



RSE

RESEARCH SOFTWARE  
ENGINEERS ASSOCIATION

:: Excellence in Research through Software  
Development & Leadership

:: A Brief History of UK's Research Software  
Engineers Movement/Association/Society

:: Sustainable Software Creation in  
Academia

ILIAN TODOROV

# Daresbury Laboratory

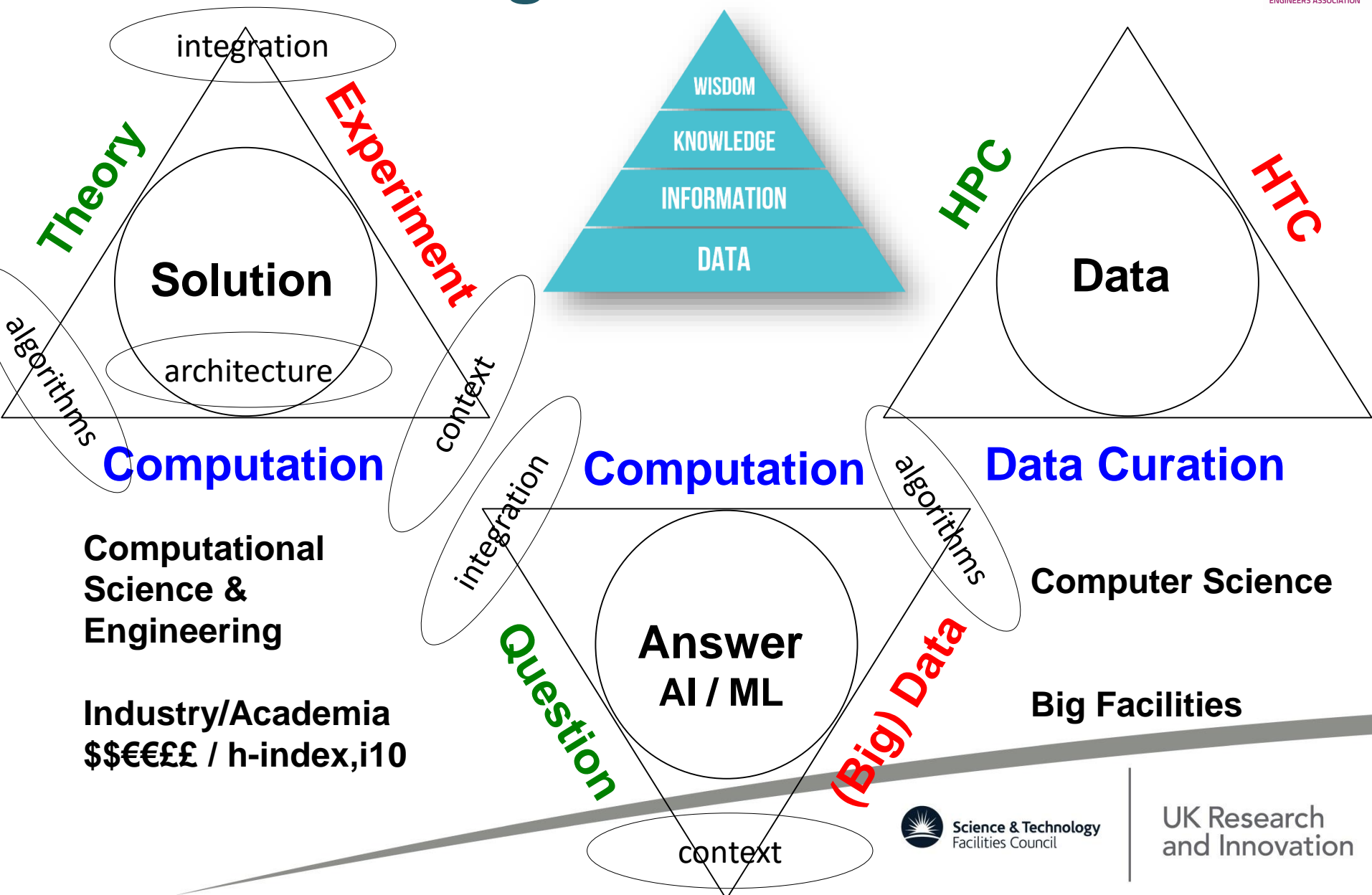
Alice's Wonderland (1865)  
Lewis Carroll (Charles Lutwidge Dodgson)



# The CECAM/CCP Path to Software

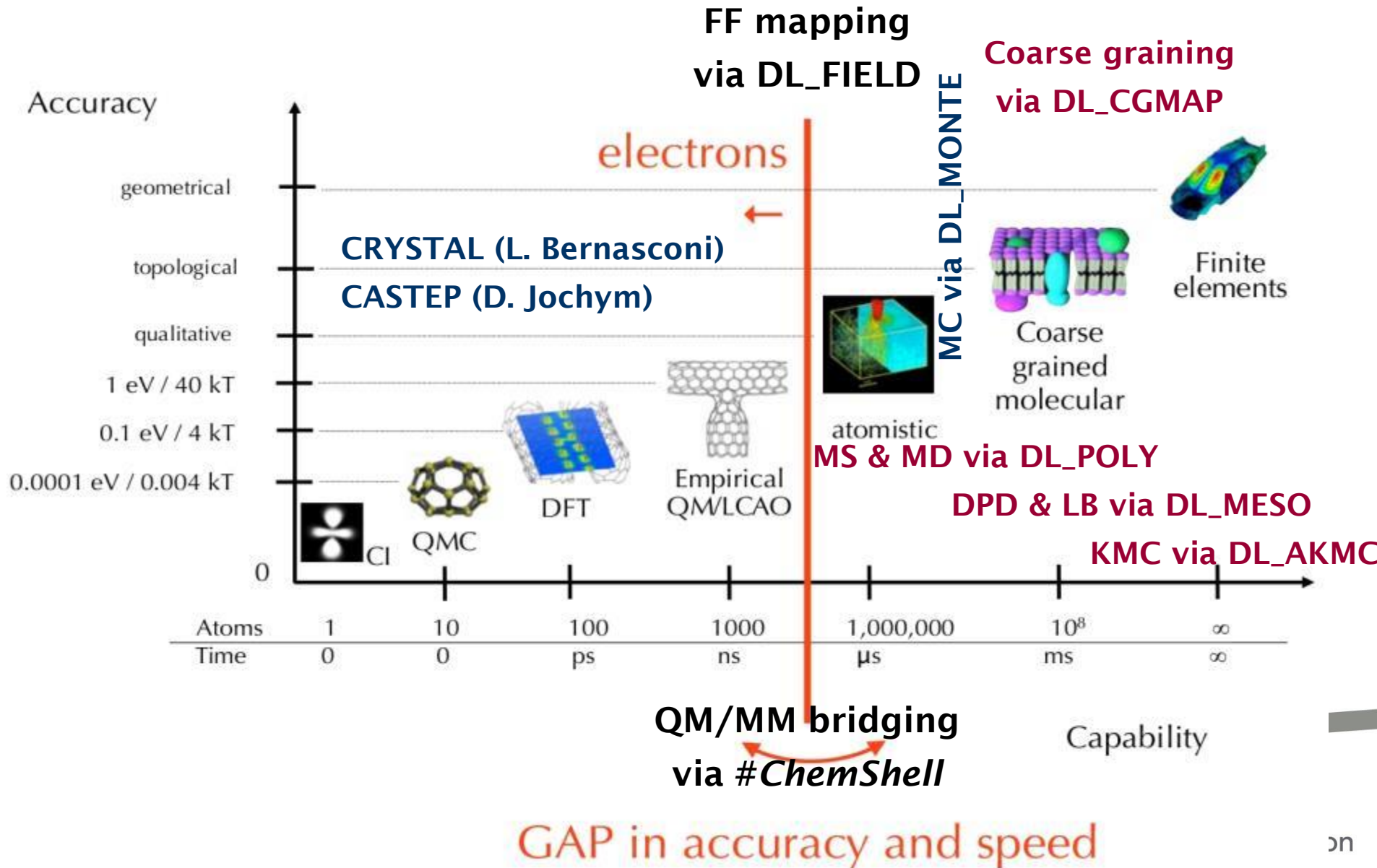


# Triangles of Research





# Multiple Scales of Materials Modelling





## RoMMVI



Modelling in H2020 LEIT-NMMP Programme Materials and Nanotechnology projects

One reality with four veridical views each at a different level of granularity.

This is true for observations and for simulations.

### ELECTRONS



### ELECTRONIC MODEL

Physics Based Model using a Physics Equation and Material Relation describing the behaviour of electrons quasi particles either as waves, particles or distributions.

### ATOMS



### ATOMISTIC MODELS

Physics Based Model using a Physics Equation and Material Relation describing the behaviour of atoms either as waves, particles or distributions.

### BEADS



### MESOSCOPIC MODELS

Physics Based Model using a Physics Equation and Material Relation describing the behaviour of Beads either as particles or distributions.

### CONTINUUM VOLUME ELEMENT



### CONTINUUM MODELS

Physics Based Model using a Physics Equation and Material Relation describing the behaviour of Continuum Volume.

a first step in the direction of a standardised description of modelling has been taken by the EC

## MODA (MOdelling Data)

is a **template** for the **standardised description** of materials models (<https://emmc.info/moda-workflow-templates/>)

The **MODA** is meant to **guide users** towards a complete **high-level documentation** of material models, starting from the **end-user case** via the **computational details** to the **results**.

It provides all necessary aspects for: **description**, **reproducibility**, **curation** and **interfacing** with other models and databases.



Modelling in H2020 LEIT-NMMP Programme Materials and Nanotechnology projects

Review of Materials Modelling VI RoMM

Vocabulary, classification and metadata for materials modelling (130 FP7 and H2020 projects)

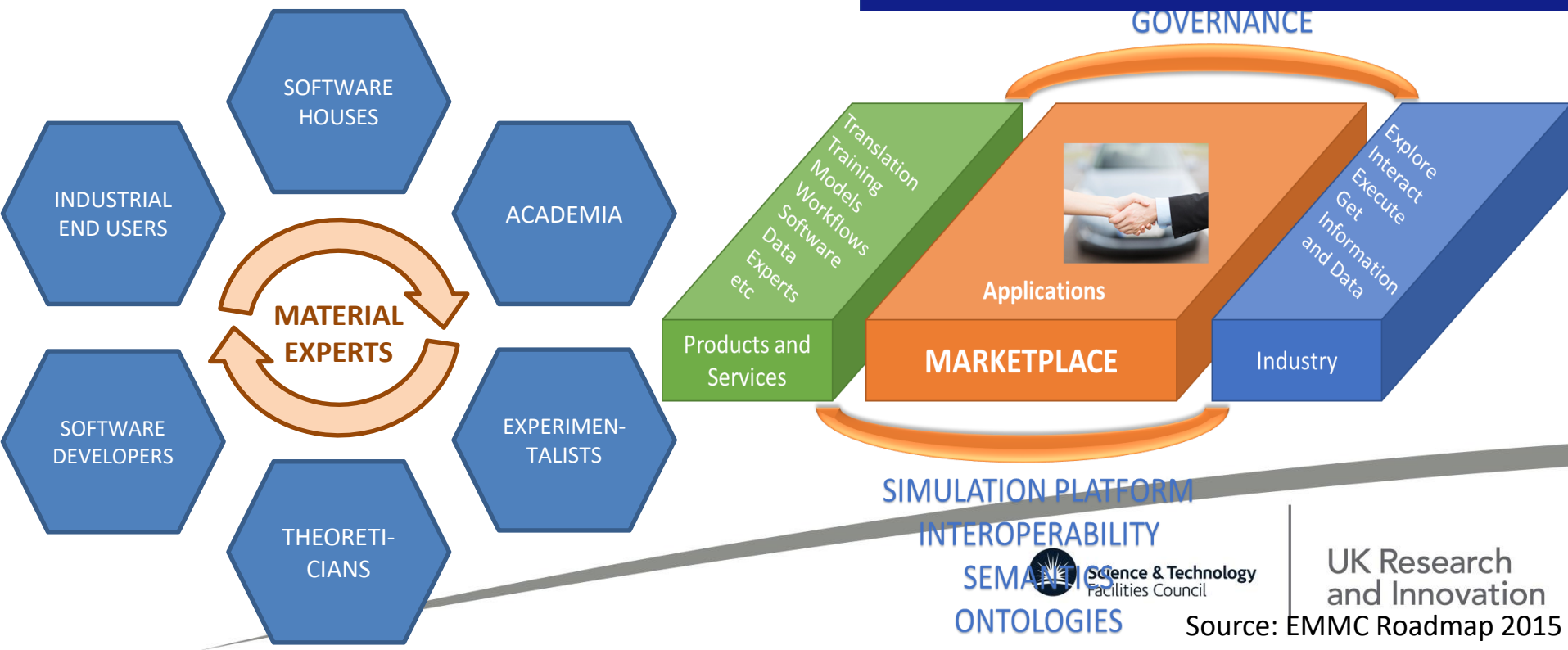
<https://bookshop.europa.eu/en/what-makes-a-material-function-pbK0616197/>

The MODA uses **core model concepts**

PHYSICS ENTITY

EQUATIONS  
(physics- or data-based)

EMMC Workshop on Interoperability in Materials Modelling, 7-8 November 2017, Cambridge (UK)



# Software Creation in Academia

## Issues & Topics (academia):

- Recognition
- Identification
- Identity
- Appreciation
- Credit
- Satisfaction
- Sustainability & Job Security
- Personal Development & Career Progression



## SOFTWARE CITATION PRINCIPLES

### IMPORTANCE

Software should be considered a legitimate and citable product of research. Software citations should be accorded the same importance in the scholarly record as citations of other research products; they should be included in the metadata of the citing work, such as a reference list. Software should be cited on the same basis as any other research product such as a paper or a book.

### UNIQUE IDENTIFICATION

A software citation should include a method for identification that is machine actionable, globally unique, interoperable, and recognized by at least a community of the corresponding domain experts, and preferably by general public researchers.

### PERSISTENCE

Unique identifiers and metadata describing the software and its disposition should persist—even beyond the lifespan of the software they describe.

### SPECIFICITY

Software citations should facilitate identification of, and access to, the specific version of software that was used. Software identification should be as specific as necessary, such as using version numbers, revision numbers, or variants such as platforms.

### CREDIT AND ATTRIBUTION

Software citations should facilitate giving scholarly credit and normative, legal attribution to all contributors to the software, recognizing that a single style or mechanism of attribution may not be applicable to all software.

### ACCESSIBILITY

Software citations should facilitate access to the software itself and to its associated metadata, documentation, data, and other materials necessary for both humans and machines to make informed use of the referenced software.

**RSE**

RESEARCH SOFTWARE  
ENGINEERS ASSOCIATION

**Software  
Sustainability  
Institute**

... yet there is little support for its acknowledgement and citation





# History Line - 2009

2009: **EPSRC**  
Pioneering research  
and skills

**There appears to be a lot of software out there...**

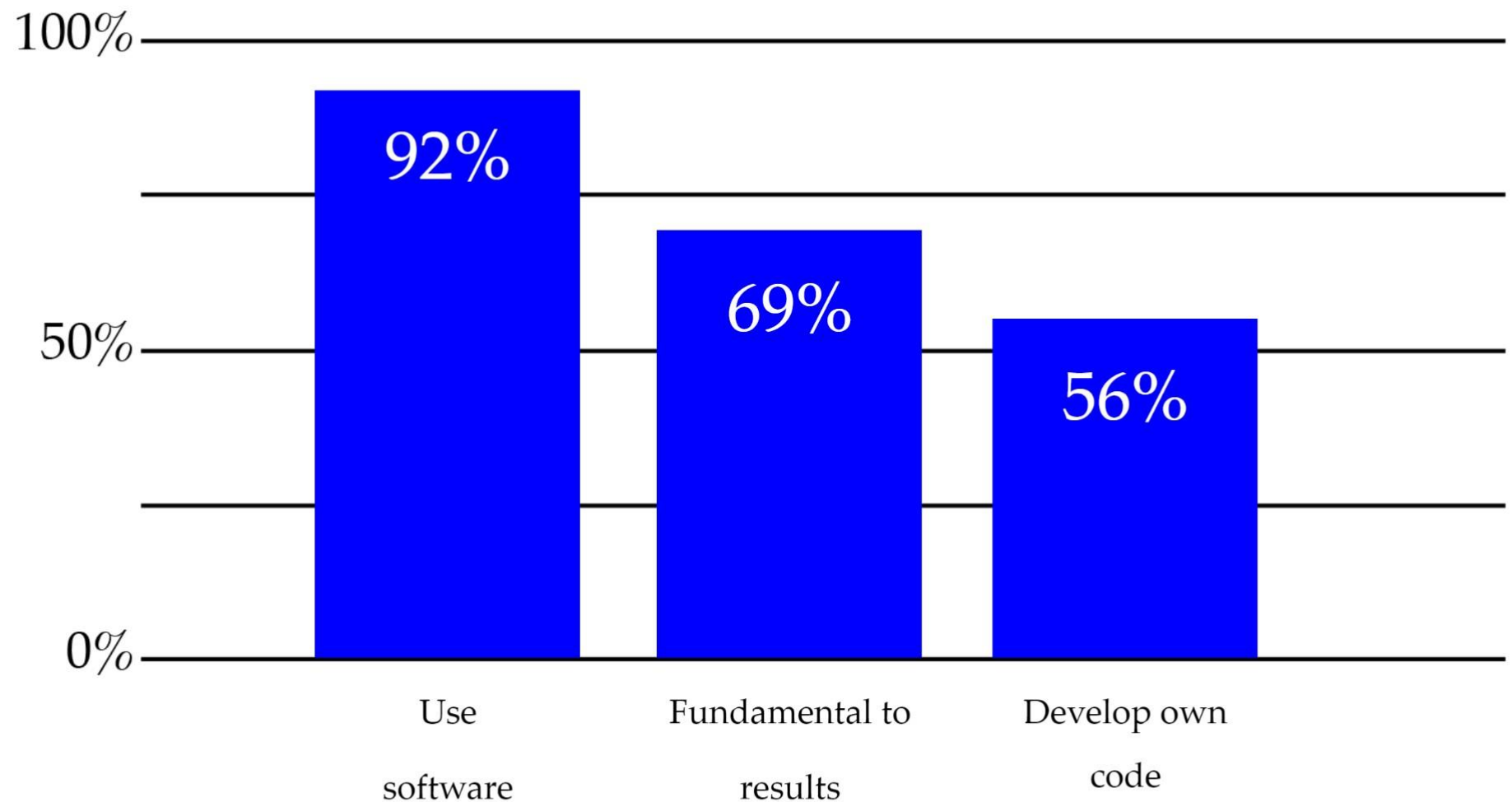
**...someone should really do something about it**

**Q: Is Software Important?**

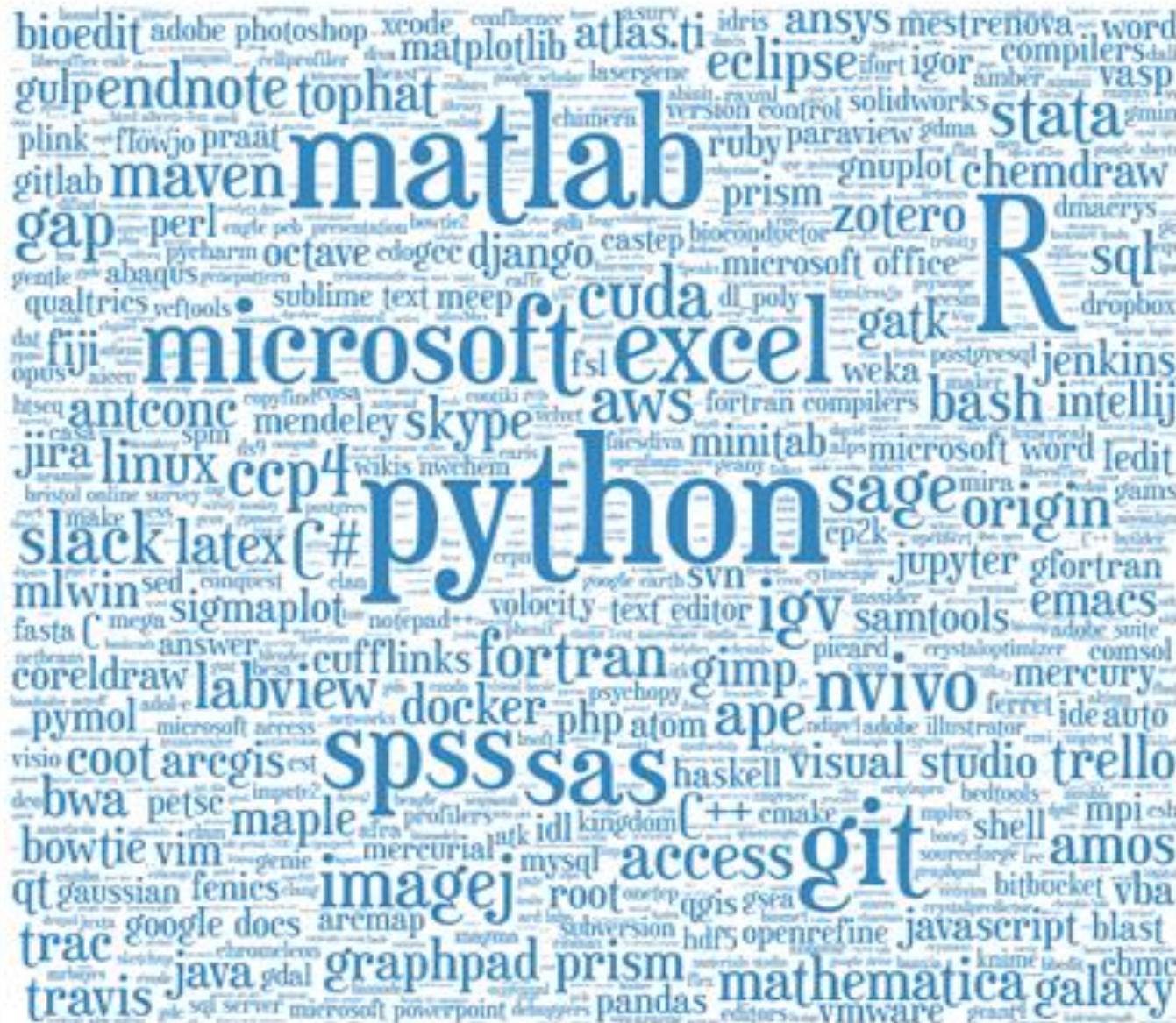
***A: “Witnesses struggled to point to a sector of the economy that was unaffected by digital technologies”***

**- Make or Break: The UK’s Digital Future, Select Committee on Digital Skills**

# Is Software Important for Research?



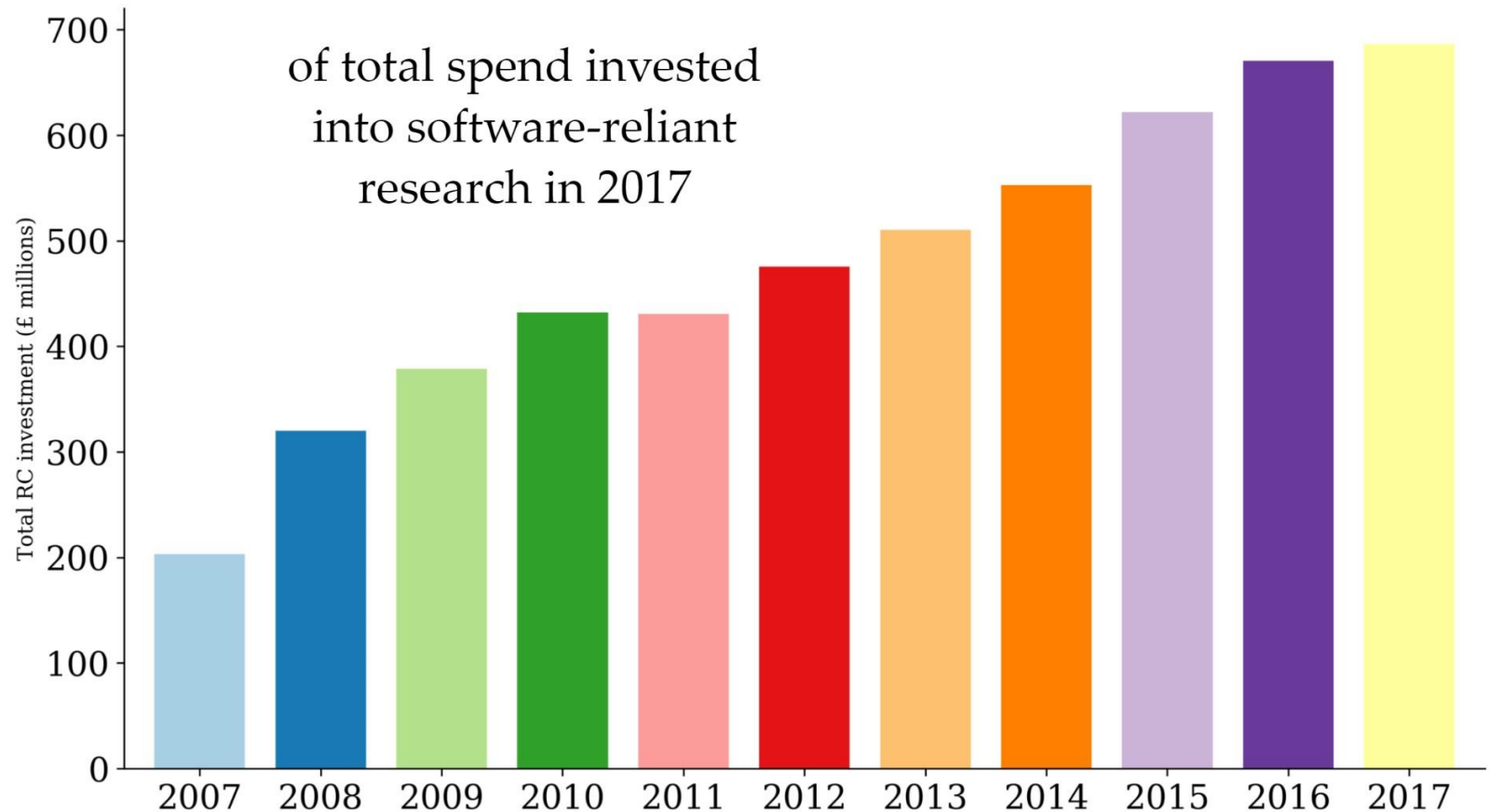
# What is Software?



# UKRI Survey

44,000 research grants (~£3bn) over 7 Research Councils

38%





# ePrints Repository Software



31 repositories  
~600,000 papers

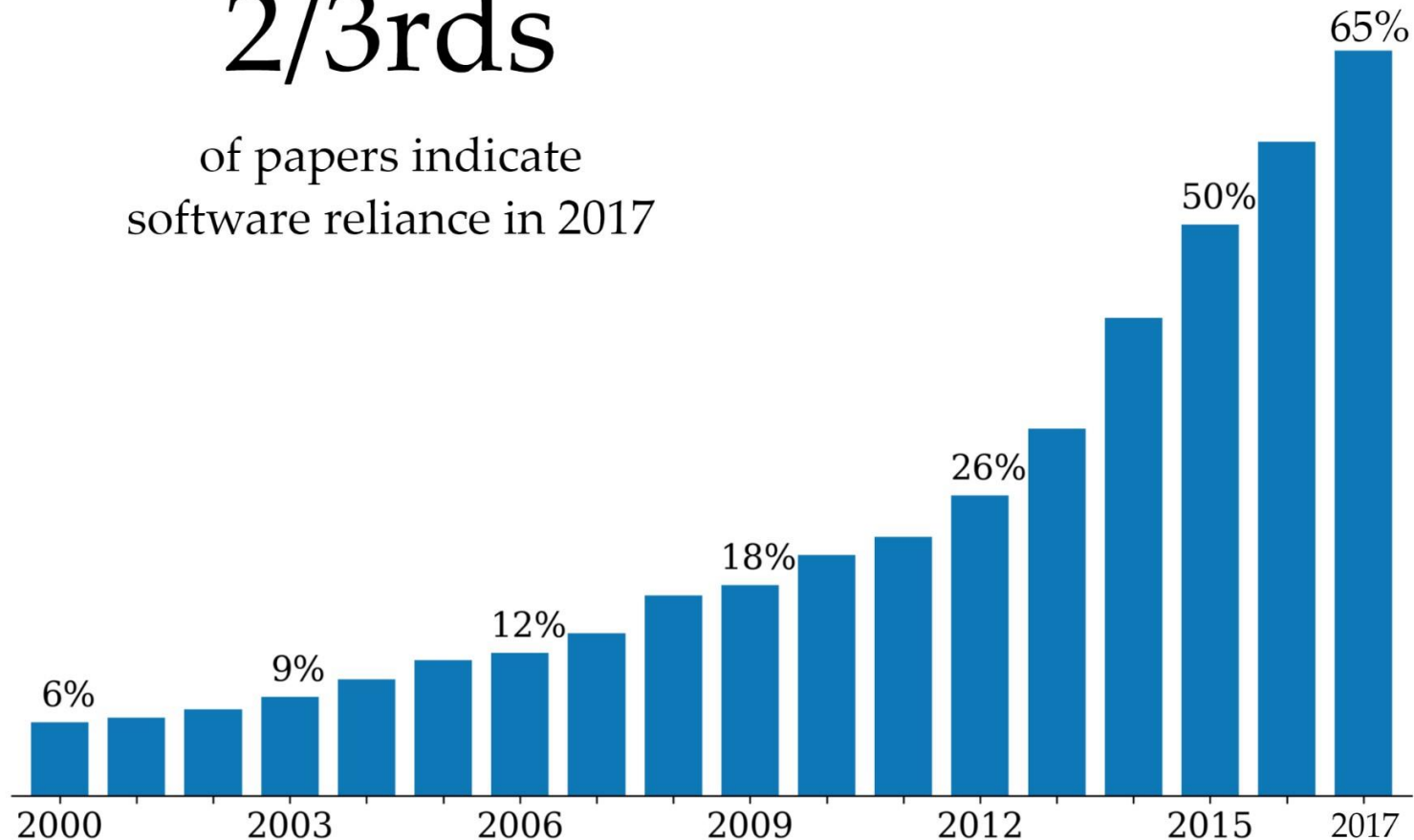




# UK Academia Publications

## 2/3rds

of papers indicate  
software reliance in 2017



# Evidence of Issues

**24%** of researchers who develop code have no training

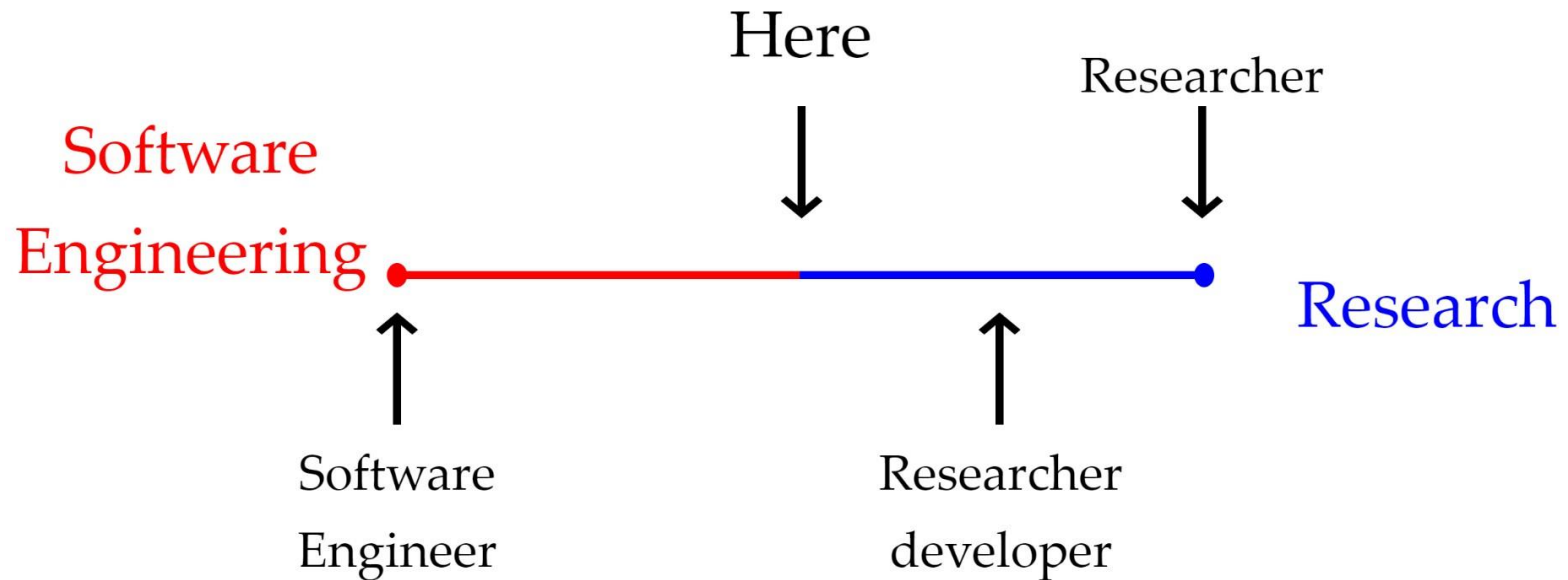
**50%** of group leaders looking to commercialise code would not feel comfortable sharing their code

**3%** of REF 2014 case studies mention software

**120 fold** more paper outcomes registered in ResearchFish<sup>®</sup> than software outcomes



# Evidence of Issues



**No career path for software experts in academia**

# History Line – 2010

**2010:**



**Software  
Sustainability  
Institute**

*Cultivating better, more sustainable research software to enable world-class research*

**Software**

29 projects  
All 7 Research Councils

**Training**

Over 4500 learners  
137 trainers  
80 guides, 50000 views

**23** staff (assoc.) catering for  
**210,000** UK researchers

- Networking
- Events
- Publicity
- Money
- Links to funders
- Research, policy, evidence

**Outreach**

20,000+ monthly visits  
Vibrant Twitter community

112 Fellows across domains  
Over 20 workshops

**Community**

RSE campaign  
Demographic studies  
Finance and career studies

**Policy**

**Enabled the RSE movement  
to get off the ground**



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Facilities Council

UK Research  
and Innovation

# History Line – 2012

## 2012: Collaborative Workshop @ Oxford



"Developing the profession of a scientific software engineer and the career track of software developers in academia"  
- James Hetherington

"It is not **the naming of the new species** that defines the problem, *but the lack of recognition and appreciation of the work, role and skill of the scientific software engineer in both academia and industry.*"  
- Ilian Todorov



# 2012 – RSE Term Coined



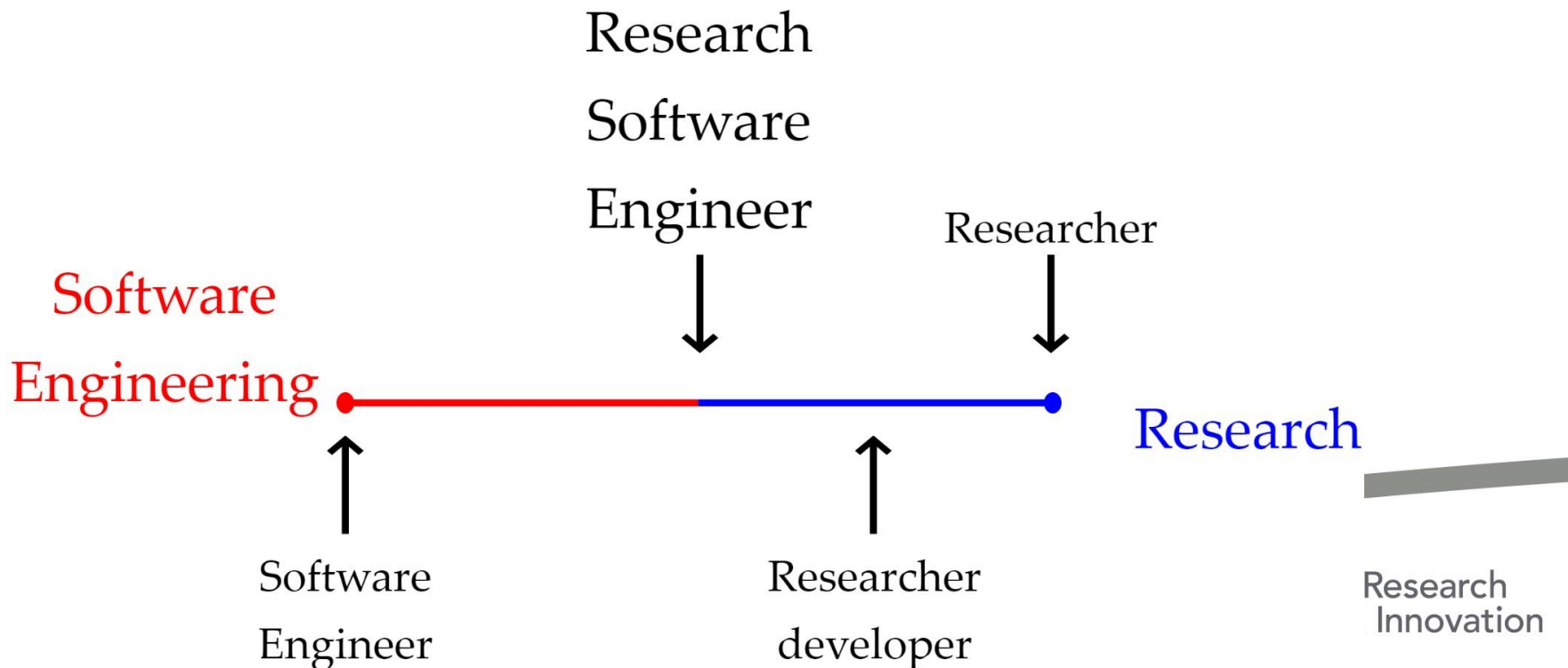
## 2012: Collaborative Workshop @ Oxford

jobs.ac.uk

10,000 jobs assessed

~400 related to software development (4%)

~194 different job titles for RSE roles within UK academia



# 2013 – RSE Publicity



## Engineering a future for research software and its makers

What do you

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## Ten reasons to be a research software engineer

By Chris Carr  
Hetherington  
Hettrick and

**Anthony Fin  
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(And if you're  
should attend  
software eng  
Oxford.)

**1. Right at**

You can reac  
know what's

### scientific computing world

Search Site

Search Q

For scientists, researchers and engineers  
who use computing in their work.

LATEST ISSUE:

Jun/July '16



POPULAR:

- Illumina to develop next-generation sequencin...

News Features Interviews Events Re

### ANALYSIS & OPINION

Tags: RESEARCH

#### Why we need to create careers for research soft

11 November 2015

Tweet 0 in Share

*Perversely, academic research penalises expert software providing the tools on which the research relies. Time for Hettrick of the Software Sustainability Institute.*

We need software: it's an integral part of modern research. However, harnessing the opportunities that software provi



PROFESSIONAL JOBS SUMMITS RANKINGS STUD

## Save your work – give software engineers a career track

Academy risks research future by failing to give credit where it's due

August 15, 2013

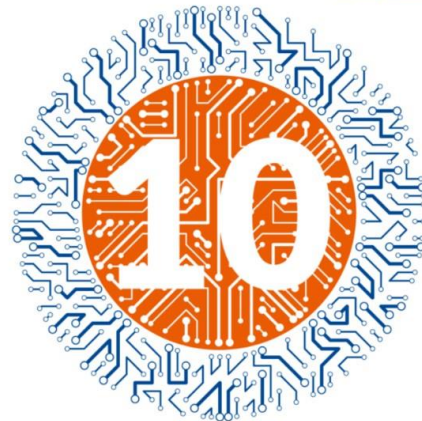
By Chris Parr Twitter: @ChrisParrTHE



# 2013 – First Meeting



## Workshop for RSEs



Oxford e-Research Centre  
driving digital discovery

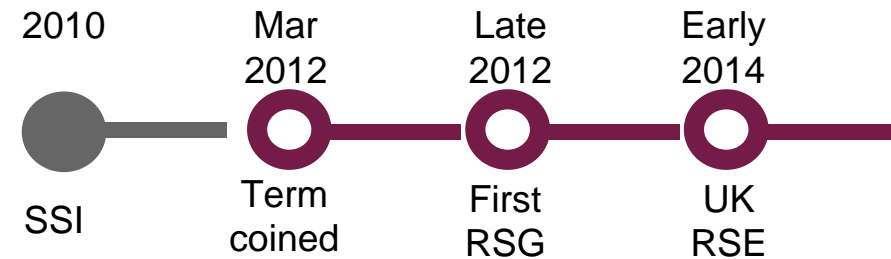
**“Should we create a community to represent RSEs?”**

Outcome: Aim for identity & inclusiveness  
“UKRSE Association”  
[www.rse.ac.uk](http://www.rse.ac.uk)  
[@ResearchSoftEng](https://twitter.com/ResearchSoftEng)

11 September 2013

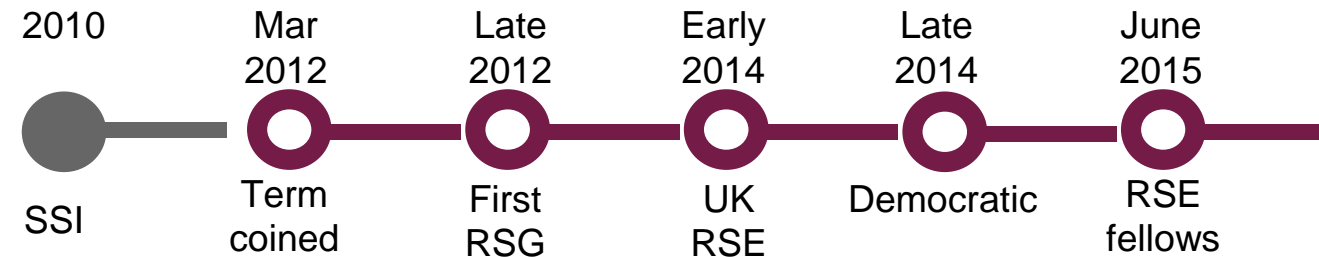
160 members in first 3 months

# 2014 – RSE Association Founded



- A common name is powerful and a symbol of self-recognition
- There are pre-existing roles and teams, and history...
- Job titles and group names may vary, e.g. “engineer” is often a protected term (preventing RSE identification)...
- But the community is inclusive and encourages diversity

# 2015 – RSE Fellowships



## EPSRC

Funding body creates dedicated  
**RSE Fellowships** (5 years duration)

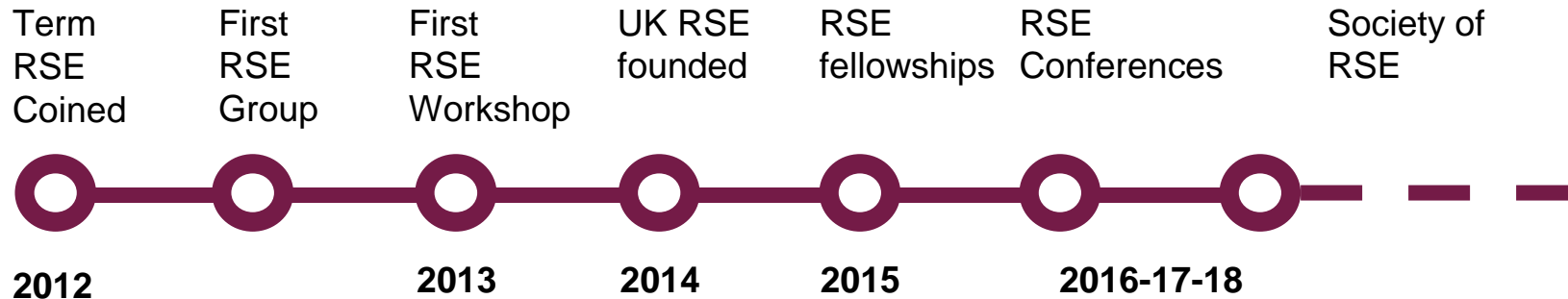
211 applicants – 6 fellowships awarded  
2<sup>nd</sup> round in 2017 – 4 fellowship awarded

## RSE Networks & groups

- RSE network coordinator: Claire Wyatt
- RSE leaders networking group & forum for networking, help & moral support for people setting up or running RSE Groups
- Expansion of more RSE groups around the country



# 2016/18 – Expansion & Society

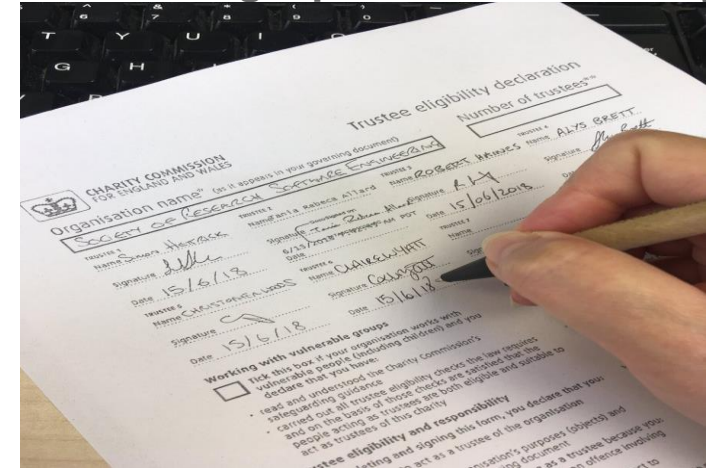


Recognition by funding bodies:

*“RSE State of the Nation Report 2017”*

[doi.org/10.5281/zenodo.495360](https://doi.org/10.5281/zenodo.495360)

Establishing a professional society



# Community Growth

**#RSE16**  
Manchester  
200 attendees!

1000

**#RSE17**  
Manchester  
224 attendees!

500

**#RSE18**  
Birmingham  
>320 attendees!!!

**160 members**  
Jan-Mar'14!

**1294 members**  
In Aug'18!

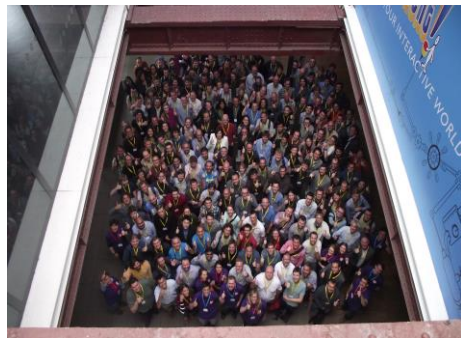
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1 Jan 2015

1 Jan 2016

1 Jan 2017

1 Jan 2018



# Communication Growth



**823** active members



● Weekly Active Users ● Weekly Users Posting Messages

**~3000** messages per month

**~44,000** in total

**> 200** members active per week



**@ResearchSoftEng**

**100s** of jobs advertised  
on the mailing list and  
#jobs every year



**>1700** followers



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and Innovation

# UK Groups Expansion

- 📍 Alan Turing Institute
- 📍 University of Bath
- 📍 University of Birmingham
- 📍 University of Bristol
- 📍 University of Cambridge
- 📍 University of Cardiff
- 📍 UKAEA
- 📍 Imperial College London
- 📍 Francis Crick Institute
- 📍 Kings College London
- 📍 University of Leeds
- 📍 University of Leicester
- 📍 The University of Manchester
- 📍 Newcastle University
- 📍 Open University
- 📍 The University of Sheffield
- 📍 University of Southampton
- 📍 University College London
- 📍 University of Warwick
- 📍 Queen Mary University
- 📍 EPCC
- 📍 Daresbury Laboratory
- 📍 Oxford eResearch Centre
- 📍 Software Engineering Suppo...







# International Follow Up

## Germany: DE-RSE

## Netherlands: NL-RSE

## Nordic Countries: NORDIC-RSE

**RSE** de-RSE Ziele Mitmachen Termine Karte Blog

### Research Software Engineers (RSEs) wissenschaftliche Software

Softwareentwicklung ist ein elementarer, unverzichtbarer Bestandteil der Forschungstätigkeit. Was Auswertung von empirischen Daten, aber auch die Modellierung und Simulation von komplexen Prozessen Forschungsergebnisse. Das Britische Software Sustainability Institut (SSI) hat dafür den £

Jedoch spiegelt der aktuelle Umgang mit Software und die Bewertung der Software-Entwicklung di wider. Die Ursachen dafür sind breit gefächert und äußern sich in vielfältigen Befunden, zum Beisp

- Fehlende Anerkennung für Software-Entwicklung als wissenschaftliche Leistung
- Fehlende Verankerung im wissenschaftlichen Reputationssystem
- Eingeschränkte Verfügbarkeit und Nutzbarkeit wissenschaftlicher Software
- Mehrfach- und Parallelentwicklung
- Ungenügende Kompetenzen im Software-Engineering

**RSE NL-RSE** Community Join NL-RSE Communicate

### The Netherlands Research Software Engineer community

The increasing use of data and digital technology in academia has gone hand in hand with a strong growth in people who write and contribute to research software. Positions like data steward, information manager, research data officer, research software engineer, research supporter and other titles are increasingly recognized as intrinsic positions in the academic system.

Following the great initiatives in the UK and Germany, we plan to bring together the community of people writing and contributing to research software from Dutch universities, knowledge institutes, companies and other organizations to share knowledge, to organize meetings, and raise awareness for the scientific recognition of research software.

We are planning to organize a meetup of Research Software Engineers in 2018. Signup to our mailing list to stay informed about any activities!

**First Meetup of the Netherlands Research Software Engineer Community - register Now!**

**When: 20 September 2018**

**Where: Jaarbeurs Innovation Mile (JIM) in Utrecht**

**Time: 13:00 - 17:30**

[Learn more and register here.](#)

**Tweets by @NL\_RSE**

**Dutch Techcentre for Life Sciences** @DTL\_nl  
Read the latest conference update about the DTL Communities@Work conference on 2 October in Utrecht. First workshops online! [bit.ly/2D0XpQ4](#)

**DTL Communities@Work**  
Jointly building life science data solutions  
3 October 2018 Utrecht

**SURF4all** @SURF4all\_NL  
Lab in the Clouds: the cloud as your research environment - workshop organized by @DTL\_nl, @Communities@Work and @ELIXIRNL, at @DTL\_nl Communities@Work Conference, October 2, 2018. Join us! [surfwiki.nl/2018/10/02/lab-in-the-clouds](#)

**RSE NORDIC RSE** contact@nordic-rse.org

### Nordic Research Software Engineer Group

We bring together the community of people writing and contributing to research software from Nordic universities, research institutes, companies and other organizations to share knowledge, to organize meetings, and raise awareness for the scientific recognition of research software. This initiative is following the international network of other RSE groups at UK, Germany, Netherlands, and other countries.

**Want to know more?**

- Follow us on Twitter.
- Join us by subscribing to the [mailing list](#). By joining the community, you will stay in touch with RSEs in the Norway and you can send and receive announcements of events organized by and for RSEs. You will also be informed about our work and will have the chance to contact people like you from all corners of the research world. The more members that we have, the easier it will be to raise awareness of the importance of software in research, and the vital role RSEs play in creating this software.
- Find great reading material at [UK RSE](#) and [The Software Sustainability Institute](#)

**What is a Research Software Engineer?**

A growing number of people in academia combine expertise in programming with an intricate

**Tweets by @nordic\_rse**

**nordic-rse** @nordic\_rse  
Extraordinary meeting: When nordic-rse was born. Exciting!

**nordic-rse** @nordic\_rse  
When nordic-rse was born.

[www.de-rse.org](http://www.de-rse.org)

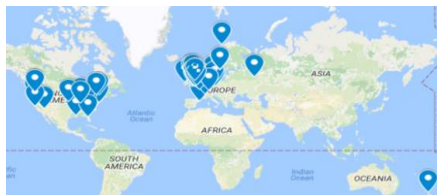
[nl-rse.org](http://nl-rse.org)

[www.nordic-rse.org](http://www.nordic-rse.org)

## Conferences



### RSE17



- ▶ Int. workshop
- ▶ WSSSPE co-located

Sessions / talks in several national & international conferences

## RSE Surveys



Comparative data from:

- ▶ Germany
- ▶ Netherlands
- ▶ UK
- ▶ USA
- ▶ South Africa
- ▶ Canada

## Networks & Groups



Name and concept being adopted, eg

- ▶ Princeton, ORNL, USA
- ▶ Radboud, Netherlands



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# First International Workshop

## International RSE leaders workshop 2018



RSE leaders met to collaborate on running RSE groups & initiatives

Read more at [researchsoftware.org](https://researchsoftware.org)



**RSE** Research Software Engineers International

### Research Software Engineers

This is the website of the international research software engineering community.

Research Software Engineers are people who combine professional software expertise with an understanding of research. They work in many contexts and may have various job titles but the term Research Software Engineer (RSE) is fast gaining international recognition.

### National RSE Associations

RSE associations exist now in several countries:

- UK RSE - UK Research Software Engineers Association
- DE-RSE - Society for Research Software in Germany
- NL-RSE - The community of Research Software Engineers in the Netherlands
- NORDIC-RSE - Nordic Research Software Engineers Community

**EPSRC**  
Engineering and Physical Sciences  
Research Council

# Promotion & Outreach

Case studies [rse.ac.uk/resources](https://rse.ac.uk/resources)

## Career case studies



“With the RSE title,  
everyone knows  
what it means”



“What’s great  
about it is that I  
learn new things  
every day”

## RSE group case studies

- University of Bath
- University of Birmingham
- University of Bristol
- Imperial College London
- University of Leicester
- University of Manchester
- Norwegian University of Science and Technology
- Oak Ridge National Laboratory
- Princeton University
- University of Sheffield
- University of Southampton
- St George’s, University of London
- UCL
- UK Atomic Energy Authority

Describing how RSE  
leaders successfully  
made the case to  
set up their group.



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# An Average RSE (UK)

- **12%** called Research Associate
  - **67%** holds a PhD
  - **27%** Computer Scientist or Physicist
  - **13 years** of experience on average
  - **58%** consider themselves professional software developer
  - **84%** are male
  - **40%** are 35-44 year's old
  - **47%** earn between £32-43k
  - **61%** use Linux
  - **15%** use Python
  - **28%** are 7/10 satisfied with their current position
  - **25%** are 7/10 satisfied with their career
- 1. Wants to work in a research environment**
  - 2. Wants to advance research**
  - 3. Wants to develop software**

# An Average RSE (worldwide)

Country	Gender	PhDs	Background	Reason to work
Canada	n/a	45%	IT	n/a
Germany	83% male	48%	Physics	Research environment
Netherlands	63% male	56%	Comp. sci.	N/A
UK	84% male	67%	Comp. sci./physics	Research environment
USA	82% male	60%	Comp. sci.	Advance research
South Africa	92% male	68%	Physics	Research environment

<https://goo.gl/ruaTue>

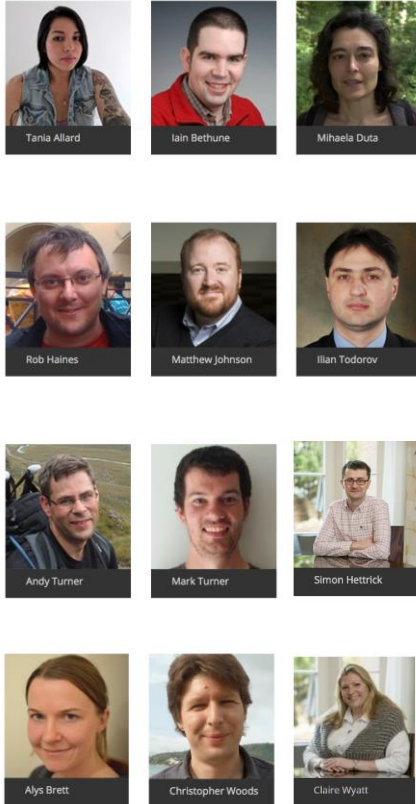


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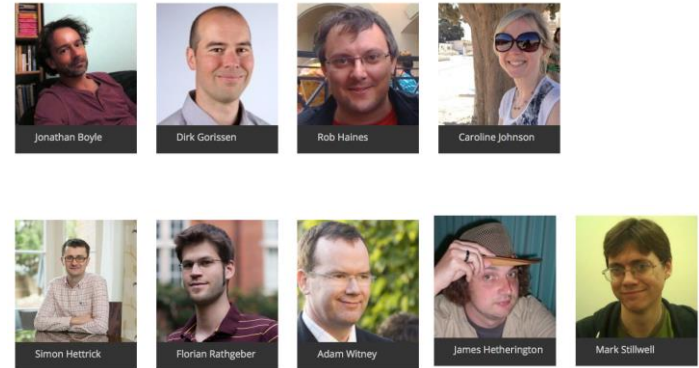
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and Innovation

# UKRSE Committees

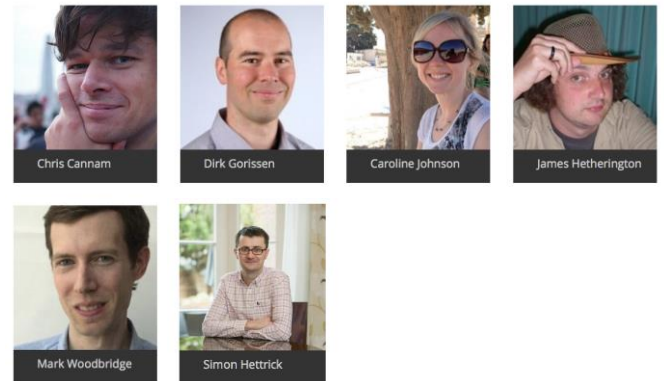
2016-2018



2015-2016



2013-2015





# What have We Achieved?

"It's a noble goal and all, but you won't change anything"

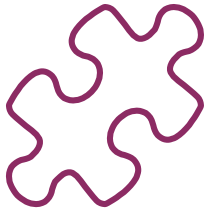
- Anonymous

"Genius is one percent inspiration, ninety-nine percent perspiration"

- Thomas Edison

- Identity & Recognition
- A career path, albeit still informal
- A growth in the number of software experts
- Greater access to RSE skills for researchers





# PICK WHAT FITS

Action can be taken on all scales  
You know your context best



CHANGE IS  
HARD



# COMMUNITIES ARE POWERFUL



# BIG GOAL SMALL STEPS

Keep going and small changes add up





MAKE IT  
HAPPEN!