Software Sustainability Institute

Midterm Review

December 2022

Software
Sustainability
Institute

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Foreword

As the contents of this document demonstrate, the SSI is addressing a set of concerns about the effective use and reuse of software in research that are pertinent in almost all domains of research in the UK and worldwide. The team continues to build effectively on its diverse strengths and earlier achievements, growing and adapting where necessary. The three themes chosen for the case studies demonstrate the variety of ways in which they deliver on their mission. Using mechanisms such as the Fellows programme and the Collaboration Workshops they deliver change through ever-growing networks of individuals.

Through collaboration they work with key partners to achieve global effects, using their acknowledged leadership in this area to achieve change in areas from policy to key software tools. Their work on building capacity utilises both collaboration and culture change to deliver real and cost-effective benefits for those involved in the production, maintenance and use of software in research at many levels.

They have also grown ever more effective in making good use of their advisory board, which it is my privilege to chair. We are asked the right questions, and given the appropriate information to be able to provide guidance that we hope is of use. I know this involves considerable preparatory work by the Director, Neil Chue Hong, and all of his colleagues. It makes the advisory board meetings something which all involved can look forward to — we know our time will be well used and we all learn as a result.

In its three phases so far the SSI has continued to build on success, to prioritise its efforts on those areas where it can have most benefit, and to use collaborations to allow others to pick up on, expand, and continue its work.

This report, and the case studies therein, provide ample evidence of how a strong team is achieving impact far beyond its size, and is also looking to the future to determine where its mission must adapt and change.

Kevin Ashley, SSI Advisory Board Chair

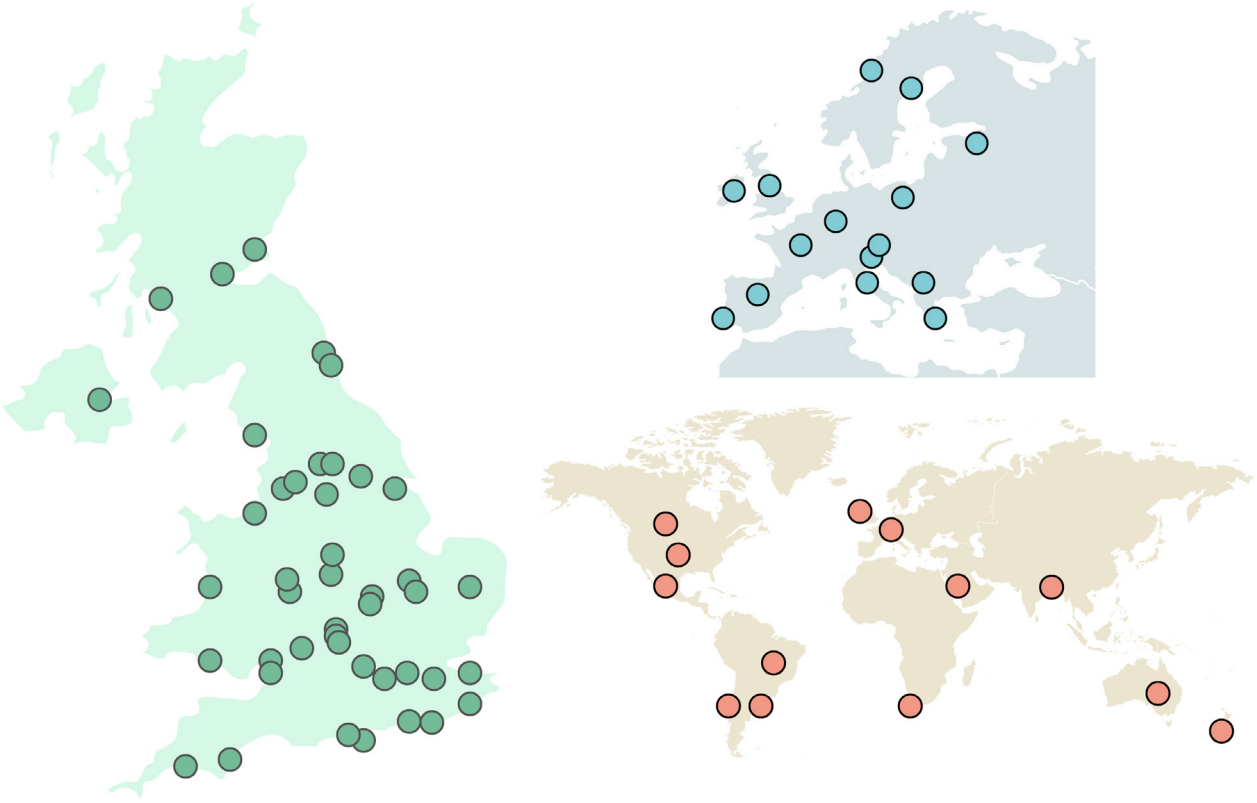
Introduction

The Software Sustainability Institute (SSI) was the first organisation in the world dedicated to improving software in research.

It was founded in 2010 on the premise that helping individuals and institutions to understand the vital role that software plays in research would accelerate progress in every field of scientific and academic endeavour. The SSI set itself the ambitious goal of transforming academic culture by establishing the principle that reliable, reproducible, and reusable software is necessary across all research disciplines. Despite the magnitude of this challenge, the SSI has delivered substantive improvements and achieved a number of truly global successes.

The case studies included in this report contain some of the highlights of the SSI's 12-year history. These include playing a leading role in the creation and international adoption of an entirely new research role: the Research Software Engineer (RSE) (see CS2); creating a scalable and sustainable national training environment in which 7,000 researchers have improved their software skills (see CS8 and CS9); novel work on software citation that has been adopted by, amongst others, international research platforms and a leading multinational company (see CS6); and bringing about a shift in funding policy that benefits research in the UK and around the world (see CS5). The SSI has also nurtured a community of 217 Fellows from 119 different organisations through its influential Fellowship Programme (see CS1), the benefits of which in terms of knowledge and career progression are so marked that our Fellows invariably continue to work with the SSI long after their initial Fellowship year is over.

In addition to these activities, the SSI has run hundreds of successful events and campaigns, which disseminate knowledge and serve as a foundry for new ideas (see CS3, CS4, and CS10). It has collaborated with 269 organisations in 30 countries, providing consultancy and guidance to hundreds of projects (see CS7). The SSI website has been visited by more than 2 million people engaging with the subject of research software, a truly phenomenal audience for an academic website.



The Software Sustainability Institute has built a network of collaborators across the UK, Europe and the globe.

Our successes are underpinned by highly effective working methodologies that we have continually refined over the organisation's lifetime. We are innovative, highly collaborative, and undeterred by even the most ostensibly unsolvable problems. We are experts in working across disciplines and identifying the people within communities who can effect change. We have learned to focus on scalable enterprises that allow us to punch far above our weight, while maximising the impact of our work through a continual process of assessment and improvement. We are evangelical about improving equality, diversity, and inclusivity across all of our activities.

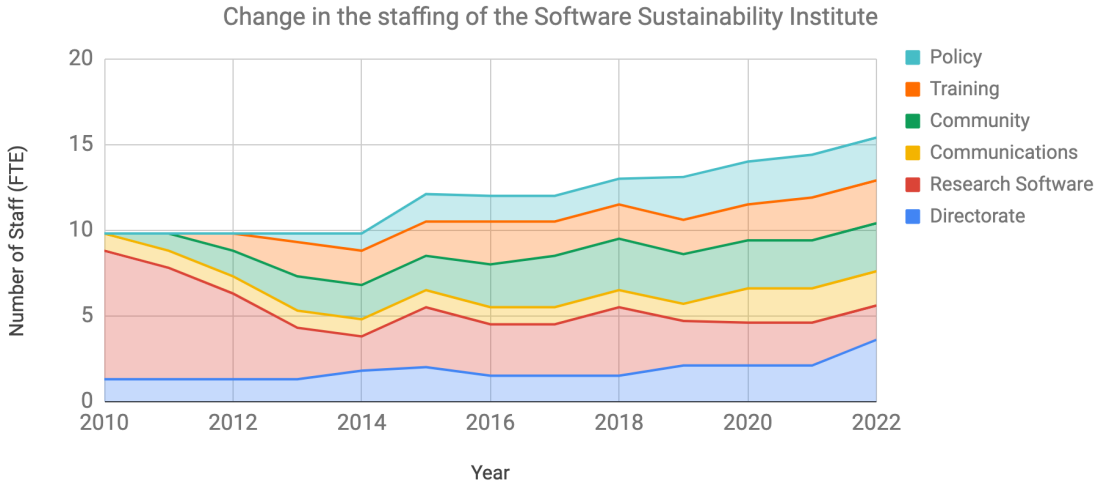
Over its 12-year history, the SSI has undergone a dramatic transformation from relative obscurity in a new field to global prominence, leading the movement to create an environment in which research is radically enhanced by software. Although we have come far, there is still more to be done. We are currently planning Phase 4 of the SSI, in which we will continue to build on our successes, collaborate with peers, including the growing number of organisations that have emulated our work in other countries, and identify new obstacles to research.

Organisation

Initially funded by the Engineering and Physical Sciences Research Council (EPSRC), the SSI now receives funding from all seven UK research councils. This has come in three main tranches:

- **Phase 1** (2010-2015): EPSRC, £4.4m, five years, 9.8 FTE[1]
- **Phase 2** (2015-2018): EPSRC, ESRC, BBSRC, £3.5m, 3.5 years, 12.1 FTE
- **Phase 3** (2018-2023): AHRC, BBSRC, EPSRC, ESRC, MRC, NERC, STFC , £6.6m, five years, 13.6 FTE

The aims of the SSI have evolved with each new tranche of funding. In Phase 1, we focused on identifying the software shortcomings that hold back research, trialled solutions to some of the issues we had identified, and worked to establish our credibility within the research community. In Phase 2, we conducted analyses of the software being used in research and cultivated communities within the burgeoning research software field. In Phase 3, we helped the communities that we had created to become independent, scaled up our successful activities, and campaigned for software to be regarded as an integral component of effective research.



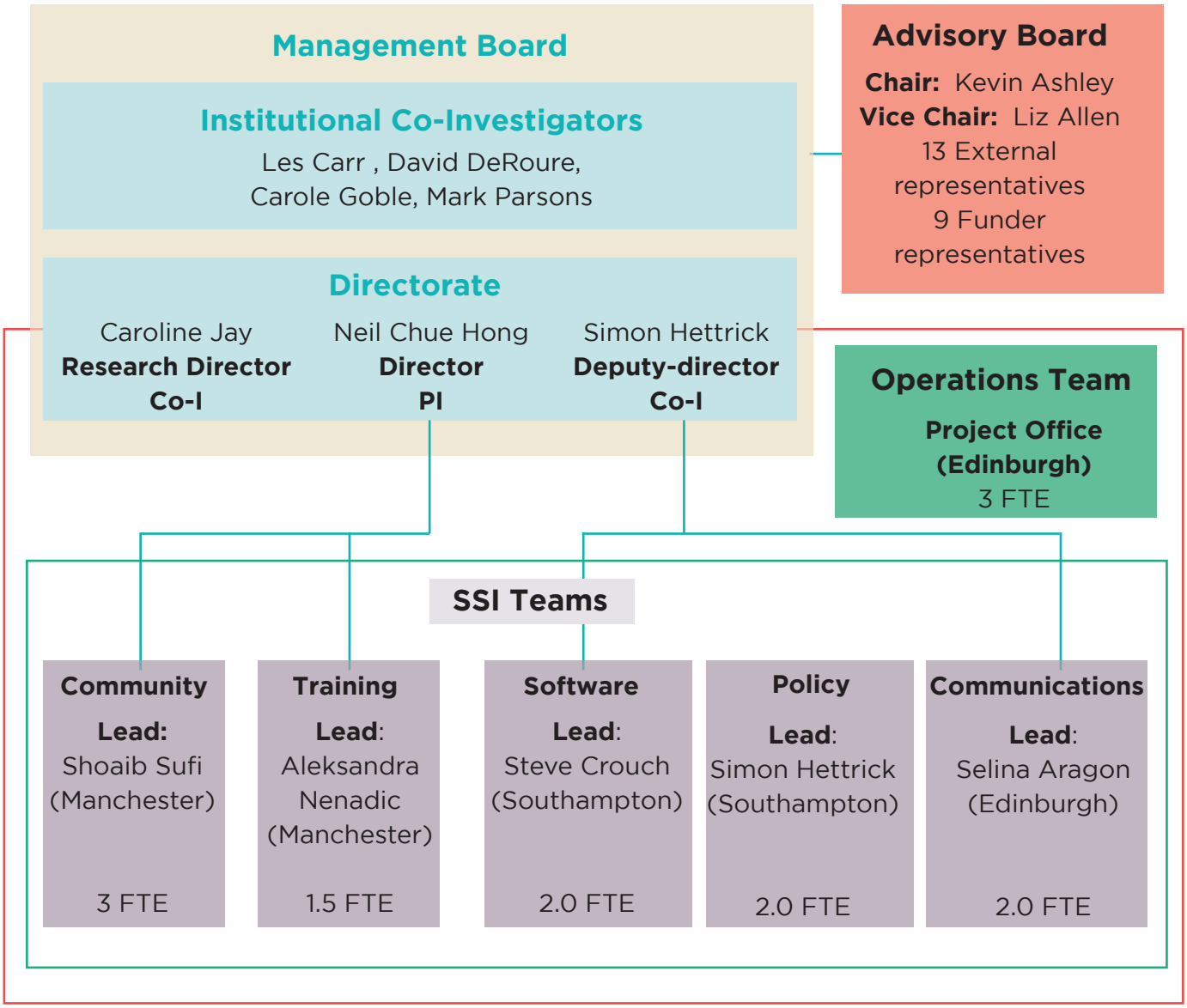
The breadth of the challenge we faced led us to split the SSI's work into six departments, all working in different ways to move academic culture in the right direction:

- **Software:** helping developers to produce software that facilitates reliable, reproducible, and reusable research;
- **Training:** teaching essential software skills to researchers;
- **Community:** bringing together and supporting relevant stakeholders;
- **Policy:** collecting evidence on research software use and sharing with stakeholders to improve practice;
- **Communications:** exploiting our platform to increase engagement, delivery, and uptake;
- **Directorate:** the project office supporting the SSI and the wider community.

These teams have changed as the landscape has evolved through the activities of the SSI.

[1] FTE: Full time equivalent

SSI Organisational Chart



Phase 3 aims and objectives

The objectives of the current phase of the SSI are:

1. To encourage the widespread adoption of research best practice, agreeing and defining best practice around research software and facilitating its widespread adoption to ensure the reliability and reproducibility of modern research.
2. To produce cutting-edge policy and guidance, collaborating with individuals and organisations to create and disseminate evidence-based guidance, infrastructure, policies, and tools with the aim of improving the reusability of research software and its associated research outputs.
3. To cultivate a capable research community, pursuing a sustainable and scalable community-led model that will extend knowledge across domains to maintain excellence and drive innovation, create new career paths, and increase the recognition of research software.
4. To deliver an open evidence bank, identifying and generating datasets and analysing them in order to uncover insights on the importance of software, adequately trained personnel, and best practice principles.

Collaborate, don't compete

When the SSI pioneered the field of software sustainability in 2010, it was a relatively small organisation (9.8 FTE) with a remit that spanned the entire UK research community of around 210,000. We made a strategic decision to adopt a highly collaborative approach towards other organisations entering the space. Although this entailed losing a degree of control in terms of how the field would develop, it significantly increased the number and range of resources we could call on to effect change. This strategy, which we characterise with the motto *collaborate, don't compete* is now a core tenet of the SSI, and a major factor behind our remarkable success over the last 12 years.

Our strategy for training, which we added to the SSI's portfolio of activities in 2012, provides an excellent example of our collaborative philosophy in practice. While we might have been expected to develop our own materials to ensure that their impact would be unambiguously attributed to the SSI, we instead chose to partner with The Carpentries[2], adopting their materials and helping to train their trainers. We shared the limelight, enjoying huge efficiency savings and access to a much broader pool of trainers in the process. There has been a sea change in the number of researchers with basic software engineering skills, bringing benefits to the research community and beyond. Had we not pursued our collaborative strategy, it is doubtful that this sea change would have taken place.

[2] The Carpentries, https://carpentries.org/

Another key goal of Phase 3 is the creation of 'communities of practice' — groups of people who "share a concern or a passion for something they do and learn how to do it better as they interact regularly"[3]. While the Research Software Engineering community is the most visible of our accomplishments, we have also formed communities of practice around software citation and the FAIR principles for research software, disciplinary software communities for biofilms and acoustics (in collaboration with the National Biofilms Innovation Centre[4] and the UK Acoustics Network respectively), and training (as part of the wider Carpentries community). We have developed further communities of practice to address equality, diversity, and inclusion challenges, with particular reference to the lack of diversity among RSEs.

Adapting to an evolving landscape

The research landscape has changed considerably since 2010. Our studies show that software has continued to grow in importance, and many more organisations and initiatives have emerged to support the shift. Within this burgeoning community, the SSI continues to play a central role as a trusted authority, partner, and backbone organisation facilitating the work of others.

International policy has evolved in recent years to incorporate the principles of open access, open data, and open research. Software is now included in research policies held by UNESCO and OECD, but there remains a need to ensure that these policies are translated into practical and implementable guidance at the funder and organisational level. We have been pursuing this agenda by promoting community discussion through initiatives like the FAIR Principles for Research Software (FAIR4RS) working group. The SSI must continue to take on similar roles in future, working with others to promote principles such as reproducibility and software quality not only among early adopters but also the 'early majority'.

Developments over the last 12 years mean that many more researchers have access to training and RSEs. But a significant number still lack this access. The SSI has moved from a strategy of delivering training and software engineering capacity to individual groups to one of developing mechanisms that allow our message to reach an exponentially greater audience. These mechanisms include 'training the trainers', providing online software sustainability tools, and developing new career pathways. As the RSE profession matures, the SSI will continue to work with the Society of Research Software Engineering to ensure that access to training, skills, and input is equitable.

There are many more organisations supporting research software now than in 2010, or even at the start of Phase 3 in 2018. Dozens of new RSE groups have been established in the UK with our support. Internationally, the SSI model and mechanisms have been emulated by counterparts in the USA (URSSI, US-RSE), Canada (CANARIE), Germany (Helmholtz Centers, de-RSE), the Netherlands (NLeSC, NL-RSE), and Australia (ARDC,

[3] Introduction to communities of practice, https://wenger-trayner.com/introduction-to-communities-of-practice/

[4] 2019 National Biofilms Innovation Centre workshop, https://www.software.ac.uk/blog/2019-12-16-2019-national-biofilms-innovation-centre-workshop

RSE-AUNZ). But there is still much to do. The SSI, along with the Research Software Alliance, has begun working with people and institutions in the Global South to understand what support is required to ensure that emerging organisations are pulling in a common direction.

Finally, we cannot overlook the impact of the COVID-19 pandemic on Phase 3 of the SSI. We were forced to adapt quickly, moving events online in a matter of days[5] and working to support the scientific community's national pandemic response with bespoke training (see CS8). We helped formulate guidance around sharing data[6], and contributed to the public debate[7,8], around the publication of the code used by Professor Neil Ferguson to model the pandemic. It was an SSI Fellow, Stephen Eglen, who verified the reproducibility of Professor Ferguson's simulation[9] via the CODECHECK initiative, which is itself supported by the SSI.

Some of our planned activities, such as RSE exchanges and in-person workshops, had to be postponed — but we learned a great deal about improving accessibility and inclusion in the process of devising alternatives. As a virtual institute, the SSI has always used online tools to communicate and collaborate, and we were able to apply our knowledge and experience in this area to the task of developing guidance for community managers pivoting to online events[10] on behalf of the Center for Scientific Collaboration and Community Engagement. As we emerged from the pandemic, we perceived the importance of not returning to the 'old normal'. The SSI is committed to improving equality, diversity and inclusion through running hybrid events, supporting a variety of working patterns and environments, and encouraging a healthy work-life balance both within the SSI and throughout the research community.

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[5] CW20: how to move an event online in three weeks, https://www.software.ac.uk/blog/2020-05-18-cw20-how-move-event-online-three-weeks

[6] RDA Releases 5th Final Draft of COVID-19 Guidelines and Recommendations, https://www.software.ac.uk/news/rda-releases-5th-final-draft-covid-19-guidelines-and-recommendations

[7] Critique software, but understand the constraints it's written under, https://www.software.ac.uk/blog/2020-06-01-critique-software-understand-constraints-its-written-under

[8] Universities under fire for accepting poor coding that led to Britain's lockdown (The Telegraph, 18/5/20)

[9] Critiqued coronavirus simulation gets thumbs up from code-checking efforts, https://www.nature.com/articles/d41586-020-01685-y

[10] A guide to using virtual events to facilitate community building: Event formats, DOI: 10.5281/zenodo.3934384

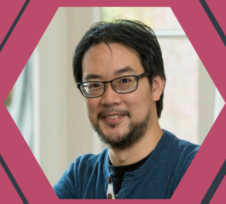
To support this evolution, the SSI has pursued a fruitful strategy of collaborating with others to secure additional funding. During Phase 3 we have been involved in 13 projects totalling £22.8m, and led a further five projects (see Appendix 4), all with the principle aims of developing new training pathways and undertaking research to inform policymakers. Collaborating in this way has allowed us to build on our core activities and deliver our work to new communities. We have won training grants from UKRI, NERC, and SFC to train domain scientists in the life sciences, environmental sciences, the Scottish public sector, and industry; AstraZeneca to pilot a version of our intermediate training courses for its staff; the UNIVERSE-HPC project, funded by the UKRI ExCALIBUR programme, to look at developing more RSEs specialising in High Performance Computing; and funding from UKRI, ESRC, AHRC, and NERC to provide evidence of the importance of research software. We will continue to diversify our funding streams in order to increase the resilience and flexibility of our organisation, while acknowledging the tremendous positive impact that stable, long-term core funding has had on the SSI's ability to take risks and address longer-term barriers that require 7-10 year timescales.

When we founded the Software Sustainability Institute more than a decade ago, it might have appeared as though our mission could be accomplished by exploiting the expertise of software engineers to improve the engineering of a few key flagship codes. What we have discovered in the years since is that this expertise must be shared by the whole community. Contemporary academic research requires that the majority of researchers recognise the importance of software, and are aware of steps they can take — whatever their career stage or role — to create more reliable, reproducible, and reusable research.

The SSI team

















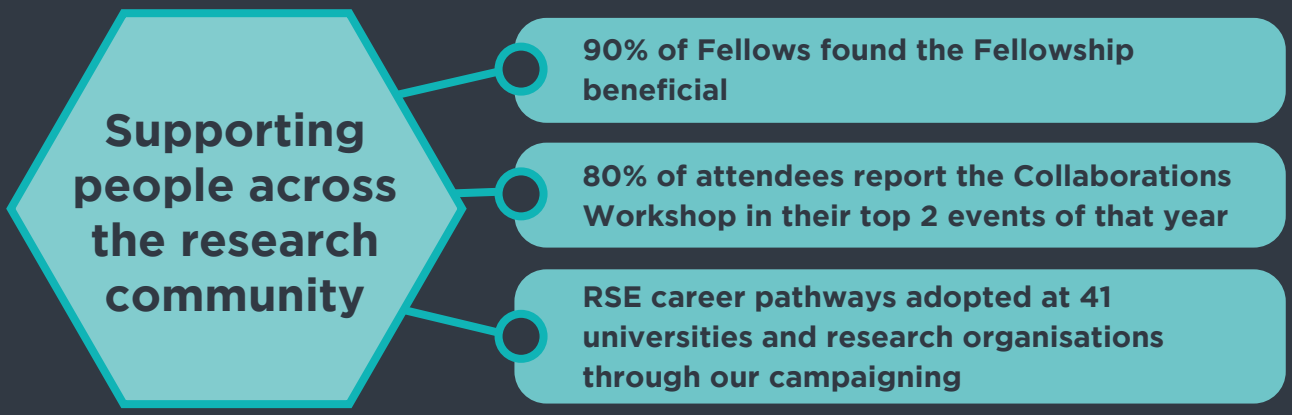




Case Studies

Changing Research Culture


Leading by example
Success based on a culture of innovation, reflection, and collaboration
Evolved over 3 phases: breaking new ground, growing self-sustaining communities, and scaling to a broader audience
Working openly across disciplines, reducing duplication of effort, translating knowledge and delivering collective impact
Backbone organisation providing longevity and support across the research sector


Supporting people across the research community
90% of Fellows found the Fellowship beneficial
80% of attendees report the Collaborations Workshop in their top 2 events of that year
RSE career pathways adopted at 41 universities and research organisations through our campaigning


Empowering others
RSE community has grown to around 10,000 RSEs around the world
Hidden REF highlighted the work of 120 non-traditional researchers at over 44 organisations
Our Fellowship scheme adopted by 4 organisations across the globe

CS1: Supporting future leaders through the SSI Fellowship Programme

Each of the Software Sustainability Institute's 217 Fellows is an important ambassador for good practice in research software. Our highly regarded Fellowship Programme offers a unique package of financial support, networking opportunities, and professional guidance, giving those who are passionate about software sustainability the confidence to engage with their respective research domains and institutions. It has an outstanding reputation for identifying and supporting future leaders, nurturing new communities, and encouraging collaborative research involving a broad range of disciplines from across the humanities and sciences.

Identifying future leaders

The SSI's selection process for inducting new Fellows has proven remarkably adept at identifying emerging leaders over the last decade. Following selection, we award each successful candidate a package of flexible financial support worth £3,000, without which many of our Fellows would be unable to pursue their ideas and develop their work. The practical and personal benefits are notable. 93% of the 2019 cohort reported that the Institute had improved their confidence in research software practices, while 70% overall have reported a benefit to their careers, no doubt arising in part from a 26% improvement in their knowledge of research issues.

Promoting diversity in research software

The Institute has created an outstanding community of Fellows, and we owe much of our success in this endeavour to a committed and energetic approach to accessibility, diversity, and inclusion. New Fellows are selected on the basis of a written submission and a series of group tasks during an online selection day. Using a variety of metrics, including participant feedback, we constantly evaluate the fairness of the process and make improvements. For instance, we have replaced the requirement for a relatively lengthy written proposal with a shorter screencast presentation, giving applicants more flexibility to convey their ideas. And in response to feedback indicating concerns that the group selection process favours more extroverted applicants, we now counsel our judging panels to consider how well applicants meet the selection criteria irrespective of personality type or any other immaterial factor. This allows all candidates to feel comfortable with the process, and confident that they'll be judged solely on their abilities.

> **I cannot speak highly enough of the experience I had on selection day and came out of the session so grateful for the experience. I was inspired by the others that I was able to work with. As a neurodivergent individual, I have struggled at times with traditional interview processes and being able to pattern match my answers best to the interviewer. In my opinion the selection day was possibly the most deeply thought out way to assess an applicant's skills and programme fit that I have seen (or heard of).** Feedback from a Fellowship selection day participant

Despite getting a PhD partially from a computer science programme, I could see that my skills and knowledge were always at least to some extent dismissed or doubted [...] Since being elected an SSI Fellow I most definitely observed a significant drop in mansplaining... I have little doubt that the SSI Fellowship was a significant [reason] I got my current position. SSI Fellow

Creating a generation of software ambassadors

The UK is a global leader in the use of Research Software Engineers (RSEs) to facilitate and enhance research, and SSI Fellows are at the heart of this movement.

Our Fellows hold prominent roles in research software, and their work has borne fruit across a range of disciplines. Some, like Matthew Bluteau (Fellows 2021), have applied their skills to the field of training. Matthew worked with the SSI to develop and pilot the Intermediate Software Carpentry course[11], teaching researchers the subtle art of team-based software development. He now runs the course independently. James Baker (Fellows 2015), meanwhile, founded Library Carpentry[12], teaching software and data skills to people working in library- and information-related roles. He was later joined by another SSI Fellow, Jez Cope (Fellows 2020), who helped to further develop and promote the Library Carpentry initiative. Another member of the same cohort, Emma Rand (Fellows 2020), earned the distinction of becoming a National Teaching Fellow in the 2020 Teaching Excellence Awards for Higher Education. And in an apt illustration of the SSI Fellowship Programme's vital role in disseminating good practice, Fellows Malvika Sharan (Fellows 2019) and Yo Yehudi (Fellows 2018) went on to co-found their own mentoring and training programme. With Yo as Executive Director, Open Life Science[13] is a nonprofit initiative that aims to break down barriers to engagement and nurture the next generation of Open Science Ambassadors. It recently won funding from the Chan Zuckerberg Initiative ($574k) and the Wellcome Trust Open Research Fund (£100k), firmly establishing it as a successful, scalable, international scheme. Open Life Science mentors more than 100 candidates every year from a diverse range of backgrounds.

SSI Fellows can also claim the distinction of having set up some of the earliest RSE groups in the UK, at UCL, the University of Manchester, and the University of Sheffield. Their groundbreaking work proved that RSE groups in universities are not only feasible, but also hugely beneficial to research. By providing researchers with access to software expertise, these early groups have engendered revolutionary change across numerous fields of academic research (see 'Founding and growing the Research Software Engineering community'). To date, eight SSI Fellows have either founded or led RSE groups in the UK.

[11] The Carpentries Incubator, https://carpentries-incubator.github.io/python-intermediate-development/

[12] Library Carpentry, https://librarycarpentry.org/

[13] Open Life Science, https://openlifesci.org/

Our close-knit community of Fellows is always eager to collaborate both within and between cohorts, not least because Fellows often encourage colleagues, collaborators, and friends to apply. Steve Harris (Fellows 2016), Danny Wong (Fellows 2017), and Edward Palmer (Fellows 2020) all worked on the Data Science for Doctors[14] network, a collaboration between clinicians, statisticians, and software engineers that aims to help doctors avoid 'Excel hell', visualise data, and gain a grounding in which statistical tests to apply. Carpentries Offline[15], meanwhile, is the product of a Collaborations Workshop project between Emily Lewis (Fellows 2020), Abhishek Dasgupta (Fellows 2021), Alison Clarke (Fellows 2021), and Jannetta Steyn (Fellows 2021). This vitally important scheme addresses training gaps in the Global South by using a cluster of Raspberry Pis to allow software training in areas with unreliable internet connections.

The SSI has pastoral as well as practical ambitions. The supportive relationship that exists between the Institute and its Fellows has encouraged collaboration on sensitive and personal topics that have historically been overlooked within the research community and beyond. Dave Horsfall (Fellows 2021) recently developed the first ever survey of mental health in the RSE community and circulated it during RSECon22. He has also given several talks on mental health among RSEs, highlighting common stressors and encouraging openness. The most recent SSI Research Software Camp, which took place in November 2022, adopted mental health as its central theme.

Inspiring and supporting others

In 2021 our Fellowship Programme invited international applications for the first time. As a result, we're now fortunate to have four international Fellows, recruited in the same open round as our UK Fellows. This small cohort is helping us to understand how well our UK-based approach works abroad, and how we can enable overseas Fellows to contribute to the UK research base. We aim to establish whether an international Fellowship Programme complements or hinders local efforts, and whether a central (e.g. international or European) or regional (country by country) approach is appropriate. Meanwhile, international Fellow Kim Martin (Fellows 2022) is currently establishing the first RSE group in South Africa.

The Fellowship Programme's highly successful approach to nurturing and supporting talent has been emulated by other organisations. The methodology, structure, and ethos of the ELIXIR-UK[16] Data Stewards Fellowship Programme is explicitly modelled on the SSI Fellowship, and the SSI has a funded advisory role in helping to develop the program. Internationally, the SSI has advised BSSw[17], de-RSE[18], and URSSI[19] on Fellowship schemes, and we're working closely with the Netherlands eScience Center to help them develop their own bespoke scheme.

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[14] Data Science for Doctors, http://datascibc.org/
[15] CarpentriesOffline, https://carpentriesoffline.github.io/
[16] ELIXIR-UK, https://elixiruknode.org/
[17] Better Scientific Software, https://bssw.io
[18] de-RSE, https://de-rse.org
[19] US Research Software Sustainability Institute, https://urssi.us/



My experiences have been extremely positive and I would like to thank the SSI for the great opportunity it gave me. I found it so valuable, and being part of such a great network will provide long-term value too. Thanks!


The Fellowship Programme has been an amazing experience — I've met lots of fantastic people and I've also developed the confidence to step outside of my academic discipline to interact and work with people across lots of different areas.






Interaction with SSI has given me the confidence and language needed to talk more widely about issues relating to software sustainability, especially with those who are less engaged with these topics in my own domain. Thank you for enabling this.







I love the SSI, the team and the fellows. The environment and atmosphere you've created within the community is unique and very impressive!








Hands-down one of the best things I've ever done. The community around the SSI is wonderful. Well done everyone!

All quotes are from Fellows2019, Inaugural Period Exit Survey

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It gave me

new hope

for the way science can be

Software Sustainability Institute Fellow

CS2: Founding and growing the Research Software Engineering community

The Software Sustainability Institute is the genesis of the Research Software Engineering movement. It has created and cultivated a thriving international community of RSEs, worked to ensure that universities and funders recognise the vital role that RSEs play in enabling high quality research, and changed the way people think about how research groups should be constructed.

Revolutionising research

Research relies on software, but there has historically been no formal role for software engineers in research. It was during a discussion on this systemic shortcoming at an SSI Collaborations Workshop in 2012 that the term 'Research Software Engineer' was coined. RSEs and researchers work closely together. They share knowledge of best practice in software development and apply it to the unique demands of a given research environment. Over the last decade the SSI has sought to establish the role of RSEs in research through community building; raising awareness among universities, research institutions, and policy makers; and campaigning for a recognised RSE career path. Over the course of the last decade RSE groups have substantially increased the uptake of good coding practices in the UK, improving the effectiveness and quality of research throughout the country.

"Research software engineering teams have dramatically improved coding practices across our researchers. It is de facto for us to use version control and to write modular code. Unit testing is becoming much more common, as is continuous integration." Professor Neil Ferguson

Over the past ten years, the SSI has orchestrated a campaign to grow the RSE concept into a large international community. In 2013 the SSI held the first workshop for RSEs, attended by 56 self-described Research Software Engineers. This new community voted unanimously to found an organisation called the UK Research Software Engineers Association (UKRSE), chaired by SSI Deputy Director Simon Hettrick. To engage the community and cement its grassroots principles, the UKRSE held its first elections in 2014. Since then, the organisation has been led by elected members. In 2015, the SSI founded the RSE Leaders Network to support the creation of new RSE groups, which have increased in number from a single group at UCL to around 40 groups across the UK. The first RSE conference, funded through a bid won by the SSI, not only spawned a successful conference series that runs to this day but also led to the development of nine distinct international RSE associations.

"The RSE movement started principally in the UK but is now international with many national groups around the world." - Better, Broader, Safer: Using Health Data for Research and Analysis, Professor Ben Goldacre

In 2019, the UKRSE became a registered charity, with an independent board of trustees, under a new name: The Society of Research Software Engineering. With this final step, the SSI has succeeded in creating a wholly independent, community-led organisation that underpins the RSE community and safeguards its future.

As a result of this remarkable progress, RSEs now belong to a robust and passionate community, with RSECon (the Society of Research Software Engineering's annual conference) attracting over 400 attendees. The event is entirely funded by corporate sponsorship, which provides sufficient surplus to fund the work of the Society. In 2020, when physical gatherings became impossible due to the pandemic, the SSI worked with the Society to swiftly improvise a virtual alternative called SORSE (a Series of Online Research Software Events), consisting of one event every month over a six-month period. The conference has continued to flourish thanks to this determined and enterprising spirit.

Nurturing the RSE community

The SSI continues to play a leading role in supporting and growing the RSE community, making an important financial contribution by funding the RSE Community Manager position. The holder of this role helps to organise the annual conference, attract conference sponsorship, and develop collaborations and connections within the community.

Thanks in significant part to the work of the SSI, there is now a great deal of competition among institutions to recruit RSEs, and RSE leaders in particular. Setting up a new RSE group within an existing institution is an extremely challenging task, and the SSI works to ensure that new and established RSE groups are supported through the RSE Leaders Network. This highly active community exists to promote knowledge exchange and provide support on issues related to employing RSEs, including job descriptions, promotion criteria, and funding models.

The UK-based RSE movement has attracted interest from all over the world, and the SSI is increasingly helping international partners to emulate its success abroad. There are now nine national RSE associations including the UK, Africa, Asia, Australia/New Zealand, Belgium, Germany, Netherlands, Nordic countries, and USA. The SSI has supported the growth of many of them. In 2017, the international council of RSE Associations was set up to ensure cohesion between associations, and to encourage discussion around international issues. By facilitating collaboration between these international groups, the SSI has ensured that decisions are taken collectively and without unnecessary duplication of time, effort, and resources.

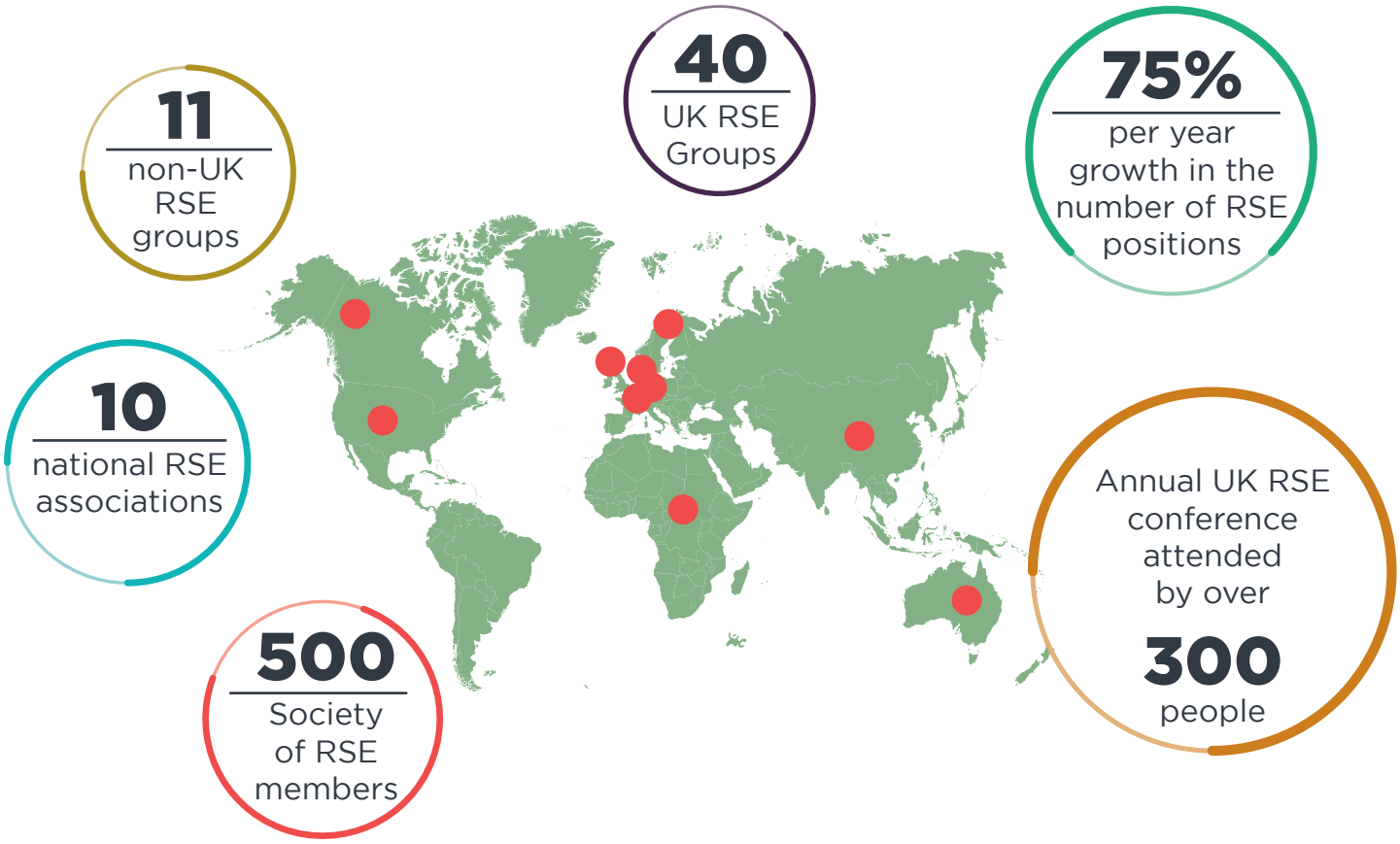
Thanks to the efforts of the SSI and other bodies, there are now around 10,000 RSEs worldwide. But there remains a shortage, due in part to the lack of a clear training path. To address this, the SSI is working with the RSE community to develop a repository of open source masters-level training materials[20], which will allow more candidates from a wider range of backgrounds to embark on highly valuable and rewarding RSE careers.

"I absolutely love the Society of Research Software Engineers, we need the rest of the world (and funders) to catch up. Data analysis is done by writing code. Efficient, creative, performant data tools are built by writing code. You need people who professionally write code." Professor Ben Goldacre

[20] Through the UNIVERSE-HPC project, funded by the UKRI ExCALIBUR programme.

10,000 RSEs around the world

The 10 national RSE organisations (represented by the red dots) support RSEs across the world.



Yay my new job title is now official - Research Software Engineer - big thanks to @SoftwareSaved for starting the movement :-D

Ashley Towers, University of Sheffield, via Twitter

The Software Sustainability Institute created the RSE job title and then cultivated a thriving international community of RSEs.

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Research software engineering teams have **dramatically improved coding practices** across our researchers

Professor Neil Ferguson at the Science and Technology Committee

CS3: Collaborations Workshop: Generating ideas and building collaborations across the research community

The Software Sustainability Institute's annual Collaborations Workshop (CW) brings together participants from across the research software community to generate new ideas and meet new collaborators. Now in its 14th year, the Workshop consistently receives enthusiastic feedback, with participants commending the diversity and inclusivity of the event and highlighting its capacity to inspire and connect.

Inspiring the research community

The Collaborations Workshop is a three-day participant-driven 'unconference', attended by a diverse interdisciplinary audience of around 80 to 100 people from across the research community, including researchers, funders, publishers, and policymakers. It promotes discussions and collaborations that continue long after the event is over, with our research showing that attendees enter into an average of two post-event collaborations.

Days one and two of the Workshop comprise a mix of plenary talks, collaborative tasks, and discussion sessions. On day three, attendees apply what they have learned in a novel Hack Day competition, which sees groups working together to develop and expand the ideas generated during the preceding days. The open and inclusive nature of the Collaborations Workshop allows participants to discuss sensitive issues and explore ideas that tend to be overlooked in the competitive research field.

"An amazing workshop where: you are a participant not just an attendee; you meet a nice bunch of people with different backgrounds but with the same goal of improving software for the good of science." CW20 participant

The Collaborations Workshop is a uniquely inspiring event, with practical keynotes on topics such as interdisciplinary working, code review, ethics, FAIR, open science, credit, and reproducible research. Attendees are invited to take part in discussions and activities exploring topics around the theme of software sustainability, before crystallising their ideas in speed blogs. These can be written posts, podcasts, video presentations, diagrams, or even short plays[21]. Any format is appropriate, as long as the material identifies problems, explores barriers, formulates solutions, and provides a meaningful call to action for an audience beyond the workshop. A series of mini-workshops allows groups of participants to explore topics of interest in depth, while panels give attendees the opportunity to take part in expertly moderated discussions with leaders in the field, often interrogating new concepts at the moment of their inception. Collaborative ideas sessions allow teams to use their collective creativity to develop solutions to problems, and Hack Days put those solutions to the test, in many cases tangibly benefiting nascent and existing tools and technologies.

[21] Collaborations Workshop, https://software.ac.uk/cw22

Promoting diverse collaborations

The SSI advocates for diversity in research teams, which has been shown to increase the success of research. This is particularly true in the field of research software, where tools are often developed by multiple researchers and RSEs working closely together. A plurality of different personalities and skills has been shown to help with problem-solving tasks involved in building and maintaining software. We have worked to identify the barriers to establishing diverse and inclusive environments, such as the accessibility of online meeting tools, and showcased good practice in building more diverse environments, such as inclusive project design.

The SSI reviews the format of the Collaborations Workshop annually to ensure that it remains a supportive and welcoming event. As a result, the Institute now operates a policy of equal gender representation among keynote speakers. In 2020, 55% of Collaborations Workshop steering committee members were female, 42% of all speakers were female, 34% of attendees reported their gender as female, and 20% of attendees reported their ethnicity as "non-white or mixed".

We passionately encourage contributions from across the research community, and we lead by example, embedding inclusivity and diversity in all of our events and activities. These principles are enshrined within the SSI Events Guide. Examples of good practice include the use of an event 'Code of Conduct', which sets out expectations concerning behaviour, describes the complaints procedure, and provides recommendations on the use of assistive technologies such as subtitles and screen readers.

"An amazing gathering of a diverse group of excellent people that produces some really interesting ideas and hacks." CW21 participant

Following the success of our workshop format, we have been asked to provide guidance to a number of organisations on running online and in-person events (including CSCCE[22], SORSE[23] and FORCE11[24]). Our expertise in running events has now been distilled into the Event Organisation Guide[25], which has received almost 30,000 pageviews since its launch in 2020.

To ensure uptake of the ideas that originate at the Collaborations Workshop, and to prevent unnecessary duplication, a record of the topics discussed at previous Collaborations Workshops is available on the SSI website.[26]

The Collaborations Workshop continues to deliver on the SSI's guiding mantra: Better Software, Better Research. It remains a vital seedbed of community and collaboration in the research community, and we aim to encourage the widest possible participation. As the pandemic subsides, we're committed to making CW23 a hybrid event, as interactive for those attending virtually as it is for those able to attend in person. The theme for CW23 will be sustainable career development, touching on technical qualifications, career pathways, and self-care.

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[22] A guide to using virtual events to facilitate community building, https://zenodo.org/record/4270106#.Y4YhF3bP1mN

[23] Series of Online Research Software Events, https://sorse.github.io/

[24] The Future of Research Communications and e-Scholarship, https://force11.org/

[25] https://event-organisation-guide.readthedocs.io/en/latest/index.html#

[26] Previously discussed topics, https://www.software.ac.uk/pdt

Ideas arising from past Collaborations Workshops

Research Software Engineering

The Collaborations Workshop has a long history of coming up with good ideas, the term 'Research Software Engineer' being a notable case in point. This revolutionary campaign, which began at the Collaborations Workshop in 2012, has created career pathways for thousands of software experts who might not otherwise have found a home in academia (see 'Founding and growing the Research Software Engineering community').

CarpentriesOffline

CarpentriesOffline[27] is an ambitious project devised by participants at the CW21 Hack Day. The aim of CarpentriesOffline is to facilitate software engineering training in areas with limited or no internet access, using Raspberry Pi minicomputers as servers and access points. The concept earned its creators first place in the Hack Day competition, and two SSI Fellows have used their funding to purchase RPi 400 units in order to continue their work on this promising humanitarian initiative.

Coding Confessions

The Collaborations Workshop is an open forum that welcomes honesty and discourages judgement. Coding Confessions[28], conceived during the CW21 Hack Day, is an expression of these values. It aims to normalise failure as an integral and unavoidable part of the research process, allowing researchers and RSEs to disclose mistakes without apprehension. Put simply, Coding Confessions is a repository of confessions on the subject of research software, offering both consolation and practical advice to those who consult it.

[27] CarpentriesOffline, https://carpentriesoffline.github.io/

[28] Coding Confessions, https://coding-confessions.github.io/blog.html#

Quotes from Collaborations Workshop Participants

Learn collaboration by experiencing it!

Intense but excellent. Gave me loads of ideas

An amazing gathering of a diverse group of excellent people

I generally feel intimidated going into conferences, but that's never happened with a collab workshop. Thank you!

An amazing workshop where: you are a participant not just an attendee

You meet a nice bunch of people with different backgrounds but with the same goal of improving software for the good of science

Very well managed and with an open friendly atmosphere

If you would like to get inspired by amazing people and contribute to making the research process easier / more fun, this is the workshop for you

An event where cross-disciplinary participants can come and truly collaborate in a dynamic and supportive environment

I wish more online events were like this one

Intensely engaging and full of inspiration for future opportunities and collaboration

CS4: The hidden REF: Working to improve the national research assessment programme

Impactful research is not the sole preserve of academics. It also relies on the efforts of many non-traditional academic roles, such as technicians, data stewards, and Research Software Engineers. The impact of these 'hidden' roles is currently underrepresented by research organisations and assessments, such as the Research Excellence Framework (REF). To address this, the Software Sustainability Institute has formulated guidelines on how to assess the non-traditional output of RSEs within the REF, and created a grassroots organisation to press for change.

Championing software in research

The REF is a national research assessment exercise aimed at supporting high quality research across academic institutions in the UK. The exercise sees a panel of experts assessing output submissions from universities and research laboratories and grading them on their quality and impact. An institution's performance in a REF assessment has a major impact on its ability to attract funding, resulting in a general tendency towards risk aversion. The REF is inclusive as a matter of policy, recognising research outputs from categories as diverse as software and musical composition, but universities are conservative in what they choose to submit and almost exclusively favour publications.

98% of outputs submitted in the most recent exercise (REF2021) were academic papers, with non-traditional research personnel seldom being included as co-authors. This approach essentially hides these roles from the REF assessment, ensuring that their contributions go unrecognised. Increasing the diversity of the outputs put before the REF will improve the recognition of these vital but underappreciated roles, leading to a fairer and more complete assessment of research in the UK.

The SSI has taken a multipronged approach to tackling this problem. In the first instance, we worked with the research software community and REF sub-panel 11 (Computer Science and Informatics) to co-produce guidelines for assessing software submissions[29]. Clearly confident in the SSI's expertise, the REF panel chairs agreed to adopt these guidelines across all REF assessment panels and included them in the REF FAQ. This effort built on previous work by the SSI that campaigned for the recognition of research software as a legitimate output, and defined the conditions under which software should be viewed as such. Our collective aim in advocating for software as a valuable output in its own right is not only to bring recognition to RSEs, but to drive improvements in standards across research.

[29] Good Practice in Submitting Software Outputs to REF2021, https://www.software.ac.uk/REF2021guidance
[30] Software Must be Recognised as an Important Output of Scholarly Research, http://www.ijdc.net/article/view/745

A competition to highlight overlooked research

In tandem with this work, the SSI has built a grassroots community to campaign for recognition of a broader range of research outputs and the hidden roles that help to create them. The centrepiece of this strategy is the popular hidden REF competition, which we held in 2021 to shine a light on underappreciated research outputs. The format of the hidden REF is modelled on the assessment approach taken by the REF itself, while the focus is on identifying and championing overlooked outputs.

The first competition received over 120 submissions in 22 categories from at least 44 institutions. The submissions were assessed by panels of experts against two main criteria: significance, which relates to the scale and importance of the contribution; and visibility, which considers the likelihood that the submission would otherwise have been overlooked by standard research evaluation measures. The hidden REF attracted significant media interest and stimulated a large number of conversations online. It culminated in an award ceremony attended by more than 130 people.

The body of submissions received by the hidden REF is an important repository of data on exclusion in research. Many entrants were able to provide specific examples of their research outputs failing to achieve recognition under the current regime. Understanding how this comes about is key to reforming the assessment framework. Interviews with hidden REF winners, along with reflections on lessons learned, have appeared in Nature, THE, and Emerald. Since running the competition, we have been asked by Research England to take part in the Future of Research Assessment Consultation. Our message is being heard.

The SSI will repeat the hidden REF every three years, as well as developing international collaborations with researchers who wish to franchise our approach and run similar competitions abroad.

To build on the momentum of the hidden REF, and provide the research community with a further opportunity to discuss ways of promoting non-traditional roles and outputs, the SSI will run the ‘Festival of Hidden REF’ in 2023. This event will bring together policymakers, funders, and members of the research community to explore issues around underrepresentation and develop solutions that will broaden research assessment and help grow the vital expertise that underpins all research.

Photo: Janine Hunter / Growing up on the Streets

“These children were so important for research, yet much of their contribution had been overlooked.”

Derrick G and Hettrick S,
Nature (2022)

Hidden REF winner (Citizen science): Growing up on the Streets
18 street children and youths provided the research team with weekly narrative accounts of what it was like to grow up on the streets of Ghana, the Democratic Republic of Congo and Zimbabwe.

“

If we don’t recognise the people who are **vital to research,** we limit our ability to conduct research

Professor Simon Hettrick, Deputy Director Software Sustainability Institute

Leadership Through Collaboration

Trusted Authority

- Pioneered research software sustainability, now helping establish equivalent organisations across the globe, including URSSI
- Invited by UKRI, OECD, UNESCO and European Commission to contribute to their software policies
- Developed “driving tests” for ARCHER and DiRAC supercomputers
- Delivered benefit to 535 projects via our consultancy and online tools

Working with other pioneers

- Founding member of the international Research Software Alliance
- Partnering with the UK Reproducibility Network and Turing Way to promote reproducible research
- Co-developed community building resources with the world-leading Center for Scientific Collaboration and Community

Global coordination

- Leading development of FAIR Principles for Research Software with 500+ contributors from 34 countries
- Formed Society of Research Software Engineering, and advised 10 national RSE chapters
- Our work on software citation adopted by major research infrastructures, including GitHub, Zenodo and Zotero

CS5: Working with policymakers to change research culture around software

The Software Sustainability Institute was founded in 2010 in response to growing concern among funders that software was poorly understood and supported by researchers, despite its integral importance to their work. The Institute has been a global leader in promoting the effective use of software in academic research, playing an instrumental role in transforming the policy landscape in the UK and internationally.

A first understanding of the role of software

One of the SSI's founding goals was to encourage researchers to use software in a way that supports reliable and reproducible research. This entailed a significant shift in behaviour, largely because traditional metrics for success in research (e.g. academic papers) tend not to engender the kind of collaborative, interdisciplinary environment that produces reliable software. Research culture emerges from a complex amalgam of policies implemented by government, funders, universities, and a number of other sources, and it was monumentally ambitious for a relatively small organisation like the SSI to attempt to change this culture. Our approach involved producing open data to evidence the need for reform, and then working collaboratively with policymakers to determine achievable changes that might move research culture in the right direction.

There was a paucity of evidence concerning the role of software in research and the extent of its use by researchers when the SSI was founded. We set out to gather this evidence. Our first study, conducted in 2014, surveyed around 500[31] staff at 15 Russell Group universities in order to measure software use and software reliance. It showed that around 90% of researchers from all disciplines used research software, while around 70% deemed software to be fundamental to their work. Having established a critical connection between research results and software, our influential and oft-cited study became a driving force for the creation of new software policy in the UK, the EU, the US, and beyond.

A collaborative approach that increases impact

The SSI's highly successful open research strategy raised the profile of the Institute and encouraged researchers to build on our data and methods. This soon led to invitations to work in partnership with policymakers. We carried out work with the BBSRC[32] on software licensing guidance, and provided early input into the Wellcome Trust's software policy[33]. We have collaborated with a vast range of policymakers to co-develop

[31] UK Research Software Survey 2014", DOI:10.5281/zenodo.1183562

[32] Developing Software Licensing Guidance for BBSRC Workshop, https://www.software.ac.uk/news/developing-software-licensing-guidance-bbsrc-workshop

[33] Our new policy on sharing research data: what it means for you, https://wellcome.org/news/our-new-policy-sharing-research-data-what-it-means-you

around 32 reports and policies[34]. These include works of national and international significance, such as the UKRI's ten year roadmap[35] and a highly influential OECD report on building digital workforce capacity and skills[36], seen by science ministers in all OECD countries. In 2022 alone, we worked with seven UK research councils to formulate policy, including the BBSRC, MRC, NERC, STFC, and UKRI. This work included a trio of reports commissioned by the AHRC[37], ESRC, and EPSRC to investigate software and computational skills. Fittingly, these expand and update our original 2014 study of software use in research.

Changing research culture relies on more than just generating new policies: organisations must also be persuaded to adopt them. The SSI is ideally placed to make the case for the reforms it helps to devise, having established itself as a significant international centre of expertise. Since 2010, SSI personnel have been invited or elected onto 135 boards and committees[38], of which 43% have an international remit and 42% have a national remit. The rate at which such invitations are being extended is accelerating as the influence of the SSI grows, with staff joining 65 boards and committees in the last three years alone.

A significant shift in culture

It can be difficult to measure the influence of a single organisation or piece of work on the formulation of new policy, since change normally comes about slowly and through the efforts of multiple parties. Nevertheless, the SSI can confidently claim a number of successes. Without the Institute, it is plainly unlikely that international policies on software citation principles or FAIR guidance for software[39] would exist. There would likely be no RSE community, and certainly no RSE Fellowships. It is doubtful that software maintenance grants would have been trialled[40], or that The Carpentries would have become so prevalent in the UK, without the intervention of the SSI.

More broadly, we have seen significant changes in the UK policy environment. Policymakers now accept that software plays an important role in research, and needs to be included in policy. A paradigm shift has occurred since the SSI came into being. As a result, we are routinely invited to consult on software early in the development of new policies, rather than having to argue, as we did in our early days, that existing policies are not fit for purpose because they fail to recognise the role of software in research.

While no institution can claim sole responsibility for bringing about this transformation in the policy landscape, and we welcome the contribution of others in the field, it is clear that much of the vital change that has taken place since 2010 is the result of the SSI's energetic and wide-ranging efforts.

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[34] https://www.software.ac.uk/other-reports

[35] White papers were not openly published

[36] Building digital workforce capacity and skills for data-intensive science, DOI: 10.1787/e08aa3bb-en

[37] To date, the AHRC report is the only one to have been published: https://www.ukri.org/wp-content/uploads/2022/10/AHRC-011122-SSIReport-ShapingDataAndSoftware PolicyInTheArtsAndHumanities.pdf

[38] See Appendix 7: Boards and Committees

[39] See following case study, "CS6: Transforming international software policy"

[40] Software for research communities, https://www.ukri.org/opportunity/software-for-research-communities/

The UK's visionary investment in the SSI enabled the adoption of practices for

developing research software

that meets the needs of

reliable, reproducible, and reusable research

Michelle Barker, Director, Research Software Alliance

CS6: Transforming international software policy

The Software Sustainability Institute is a global leader in promoting the development, implementation, and adoption of policies around research software. The widely used Software Citation Principles ensure that software developers are properly credited in scholarly publications, and the Citation File Format that derives from these principles has been adopted by three international organisations: GitHub[41], Zenodo[42] and Zotero. The FAIR Principles for Research Software (FAIR4RS) help developers to make tools that are findable, accessible, interoperable, and reusable. We have used our role as a trusted authority to define and develop these principles in collaboration with the research software community, while also contributing to major policies and recommendations around open research, reproducibility, and skills development.

Facilitating innovation in software policy

The SSI has been integral to the development and adoption of international research software standards through a combination of leadership, facilitation, and expertise. We bring together colleagues from across the wider research community to share ideas, obtain feedback, and encourage the adoption of policies that we have been instrumental in formulating. Both the Software Citation Principles and FAIR4RS have substantial roots in events organised and run by the SSI. Our 2015 Software Credit Workshop[43] involved many of the figures who would go on to develop the Software Citation Principles, while the SSI is a co-sponsor of the Workshop on Sustainable Software Sustainability (WoSSS)[44], which in 2017 ran one of the very earliest sessions on adapting the FAIR principles for software.

The Software Citation Principles were conceived in 2012 by Mike Jackson (an SSI staff member at the time) who published a green paper entitled 'How to cite and describe software'[45]. The following year, SSI Fellow Robin Wilson wrote an article[46] proposing a simple method for obtaining credit using plaintext citation files in code, and in 2014 the SSI started collaborating with the FORCE11 Software Citation Working Group, led by Arfon Smith, Daniel S. Katz, and Kyle Niemeyer, to devise a consistent interdisciplinary policy for software citation.

[41] Twitter, July 7 2021, https://twitter.com/natfriedman/status/1420122675813441540?lang=en
[42] Twitter, July 28 2021, https://twitter.com/ZENODO_ORG/status/1420357001490706442?s=20
[43] Software Credit Workshop, https://www.software.ac.uk/software-credit
[44] WoSSS workshop report (2017), DOI:10.17026/dans-xfe-rn2w
[45] How to cite and describe software, https://software.ac.uk/how-cite-software
[46] Encouraging citation of software – introducing CITATION files, https://www.software.ac.uk/blog/2016-10-06-encouraging-citation-software-introducing-citation-files

In 2017, the WSSSPE5.1 workshop and the FORCE11 hackathon, both co-organised by the SSI, established the need for a standard file format for citation, and brought together leading groups working on software citation to address key challenges. As a result, the SSI's 2018 Collaborations Workshop saw SSI Fellow Stephan Druskat presenting the first draft of the Citation File Format (CFF)[47] for community feedback. This groundbreaking concept was further developed during an SSI-sponsored Hack Day[48] at the RSE Conference in 2018, resulting in the creation of the Ruby-CFF library[49] by another SSI Fellow, Robert Haines. Thanks in large part to the efforts of the FORCE11 Software Citation Working Group (co-chaired by SSI Director, Neil Chue Hong), support for software citation using CFF was announced in 2021 by GitHub, Zenodo, and Zotero.

Ten years after the inception of the Software Citation Principles, guidance on software citation[50] was laid out by major publishers. The Journal Article Tag Suite for Reuse (JATS4R) now includes software citation metadata[51], and CHORUS maintains a list of journals and publishers[52] who have adopted the Software Citation Principles, all of which demonstrates the impact of the SSI's enduring community leadership and engagement. Our continued support of software citation has resulted in its implementation and adoption across the research infrastructure, ensuring that the people who create software are properly recognised.

A similar process is taking place with FAIR4RS. Initial discussions on how to extend FAIR to software at WoSSS17 led to the co-authorship of a position paper entitled 'Towards FAIR principles for research software'[53] and the formation in 2020 of an international working group to develop these principles, comprising the Research Data Alliance, the Research Software Alliance, and FORCE11, and co-chaired by SSI Director Neil Chue Hong. Over the next two years, Neil facilitated an international community consultation process that brought together more than 500 collaborators from 110 organisations and 34 countries to agree the text of the principles, which was published in 2022.[54]

[47] Citation File Format (CFF), https://citation-file-format.github.io/
[48] Citation File Format Hack Day @ RSE18, https://citation-file-format.github.io/events/rse18-hack-day/
[49] Citation File Format - Ruby CFF, https://github.com/citation-file-format/ruby-cff
[50] Recognizing the value of software: a software citation guide, DOI: 10.12688/f1000research.26932.2
[51] JATS4R Software Citations, Version 1.0, DOI:10.3789/niso-rp-40-2021
[52] Software Citation Policies Index, https://www.chorusaccess.org/resources/software-citation-policies-index/
[53] Towards FAIR principles for research software, DOI:10.3233/DS-190026
[54] FAIR Principles for Research Software (FAIR4RS Principles), DOI:10.15497/RDA00068

Software is a critical part of modern research yet there is little support for its acknowledgment and citation. Image Source DataCite

“Software is a critical part of modern research yet there is little support for its acknowledgement and citation”

DataCite

The SSI has been integral to the development and adoption of international research software standards. For example, the widely used Software Citation Principles were initially proposed by an SSI staff member and then championed by SSI Fellows and developed in SSI workshops and collaborations. The Software Citation Principles have since been adopted by three international organisations (GitHub, Zenodo, and Zotero).

Providing global leadership

The SSI is a recognised authority on research software policy, and in this capacity it has been asked to contribute to international efforts such as the UNESCO Recommendation on Open Science[55], the Paris Call on Software Source Code as Heritage for Sustainable Development[56], the OECD Recommendation on Access to Research Data from Public Funding[57], the OECD Expert Group on building digital workforce capacity and skills for data-intensive science[58], and NISO's recommended practice for reproducibility and badging[59]. We have also taken part in national funder reviews, including the BBSRC Review of Data-Intensive Bioscience[60] and the UKRI Research and Innovation Infrastructure Review.

We believe that culture change towards more reusable research and research software should not be seen as a top-down exercise. The SSI is a vital conduit through which grassroots community efforts to develop policy can secure recognition at the highest levels. Our approach has established the SSI on the international stage as an effective facilitator and coordinator, bringing together funders, policymakers, and other key players to encourage the adoption of forward-looking software policies that we have helped to design. The SSI's work on software policy is now a central plank of national and disciplinary research strategies.

[55] UNESCO Recommendation on Open Science, https://en.unesco.org/science-sustainable-future/open-science/recommendation

[56] Paris Call: Software Source Code as Heritage for Sustainable Development, https://unesdoc.unesco.org/ark:/48223/pf0000366715.locale=fr

[57] Recommendation of the OECD Council concerning Access to Research Data from Public Funding, https://www.oecd.org/sti/recommendation-access-to-research-data-from-public-funding.htm

[58] Building digital workforce capacity and skills for data-intensive science, DOI:10.1787/e08aa3bb-en

[59] Reproducibility Badging and Definitions, https://www.niso.org/publications/rp-31-2021-badging

[60] BBSRC publishes review of data-intensive bioscience, https://www.ukri.org/news/bbsrc-publishes-review-of-data-intensive-bioscience/

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The materials and approach developed by the Software Sustainability Institute **clearly demonstrate compounded experience, built up over a long period of time**, **and we consider ourselves lucky to be able to benefit from this experience.**

Tom Honeyman, Australian Research Data Commons

CS7: Healthchecks: Consultancy that improves research software

The Software Sustainability Institute's Online Sustainability Evaluation and Research Software Health Check services have a proven track record of transforming the way researchers carry out their work and interact with their communities. Tailored consultations with experienced RSEs equip researchers to write and use better software by providing knowledge of coding best practice, strategies for harnessing community feedback, and the confidence to embrace open science principles.

Offering world-class expertise

Too much research software is written without the help of skilled software engineers, which means that too much research is underpinned by poor and potentially unreliable code. A significant proportion of the SSI's work focuses on creating a research environment that demands reliable software. We also directly address the problem of poor code by providing tailored advice through two distinct consultation services: the Online Sustainability Evaluation and the Research Software Healthcheck.

The Online Sustainability Evaluation is a light-touch consultation in which participants complete a straightforward 15-minute online survey. On the basis of their responses, a bespoke report is generated with recommendations on how to implement best practice in their work. More than 460 projects have benefited from an Online Sustainability Evaluation. We encourage researchers to consider factors like the needs of their users and the ongoing sustainability of their software. Unlike some forms of code review, the Online Sustainability Evaluation process is designed to be encouraging rather than intimidating.

"I'd recommend the Online Sustainability Evaluation provided by the SSI for anyone seeking to improve the sustainability of their research software." Graeme Watt, Durham University

The Research Software Healthcheck is a significantly more rigorous process that sees the Institute's RSEs working directly with researchers for up to two months to improve the quality and usability of their research software. This service is available by application only and builds on our previous consultancy work with over 75 projects. We review submitted proposals every two months, with four accepted projects in the first pilot, and prioritise them based on which projects are most in need of our help and which will be most impactful for the research community.

Creating confidence and raising standards

Researchers, anticipating negative feedback, can be reluctant to show their software to colleagues. Software developed without scrutiny is far more likely to contain errors and fall short in terms of reliability and user-friendliness. With the Research Software

Healthcheck, the SSI has deliberately set out to create a supportive environment in which researchers can share their software, discuss their concerns, and receive world-class advice. Our goal is both to assist individual researchers and to improve open software standards generally.

Ersilia Open Source Initiative: Encouraging community engagement

The Ersilia Open Source Initiative is a nonprofit organisation that accelerates drug discovery for neglected diseases by equipping hospitals, universities, and laboratories in under-resourced countries with data science tools for research. Ersilia recently approached the SSI for help, completing an initial Online Sustainability Evaluation before taking part in a full Research Software Health Check. The SSI produced an eight-page report containing not only a number of technical and best practice recommendations, but also some crucial insight on user experience.

We quickly realised that the report was not about the technicalities. It was much more profound than this. I believe that [it was] trying to tell me: think about your users, think about your community." Miquel Duran-Frigiola, co-founder of Ersilia

One of the Ersilia's most consequential acts following the Research Software Health Check was to cultivate an active, strong international community of 91 researchers & developers on Slack. These new collaborators routinely test and provide feedback on the machine-learning models they write and the software they produce.

Thanks to the recommendations contained in the SSI Health Check, the number of models held in the Ersilia Model Hub has increased more than twelvefold (from seven to 89), with Ersilia aiming to reach 200 models by March 2023. Our Health Check was also integral to the development of the Ersilia Model Hub itself, the creation of which enabled the organisation to join Fast Forward's Accelerator programme[61] where it became the first non-profit organisation outside of the US to have been selected in 12 years.

Having sought the help of the SSI, Ersilia is better able to create software that addresses the needs of its end users.

"Coming from a purely academic background, we did not realise how critical good software development practices are. The Research Software Health Check gave us the necessary guidelines to evolve our prototype to a professional-looking, stable and scalable platform. Thanks to this, we now have a dynamic community of contributors, many of them joining spontaneously and autonomously." Miquel Duran-Frigiola, co-founder of Ersilia

[61] Fast Forward, https://www.ffwd.org/accelerator/

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I understood very quickly that the service was here to help,

not to judge me.

So I would recommend that people just apply no matter the current status of their code

Miquel Duran-Frigiola, co-founder of Ersilia

Building capacity

Reaching new audiences

- 500 training workshops in the UK
- 7000 learners from across research disciplines
- 10,000 twitter followers and 2 million website views including 500,000 unique readers of our blog
- 42% of people at Research Software Camps are new to the SSI

Nurturing the next generation

- 300 UK instructors trained to deliver and develop lessons
- Network of 217 Fellows from 119 organisations
- New RSE groups at 40 research organisations in the UK
- 1-to-1 mentoring for 22 researchers in 2022

Meeting community needs

- Met international demand for intermediate software development course, delivered to 120 people in 2022
- Commissioned and developed new courses in coding for AI/ML, statistics, social sciences, HPC and industry
- Training COVID-19 researchers to produce better software as part of Rapid Assistance in Modelling the Pandemic

CS8: Revolutionising access to software training

Lack of access to training makes research slow, inefficient, and frustrating. To combat this, the Software Sustainability Institute has entered into a highly successful collaboration with The Carpentries, an international nonprofit organisation, to deliver high quality training in research software and reproducible research skills. In the last 10 years the SSI has organised, helped facilitate, and taught more than 500 UK workshops, reaching over 7,000 learners. We have also played a crucial role in identifying additional training requirements, and supported the development of new Carpentries courses that have been adopted across the world. The Institute is now working to further broaden access to training by enabling researchers to develop bespoke training regimes around the needs of their particular research domains.

Supporting good practice in research software

Too few researchers use software effectively, leading to inefficient research that lacks reproducibility. In seeking to remedy this issue, the SSI chose to partner with The Carpentries rather than develop a rival set of training materials. This partnership embraces the SSI's 'collaborate, don't compete' ethos, and has led to a fruitful collaboration that has revolutionised access to research software training within the UK and around the world.

> ***"Without the Software Sustainability Institute, The Carpentries would probably not exist today. The SSI's support was instrumental in helping prove that The Carpentries' model worked and could scale, and subsequent collaborations at multiple levels have helped to shape everything from curriculum to policy."***
> Dr Greg Wilson, co-founder, Software Carpentry

One of the aims of Phase 3 is to ensure that our activities are scalable, enabling us to meet growing demand with the resources currently at our disposal. To this end, we have embraced the 'train the trainer' approach of The Carpentries, teaching around 300 instructors how to deliver their own workshops and train new instructors. Having seen success with this approach, we are applying it again in a scheme aimed at equipping researchers with lesson development skills, enabling them to transcribe their knowledge and methods into high quality training materials. The SSI also supports training through the Fellowship Programme: many of our Fellows have devoted their resources to developing and delivering training, and creating communities of practice within their respective research domains.

Shaping the future of software training

The SSI is a backbone organisation that provides behind-the-scenes support to the training community. We bring UK trainers from across the sector together once a month for the 'leadership training meeting', maintain the community's mailing list, help to organise events (e.g. CarpentryCon, CarpentryConnect, and the Collaborations Workshops), and work to bring colleagues from a diverse range of disparate communities into a single network. This in turn encourages individuals to develop training communities, greatly increases the amount of training available, and improves researchers' access to training. As a result, the UK is now an international leader in the number of workshops it delivers.

"The instructors and helpers are very knowledgeable and the learning material was brought across very clearly. As a whole,the workshop taught me valuable tools which I will indeed apply in current and future research." Workshop participant

"You can ask questions about anything you find unclear and an expert will answer them. This is much faster than hunting for answers online when you're starting from no knowledge as you don't even know how to pose the question"
Workshop participant

"The instructors were well prepared, knowledgeable,very helpful and created an interactive environment to make learning of the skills easier." Workshop participant

More recently, the SSI has become instrumental in shaping the future of training in the UK by driving the development of new courses. We worked closely with The Carpentries to support the expansion of the training it offers, from general foundation skills to courses within the Library Carpentry and Data Carpentry projects. We are currently developing additional materials on statistics in machine learning for public health, the use of GitHub for project management, intermediate research software development, and more (see 'CS9: Intermediate Software Skills: The next step in collaborative research software training'). Our close working relationship with The Carpentries has enabled us to play a key role in its development. For example, the SSI's Training Lead, Aleksandra Nenadic, is a member of The Carpentries Executive Council, and thus holds a key role in shaping the strategy and direction of The Carpentries at an international level.

The SSI recognises that researchers are hugely knowledgeable within their domains, and uniquely aware of their communities' training needs. But they too often lack the time, skills, and confidence to develop the bespoke training they require. We have addressed this by developing a course that teaches pedagogical principles and provides a template for lesson infrastructure.[62] This course enables domain experts to write and deliver their own bespoke training materials using a single, reusable format that they can share with other instructors within the community. This course goes hand-in-hand with Carpentries Instructor Training and the broader Carpentries lesson infrastructure approach. By using a common set of principles, formats, and teaching patterns, we have created a large pool of instructors to deliver training to the same high standard and with a consistent approach.

[62] Introducing The Carpentries Workbench, https://carpentries.org/blog/2022/01/live-lesson-infrastructure/

While the SSI and its collaborators have made enormous progress in bringing accessible, high quality training to researchers, our task is not complete. We will continue to increase the quantity and scope of training available to researchers by enabling communities to develop and deliver their own training to future generations of instructors and lesson developers. In addition, we are working with communities to identify and meet emerging needs. In pursuit of these goals, the SSI will continue to advocate that universities incorporate training in computational research tools and best practices into their undergraduate and postgraduate curricula, while meeting current needs through foundational and advanced short courses.

UK coordinator for Software Carpentry since 2012

> 500 workshops run across 60 Institutions, including

81 Data carpentry

13 Library carpentry

25 Train the trainer

283 Software carpentry

7000 people trained (in the UK)

300+ new instructors trained

14 UK institutions hosted 10 or more Carpentry workshops

Ramp Pandemic Response

In the very early days of the COVID-19 pandemic, the SSI was approached by the Scottish Covid-19 Response Consortium (SCRC) and asked to provide urgent training to scientists working on the country's public health response. The SSI responded quickly and delivered a bespoke course on version control within just three days of the initial contact. When surveyed after the course, 90% of participants said they intended to use the skills that were taught.

"The work you did early on to set up and give these courses remotely definitely sped up the early stages of our model development and made it go much more smoothly than we had expected." Richard Reeve, founder of the Scottish Covid Response Consortium response to the Royal Society's RAMP scheme

"Perfect for my needs." RAMP training participant

"100% useful, very well thought through and paced well."
RAMP training participant

“Best course I have been on for a long time. Highly recommended. Will be promoting this within my team”

Intermediate Skills training participant from AstraZeneca

The SSI has worked with researchers across academia and industry to develop new training materials aimed at taking learners beyond the initial Carpentries training. These materials have been accepted into the Carpentries Incubator, where they are being tested and refined by the global Carpentries community.

“

Without the Software Sustainability Institute,

The Carpentries would probably not exist today

Dr Greg Wilson, co-founder, Software Carpentry

CS9: Intermediate Software Skills: The next step in collaborative research software training

Our foundation-level training materials have been hugely popular among researchers seeking to improve their software engineering skills. But the advanced knowledge required for collaborative software development is beyond the scope of foundation teaching. We addressed this by developing open source materials on collaborative research software development. These popular new materials have been accepted to The Carpentries Incubator, where they are being tested and refined by the global Carpentries community.

Helping researchers to improve their software skills

There is a notable lack of advanced training material on research software engineering, and graduates of the introductory Software Carpentry course commonly express frustration at the absence of a pathway into more advanced topics. To address this widespread frustration, the SSI has developed and extensively tested the Intermediate Software Skills training course, which allows researchers to progress beyond foundation level and gain the necessary skills to produce more efficient, robust, and reproducible research. The course helps researchers create well-engineered, reusable, robust, and fully tested software.

We developed the course in close collaboration with our colleagues in the research community, allowing us to ensure that it addresses their needs. Among the most significant of those needs was a strategy for managing the highly complex process of collaborating with multiple research software users and developers. The materials we developed provide deeper training on tools such as version control and automated testing, and on practices like architecting code. The course teaches participants how to work with others to co-develop software, using an open, collaborative approach to software design. The format of the course allows for a variety of approaches, including self-learning with helper support and instructor-led, either in person or online.

Working with learners to refine Intermediate Software Skills training

Since launching the course in mid-2021, we have delivered nine Intermediate Software Skills workshops. At least three additional workshops have been delivered independently by people and institutions outside the SSI, and in total the course has reached no fewer than 120 learners so far. Our Intermediate Software Skills course has enjoyed significant input from both academic and industrial collaborators, and it continues to evolve, incorporating feedback from PhD students via the SABS:R3 Centre for Doctoral Training in Biomedical Scientists, and from AstraZeneca staff who took part in the Intermediate Software Skills course after AstraZeneca awarded a $100k training grant to the SSI. This iterative and collaborative approach to lesson development, where materials are refined in response to feedback from a range of sources, allows the SSI to address the needs of multiple communities.

We anticipate that the course will be officially endorsed in The Carpentries Laboratory in 2023. In the meantime, the materials are publicly available, and any qualified Carpentries instructor may use them. Based on the demand we have received for this training, we expect the Intermediate Software Skills course to become as popular as our fundamentals course in time, with substantial take-up across the UK and worldwide.

CS10: Building new audiences with Research Software Camps

The lack of software skills in research is well known. The Software Sustainability Institute's Research Software Camps (RSCs) help address this widespread shortcoming through free online introductory workshops and resources. Our RSCs allow researchers with limited or no experience of software engineering to learn new coding skills and receive personal guidance in a welcoming and supportive environment. With more than 40% of participants being previously unaware of the SSI, our RSCs successfully fulfil their remit of broadening our audience.

Tapping into new audiences

Over the last decade the SSI has encountered a significant number of researchers who are unaware of good research software practices, and lack the professional support or personal confidence to learn. Our Research Software Camp initiative improves coding literacy by providing researchers with tailored programmes consisting of online workshops; panel discussions; resources such as guides, articles, and videos; and one-to-one support around specific topics within research software. The RSC format prioritises entry-level training while also supporting the transition to intermediate skills.

> ***"Brilliant content, engaging presenters, really useful topics explained in an accessible way without overwhelming jargon, and a well thought out way to present it with … interactive elements and plenty of resources for further reading."***
> RSC attendee

Raising awareness of research software practices

Since the inception of the programme in 2021, the SSI has run four Research Software Camps, tackling the themes of research accessibility, research tools, improving computational skills, and mental health. Research Software Camps have succeeded in the difficult feat of reaching new audiences: more than 40% of those who have attended Research Software Camps to date were unaware of the SSI at the time of registration, and the number of attendees has grown by around 300% since the first RSC, from under 50 to almost 200. This was achieved by targeting specific projects we had not contacted before and making sure that publicity was clear on the experience level: beginners with no previous experience of coding. Examples of new collaborators include Liberate Science (led by Chris Hartgerink) and Metadocencia (through Yanina Bellini Saibene, now on the RSCs steering committee).

The RSCs have received excellent feedback, indicating a clear appetite for both introductory and pre-intermediate workshops and resources:

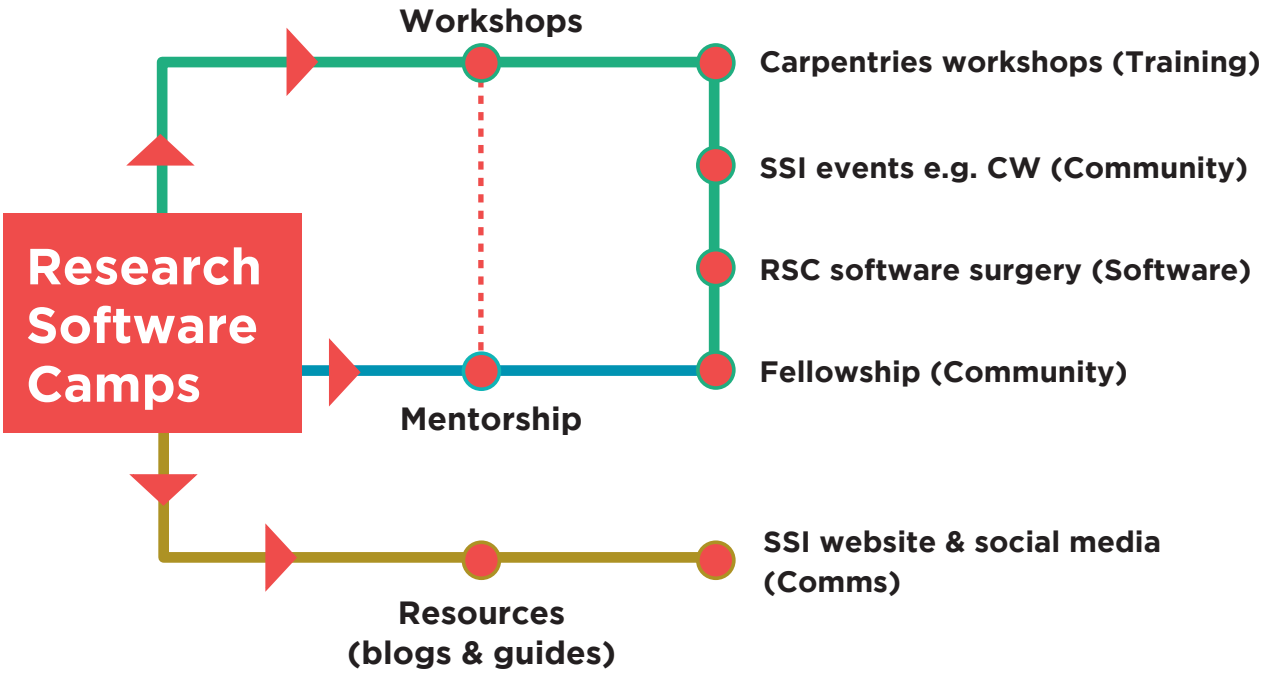
"I thought the Camp was great. I learnt a lot about what I didn't know, so now I can" learn more about areas that I didn't know existed!" RSC participant

"I have learned so much! Great to have a software sustainability course tailored to researchers!" RSC participant

Through online panel discussions and workshops, Research Software Camp have facilitated new collaborations between members of the research community and served as a gateway for many into the world of research software. Some attendees and workshop facilitators have even entered into collaborations with the SSI itself. In May 2022, we worked with MetaDocencia, a Latin American community of educators, to offer the first Research Software Camp workshop in Spanish, teaching researchers how to use R for data visualisation. This importantly addresses the English-language centric nature of most training. Participants awarded this session a rating of 10/10 on the question of whether they would be prepared to recommend it to others.

Future RSCs will explore better engagement with potential collaborators and encourage participation in other important schemes and activities offered by the SSI.

The Research Software Camps are a pathway to many other SSI resources and activities.



Providing one-to-one support

One of the conclusions the SSI drew from running the first RSC is that beginners and unskilled learners need additional support. As a result, we now integrate a supplementary 10- to 12-week mentorship programme where appropriate, allowing participants to receive follow-on training from volunteer mentors to further develop their skills and knowledge.

This [mentorship] programme was a valuable learning experience, and has encouraged me to continue to learn more about the field of Research Software Engineering, especially within the area of Psychology." RSC mentee

The RSC mentorship scheme benefits mentors, too.

[Being a mentor is] a valuable opportunity … to pay forward the generosity of those who mentored us and a chance to reinforce your own coding fundamentals.
RSC mentor

Through its RSC programme, the SSI has coordinated mentor support for 22 researchers worldwide so far. We intend to build on this experience to refine the application process, and will organise information sessions for mentors and mentees and attract alumni of previous mentorships to become mentors in future programmes.

RSCs are inclusive and supportive events that encourage participants to discuss difficult topics. Our most recent RSC, which took place in November 2022, dealt with mental health in research, and included a panel on managing stress in research software and a workshop on mindfulness.

We will continue to explore a broad range of themes in our RSCs, which will further broaden the SSI's audience and help cultivate a robust, skilled, and happy research software community.

“

I have learned so much!

Great to have a software sustainability course tailored to researchers!

Research Software Camp participant

Glossary

AHRC – The Arts and Humanities Research Council.

BBSRC – The Biotechnology and Biological Sciences Research Council.

BSSw – Better Scientific Software provides a central hub for the community to address pressing challenges in software productivity, quality, and sustainability.

CarpentriesOffline – A project that aims to facilitate Software Carpentry and Data Carpentry lessons to be taught from a cluster of Raspberry Pis, allowing them to be run in places with unreliable Internet connections.

CarpentryCon – The key biennial community-building and networking event in The Carpentries' calendar of activities.

CarpentryConnect - Community convenings organised to bring together community members of The Carpentries that are in close proximity geographically for knowledge exchange, collaboration, and networking.

CFF – Citation File Format is a human and machine-readable file format which provides citation metadata for software.

CHORUS – A suite of services and best practices that provide a sustainable solution for agencies and publishers to monitor and deliver open access to published articles reporting on funded research.

Citation File Format – See CFF.

CODECHECK – An Open Science initiative for the independent execution of computations underlying research articles during peer review to improve reproducibility.

Coding Confessions – An initiative to change the culture of disclosing mistakes and build a collection of stories highlighting failures and lessons learned from them.

Collaborations Workshop – See CW.

Communities of practice – Groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly.

CSCCE – The Center for Scientific Collaboration and Community Engagement.

CW – Collaboration Workshops are three-day participant-driven events, attended by a diverse interdisciplinary audience of around 80 to 100 people from across the research community.

Data Carpentry – A lesson program within The Carpentries that aims to teach fundamental concepts, skills and tools for working more effectively with data.

Data Science for Doctors – A programme based on The Carpentries' Data Carpentry aimed at teaching healthcare professionals basic concepts, skills and tools for working more effectively with data.

de-RSE – The German RSE chapter.

ELIXIR-UK Data Stewards Fellowship Programme – A project that aims to support the life sciences UK workforce in research data management and to professionalise the role of Data Stewards.

EPSRC – The Engineering and Physical Sciences Research Council.

Ersilia Model Hub – A repository of ready-to-use machine learning models for drug discovery and global health.

Ersilia Open Source Initiative – A UK-based charity whose mission is to strengthen research capacity against infectious and neglected diseases.

ESRC – The Economic and Social Research Council.

Event Organisation Guide – A guide developed by the SSI based on the Institute's experience organising small and large-scale events.

FAIR principles for Research Software – See FAIR4RS.

FAIR4RS – A set of principles that help developers make tools that are findable, accessible, interoperable, and reusable.

Fast Forward's Accelerator programme – An initiative that bridges the tech and non-profit worlds, providing training and resources applicable to the specific challenges a tech non-profit entrepreneur may encounter.

Fellowship Programme – An initiative that provides funding for individuals who want to improve how research software is used in their domains, fields, and/or areas of work.

Festival of Hidden REF – An event that brings together policymakers, funders, and members of the research community to explore issues around underrepresentation and develop solutions that will broaden research assessment and help grow the vital expertise that underpins all research.

FORCE11 – The Future of Research Communications and e-Scholarship is a community of scholars, librarians, archivists, publishers, and research funders that has arisen organically to help facilitate the change toward improved knowledge creation and sharing.

FORCE11 Software Citation Working Group – A group that aims to uphold, test, and update the principles developed by the Software Citation Working Group.

Future of Research Assessment Consultation – An initiative that aims to explore possible approaches to the assessment of UK higher education research performance.

Hack Day competition – An initiative that takes place on the third day of the Collaborations Workshops in which groups work together to develop and expand the ideas generated during the preceding days.

Hidden REF competition – A competition that recognises all research outputs and every role that makes research possible.

International Council of RSE Associations – An organisation that provides a formal open forum for established national and multinational RSE associations to talk and coordinate regularly, and thus sustain international collaboration.

JATS4R – A working group devoted to optimising the reusability of scholarly content by developing best-practice recommendations for tagging content in JATS XML.

Journal Article Tag Suite for Reuse – See JATS4R.

Liberate Science – An organisation that aims to distribute the production and consumption of research in an equitable and fair manner.

Library Carpentry – An organisation that focuses on building software and data skills within library and information-related communities.

MetaDocencia – An organisation that aims to advance innovation with a local perspective that responsibly builds scientific and technical capacities through the co-creation of networks, learning spaces, and accessible resources for Spanish-speaking communities.

MRC – The Medical Research Council.

National Teaching Fellow – An individual that has been recognised by The National Teaching Fellowship Scheme (NTFS) for their outstanding impact on student outcomes and the teaching profession.

NERC – The Natural Environment Research Council.

NISO – The National Information Standards Organization is a non-profit organization that develops, maintains, and publishes technical standards related to publishing, bibliographic and library applications.

OECD – The Organisation for Economic Co-operation and Development is an intergovernmental organisation that aims to stimulate economic progress and world trade.

Online Sustainability Evaluation – A short, free, online version of the full sustainability evaluation delivered by the SSI.

Open Life Science – A programme that helps people interested in applying open principles in their work and becoming Open Science ambassadors in their communities.

REF – The Research Excellence Framework is the UK's system for assessing the excellence of research in UK higher education providers.

Research Data Alliance – A community-driven initiative that aims to build the social and technical infrastructure to enable open sharing and re-use of data.

Research Excellence Framework – See REF.

Research Software Alliance – An organisation that aims to bring research software communities together to collaborate on the advancement of the research software ecosystem.

Research Software Camp – See RSC.

Research Software Health Check – A free evaluation service delivered by the SSI.

RSC – Research Software Camps are free online events organised by the SSI to introduce and explore a topic around research software and start discussions among various research communities.

RSE – Research Software Engineer.

RSE Leaders Network – A community that exists to promote knowledge exchange and provide support on issues related to employing RSEs.

RSECon – The Society of Research Software Engineering's annual conference.

Ruby-CFF library – A library that provides a Ruby interface to create and edit Citation File Format files.

SABS:R3 – The EPSRC Sustainable Approaches to Biomedical Science: Responsible and Reproducible Research Centre for Doctoral Training trains doctoral students in cutting-edge, collaborative systems approaches to biomedical research and advanced practices in software engineering.

Scottish Covid-19 Response Consortium – See SCRC

SCRC – The Scottish Covid-19 Response Consortium is a group of epidemiologists, mathematical modellers, data scientists, software developers and other scientists that have come together to develop new models to help inform the control of COVID-19.

Software Citation Principles – A set of principles that explain how to cite and describe software.

Software Credit Workshop – An event that aimed to capture the credit needs of those who produce software as part of or in support of research.

SORSE – A Series of Online Research Software Events developed as an answer to the COVID-19-induced cancellation of many national RSE conferences.

Speed blogs – Written posts, podcasts, video presentations, diagrams, or short plays that put together the ideas developed during the Collaborations Workshops.

SSI – The Software Sustainability Institute.

STFC – The Science and Technology Facilities Council carries out research in science and engineering, and funds research in areas including particle physics, nuclear physics, space science, and astronomy.

The Carpentries – The Carpentries project comprises the Software Carpentry, Data Carpentry, and Library Carpentry communities of instructors, trainers, maintainers, helpers, and supporters who share a mission to teach foundational computational and data science skills to researchers.

The Carpentries Incubator – A space for The Carpentries community to create, test, and improve lessons, supported by systems, process, and training to foster collaboration and promote better lesson design.

The Carpentries Instructor Training – A training course that covers the basics of educational psychology, evidence-based classroom practices, and how to apply both to teaching workshops for The Carpentries.

The Carpentries Laboratory – A place for high-quality, stable lessons, which provides a space and processes for open peer review of lessons and hosts a collection of reviewed lessons for members of The Carpentries community to teach in their own workshops.

The Carpentries Workbench – The place where all lessons developed by The Carpentries are stored and accessed.

The Society of Research Software Engineering – An organisation that aims to establish a research environment that recognises the vital role of software in research.

UKRI ExCALIBUR – The Exascale Computing ALgorithms & Infrastructures Benefiting UK Research is a UK research programme that aims to deliver the next generation of high-performance simulation software for the highest priority fields in UK research.

UKRSE – The UK Research Software Engineers Association.

URSSI – The US Research Software Sustainability Institute.

Workshop on Sustainable Software Sustainability – See WoSSS.

WoSSS – Workshop on Sustainable Software Sustainability is a series of international workshops on the topic of software sustainability.

WSSSPE - The Workshop on Sustainable Software for Science: Practice and Experiences is an international community-driven organization that promotes sustainable research software by addressing challenges related to the full lifecycle of research software through shared learning and community action

Appendix

Appendix 1: Software Sustainability Institute staff members

Name	Role
Neil Chue Hong	Director, PI
Simon Hettrick	Deputy Director, Co-I
Caroline Jay	Research Director, Co-I
Les Carr	Co-investigator
David De Roure	Co-investigator
Carole Goble	Co-investigator
Mark Parsons	Co-investigator
Selina Aragon	Team Lead - Communications
Steve Crouch	Team Lead - Software
Aleksandra Nenadic	Team Lead - Training
Shoaib Sufi	Team Lead - Community
Rachael Ainsworth	Community Manager
Mario Antonioletti	Community Officer / Research Software Engineer
Anita Banerji	Research associate - impact and equity, diversity and inclusivity
Jenny Braidwood	Project Officer
Clem Hadfield	Event Manager
Denis Barclay	Communications Officer
Giacomo Peru	Project Coordinator
Kirsty Pringle	Project Manager
John Robinson	Senior Software Consultant
Graeme Smith	Events Coordinator
Sohail Sukhiani	Project Officer

Appendix 2: Software Sustainability Institute Alumni

List of previous staff members at the SSI in reverse chronological order

Leaving Year	Name	Category	SSI Role	Current Role	Current Institution
2022	James Graham	SSI Staff Alumni	Research Software Engineer	Head of RSE Group	Kings College London
2022	Ioanna Lampaki	SSI Staff Alumni	Data Scientist	Architect (Data Science)	University of Edinburgh
2022	Jacalyn Laird	SSI Staff Alumni	Communications Officer	Communications Officer	SAC Consulting
2022	Johanna Walker	SSI Staff Alumni	Researcher		
2022	Claire Wyatt	SSI Staff Alumni	Community Manager for UK Research Software Engineering	Community Manager for Research Software Engineering	Jülich Supercomputing Centre
2021	Ania Brown	SSI Staff Alumni	Research Software Engineer	Research Software Engineer	NVIDIA
2020	Agata Dybisz	SSI Staff Alumni	Events Manager (interim)	Administrator for Alumni, Events and Teaching Support	University of Oxford
2020	Lucia Michielin	SSI Staff Alumni	Edinburgh Carpentries Coordinator	Digital Skills Training Manager	University of Edinburgh
2019	Olivier Philippe	SSI Staff Alumni	Policy Researcher	Research Engineer	Barcelona Supercomputing Center
2019	Raniere Silva	SSI Staff Alumni	Community Officer	PhD Student	City University of Hong Kong
2018	Iain Emsley	SSI Staff Alumni	Research Software Engineer	Academic Technologist	University of Warwick

Software Sustainability Institute Alumni

Leaving Year	Name	Category	SSI Role	Current Role	Current Institution
2018	Mike Jackson	SSI Staff Alumni	Research Software Engineer	Principal Architect	University of Edinburgh
2017	Malcolm Illingworth	SSI Staff Alumni	Research Software Engineer	Applications Consultant	University of Edinburgh
2017	Devasena Inupakutika	SSI Staff Alumni	Research Software Engineer	Senior Performance Engineer	Samsung Semiconductor
2017	Charaka Palansuriya	SSI Staff Alumni	Research Software Engineer	Applications Consultant	University of Edinburgh
2017	Priyanka Singh	SSI Staff Alumni	Research Software Engineer	Data Science Lead	Babcock International Group
2016	Toni Collis	SSI Staff Alumni	Consultant	Leadership Coach and Company Director	Collis Holmes Innovations
2016	Paul Graham	SSI Staff Alumni	Research Software Engineer	Senior Solutions Architect	NVIDIA
2016	Albert Heyrovsky	SSI Staff Alumni	Research Software Engineer	Data Engineer	Farm Sanctuary
2016	Jeremy Nowell	SSI Staff Alumni	Research Software Engineer	Senior Software Developer	Yardi
2016	Aleksandra Pawlik	SSI Staff Alumni	Training Lead	e-Research Instructor	Manaaki Whenua - Landcare Research
2015	Alexander Hay	SSI Staff Alumni	Communications Officer	Lecturer of Digital Journalism	Southampton Solent University
2014	Arno Proeme	SSI Staff Alumni	Software Consultant	Architect	University of Edinburgh
2013	Malcolm Atkinson	SSI Staff Alumni	Co-Investigator	Retired / Professor Emeritus	University of Edinburgh
2012	Rob Baxter	SSI Staff Alumni	Development Manager	National Digital Infrastructure Technical Lead for the DARE UK	Health Data Research UK
2012	Duncan Hull	SSI Staff Alumni	Community Officer	Lecturer	University of Manchester

Appendix 3: Publications

List of publications that SSI has contributed to during SSI3, sorted reverse chronologically.

1. Stewart, S. et al. including Jay, C., 2022, **Reforms to improve reproducibility and quality must be coordinated across the research ecosystem: The view from the UKRN Local Network Leads,** *BMC Research Notes,* https://doi.org/10.1186/s13104-022-05949-w
2. Martinez-Ortiz, C., Goble, C., Katz, D., Honeyman, T., Martinez, P., Barker, M , Castro, L.J., Chue Hong, N., Gruenpeter, M., Harrow, J., Lamprecht, A.-L. and Psomopoulos, F., 2022, **How does software fit into the FDO landscape?,** *Research Ideas and Outcomes,* https://doi.org/10.3897/rio.8.e95724
3. Soiland-Reyes, S., Castro, L. J., Garijo, D., Portier, M, Goble, C. Groth, P., 2022, **Updating Linked Data practices for FAIR Digital Object principles,** *Research Ideas and Outcomes,* https://doi.org/10.3897/rio.8.e94501
4. Yehudi, Y., Hughes-Noehrer, L, Goble, C and Jay, C., 2022, **Subjective data models in bioinformatics: Do wet-lab and computational biologists comprehend data differently?,** *arXiv,* https://doi.org/10.48550/arXiv.2208.12346
5. Bjaalie, J. G., Goble, C., Sansone, S-A., Nakamura, R. and Martone, M., 2022, **Perspectives on Data Sharing and the New NIH policy from the European Union,** *Harvard data science review,* https://doi.org/10.1162/99608f92.bcd0b999
6. Soiland-Reyes, S. et al including Goble, C., 2022, **Packaging research artefacts with RO-Crate,** *Data Science,* https://doi.org/10.3233/ds-210053
7. Crusoe, M. et al including Goble, C. , 2022, **Methods included: standardizing computational reuse and portability with the Common Workflow Language,** *Communications of the ACM,* https://doi.org/10.1145/3486897
8. Yehudi, Y. Hughes-Noehrer, L., Goble, C. and Jay, C. , 2022, **COVID-19: An exploration of consecutive systemic barriers to pathogen-related data sharing during a pandemic,** *arXiv,* https://doi.org/10.48550/arXiv.2205.12098
9. Alharbi, E. et al including Jay, C. and Goble, C. , 2022, **Selection of data sets for FAIRification in drug discovery and development: Which, why, and how?,** *Drug Discovery Today,* https://doi.org/10.1016/j.drudis.2022.05.010
10. Xu, F. including Goble, C., 2022, **Features of a FAIR vocabulary,** *Research Square,* https://doi.org/10.21203/rs.3.rs-1465079/v1
11. Hardisty, A. including Goble, C., 2022, **The Specimen Data Refinery: A Canonical Workflow Framework and FAIR Digital Object Approach to Speeding up Digital Mobilisation of Natural History Collections,** *Data Intelligence,* https://doi.org/10.1162/dint_a_00134

12. Brack, P. including Goble, C. , 2022, **Ten simple rules for making a software tool workflow-ready,** *PLOS Computational Biology,* https://doi.org/10.1371/journal.pcbi.1009823

13. Radanliev, P. and De Roure, D. , 2022, **Advancing the cybersecurity of the healthcare system with self-optimising and self-adaptative artificial intelligence (part 2),** *Health and Technology,* https://doi.org/10.1007/s12553-022-00691-6

14. Radanliev, P. and De Roure, D. , 2022, **New and emerging forms of data and technologies: literature and bibliometric review,** *Multimedia Tools and Applications,* https://doi.org/10.1007/s11042-022-13451-5

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Appendix 4: Grants awarded to the Software Sustainability Institute

Title	Total Value	Funder	Date	SSI Role	SSI Staff
"Understanding and Nurturing an Integrated Vision for Education in RSE and HPC (UNIVERSE-HPC), EP/W035731/1"	£506,812	EPSRC	March 22 - March 25	SSI Led	PI: Neil Chue Hong
https://gow.epsrc.ukri.org/NGBOViewGrant.aspx?GrantRef=EP/W029588/1	£400,525	EPSRC	March 22 - March 25	SSI Collaborator	PI: Simon Coles, University of Southampton CoI: Simon Hettrick
Provision of Intermediate Software Development Training for AstraZeneca	£124,800	AstraZeneca	March 22 - October 22	SSI Led	PI: Aleksandra Nenadic
FAIR-Impact: expanding FAIR solutions across EOSC	£8,300,000	Horizon Europe	Feburary 22 - January 25	SSI Collaborator	PI: Ingrid Dillo, DANS
Software and Skills for Large-Scale Computing: collecting evidence to develop a National Research Software Strategy	£160,812	EPSRC, UKRI Digital Research Infrastructure Fund	December 21 - March 22 (Stage 1), April 22 - June 22 (Stage 2)	SSI Led	PI: Neil Chue Hong
Understanding the software used to analyse social sciences data	£61,860	ESRC	October 21 - March 22	SSI Led	PI: Neil Chue Hong
The NERC Digital Solutions Hub	£7,000,000	NERC	June 21 - September 25	SSI Collaborator	PI: Richard Kingston, University of Manchester Co-I: Steve Crouch
Data and software loss in the Arts and Humanities research community	£149,891	AHRC	May 21 - June 22	SSI Led	PI: Simon Hettrick
"Cloud-SPAN: Specialised analyses for environmental 'omics with Cloud-based High Performance Computing, MR/V038680/1"	£504,857	UKRI	March 21 - March 23	SSI Collaborator	PI: James P.J. Chong, University of York Co-I: Neil Chue Hong

Title	Total Value	Funder	Date	SSI Role	SSI Staff
"Data driven life science skills development - equipping society for the future (Ed-DASH) MR/V039075/1"	£344,297	UKRI	February 21 - February 23	SSI Collaborator	PI: Alison Meynart, University of Edinburgh SSI Lead: Giacomo Peru
Workforce Development DataCarpentry	£21,750	Scottish Funding Council	August 21 - July 22 (Round 1) August 22 - July 23 (Round 2)	SSI Collaborator	SSI Lead: Giacomo Peru
UKRN Research England Development (RED) Funding	£4.5m	Research England	2022 - 2026	SSI Led	PI: Aleksandra Nenadic
ELIXIR-UK: FAIR Data Stewardship training	£687,857	UKRI	March 21 - March 23	SSI Collaborator	PI: Krzysztof Poterlowicz, University of Bradford SSI Lead: Shoaib Sufi

Appendix 5: Training provided by the Software Sustainability Institute

Title	Year	Contact	Organising Institution	Host Institution
Collaborative Lesson Development Training	2022	Toby Hodges	The Carpentries	The Carpentries
Training for Oxford SABS R3 CDT	2022	Martin Robinson; David Gavaghan	SSI	Oxford University
Intermediate Software Skills workshop for AstraZeneca	2022	Gabriella Rustici	SSI	AstraZeneca
Git workshop	2022	Graeme Grimes	Institute for Genetics and Cancer (IGC), University of Edinburgh	University of Edinburgh
Git workshop	2022	Charlotte Desvages	School of Maths, University of Edinburgh	University of Edinburgh
DiRAC HPC Skills second training pilot	2022	Richard Regan	SSI	DiRAC
Introductory Research Data Management with R	2022	Simon Hettrick	SSI	University of Southampton
Intermediate Research Software Skills workshop for the international LSST (Vera Rubin Observatory) astronomy community	2022	Rachel Street	Vera Rubin Observatory/LSST	Vera Rubin Observatory/LSST
Digital Humanities Oxford Summer School	2022	Dave de Roure	Oxford University	Oxford University
Software Carpentry workshop	2022	Haoyu Niu	Wellcome Trust Sanger Institute	Wellcome Trust Sanger Institute
Carpentries Instructor Training workshop	2022	Aleksandra Nenadic	SSI	The Carpentries
DiRAC HPC Skills first training pilot	2022	Richard Regan	SSI	DiRAC
Introductory Research Software Development with Python	2022	Simon Hettrick	SSI	University of Southampton
Collaborative Lesson Development Training	2022	Toby Hodges	The Carpentries	The Carpentries
Workforce Development Data Carpentry 2022: Data Life Cycle	2022	Gina Pegu; Lucie Wöllenstein	Edinburgh Carpentries	University of Edinburgh
Collaborative Lesson Development Training	2022	Toby Hodges	The Carpentries	SSI
Building websites with Jekyll and GitHub Pages workshop	2022	Renato Alvares	European Molecular Biology Laboratory (EMBL), Germany	SSI
Intermediate Software Skills workshop	2022	James Graham	SSI	SSI

Managing academic software development workshop	2022	Sam Mangham	SSI	SSI
Carpentries Instructor Training workshop	2022	Annajiat Alim Rasel	SSI	SSI
Introduction to scientific analaysis using Python and NumPy workshop (in Italian)	2022	Lucca Di Stasio; Giacomo Peru	SSI	SSI
Good Enough Scientific Computing Practices workshop	2022	Jennifer Daub; Dan Brady	SSI	SSI
Introduction to R workshop	2022	Robert Nagy; Mario Antonioletti	SSI	SSI
Carpentries Instructor Training workshop	2022	Ayesha Dunk; Annajiat Alim Rasel	SSI	The Alan Turing Institute
Introduction to R workshop (in Spanish)	2022	Yanina Bellini Saibene	SSI	SSI
Python for beginners workshop	2022	Rika Kobayashi; Sarah Jaffa	SSI	SSI
Mentorship Programme (10 weeks)	2022	Selina Aragon	SSI	SSI
Software Surgery	2022	Selina Aragon; Steve Crouch	SSI	SSI
Research Software Camp #3: Next Steps in Coding	2022	Selina Aragon	SSI	SSI
Introductory Research Software Development with Python	2022	Simon Hettrick	SSI	Universtiy of Southampton
Workforce Development Data Carpentry 2022: R	2022	Gina Pegu; Lucie Wöllenstein	Edinburgh Carpentries	University of Edinburgh
Workforce Development Data Carpentry 2022: Data Organising and Cleaning	2022	Gina Pegu; Lucie Wöllenstein	Edinburgh Carpentries	University of Edinburgh
Carpentries Instructor Training workshop	2022	Aleksandra Nenadic	The Carpentries	The Carpentries
Intermediate Software Skills workshop for AstraZeneca	2022	Gabriella Rustici	SSI	AstraZeneca
From spreadsheets to R workshop	2021	Yanina Bellini; Paola Corrales	R-Ladies Global	SSI
CZI Essential Open Source Software for Science workshop	2021	Steve Crouch; Neil Chue Hong	SSI	Chan Zuckerberg Initiative (CZI)
Filament workshop	2021	Clive Siviour; Euan Wielewski; Annie Sinclair	Filament	SSI
Google Sheets workshop	2021	Mor Rubinstein	Parkinson's UK	SSI
OpenRefine workshop	2021	Lucia Michielin; Giacomo Peru	Centre for Data, Culture & Society (CDCS), University of Edinburgh	SSI
Mentorship Programme (8 weeks)	2021	Selina Aragon	SSI	SSI
Research Software Camp #2: Beyond the Spreadsheet	2021	Selina Aragon	SSI	SSI
Computational Research Skills Series for the South Coast Biosciences Doctoral Training Partnership (SoCoBio DTP)	2021	Simon Hettrick	SSI	University of Southampton

Data cleaning with OpenRefine workshop	2021	Reka Solymosi; Mark Elliot (NCRM Deputy Director); Claire Spencer	ESRC National Centre for Research Methods; Methods@ Manchester	University of Manchester
Best practices in data organisation with spreadsheets workshop	2021	Reka Solymosi; Mark Elliot (NCRM Deputy Director); Claire Spencer	ESRC National Centre for Research Methods; Methods@ Manchester	University of Manchester
WebSci CDT research skills workshop	2021	Simon Hettrick	SSI	University of Southampton
Training for Oxford SABS R3 CDT	2021	Martin Robinson (Oxford); David Gavaghan (Oxford)	SSI	Oxford University
Intermediate Software Skills workshop for LSST:UK astronomy community	2021	Terence Sloan	SSI	LSST:UK, EPCC
Data Carpentry workshop	2021	Aleksandra Nenadic	SSI	University of Manchester
Data Carpentry workshop	2021	Aleksandra Nenadic	SSI	University of Manchester
Software Carpentry workshop	2021	Aleksandra Nenadic	SSI	University of Manchester
Digital Humanities @ Oxford Summer School 2021	2021	Dave de Roure	University of Oxford	University of Oxford
Intermediate Software Carpentry pilot workshop (external pilot #1)	2021	Steve Crouch	SSI	SSI
Carpetries Instructor Training workshop	2021	Aleksandra Nenadic	SSI	The Carpentries
Library Carpentry workshop	2021	Phil Reed	SSI	University of Manchester
Library Carpentry workshop for the NHS Library and Technology Services	2021	Holly Case-Wyatt	SSI	Library and Knowledge Services, NHS
Intermediate Software Carpentry pilot workshop (internal pilot #2)	2021	Steve Crouch	SSI	SSI
Workforce Development Data Carpentry (Workshop 3)	2021	Bailey Harrington	Edinburgh Carpentries	University of Edinburgh
Workforce Development Data Carpentry (Workshop 2)	2021	Bailey Harrington	Edinburgh Carpentries	University of Edinburgh
Workforce Development Data Carpentry (Workshop 1)	2021	Bailey Harrington	Edinburgh Carpentries	University of Edinburgh
Intermediate Software Carpentry workshop (internal pilot #1)	2021	Steve Crouch	SSI	SSI
Lesson development workshop for Ed-DaSH project	2021	Giacomo Peru	SSI	SSI
Software Licensing workshop for BBSRC institutes	2021	Neil Chue Hong	Earlham Institute	Earlham Institute
Carpentries Instructor Training workshop	2021	Aleksandra Nenadic	SSI	SSI

Building websites with Jekyll and GitHub Pages workshop	2021	Aleksandra Nenadic	SSI	SSI
Boost your research reproducibility with Binder workshop	2021	Sarah Gibson	The Alan Turing Institute	SSI
Software Carpentry (Python) workshop for UK Acoustics Community (UKAN)	2021	Amelia Gully (York);Jonathan Hargreaves (Salford);Nick Ovenden (UCL)	SSI	UK Acoustics Community (UKAN)
Software Carpentry (Python) workshop for UK Acoustics Network community	2021	Amelia Gully (York);Jonathan Hargreaves (Salford);Nick Ovenden (UCL)	SSI	UK Acoustics Community (UKAN)
UK Carpentry community montly calls	2021	Aleksandra Nenadic	SSI	SSI
Sustainable Software Development for Researchers workshop	2021	Carina Haupt	German Aerospace Centre	SSI
Research Software Camp #1: Research Accessibility	2021	Selina Aragon	SSI	SSI
Lesson Development Study Group #1	2021	Toby Hodges	The Carpentries	The Carpentries
Building websites with Jekyll and GitHub Pages workshop	2020	Toby Hodges	European Molecular Biology Laboratory (EMBL), Germany	Data Science Centre, UW-Madison
Building websites with Jekyll and GitHub Pages workshop	2020	Toby Hodges	European Molecular Biology Laboratory (EMBL), Germany	Data Science Centre, UW-Madison
Software Carpentry (Python) workshop for NBIC community	2020	Jin Ling; Jo Slater-Jefferies	SSI	National Biofilms Innovation Centre (NBIC)
Computational Research Skills Series for the South Coast Biosciences Doctoral Training Partnership (SoCoBio DTP)	2020	Simon Hettrick	SSI	University of Southampton
Data Carpentry (R) workshop for the NBIC community	2020	Jin Ling; Jo Slater-Jefferies	SSI	National Biofilms Innovation Centre (NBIC)
Training for Oxford SABS CDT	2020	Martin Robinson (Oxford); David Gavaghan (Oxford)	SSI	Oxford University
Open Source Fundamentals tutorial at JupyterCon2020	2020	Neil Chue Hong	SSI	JupyterCon 2020
Carpetries Instructor Training workshop	2020	Aleksandra Nenadic	SSI	SSI
Data Carpentry at Heriot Watt	2020	Evgenij Belikov	Edinburgh Carpentries	Heriot Watt University
Data Carpentry workshop	2020	Lucia Michielin	Edinburgh Carpentries	University of Edinburgh
Library Carpentry workshop at the Royal Astronomical Society	2020	Sian Prosser	SSI	Royal Astronomical Society
Genomics Data Carpentry	2020	Edward Wallace	Edinburgh Carpentries	University of Edinburgh
Introduction to Using GitHub workshop	2020	Rachael Ainsworth	SSI	University of Manchester

Data Carpentry workshop	2020	Lucia Michielin	Edinburgh Carpentries	University of Edinburgh
Library Carpentry workshop for the librarians at the University of Cambridge	2020	Beatrice Gini; Alexia Cordona	SSI	Cambridge University Libraries
Data Carpentry workshop	2020	Lucia Michielin	Edinburgh Carpentries	University of Edinburgh
Carpetries Instructor Training workshop	2020	Aleksandra Nenadic	SSI	University of Edinburgh
Data Carpentry	2020	Lucia Michielin	Edinburgh Carpentries	University of Edinburgh
Covid-19 Rapid Assistance in Modelling the Pandemic (RAMP) initiative workshop	2020	Alys Brett	SSI	Scottish COVID-19 Response Consortium
Django Girls Manchester	2020	Aleksandra Nenadic	Django Girls	Django Girls
Data Carpentry	2020	Lucia Michielin	Edinburgh Carpentries	University of Edinburgh
Covid-19 Rapid Assistance in Modelling the Pandemic (RAMP) initiative workshop	2020	Alys Brett	SSI	Scottish COVID-19 Response Consortium
Data Carpentry	2020	Lucia Michielin	Edinburgh Carpentries	University of Edinburgh
Data Carpentry	2020	Lucia Michielin	Edinburgh Carpentries	University of Edinburgh
Data Carpentry for Social Sciences	2020	Cathy Naughton	SSI	University of Edinburgh
Software Carpentry	2020	Louise Bowler	SSI	The Alan Turing Institute
HPC Carpentry	2020	Ania Brown	Women in HPC	Sheffield University
Software Carpentry	2020	Magnus Hagdorn	University of Edinburgh	University of Edinburgh
5 half-day training events in Software and HPC Carpentry	2020	Antonia Mey; David McKain	Edinburgh Carpentries	University of Edinburgh
Software Carpentry	2020	Fiona Wardle	King's College London	King's College London
Software Carpentry	2019	Simon Hettrick	SSI	University of Southampton
Software Carpentry	2019	Fiona Wardle	King's College London	King's College London
Software Carpentry	2019	Simon Hettrick	SSI	University of Southampton
Data Carpentry	2019	Rachel Gibson	University of Manchester	Cathie Marsh Institute for Social Research, University of Manchester
Software Carpentry	2019	Evgenij Belikov	Edinburgh Carpentries	Heriot Watt University
Data Science for Doctors	2019	Edward Palmer; Gabriella Rustici; Steve Harris	HDR UK	Wellcome Trust
Software Carpentry	2019	Simon Hettrick	SSI	Astronomy & Astrophysics, University of Southampton
Software Carpentry	2019	Gerard Capes	University of Manchester	Research IT, University of Manchester

Library Carpentry	2019	Giacomo Peru	Edinburgh Carpentries	University of Edinburgh
Software and HPC Carpentry	2019	Edward Wallace	School of Biological Sciences, University of Edinburgh	School of Biological Sciences, University of Edinburgh
Data Science for Doctors workshop	2019	Gabriella Rustici	SSI	Health Data Reseach UK (HDR UK)
Python workshop	2019	Graeme Grimes	Edinburgh Carpentries	University of Edinburgh
Git workshop	2019	Mario Antonioletti	Edinburgh Carpentries	University of Edinburgh
Instructor Training workshop	2019	Aleksandra Nenadic	SSI	
UNIX shell workshop	2019	Graeme Grimes	Edinburgh Carpentries	University of Edinburgh
Software Carpentry	2019	Antonia Mey	Edinburgh Carpentries	University of Edinburgh
Instructor Training workshop	2019	Aleksandra Nenadic	SSI	
Software Carpentry	2019	David McKain	Edinburgh Carpentries	University of Edinburgh
Data Carpentry	2019	Evgenij Belikov	Edinburgh Carpentries	Heriot Watt University (Riccarton campus)
Software Carpentry	2019	Edward Wallace	Edinburgh Carpentries	University of Edinburgh
Software Carpentry	2019	Juan Herrera	University of York	University of York
Data Carpentry	2019	Lucia Michielin	Edinburgh Carpentries	Edinburgh University
Software Carpentry	2019	Lucia Michielin	Edinburgh Carpentries	Edinburgh University
Data Carpentry	2019	Edward Wallace	Edinburgh Carpentries	Edinburgh University
Software Carpentry	2019	Evgenij Belikov	Edinburgh Carpentries	Heriot Watt University
Data Carpentry	2019	Sara Buonomo; Edward Wallace	Edinburgh Carpentries	The University of Edinburgh, School of Biological Sciences
Data Carpentry	2019	Justin Ho	Edinburgh Carpentries	The University of Edinburgh - Business School
OpenRefine	2019	Jennifer Daub	Edinburgh Carpentries	The University of Edinburgh - Lister Learning and Teaching Centre (Central Area)
Software Carpentry	2019	Magnus Hagdon	Edinburgh Carpentries	University of Edinburgh, GeoSciences (Drummond St)
Carpentries Instructor Training workshop	2019	Aleksandra Nenadic	The Carpentries	The Carpentries

Appendix 6: Conferences and Events

List of conferences and events that SSI staff have attended or contributed to, in reverse chronological order.

EuroCC Mentoring Workshop on Programming best practice and industrial software development
Friday, 11 February 2022
European workshop series organised by the National Competency Centres of the EuroHPC network. Neil Chue Hong: keynote speaker.

Netherlands eScience Center Fellowship Programme launch
Tuesday, 22 February 2022
Shoaib Sufi: invited speaker.

Fellows 2022 Inaugural meeting
Thursday, 3 February 2022
Neil Chue Hong: welcome and introduction to the SSI. All team leads participated.
Rachael Ainsworth: organiser and chair. Shoaib Sufi: co-organiser.

FAIR data in practice
Tuesday, 1 February 2022
Rachael Ainsworth: attendee

ASCR Workshop on the Science of Scientific-Software Development and Use
13 - 15 December 2021
US Department of Energy funded workshop on scientific software. Neil Chue Hong, Simon Hettrick: participants

Open Publishing Awards 2021
Thursday, 9 December 2021
Biennial international awards for advancing open scholarship. Neil Chue Hong: judge

Hack the Hackathon: Shaping the Future of Hackathon Research and Practice
6 - 10 December 2021
Lorentz Center workshop on hackathons. Neil Chue Hong: participant and speaker.

FORCE2021
6 - 10 December 2021
Organisation of a Software Citation Hackathon during the FORCE2021 conference.
Neil Chue Hong: hackathon co-organiser and speaker.
Rachael Ainsworth: programme committee member; co-organiser of opening keynote session.

Fellows 2022 Online Selection Day
Thursday, 2 December 2021
Rachael Ainsworth: organiser. Shoaib Sufi, Mario Antonioletti, Selina Aragon, Kistry Pringle, Jacalyn Laird, Giacomo Peru: participating, providing help & support.

Helmholtz Information and Data Science Academy Virtual Annual Conference 2021
Tuesday, 30 November 2021
Annual conference for students of the Helmholtz Information and Data Science Academy, based across the Helmholtz centres in Germany.
Neil Chue Hong: keynote speaker

Presentation for EPSRC Council and SAN about RSE community
Monday, 29 November 2021
Invitation was for an after-dinner speech, but it was moved online with lockdown
Simon Hettrick: speaker.

UK SKA Town Hall
Friday, 19 November 2021
Meeting to bring the UK astronomical community together to provide information on the current status of the SKA project. Rachael Ainsworth: attendee.

Open Publishing Fest
Monday, 15 November 2021
Rachael Ainsworth co-facilitated a workshop session: Good Practices for Collaboration (TheTuring Way).

16th Workshop on Workflows in Support of Large-Scale Science
Held in conjunction with SC21: The International Conference for High Performance Computing
Monday, 15 November 2021
Premier technical workflow event . Carole Goble: keynote, FAIR Computational Workflows.

Research Software Engineers in HPC
Monday, 15 November 2021
Simon Hettrick: organiser with Charles Ferenbaugh, Sandra Gesing and Dan Katz.

AltitudeX Summit
Thursday, 4 November 2021
Conference to bring together the business and data community to discuss AI and commercial decision making. Rachael Ainsworth: participant.

CZI EOSS Software Management Plans workshop
Thursday, 4 November 2021
Annual meeting of CZI funded scientific software projects and invited collaborators to discuss best practice for open source scientific software development.
Neil Chue Hong: organiser, workshop creation and delivery. Steve Crouch: workshop creation and delivery.

Research Software Camp #2
1-12 November 2021
Topic: Beyond the Spreadsheet, focussing on the uses of spreadsheets in research and the next steps into further use of software in research.
Selina Aragon: chair, Simon Hettrick, Panel chair & organising committee, Jacalyn Laird, organising committee. Various other staff members participated.

Data Horror Stories
Tuesday, 26 October 2021
Annual Halloween event to share mistakes with data management and analyses.
Rachael Ainsworth: organiser.

Ed-DaSH workshops
September 2021 - March 2022
9 workshops were delivered as part of the Ed-DASH project where SSI is a partner.
Giacomo Peru: organiser.

NCRM's Research Methods e-Festival
25 - 29 October 2021
Workshops on "Best practices in data organisation with spreadsheets" and "Data cleaning with OpenRefine".
Aleksandra Nenadic: organised and delivered 2 workshops as part of the Festival.

Workshop on the Review of EPSRC Funded Doctoral Education
Wednesday, 20 October 2021
Steve Crouch: participant.

WoSSS21
6-8 October 2021
The Workshop on Sustainable Software Sustainability 2021. Over 150 registered, 4 sessions, 23 speakers and an attendees from UK, Europe, US, Australia, Japan, Nigeria and Brazil
Shoaib Sufi: Event Lead, Co-Chair and Programme Committee member. Neil Chue Hong: steering committee and participant. Carole Goble: speaker, FAIR Computational Workflows.

Fellows 2022 Launch Webinar
Thursday, 23 September 2021
To provide more info about the SSI, our Fellowship Programme and the application process. Rachael Ainsworth: organiser. Shoaib Sufi, Mario Antonioletti: participants.

FAIReScience 2021 online workshop virtually co-located with the 17th IEEE International Conference on eScience (eScience 2021)
20th September 2021
Carole Goble: invited speaker, FAIR Computational Workflows

Open Science Fair Workshop
Tuesday, 21 September 2021
Co-facilitated a workshop session: Good Practices for Collaboration (The Turing Way) resulting in a co-created presentation.
Rachael Ainsworth: session co–facilitator.

CSCCE Hybrid events: Making hybrid events the best of both worlds
Tuesday, 14 September 2021
Rachael Ainsworth: participant.

Data Carpentry workshop
14 - 17 September 2021
Aleksandra Nenadic: organiser.

OAI12 – The Geneva Workshop on Innovations in Scholarly Communication
Wednesday, 8 September 2021
Incentivising sustainable and collaborative research and invited panellist on Changing times, challenging norms: How are changes in research practice re-shaping our thinking about what research integrity should be?
Rachael Ainsworth: invited speaker

German Conference on Bioinformatics 2021
Tuesday, 7 September 2021
Carole Goble: keynote speaker FAIR Computational Workflows

ELIXIR-UK Fellows selection day
Tuesday 7 September 2021
Shoaib Sufi provided consultancy for starting this programme based on the SSI Fellowship. Shoaib Sufi: consultant and co-organiser.

Open Software for the British Library
Thursday, 26 August 2021
Simon Hettrick - invited speaker

The Irish National Astronomy Meeting 2021 (INAM 2021)
Tuesday, 31 August 2021
International panel. Rachael Ainsworth - invited panelist.

Briefing of BBSRC
Thursday, 12 August 2021
Policy meeting with BBSRC who are drafting UKRI's developing Digital Research Infrastructure strategy on People and Skills.
Carole Goble & Simon Hettrick - participated in discussion.

Roundtable with Minister Amanda Solloway
Friday, 6 August 2021
A policy meeting around Open Research and the R&D People & Culture Strategy and to announce the Open Access policy.
Carole Goble - participated in discussion.

AHRC Cultural Heritage 360 Workshop 6: Training for the Future
Wednesday, 21 July 2021
One in a series of workshops by AHRC's Cultural Heritage 360 project.
Aleksandra Nenadic - attended and participated in discussions by invitation.

Digital Humanities @ Oxford Summer School 2021
Monday, 12 July 2021
National summer school. Dave de Roure - co-organiser, gave introductory talk. Graeme Smith, Clem Hadfield - facilitated.

Figshare Ambassador Programme meeting
Thursday, 10 June 2021
Rachael Ainsworth - attended.

RDA4EOSC Webinar - addressing organisational interoperability
Thursday, 10 June 2021
Rachael Ainsworth - attended.

IOI Webinar: Maintenance & Labor of Open Infrastructure
Wednesday, 2 June 2021
Rachael Ainsworth - attended.

Intermediate Software Carpentry pilot workshop (external pilot #1)
Tuesday, 29 June 2021
Regional training event. The first pilot with close external collaborators and SSI Fellows.
Steve Crouch, James Graham and Aleksandra Nenadic - organised and taught at the event.

Future Research Assessment Programme (FRAP) Project meeting
23 and 24 June 2021
National policy meeting. Carole Goble and Simon Hettrick invited.

Seminar at Edinburgh Neuroscience Day
Friday, 11 June 2021
Interdisciplinary seminar series drawing neuroscience experts together.
Giacomo Peru - invited speaker.

ESCAPE Summer School
Monday, 7 June 2021
Summer school for data science for astronomy, astroparticle and particle physics.
Rachael Ainsworth - keynote speaker.

NeSC/NWO Workshop on Software Management Plans
Sunday, 6 June 2021
Workshop attended by more than 40 participants from 28 different Dutch research organisations, explored the need for a national SMP template for research.
Steve Crouch - invited speaker.

Marketing and Comms Forum
Thursday, 27 May 2021
Selina Aragon - attended.

FAIRplus Webinar: Discovering the FAIR Cookbook
Wednesday, 26 May 2021
Rachael Ainsworth - attended.

UKRI Innovation Scholars: Data Science Training in Health and Bioscience Networking Event
Tuesday, 25 May 2021
Shoaib Sufi - attended.

Introduction to Figshare at The University of Manchester
Wednesday, 19 May 2021
Rachael Ainsworth - attended.

UKRI-BBSRC Workshop on Computing in the Biosciences
29 Apr 2021. Aleksandra Nenadic - attended.

RDA 17th Plenary Meeting - Edinburgh
Thursday, 1 April 2021
Neil Chue Hong - attended.

CSCCE Diversity, Equity, & Inclusion (DEI) focus group meeting
Tuesday, 27 April 2021
Focus group to try to identify ways to make online activities more inclusive.
Rachael Ainsworth - invited to participate in the focus group.

PyDataMCR - Data FAQs with the UKDataService
Tuesday, 27 April 2021
Regional workshop. Rachael Ainsworth - invited panelist.

Software sustainability: why it's vital to research for the York Open Research
Thursday, 1 April 2021
Simon Hettrick - invited speaker

SSI Collaborations Workshop 2021
30 Mar - 1 Apr 2021 "SSI's annual signature event attended by representatives of all our communities. Rachael Ainsworth and Shoaib Sufi - organisers. Helped by other SSI staff.

Helmholtz Incubator 2021Workshop
27-28 Apr 2021
Helmholtz Information & Data Science Incubator works to network and strengthen the Association's expertise and enormous stores of data.
Neil Chue Hong - an invited expert and panellist.

Wellcome Trust - Reimagine Research Culture Festival
Monday, 22 March 2021
Neil Chue Hong - attended.

UK-Ireland Digital Humanities panel to explore advocacy
Tuesday, 16 March 2021
Simon Hettrick attended.

Mozilla Festival (MozFest) 2021
Monday, 8 March 2021
Neil Chue Hong - attended.

The Hidden REF for the Technician Commitment signatory event
Wednesday, 24 March 2021
Simon Hettrick - invited speaker

Software Licensing Workshop for BBSRC-funded institutes
Sunday, 21 March 2021
Neil Chue Hong - invited speaker

RSE challenges and successes: a lightning-fast history for the Series of Online RSE events
Wednesday, 17 March 2021
National series of online events organised by the RSE community.
Simon Hettrick - invited speaker.

UK Carpentry Community Monthly calls
Started on 22 Mar 2021 - ongoing.
National community monthly calls for the UK Carpentry Community.
Aleksandra Nenadic: organised and facilitated. Mario Antonioletti, Giacomo Peru: facilitated.

HER+Data MCR
Thursday, 11 March 2021
Regular monthly calls to connect, inspire, support and empower anyone who identifies as a woman in the North West and help them progress in their roles.
Rachael Ainsworth - organiser.

Carpentries Community Discussions
March 2021, ongoing
Hosting and facilitating discussion sessions, helping new instructors and members of the community get integrated better and faster, offer advice and help, or run discussions or particular selected topics. Ongoing calls a few times a month.
Aleksandra Nenadic - organiser and facilitator.

Research Software Camp on Research Accessibility
22 Feb 2021 - 5 Mar 2021
The inaugural international Research Software Camp organised by the SSI, bringing together people working with research software to explore and discuss the state of research culture and encourage better practices around research accessibility.
Selina Aragon, lead organiser and facilitator, Jacalyn Laird, helped with organisation, and Rachael Ainsworth, expert advisor and facilitator. Other SSI staff helped with facilitation and preparing content.

Community-building study group
Started on 16 Feb 2021
Ongoing monthly community building calls with Fellows and close collaborators.
Mario Antonioletti, Shoaib Sufi, Rachael Ainsworth, Aleksandra Nenadic - attended, chaired, presented and facilitated.

Lesson Development Study Group #1
15 Feb 2021, April 2021
The inaugural round ofinternational Lesson Development Study Groups (LDSG), delivered together with The Carpentries.
Aleksandra Nenadic: co-organiser - facilitator and instructor.

Collaborations Workshop 2021
Monday, 1 March 2021
Organised by Aleksandra Nenadic.

Launch of UK Carpentry Community calls
Thursday, 25 February 2021
Organised by Aleksandra Nenadic.

SSI Research Software Camp: Research Accessibility
22 February - 5 March 2021
Events including live speakers, web resources and online engagement. Designed to inform, build communities and reach new audiences.
Organised by Selina Aragon and Rachael Ainsworth.

Lesson Development Study Groups Programme - programme/cohort 1 launch
February - April 2021
A 10 week series on teaching good practices in lesson design and sharing experience to help community members start developing their own lessons.
Organised by Aleksandra Nenadic in collaboration with The Carpentries.

Fair4RS Town Hall meeting
Tuesday, 2 February 2021
FAIR for Research Software (FAIR4RS) Working Group meeting
WG Member: Neil Chue Hong

SKA Science Data Challenge 2 (SDC) Reproducibility Awards
Monday, 1 March 2021
An awards challenge that runs over a period of ~6 months
Rachael Ainsworth, Steve Crouch and Neil Chue Hong involved in planning and organising the reproducibility awards.

Fellowship 2021 Launch Webinar
Monday, 1 February 2021
Organised by Rachael Ainsworth

SORSE Christmas event When Spreadsheets Attack!
Thursday, 17 December 2020
A lighthearted but informative community event to give people the opportunity to come together and relax a little. Organised by Claire Wyatt. Co-hosted by Rachael Ainsworth. Simon Hettrick was a speaker.

STFC Scientific Computing Department seminar series
Tuesday, 15 December 2020
Speaker: Neil Chue Hong. Spoke on current challenges to the development and sustainability

JROST Conference - Invest in Open Infrastructure
14-16 December 2020
Speaker: Rachael Ainsworth

Hackathon: Exploring the Relationship between Crowds, Safety and Crime
9 and 11 December 2020
Included an SSI led on data analysis and visualisation in R. Contributor: Mario Antonioletti.

Supercomputing 2020, RSEs in HPC Workshop
12 November 2020
Co-organised by Simon Hettrick.

Digital Preservation Awards 2020
Thursday, 5 November 2020
Co-judged by Neil Chue Hong. Sponsored by SSI.

SORSE series: Configuring Sphinx from scratch: making your own & making your documentation your own
Tuesday, 3 November 202
Organised by Claire Wyatt.

FAIRIO workshop on accessibility of research information
Monday, 2 November 2020
Interactive session aiming to explore benefits of making research information available and obtainable but also investigate common barriers.

SORSE Online Lecture Series: What do we (not) know about RSE?
Wednesday, 28 October 2020
Organised by Claire Wyatt.

ODM HER+DataMcr and PyData Mcr: Data Horror Stories
Tuesday, 27 October 2020
Organised by Rachael Ainsworth.

Open Source Fundamentals tutorial at JupyterCon2020
Friday, 9 October 2020
Neil Chue Hong: Organised and participated.

SORSE - Online Lecture Series: About FAIRness and Research Software Managers
Wednesday, 7 October 2020
Organised by Claire Wyatt and hosted by Rachael Ainsworth

2nd International Research Software Engineering (RSE) Leaders Workshop
16 and 30 September 2020
Organised by Claire Wyatt and Simon Hettrick.

SORSE - a Series of Online Research Software Events
September 2020 - February 2021
Large international series of lectures and workshops organised in response to the cancellation of the annual RSE conference. Organised by Claire Wyatt.

Building the Research Innovation Workforce
August - September 2020
A workshop to identify new insights and directions to advance the research computing community . Keynote by Neil Chue Hong.

CarpentryCon@Home
Saturday, 1 August 2020
Organising committee: Aleksandra Nenadic. Speaker: Rachael Ainsworth.

NSF Cyberinfrastructure Workforce Development Workshops (USA)
Wednesday, 19 August 2020
HER+Data MCR monthly women in data meetups and collaboration events during the periodApril - August 2020

Science Europe Validation Workshop on Research Assessment Processes
28th April 2020

Cyberinfrastructure Workforce Development Workshop
19 & 25 August

CarpentryCon@Home session
Challenges and opportunities in transitioning meetings online
Wednesday, 5 August 2020

ELIXIR Software Best Practices WG Software Management Plans webinar and panel
Thursday, 9 July 2020

Introduction to Using GitHub" session as part of Open Data Manchester's Pick N Mix series
Tuesday, 30 June 2020

Sustainable Software in HEP" workshop
Monday, 22 June 2020

First virtual Community of Edinburgh RSEs (CERSE) meeting
Wednesday, 13 May 2020

Launch event for SORSE - a Series of Online Research Software Events - an international answer to the COVID-19-induced cancellation of many RSE conferences
Tuesday, 1 September 2020
https://software.ac.uk/news/new-initiative-sorse-launched-help-rses-stay-connected

2 online workshops for Covid-19 Rapid Assistance in Modelling the Pandemic (RAMP) initiative
Sunday, 1 March 2020

3rd International Workshop on Practical Reproducible Evaluation of Systems (P'RECS20)
Wednesday, 24 June 2020

International Conference on Computational Science - Software Engineering for Computational Science Track
3-5 June 2020

Remote N8 CIR Reprohack
Friday, 15 May 2020
Organised by SSI Fellow

EPSRC Review of Doctoral Support workshop
Wednesday, 8 April 2020

Collaborations Workshop 2020
31 March - 2 April 2020
Organised by SSI

25th Pacific Symposium on Biocomputing - Building the FAIR Research Commons: for Life Sciences: the pain, the glory
Wednesday, 1 January 2020
Carole Goble

Supercomputing Wales 2020 - The role of the Research Software Engineer
Friday, 24 January 2020
Simon Hettrick

N8 RSE Group Leaders - Understanding Software (and staying out of trouble)
Friday, 24 January 2020
Simon Hettrick

Open Research London - The Importance and Challenges of Sharing Research Software Wednesday, 5 February 2020
Rachael Ainsworth

Chan-Zuckerberg Initiative Summit on Essential Open Source Software
Tuesday, 25 February 2020
Neil Chue Hong

"Beware: Results May Vary" A workshop on openness as a means of enhancing research quality.
Friday, 28 February 2020
https://software.ac.uk/beware-results-may-vary-workshop-openness-means-enhancing-research-quality Organised by an Institute Fellow and co-hosted by the Software Sustainability Institute and the UK Reproducibility Network.

AHRC e-Infrastructure focus group
Friday, 14 February 2020
Organised by David De Roure and attended by the Institute member of staff

The importance and challenges of sharing research software Open Research London event, in collaboration with RSLondonSouthEast 2020
Wednesday, 5 February 2020
Rachael Ainsworth: Invited talk on “Reproducibility and Open Research Software”.

N8 CIR 2020 ReproHack Northern Tour - a series of one-day reproducibility hackathons across N8 universities
5 dates from January - March 2020
Organised by SSI Fellow and sponsored by the SSI.

N8 CIR RSE leaders and aspiring leaders event
Thursday, 30 January 2020
“A one-day meeting to look at similarities, challenges and opportunities for research software engineering groups across the N8 Research Partnership.
Simon Hettrick: Invited Speaker”

Appendix 7: Boards and Committees

List of boards and committees that SSI staff have contributed to, grouped by category and sorted in chronological order.

Start Year	Name	Organisation	Description	Recognition	Category
2016	David De Roure	BEIS	Member, BEIS Open Research Data Task Force	National	GOVERNMENT
2018	Carole Goble	BEIS	Member, BEIS Open Research Data Task Force	National	GOVERNMENT
2018	Carole Goble	UKRI	Member, BEIS e-Infrastructure Advisory Board	National	GOVERNMENT
2019	Carole Goble	G7	Member, Open Science Working Group, UKRI/ BEIS UK expert	International	GOVERNMENT
2020	Carole Goble	All Parliamentary Advisory Group on Longevity and National Data Strategy Open Life Data Working Group	Member	National	GOVERNMENT
2013	David De Roure	TORCH (The Oxford Research Centre for the Humanities)	Director of Digital Humanities programme and DHOxSS, Member of Management Committee	Local	POLICY AND PRACTICE
2014	Carole Goble	Force (Future of Research Communications)	Member, DCIP Executive Committee	International	POLICY AND PRACTICE
2015	Carole Goble	ELIXIR	ExCo, Interoperability Platform	International	POLICY AND PRACTICE
2016	Carole Goble	ELIXIR	Head of Node, ELIXIR-UK	National	POLICY AND PRACTICE
2017	Carole Goble	Common Workflow Language	Member, Advisory Board	International	POLICY AND PRACTICE
2017	Carole Goble	European Commission	Member, ESFRI Strategy Working Group On Data, Computing & Digital Research Infrastructures	International	POLICY AND PRACTICE
2017	David De Roure	UKCRC	Member, UK Computing Research Committee Executive Committee	National	POLICY AND PRACTICE
2017	Neil Chue Hong	Research Data Alliance	Chair, Software Source Code Interest Group	International	POLICY AND PRACTICE
2018	Neil Chue Hong	OECD	OECD Global Science Forum Expert Group on Digital Skills for Science	International	POLICY AND PRACTICE

2018	Neil Chue Hong	UNESCO	UNESCO Expert Group on Software Source Code as Heritage for sustainable development	International	POLICY AND PRACTICE
2018	Shoaib Sufi	WoSSS Series	Member of organising committee	International	POLICY AND PRACTICE
2018	Steve Crouch	Computational Science Centre for Research Communities (CoSeC)	Software Outlook Working Group	National	POLICY AND PRACTICE
2019	Neil Chue Hong	National Information Standards Organization	Taxonomy, Definitions, and Recognition Badging Scheme Working Group	International	POLICY AND PRACTICE
2019	Neil Chue Hong	EOSC Secretariat	EOSC FAIR Working Group	International	POLICY AND PRACTICE
2019	Neil Chue Hong	Open Publishing Awards 2019	Judge	International	POLICY AND PRACTICE
2019	Rachael Ainsworth	Liberate Science	Member of Code of Conduct Committee	International	POLICY AND PRACTICE
2019	Simon Hettrick	Oxford Research Software Group	Member, Steering Committee	National	POLICY AND PRACTICE
2020	Neil Chue Hong	Code Review Community Working Group	Member, Task Group: Code Review at Publication	International	POLICY AND PRACTICE
2020	Neil Chue Hong	Digital Preservation Awards 2020	Judge	International	POLICY AND PRACTICE
2020	Neil Chue Hong	Hidden REF	Member, Steering Committee	National	POLICY AND PRACTICE
2020	Neil Chue Hong	Research Data Alliance	Chair, FAIR for Research Software Working Group	International	POLICY AND PRACTICE
2020	Rachael Ainsworth	Series of Online Research Software Events (SORSE)	Member of Organising Committee	International	POLICY AND PRACTICE
2020	Rachael Ainsworth Rachael Ainsworth	Open Access Week	Member of Advisory Committee	International	POLICY AND PRACTICE
2020	Rachael Ainsworth	Code Review Community Working Group	Chair, Task Group: Diversity, Equity and Inclusion	International	POLICY AND PRACTICE
2020	Rachael Ainsworth	Square Kilometre Array Regional Centre Steering Committee (SRCSC)	Core Member, Working Group 4: SW, Science Archive-VO-FAIR	International	POLICY AND PRACTICE
2020	Shoaib Sufi	FAIR4RS	Member of subgroup 3	International	POLICY AND PRACTICE
2020	Simon Hettrick	Hidden REF	Chair, Steering Committee		POLICY AND PRACTICE
2021	Carole Goble	Helmholtz Association	Member Helmholtz Metadata Collaboration steering and evaluation committee	International	POLICY AND PRACTICE
2021	Carole Goble	RDA FAIR4RS	Member group1/4 sprinkling in workflows	International	POLICY AND PRACTICE
2021	Carole Goble	EOSC Association	Member, Task Force on Semantic Interoperability	International	POLICY AND PRACTICE
2021	Claire Wyatt	Hidden REF	Member of Communications Team	National	POLICY AND PRACTICE

2021	Claire Wyatt	PRISM (Professional Research Investment and Strategy Managers) Network	Committee member	National	POLICY AND PRACTICE
2021	Claire Wyatt	SeptembRSE 2021	Sponsorship Chair	International	POLICY AND PRACTICE
2021	Neil Chue Hong	British Computer Society	Member, Fellows Technical Advisory Group	National	POLICY AND PRACTICE
2021	Neil Chue Hong	Open Publishing Awards 2021	Judge	International	POLICY AND PRACTICE
2021	Neil Chue Hong	EOSC Association	Member, Task Force on Infrastructures for Quality Research Software	International	POLICY AND PRACTICE
2021	Rachael Ainsworth	FORCE (Future of Research Communications)	Member, FORCE2021 Programme Committee	International	POLICY AND PRACTICE
2021	Rachael Ainsworth	UK Square Kilometre Array Regional Centre (UKSRC) Forum	Member	National	POLICY AND PRACTICE
2022	Carole Goble	Workflow Community Initiative	Director, FAIR Computational Workflows	International	POLICY AND PRACTICE
2022	Carole Goble	Scicodes, Consortium of scientific software registries and repositories	Member	International	POLICY AND PRACTICE
2022	Carole Goble	ERC “A Philosophy of Open Science for Diverse Research Environments”	SAB member	International	POLICY AND PRACTICE
2022	Simon Hettrick	National Physical Laboratory	Reviewer, national review	National	POLICY AND PRACTICE
2022	Simon Hettrick	University of Leeds	Judge, Leeds research culture awards	Local	POLICY AND PRACTICE
2019	Carole Goble	Gigascience	Editorial Board	International	PUBLICATIONS AND JOURNALS
2014	David De Roure	Ubiquity Press	Member, General Advisory Board	National	PUBLICATIONS AND JOURNALS
2015	Shoaib Sufi	Data Science Journal	Section Editor	International	PUBLICATIONS AND JOURNALS
2018	Simon Hettrick	Patterns Journal	Advisory Board	International	PUBLICATIONS AND JOURNALS
2020	Carole Goble	Elsevier, Patterns Journal	Editorial Board	International	PUBLICATIONS AND JOURNALS
2022	Carole Goble	F1000Research Bioinformatics Gateway	Advisory Board	International	PUBLICATIONS AND JOURNALS
2013	Carole Goble	BBSRC	Member, Council	National	RESEARCH FUNDERS
2014	Carole Goble	BBSRC	Member, Exploiting New Ways of Working Strategic Advisory Panel	National	RESEARCH FUNDERS

2014	Neil Chue Hong	EPSRC	Member, e-Infrastructure Strategic Advisory Team	National	RESEARCH FUNDERS
2014	Neil Chue Hong	EPSRC	Member, Computational Science Centre for Research Communities (CoSeC) Steering Committee	National	RESEARCH FUNDERS
2015	Steve Crouch	Jisc	Research Data Shared Service External Steering Group	National	RESEARCH FUNDERS
2018	David De Roure	UKRI	Member, UKRI RII sectoral group for Social Sciences, Arts & Humanities	National	RESEARCH FUNDERS
2018	Neil Chue Hong	EPSRC	Chair, e-Infrastructure Strategic Advisory Team	National	RESEARCH FUNDERS
2018	Simon Hettrick	UKRI-STFC	Project peer review panel (large projects)	National	RESEARCH FUNDERS
2019	Aleksandra Nenadic	UKRI-BBSRC	National Capabilities Mid-Term Review Panel	National	RESEARCH FUNDERS
2019	David De Roure	ESRC	Member, Leadership group for New and Emerging Forms of Data	National	RESEARCH FUNDERS
2019	David De Roure	UKRI	Member, Living with Machines Advisory Board (SPF)	National	RESEARCH FUNDERS
2019	Simon Hettrick	UKRI-AHRC	Member, Infrastructure advisory group	National	RESEARCH FUNDERS
2019	Simon Hettrick	UKRI e-Infrastructure expert group	Chair, Software and Skills working group	National	RESEARCH FUNDERS
2019	Simon Hettrick	UKRI-MRC	Data Science Advisory Group	National	RESEARCH FUNDERS
2020	David De Roure	AHRC	Chair, Infrastructure Advisory Group	National	RESEARCH FUNDERS
2020	David De Roure	DFG NFDI Review Panel	Member	International	RESEARCH FUNDERS
2020	David De Roure	EPSRC	Member, Research Excellence Board, PETRAS National Centre of Excellence for IoT Systems Cybersecurity	National	RESEARCH FUNDERS
2020	Neil Chue Hong	Met Office / UKRI	Chair, ExCALIBUR Steering Committee	National	RESEARCH FUNDERS
2020	Neil Chue Hong	UKRI	Chair, Software Working Group of Digital Research Infrastructure Committee	National	RESEARCH FUNDERS
2020	Neil Chue Hong	UKRI-BBSRC	Member, Transformative Technologies Strategic Advisory Panel	National	RESEARCH FUNDERS
2020	Neil Chue Hong	UKRI-STFC	Member, Particle Physics Technology Advisory Panel	National	RESEARCH FUNDERS
2021	Carole Goble	NERC	Member NERC EDS Strategic Need Advisory Working Group	National	RESEARCH FUNDERS

2021	David De Roure	UKRI	Technical Adviser, Digital Research Infrastructure Committee	National	RESEARCH FUNDERS
2021	Neil Chue Hong	UKRI-BBSRC / UKRI-MRC	Member, Joint BBSRC/ MRC Supercomputing Task Force	National	RESEARCH FUNDERS
2021	Neil Chue Hong	UKRI-BBSRC	Member, Technology Development Task and Finish Group	National	RESEARCH FUNDERS
2022	Caroline Jay	EPSRC	Chair, Software for Research Communities ICT Sift Panel	Regional	RESEARCH FUNDERS
2022	Caroline Jay	EPSRC	Chair, Software for Research Communities Funding Panel	Regional	RESEARCH FUNDERS
2022	Neil Chue Hong	UKRI	Member, Steering Committee for UKRI Net Zero Digital Research Infrastructure Project	National	RESEARCH FUNDERS
2022	Neil Chue Hong	UKRI-NERC	Member, NERC Digital Research Infrastructure Investment Board	National	RESEARCH FUNDERS
2022	Simon Hettrick	UKRI-EPSRC	Member, EPSRC e-Infrastructure Strategic Advisory Team	National	RESEARCH FUNDERS
2012	David De Roure	Web Science Trust	Member, Web Science Network of Laboratories	International	STEERING AND ADVISORY BOARD
2014	Neil Chue Hong	Trusted CI	Member, Advisory Board	National	STEERING AND ADVISORY BOARD
2015	Carole Goble	Software Carpentry	Software Carpentry Foundation Interim Board and Advisory Board	International	STEERING AND ADVISORY BOARD
2015	Carole Goble	ELIXIR	Chair, Czech ELIXIR Node Advisory Board	International	STEERING AND ADVISORY BOARD
2016	Carole Goble	ELIXIR	Bioschemas Steering Council	International	STEERING AND ADVISORY BOARD
2016	Carole Goble	NLeSC (Dutch e-Science Center)	International Advisory Board	International	STEERING AND ADVISORY BOARD
2016	David De Roure	e-Research Alliance, University of Göttingen	Member, International Advisory Board	International	STEERING AND ADVISORY BOARD
2016	David De Roure	FORCE (Future of Research Communications)	Board member	International	STEERING AND ADVISORY BOARD
2017	Neil Chue Hong	CompBioMed	Member, Innovation Advisory Board	International	STEERING AND ADVISORY BOARD
2018	Carole Goble	Biocompute Object	Member, Advisory Board	International	STEERING AND ADVISORY BOARD
2018	Carole Goble	ReproNim NIH consortia	Chair, SAB	International	STEERING AND ADVISORY BOARD
2018	Caroline Jay	Open Data Manchester	Director	National	STEERING AND ADVISORY BOARD

2018	Neil Chue Hong	Software Preservation Network	Member, Steering Committee	International	STEERING AND ADVISORY BOARD
2018	Neil Chue Hong	Research Software Alliance	Member, Steering Committee (Treasurer, 2020 - present)	International	STEERING AND ADVISORY BOARD
2019	Ania Brown	Society of Research Software Engineering	Trustee	National	STEERING AND ADVISORY BOARD
2019	Carole Goble	ACM	Deputy chair (2019-2021) Chair (2021-) Grace Murray Hopper Award Panel	International	STEERING AND ADVISORY BOARD
2019	Claire Wyatt	Society of Research Software Engineering	Trustee (2019-), Vice-President (2020-2021)	National	STEERING AND ADVISORY BOARD
2019	David De Roure	Reproducible Research Oxford (part of UKRN)	Member of Steering Group (Humanities)	Local	STEERING AND ADVISORY BOARD
2019	James Graham	Society of Research Software Engineering	Trustee	National	STEERING AND ADVISORY BOARD
2019	Neil Chue Hong	Helmholtz Association	Member, Scientific Advisory Board, Helmholtz Federated IT Services (HIFIS)	National	STEERING AND ADVISORY BOARD
2019	Neil Chue Hong	Sustainable Approaches to Biomedical Science CDT	Member, External Advisory Board	Regional	STEERING AND ADVISORY BOARD
2019	Simon Hettrick	Society of Research Software Engineering	Trustee	National	STEERING AND ADVISORY BOARD
2019	Simon Hettrick	Rosalind Franklin Institute	Advisory panel for AI and Informatics	National	STEERING AND ADVISORY BOARD
2020	David De Roure	NCRM Independent Advisory Board (ESRC)	Member	National	STEERING AND ADVISORY BOARD
2020	David De Roure	The Alan Turing Institute	Chair, Arts, Humanities & Cultural Heritage Steering Group	National	STEERING AND ADVISORY BOARD
2020	David De Roure	Brunel University	Member, Institute of Digital Futures (IDF) Advisory Board	National	STEERING AND ADVISORY BOARD
2020	Kirsty Pringle	Society of Research Software Engineering	Trustee, Treasurer	National	STEERING AND ADVISORY BOARD
2020	Simon Hettrick	Computational Science Centre for Research Communities (CoSeC)	Steering Committee	National	STEERING AND ADVISORY BOARD
2020	Simon Hettrick	MiTALENT	Member, Advisory Board	National	STEERING AND ADVISORY BOARD
2021	Aleksandra Nenadic	The Carpentries	Carpentries Executive Council	International	STEERING AND ADVISORY BOARD
2021	David De Roure	University of Oxford	Chair, Digital Scholarship Steering Committee	Local	STEERING AND ADVISORY BOARD
2021	Neil Chue Hong	Chaste (Cancer, Heart and Soft Tissue Environment)	Chair, External Advisory Board	National	STEERING AND ADVISORY BOARD

2021	Sam Manghan	Society of Research Software Engineering	Trustee	National	STEERING AND ADVISORY BOARD
2021	Simon Hettrick	Jonathan's Voice RSE steering committee	Steering committee	National	STEERING AND ADVISORY BOARD
2022	Carole Goble	Swedish Foundation for Strategic Research	Evaluation Committee for Research Infrastructure Fellows	International	STEERING AND ADVISORY BOARD
2022	Caroline Jay	University of Amsterdam	Data Science Centre International Advisory Board	International	STEERING AND ADVISORY BOARD
2022	Neil Chue Hong	Towards Large-scale Cultural Analytics in the Arts and Humanities	Chair, Steering Group	National	STEERING AND ADVISORY BOARD
2022	Simon Hettrick	DiRAC Federation Project	Member, Steering committee	National	STEERING AND ADVISORY BOARD
2022	Simon Hettrick	Society of Research Software Engineering	Member, Advisory Board	International	STEERING AND ADVISORY BOARD
2018	Giacomo Peru	Edinburgh Carpentries	Organising Committee	Local	TRAINING
2019	Aleksandra Nenadic	HDR UK	Member, Health Data Research Curriculum Advisory Committee	National	TRAINING
2020	Aleksandra Nenadic	CarpentryCon2020	Steering Committee	International	TRAINING
2021	Aleksandra Nenadic	The Carpentries	Lead/organiser, Lesson Program Governance Committee	International	TRAINING
2021	Aleksandra Nenadic	The Carpentries	Lead/organiser, Value Alignment Committee	International	TRAINING
2020	Giacomo Peru	Ed-DaSH	Steering Group	Local	TRAINING
2020	Giacomo Peru	Edinburgh Carpentries	Steering Committee	Local	TRAINING

Appendix 8: Collaborators of the Software Sustainability Institute

The SSI collaborators shown on this page include everyone that has been awarded a Fellowship, people that participated in a consultancy project, are members of our advisory board or we have collaborated with or named in a project or proposal.

Abhishek Dasgupta, University of Oxford
Abigail Cabunoc Mayes, Mozilla
Adam Crymble, King's College London
Adam Tomkins, University of Sheffield
Adrian Mullholland, University of Bristol
Alan Williams, The University of Manchester
Alejandra Gonzalez-Beltran, University of Oxford
Aleksandra Pawlik, The Open University
Alex Chartier, University of Bath
Alex Clarke, Jodrell Bank Centre for Astrophysics
Alexander Morley, University of Oxford
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Alexandra Simperler, Simperler Consulting
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