participate in the Royal Society Summer Science Exhibition and Science Weeks

We will also leverage existing centres and institutes who work in science policy, such as the Centre for Science and Policy (<http://www.csap.cam.ac.uk>), the Cambridge Institute for Sustainability Leadership (<http://www.cisl.cam.ac.uk>), and their counterparts at other institutions. We will present issues to relevant members and involve them in SIGs devoted to public policy.

Deliverables and milestones

The establishment of the website, the initial set of SIGs and the initial round of short research visits are timetabled in the Case for Support. Thus the impacts will begin as soon as these tasks are completed. Other items, such as the production of new films and videos will occur later and are currently dependent on the outcome of on-going funding discussions. Deliverables and milestones during the first 3 years are listed in the workplan. At the 5 year stage, the performance of the network will be re-evaluated against its original targets and new performance indicators set.

Resources

The resources for these activities are all included in the budget as described in the Justification of Resources.