

A Research Software Engineering (RSE) Strategy for Imperial College London: Quality, Visibility, Skills and Careers

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Action Requested

- **Support the setup of a cross-College RSE Leadership Network.**
- **Assistance with improving visibility for RSE activities within your faculties and departments** (e.g. by helping to secure slots to speak at departmental seminars/staff meetings and Faculty Research Computing Committees).
- **Support for an investigation into improving/extending research computing training across Imperial and application of concrete actions based on outputs.**

Executive Summary

Software underpins a vast amount of the research undertaken at Imperial and is a significant contributor to our world-class research outputs. Despite this it is often hidden or seen as secondary element within many research processes. Nonetheless, the power of software to enable new, larger-scale, more effective or faster research processes and data analyses is undeniable. It is vital that Imperial can continue to take advantage of these capabilities and ensure that we remain at the forefront of world-class research as computational infrastructures become more complex and data volumes grow. To support this we need a comprehensive and effective strategy to deliver the necessary research software skills, capabilities, opportunities and resources to our research community.

The College currently has a grassroots RSE community with over 300 members, a central RSE team with 4 RSEs, and a variety of other teams or individuals embedded in departments undertaking RSE-type work. We also have an active training programme focusing on postgraduate and postdoctoral training in key research computing skills.

The core aim of the strategy is to support the development of **quality** research software. To achieve this we need **visibility** and awareness of RSE best practices across the College's research community, and we need to be able to deliver the **skills** to support the understanding and use of these practices. We also need viable **career paths** on both the professional services and research sides to ensure that we can retain talent in this area and maintain a base of vitally important skills that take many years to develop.

This strategy will be delivered through engagement with the research community, training providers, HR and a range of other relevant stakeholders across the College. The initial phase of the strategy will involve:

- development of our existing grassroots community
- set up of an internal RSE leadership network
- review of opportunities for expanding our training provision for researchers
- developing stronger links between the research community and RCS/ICT
- active engagement with departments to raise awareness of the importance of sustainable research software and reproducible research outputs, supported by key groups and individuals within the College.

Background

While software has been developed within research for many decades, the term “Research Software Engineer (RSE)” and the concept of Research Software Engineering only emerged comparatively recently, in around 2012¹. It came about as a result of discussions about the increasing challenges faced by individuals working within research groups and teams but focusing on writing software to support or undertake research tasks. With the use and quantity of software increasing across all domains, some researchers were finding themselves spending more and more of their time writing code and also particularly enjoying this part of their role. These individuals were, however, also finding themselves getting left behind from a career perspective, being unable to maintain the volume of paper outputs or gain teaching experience, requirements that researchers often need in order to have an opportunity to progress along the academic career path. The specialist experience that these research software engineers were building up over many years was recognised by PIs as being very valuable in supporting the development of their research outputs but without a viable and accepted career path, RSEs generally found themselves stuck on successive short-term contracts, often for many years.

The emergence of the label “Research Software Engineer”, and then the setup of “Research Software Engineering” groups at institutions around the UK, provided a professionalisation of the RSE role in addition to a realistic career path. Central teams now exist at several institutions around the UK and internationally, with some teams in the UK numbering more than 25 members. Research software engineering spans a wide scale of skills and expertise consisting, at one end, of more professional software engineering roles and, at the other, of more traditional research roles. While central research software engineering teams, which often provide a series of roles on a professional services or equivalent scale, address a significant element of the career challenge for RSEs, there are still many individuals doing some RSE-type work embedded in research teams and with roles more towards the research end of the scale. This is something that has not yet been addressed in many institutions, Imperial included.

Despite these challenges, the professionalisation of Research Software Engineering is an important step forward. Indeed, it is vital in ensuring that as research becomes increasingly computationally focused and needs to take advantage of more complex software and infrastructure, there are opportunities to provide sustainable roles and career options for the individuals undertaking this work.

Alongside the emergence and development of the RSE space, an active community has emerged, initially UK-focused, but now with a strong international reach. The RSE Slack workspace has well over 3,000 members and there are national communities in several countries. The UK national community has now become the Society of Research Software Engineering², a registered charity. There are also local communities at several institutions, Imperial included, and an emerging layer of regional communities. The first regional community was RSLondon³, the Regional Research Software Community for London and the South East of England, started in 2018. This community continues to be led from Imperial and run by a volunteer community committee including members from a number of institutions in the region. RSLondon has provided an example from which a new Regional Communities Special Interest Group (SIG), supported by the Society of Research Software Engineering, has recently been set up.

¹ S. Hettrick, “A not-so-brief history of Research Software Engineers”. SSI blog, August 2016. <https://www.software.ac.uk/blog/2016-08-17-not-so-brief-history-research-software-engineers-0>

² Society of Research Software Engineering, <https://www.society-rse.org>

³ Research Software London (RSLondon), <https://rslondon.ac.uk>

Current Status

The first RSE activity at Imperial was the [research software community](#). Started in 2015, this is a grassroots community that has a very general remit, aiming to bring together researchers, academics, RSEs, systems professionals and, indeed, anyone who is building, supporting or using software as part of their research. The community now represents **over 300 members** across its Slack workspace and mailing list and is supported by a volunteer committee of 7 researchers and RSEs. Imperial is also represented in the [RSLondon](#) regional research software community, which is run by Jeremy Cohen, supporting RSEs across the London and South East of England region.

The College's [central RSE team](#), started in 2017, now consists of 4 experienced research software engineers, with a range of advanced technical expertise, who are working on projects across the College. In addition, the [RESIDE-IC](#) research software team based within the [MRC Centre for Global Infectious Disease Analysis](#) consists of 7 RSEs and there are a number of individuals based around College within research departments/centres who are undertaking RSE-type work. Many of these individuals will be working towards the research end of the RSE spectrum and will have general research-related job titles such as Research Associate or Research Fellow. There are, however, a very small number of RSEs working within departments across the College and holding the job title of Research Software Engineer.

There is an active **training programme** covering a wide range of RSE skills. Postgraduates are supported through the extensive series of training courses provided by the [Research Computing and Data Science \(RCDS\) programme](#) based within the Graduate School and led by Katerina Michalickova. These courses are also accessible to researchers. Undergraduate training is being pioneered through a new "Interdisciplinary Research Computing" course, co-developed by the RCDS team and Jeremy Cohen, being run under the College's [iExplore STEMM](#) programme. A regular programme of [Software Carpentry](#) training is also being run by the research software community and RCDS team, with some courses being run in collaboration with RSLondon. These courses provide core basic research computing skills along with an introduction to either Python or R programming. In addition, places continue to be made available for Imperial participants, via RSLondon, at runs of the [Reproducible computational environments using containers](#) courses covering Docker and Singularity.

RSE policy and careers are being supported through a range of activities being undertaken as part of Jeremy Cohen's RSE Fellowship. This includes work on supporting **Equality, Diversity and Inclusion** in RSE^{4,5} advocating for **stronger career paths for RSEs** and investigating various aspects around the **structures and business models of different approaches to developing research software**. Work in this area has also resulted in defining the "Four Pillars of RSE"⁶.

Challenges / Opportunities

The College faces a range of challenges in ensuring it can meet the need to support the huge growth in volume and complexity of computational research. This stems from the ever-

⁴ Chue Hong N. P. Chue Hong, J. Cohen and C. Jay (2021) Understanding Equity, Diversity and Inclusion Challenges Within the Research Software Community. In Proceedings of ICCS 2021. LNCS, vol 12747. Springer, Cham. https://doi.org/10.1007/978-3-030-77980-1_30

⁵ Missing narratives in discussions around diversity and inclusion in research software engineering, Panel session at the SeptembRSE conference, 28th September 2021. <https://septembrse.github.io/#/event/L1001>

⁶ J. Cohen, D. S. Katz, M. Barker, N. Chue Hong, R. Haines and C. Jay. "The Four Pillars of Research Software Engineering" in IEEE Software, vol. 38, no. 01, pp. 97-105, 2021. doi: [10.1109/MS.2020.2973362](https://doi.org/10.1109/MS.2020.2973362)

increasing volume of data, complexity of hardware and the associated challenges of developing software to address these issues.

There are, however, also many opportunities to take advantage of the developments in computational capabilities. These developments are key in supporting Imperial in retaining its role as a world-leading research institution, as research continues to develop in the direction of a greater focus on data and computation.

To help support the College, address the challenges and provide a framework to capitalise on the opportunities, an RSE strategy is being proposed based on 4 areas:

Quality; Visibility; Skills; Careers.

Quality: The core aim of the strategy is to support the development of high-quality research software to underpin Imperial's research outputs.

Visibility: This focuses on building awareness of the concept of Research Software Engineering and the importance of research software skills in developing world-leading research outputs. Improving awareness of research software skills and best practices across the College's full range of faculties and departments is vitally important to offering more general support for the quality of research outputs. Improved visibility will help to improve engagement and develop a two-way dialogue between the research community and RCS/ICT as well as other groups offering RSE support at Imperial.

Skills: Upskilling researchers and existing RSEs is of huge importance in maintaining and enhancing our RSE capabilities as software process, languages and libraries change constantly. The approaches we use to provide RSE skills development within our research community, but also to undergraduate and postgraduate students – the next generation of research software developers – need to be well structured and comprehensive to ensure that we don't fall behind in this space.

Careers: Working with relevant stakeholders within the College to identify approaches that can better support the career options and long-term aims of RSEs/researchers who focus on developing software at the College. We must look at ways to retain specialist talent – research software skills are time consuming to develop and are increasingly important to research across all domains. This is likely to require improved career paths that address career progression pathways across both professional services and research job families.

The key challenges across these 4 areas can be summarised as follows:

- **Ensuring that researchers and RSEs have access to the necessary skills and resources.**
- **Ensuring visibility of the Research Computing Service, Research Software (RS) community and the wide range of services, support and opportunities these entities provide. Providing long-term sustainability for the RS community.**
- **Developing an understanding of the importance of software, and associated development best practices, across the College's research community.**
- **Improving engagement between the research community and entities across College offering research software support, training and infrastructure access.**
- **Developing enhanced career paths and opportunities for individuals undertaking RSE work in both professional services and research contexts.**

Looking at our RSE provision and activity under each of the four pillars of RSE – software development, community, training and policy – is one way to help identify both the existing state of RSE within the College and to understand how this has changed over time.

In the context of the Research Software community we have a challenge in sustaining the community which requires the organisation of regular events and community activities (e.g. networking sessions, hackathons, etc.). We are now at the stage where a Community Manager would make a significant difference to our capabilities in this area.

Opportunities from addressing these challenges include:

- **Improved sustainability of research software outputs and reproducibility of the results they produce.**
- **Developing wide recognition for Imperial as an institution that develops high-quality research software – this could have positive implications for a number of areas including funding.**
- **Enhanced career prospects for graduates and researchers.**

Objectives for next 12 months

The College RSE Strategy will provide ongoing support for our existing set of research software activities, extending them where this is required. General objectives and specific aims as the strategy moves forward are highlighted below:

- Set up an RSE leadership network including individual RSEs and representatives from RSE teams across the College – this will provide one route to increasing awareness of RSE and the College's RSE provision across all faculties/departments
- Update the <https://www.imperial.ac.uk/rse> web page.
- Help to enhance and optimise links between the Imperial research community, the RSE team and resources such as the HPC service and technical/systems support.
- Further develop and grow the RSE community.
- Engage with HR and relevant stakeholders to investigate options for better supporting the full spectrum of RSE roles from more research-focused to the more software-focused.
- Strengthen RSE-related links with, and learn from, other institutions active in the RSE space.