

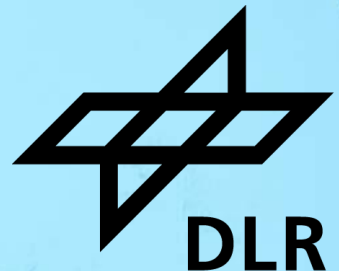
RESEARCH SOFTWARE REQUIREMENTS ENGINEERING?

Stephan Druskat

German Aerospace Center (DLR), Institute for Software Technology
Sustainable Software Engineering Group

DOI [10.5281/zenodo.10696026](https://doi.org/10.5281/zenodo.10696026)

License [CC-BY-4.0 International](https://creativecommons.org/licenses/by/4.0/)



Research software requirements engineering?

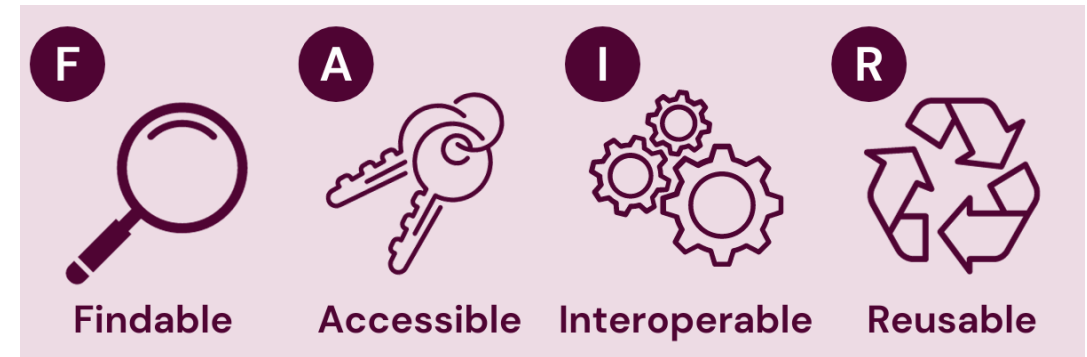


Research software:

- Specific aim: Creation and validation of **knowledge**
- Specific paradigms: **Research methods**
- Specific context: **Research Software Engineering**

Together, aim, paradigms and context impact the application of requirements engineering in research software projects.

- **Functional requirements:**
 - May not be known / knowable upfront
- **Non-functional requirements:**
 - Derived from research setting:
 - FAIR Research Software
 - Reproducibility (of research results)
 - Citable software (versions)



N. P. Chue Hong *et al.*, “FAIR Principles for Research Software (FAIR4RS Principles),”
May 2022, doi: [10.15497/RDA00068](https://doi.org/10.15497/RDA00068).

Research software requirements engineering: Anecdotal evidence



- "Requirements what?"
- "Overkill for my scripts"
- "Yet Another Thing I Have To Do And Don't Know How"
- "Issue-based requirements engineering"

„The use of software engineering practices in research applications“

- A community of practice
- A role: **Research Software Engineer (RSE)**
 - A development context



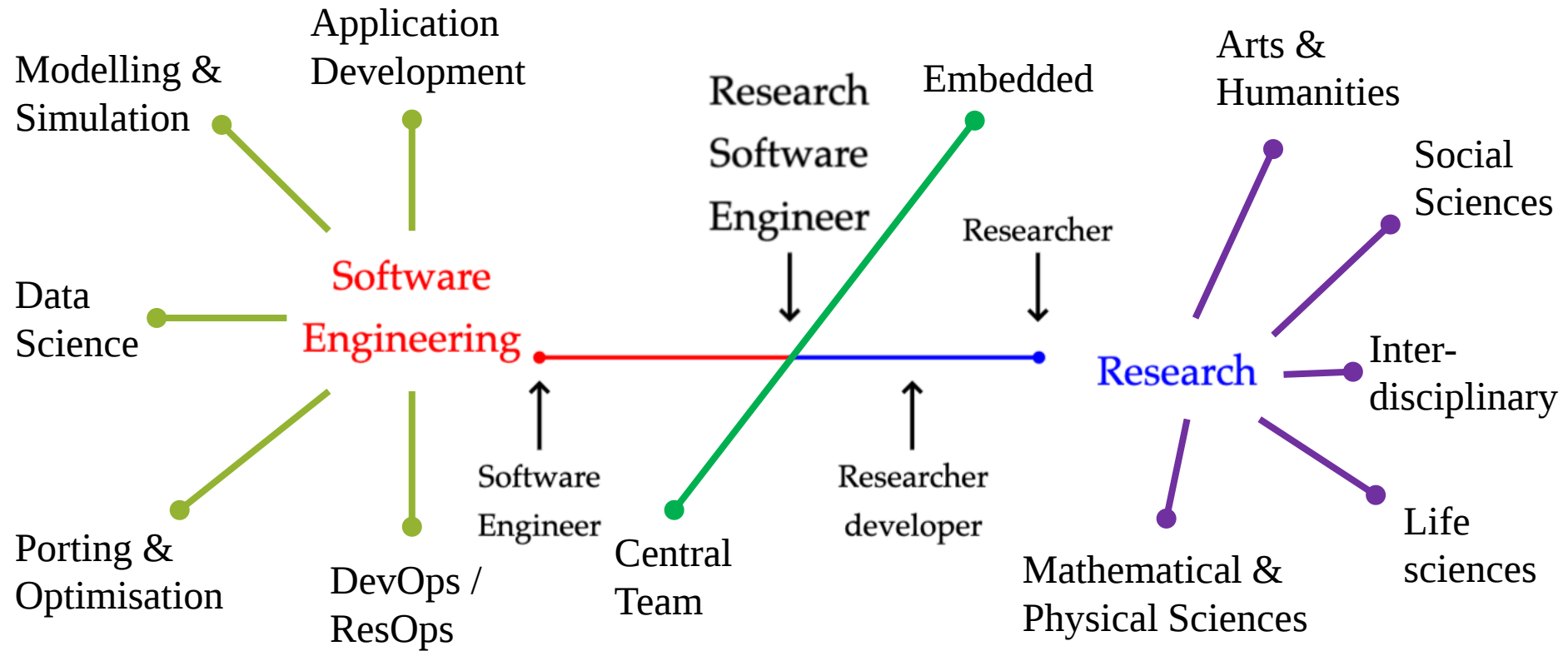
Research Software Engineering community



- Conferences
- Associations
- International Council



The Research Software Engineer role



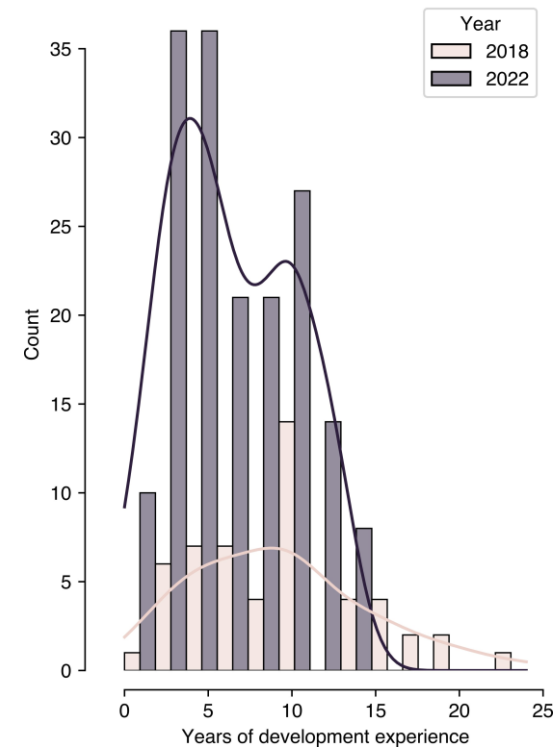
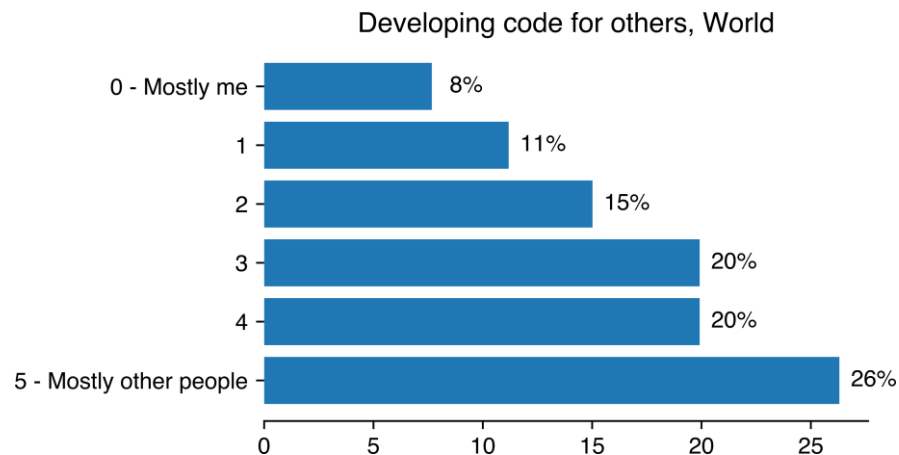
Chue Hong, Neil (2023). Is Research Software Engineering coming of age?

<https://doi.org/10.6084/m9.figshare.24078054>

Research Software Engineering context



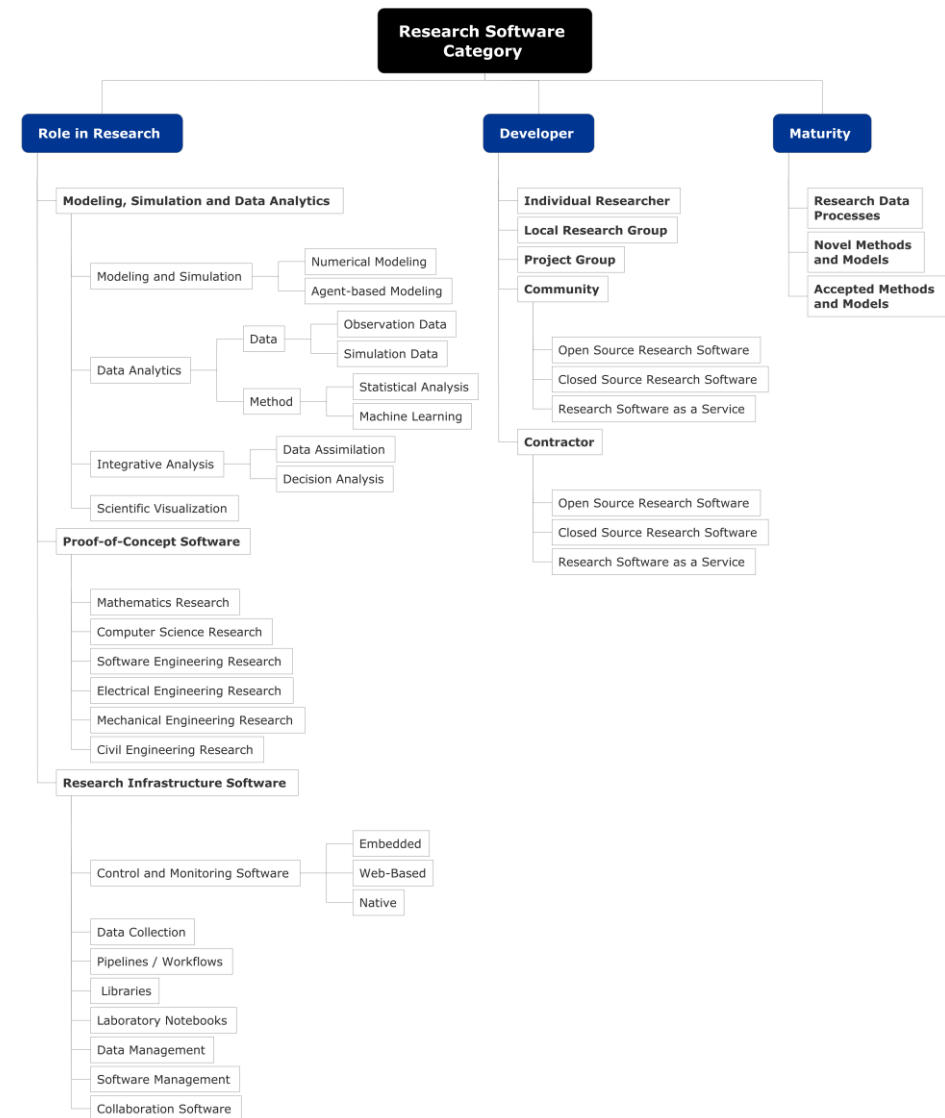
- An "average RSE" is generally not a useful assumption, but:
 - Small bus factors: few resources
 - ~80% not computer scientists
 - ~42% „not professional developers“
 - ~44% fixed-term/zero-hour contracts



S. Hettrick *et al.*, "International RSE Survey 2022." Zenodo, Aug. 22, 2022.
doi: [10.5281/zenodo.7015772](https://doi.org/10.5281/zenodo.7015772).

Research Software Engineering context: Categories of research software

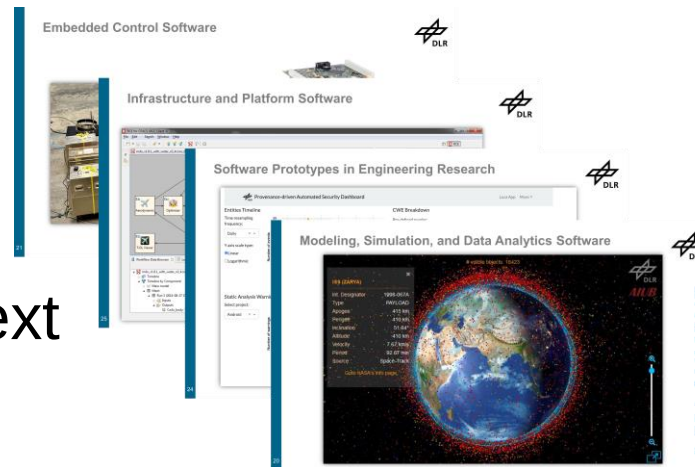
- Different categories along different dimensions
 - Role of software in research
 - Development context
 - Maturity



Research Software Engineering context: Categories of research software

Research software requirements engineering:

- Does the role in research require (formal) RE?
- Does the development context support RE?
- Does the target maturity level require a specific RE process?



TECHNOLOGY READINESS LEVEL (TRL)

DEVELOPMENT	9	ACTUAL SYSTEM PROVEN IN OPERATIONAL ENVIRONMENT
	8	SYSTEM COMPLETE AND QUALIFIED
	7	SYSTEM PROTOTYPE DEMONSTRATION IN OPERATIONAL ENVIRONMENT
	6	TECHNOLOGY DEMONSTRATED IN RELEVANT ENVIRONMENT
	5	TECHNOLOGY VALIDATED IN RELEVANT ENVIRONMENT
	4	TECHNOLOGY VALIDATED IN LAB
RESEARCH	3	EXPERIMENTAL PROOF OF CONCEPT
	2	TECHNOLOGY CONCEPT FORMULATED
	1	BASIC PRINCIPLES OBSERVED

Should RSEs do requirements engineering?



Can RSEs do requirements engineering?

- Lack of education and training
- Lack of resources
- Lack of knowledge transfer
- Potentially unclear functional requirements

VS

- Agile RE
- Usage of development/DevOps platforms

A screenshot of the Dagstuhl Seminar 24161 website. The page has a white background with a dark header bar. The header bar contains the text "Seminars / Seminar Calendar / Seminar 24161" and a "QUICK LINKS" button. The main content area is titled "Dagstuhl Seminar 24161" and "Research Software Engineering: Bridging Knowledge Gaps (Apr 14 – Apr 19, 2024)". Below the title, there is a "Permalink" section with a short URL. The "Organizers" section lists four names with their affiliations. The "Contact" section lists two names with their roles. The "Dagstuhl Seminar Wiki" section has a link to the wiki. The "Shared Documents" section has a link to the materials page. The "Schedule" section has a link to the upload page. The "Motivation" section has a small downward arrow icon and a paragraph of text.

Dagstuhl Seminar 24161
Research Software Engineering: Bridging Knowledge Gaps
(Apr 14 – Apr 19, 2024)

Permalink
Please use the following short url to reference this page:
<https://www.dagstuhl.de/24161>

Organizers

- [Stephan Druskat](#) (DLR - Berlin, DE)
- [Lars Grunske](#) (HU Berlin, DE)
- [Caroline Jay](#) (University of Manchester, GB)
- [Daniel S. Katz](#) (University of Illinois Urbana-Champaign, US)

Contact

- [Marsha Kleinbauer](#) (for scientific matters)
- [Jutka Gasiotowski](#) (for administrative matters)

Dagstuhl Seminar Wiki

- [Dagstuhl Seminar Wiki](#) (Use personal credentials as created in DOOR to log in)

Shared Documents

- [Dagstuhl Materials Page](#) (Use personal credentials as created in DOOR to log in)

Schedule

- [Upload](#) (Use personal credentials as created in DOOR to log in)

Motivation ▾
Research software is crucial to all computational research across many academic disciplines. Multiple communities are invested in research software,

When should RSEs do requirements engineering?



Whenever ...

- ... RE is supported in the development context
→ *Resources, training*
- ... RE is required by research software category
→ *Policies, requirements/software engineering knowledge*

How should RSEs do requirements engineering?

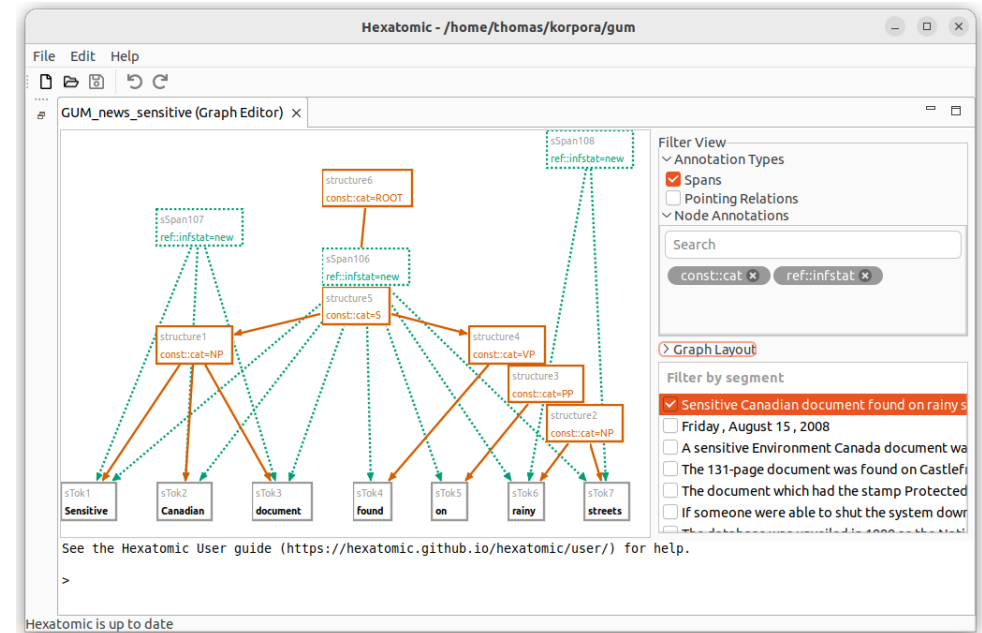


- We don't know (yet!)
 - *Knowledge exchange with the RE community*
- Research process as requirements engineering?
 - *Project proposal (funder as stakeholder), project publications*
- Bootstrap existing documentation requirements in research?
 - *RSEng as accepted project activity, RSEs as co-authors*

Examples:

Hexatomic (hexatomic.github.io)

- Multi-layer annotation of linguistic data
- Categories:
 - Research infrastructure software
 - Project group (3yrs 1.5 FTE, cont. ~0.2 FTE)
 - Target TRL: 7
Current TRL: 5
- Requirements engineering:
 - 0.5 FTE w/ computer science background
 - No defined process for RE, no requirements explicitly documented, semi-agile development, "issue-based"
 - Implicit requirements documentation in project proposal, software paper, documentation



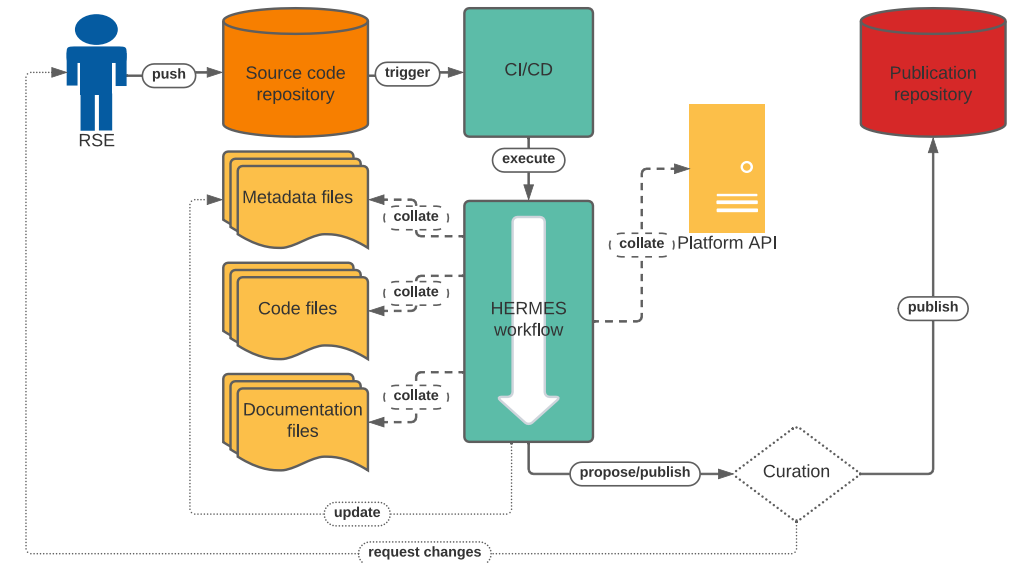
S. Druskat, T. Krause, C. Lachenmaier, and B. Bunzeck, "Hexatomic: An extensible, OS-independent platform for deep multi-layer linguistic annotation of corpora," *JOSS*, vol. 8, no. 86, p. 4825, Jun. 2023, doi: [10.21105/joss.04825](https://doi.org/10.21105/joss.04825).

Examples:

HERMES (software-metadata.pub)



- CD for automated software publication
- Categories:
 - Research infrastructure software
 - Project group (2.5yrs 2 FTE)
 - Target TRL: 7
Current TRL: 3
- Requirements engineering:
 - ~0.5 FTE w/ computer science background
 - No defined process for RE, no requirements explicitly documented, *stakeholder workshops*, semi-agile development, "issue-based"
 - Implicit requirements documentation in project proposal and preprint



S. Druskat, O. Bertuch, G. Juckeland, O. Knodel, and T. Schlauch, "Software publications with rich metadata: State of the art, automated workflows and HERMES concept," *arXiv*, Jan. 2022, doi: [10.48550/arXiv.2201.09015](https://doi.org/10.48550/arXiv.2201.09015).

Conclusion



- RE for research software is neither well-understood nor common practice
- The aims of research software, its development paradigms and context impede 1:1 adoption of RE practices from other SE disciplines
- Solutions may exist, but we need better knowledge exchange between SE (research) and RSE



derse24.physik.uni-wuerzburg.de/

Thanks!



Contact: stephan.druskat@dlr.de

Fediverse: [@sdruskat@fosstodon.org](https://fosstodon.org/@sdruskat)

Image sources:

- FAIR: Karolinska Institutet University Library, CC BY-SA 4.0
- RSE: CC0 1.0
- Photo deRSE19: A. Cozacu, J. P. Dietrich, de-RSE e.V., CC BY 4.0
- RSE Association logos: CC0 1.0 / fair use
- TRL infographic: TWI Global based on Horizon 2020 WP, fair use
- DLR slides: Michael Felderer / DLR, CC BY-NC-ND 3.0
- Dagstuhl website: Schloss Dagstuhl – Leibniz-Zentrum für Informatik GmbH, fair use