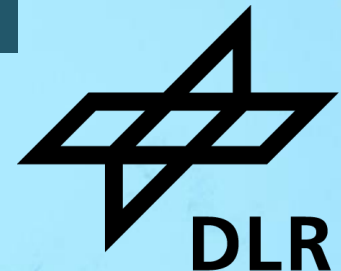


# RESEARCH SOFTWARE DEVELOPMENT AT DLR

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German Aerospace Center (DLR)  
<http://www.dlr.de/sc>



# Research Software Development at DLR



## Some context:

- More than 10.000 employees, ~20% of DLR employees involved in software development
- Variety of fields, maturity, and technologies:  
<https://doi.org/10.1145/3387940.3392244>

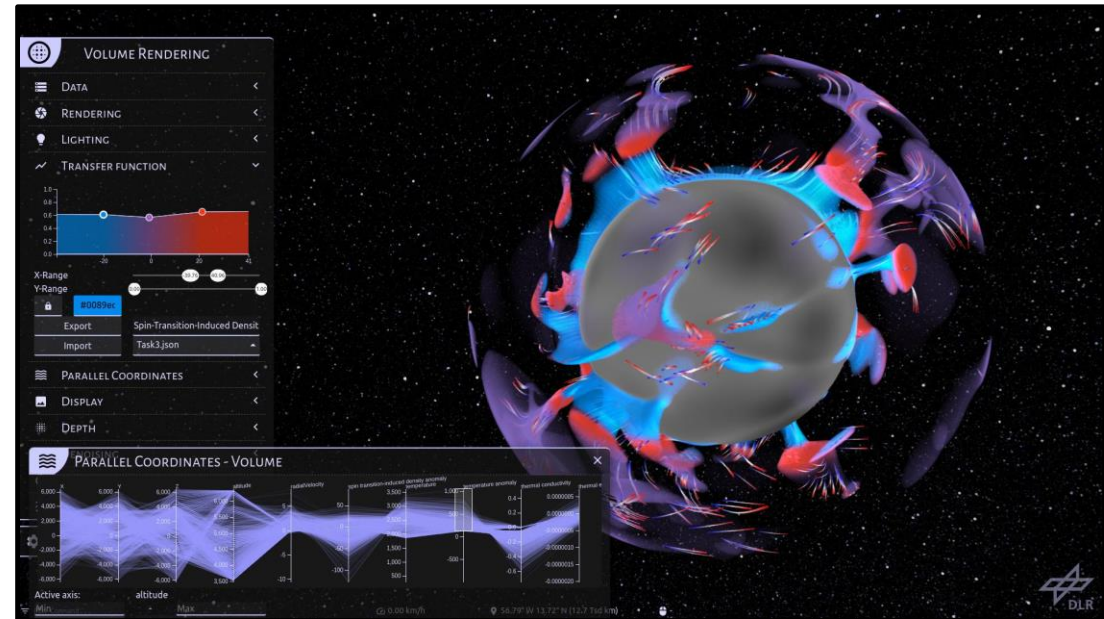
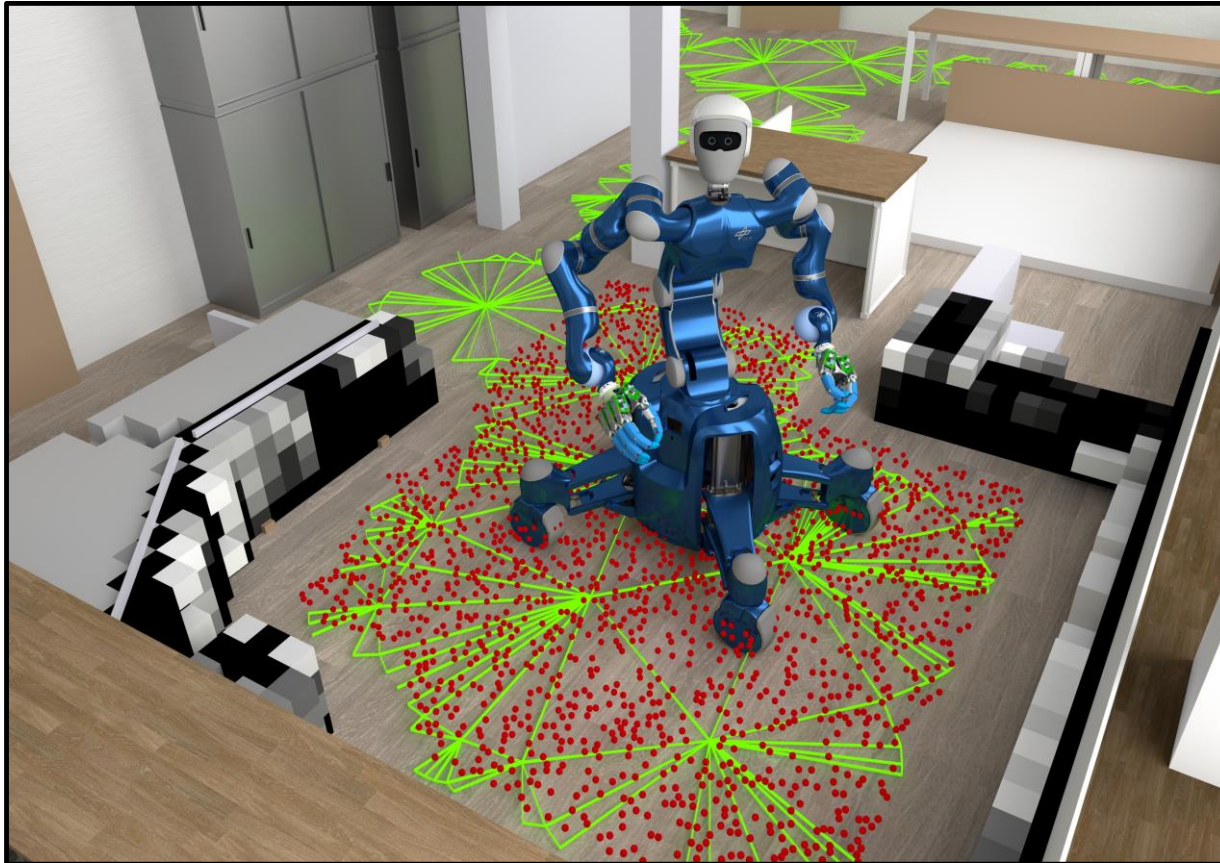
## Brief history of DLR`s Software Engineering Initiative:

- Activities started in 2005
- Since 2017 focus moved on research software development
- Work is driven by the DLR institute for Software Technology and funded by DLR IT



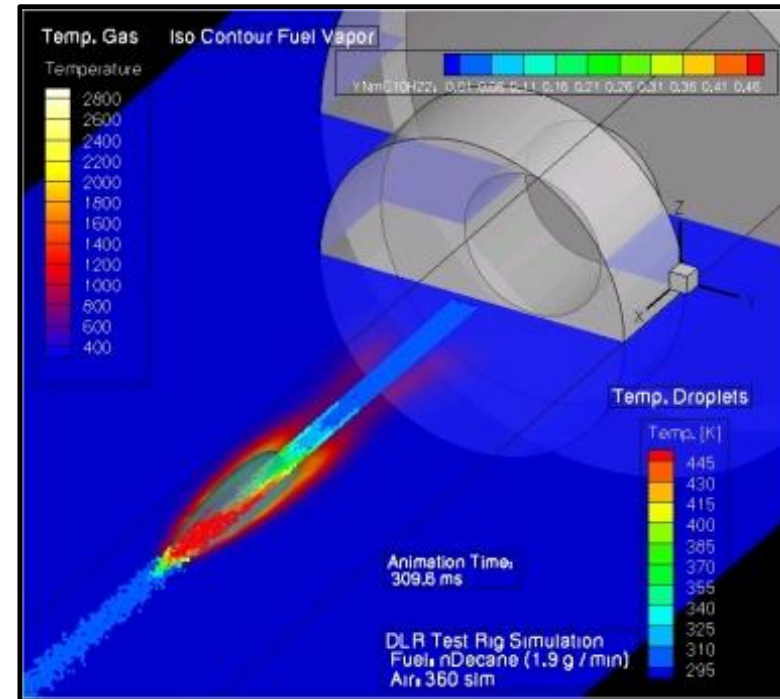
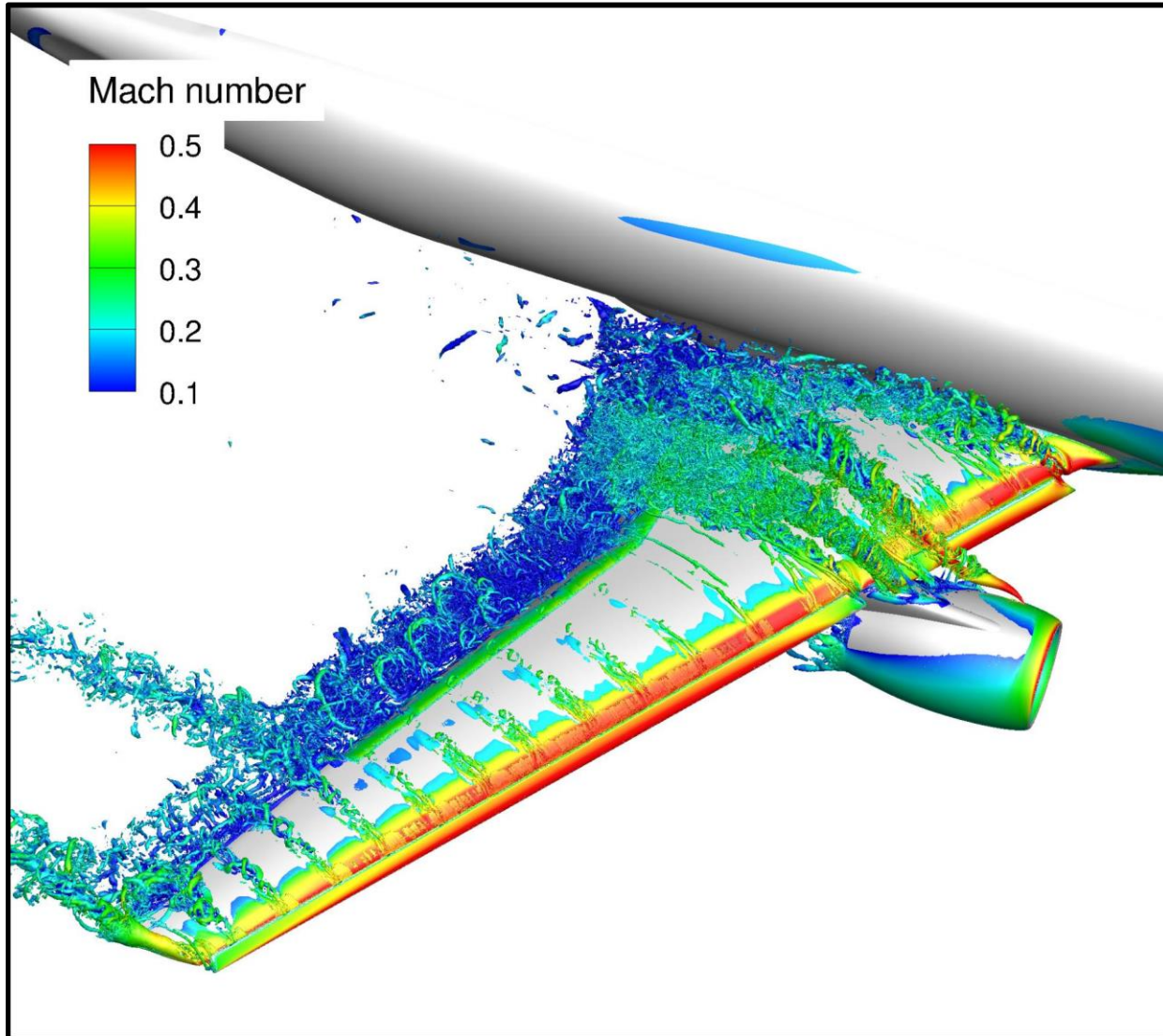
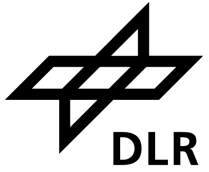


# Examples of DLR Software (1/3)

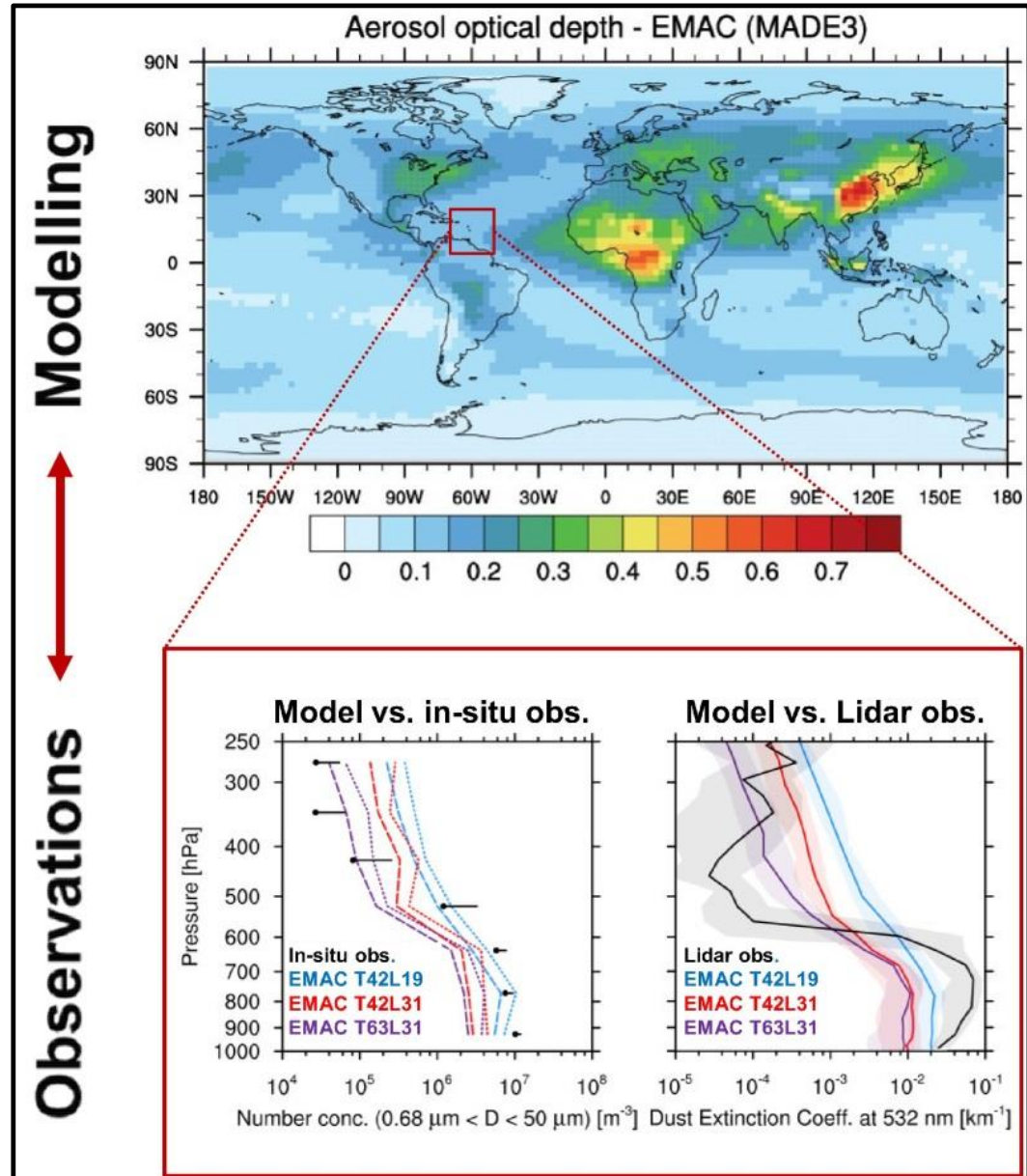
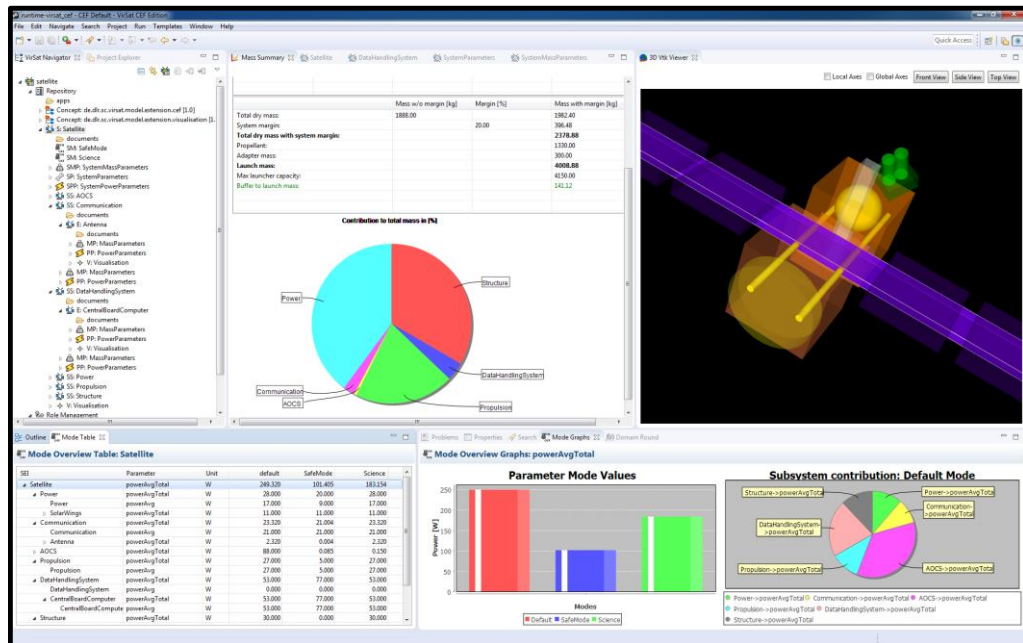
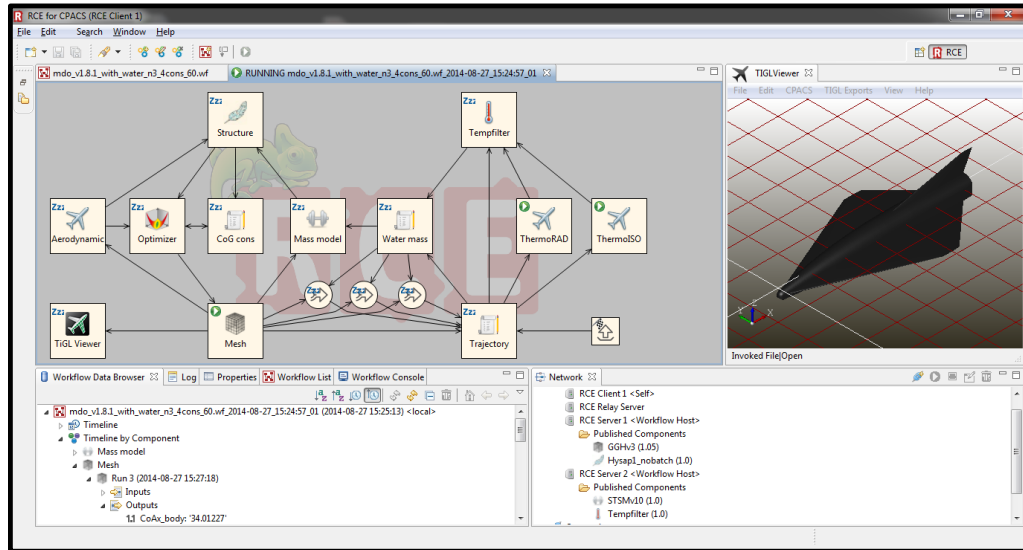




# Examples of DLR Software (2/3)



# Examples of DLR Software (3/3)



Modelling

Observations

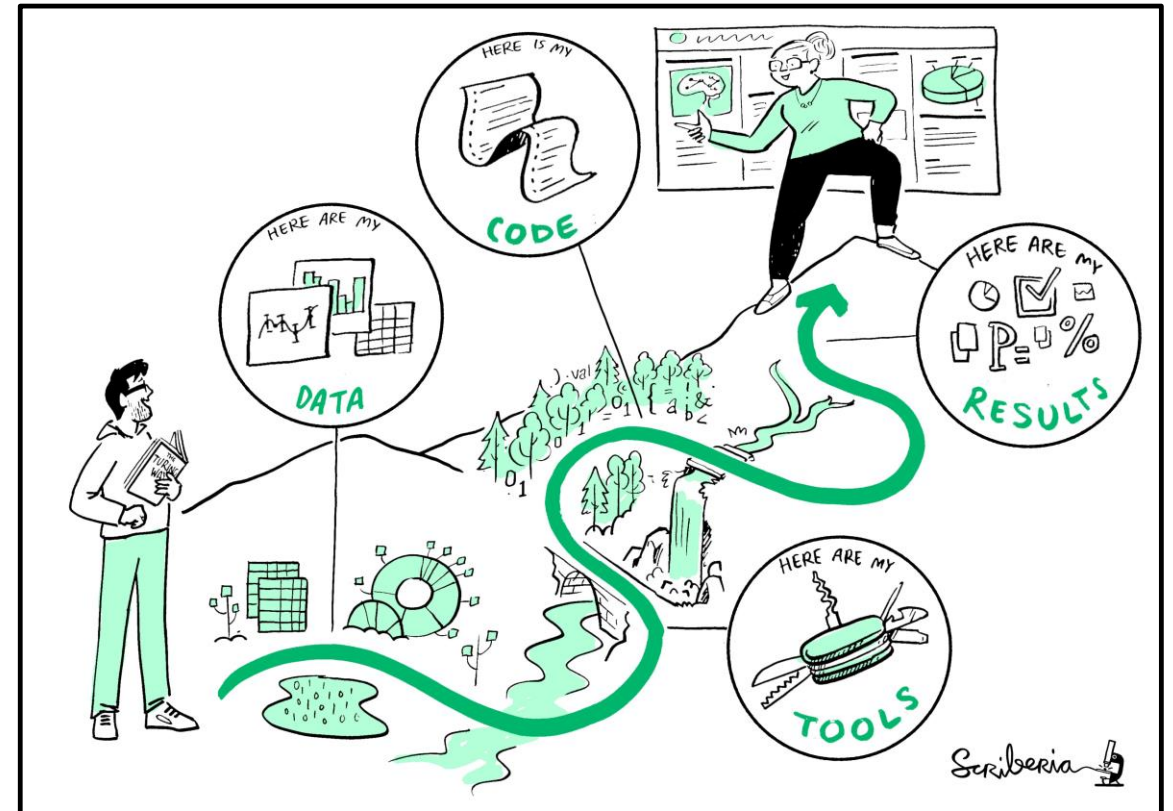


# **REPRODUCIBILITY – A SPECIAL CHALLENGE IN RESEARCH**



# Reproducibility – A Special Challenge in Research

- Reproducibility of scientific results is vital in research!
- Making scientific results reproducible is context-specific and can be hard in the concrete case 😞
- To enable reproducibility in computational research:
  - Researchers must make relevant data and software available and cite them properly in their research paper
  - Researchers need to follow certain minimum practices (see also: [FAIR Principles for Research Software](#))



# How to cite Software?

## Example



*“The Jupyter notebook containing the analysis details have been published separately [11].”*

### References:

[11] Schlauch, Tobias, & Haupt, Carina. (2019).  
Analysis of the DLR Knowledge Exchange Workshop  
Series on Software Engineering (Version 1.2.0).  
Zenodo. <https://doi.org/10.5281/zenodo.3403991>

- **Authors**
- **Software Name**
- **Software itself**
- **Source code version**
- **Exact version**
- **Publication date**
- **Persistent Identifier (PID)**
  
- **See also:** [Software Citation Principles](#)



# How to make Software citable?

## Provide Citation Metadata



- [Citation File Format](#)
- Full control over citation metadata
- Growing tool support (e.g., in GitHub, Zotero, Zenodo)

```
cff-version: 1.2.0
message: If you use this software, please cite it using these metadata.
title: My Research Software
abstract: This is my awesome research software. It does many things.
authors:
  - family-names: Druskat
    given-names: Stephan
    orcid: "https://orcid.org/0000-0003-4925-7248"
version: 0.11.2
date-released: "2021-07-18"
identifiers:
  - description: This is the collection of archived snapshots of all versions of My Research Software
    type: doi
    value: "10.5281/zenodo.123456"
  - description: This is the archived snapshot of version 0.11.2 of My Research Software
    type: doi
    value: "10.5281/zenodo.123457"
license: Apache-2.0
repository-code: "https://github.com/citation-file-format/my-research-software"
```

# How to make Software citable?

## Archive the Release and obtain a PID



### Installation

- Install Python  $\geq 3.6$
- Install the dependencies via: `pip install -r requirements.txt`

### Run the Jupyter notebook(s)

- Start Jupyter: `jupyter notebook`
- Your browser should start and you can select the corresponding analysis notebook.

### Citation

If you use this work in a research publication, please cite the specific version that you used using the citation metadata Zenodo `DOI 10.5281/zenodo.3611306`.

You can find an overview about the different versions of the material in the [changelog](#).

### License

Copyright © 2020 German Aerospace Center (DLR)

### Versions

Version 1.0.0	Jan 22, 2020
10.5281/zenodo.3611307	


**Cite all versions?** You can cite all versions by using the DOI [10.5281/zenodo.3611306](https://doi.org/10.5281/zenodo.3611306). This DOI represents all versions, and will always resolve to the latest one. [Read more](#).

### Cite as

von Kurnatowski, Lynn, & Schlauch, Tobias. (2020). Role and practice of research software development at DLR (Version 1.0.0) [Data set]. Zenodo. <http://doi.org/10.5281/zenodo.3611307>

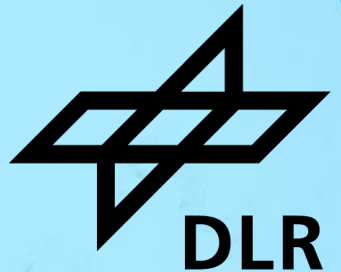
### Export

[BibTeX](#) [CSL](#) [DataCite](#) [Dublin Core](#)  
[DCAT](#) [JSON](#) [JSON-LD](#) [GeoJSON](#)  
[MARCXML](#) [Mendeley](#)





# **SUPPORTING THE RESEARCH SOFTWARE DEVELOPMENT COMMUNITY AT DLR**



## Software Engineering Initiative for DLR

Policy  
Development

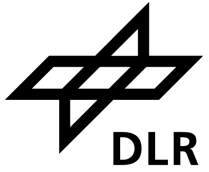
Guidelines  
and  
Tools

Training  
and  
Consulting

Community  
Building  
and Experience  
Exchange



# Software Engineering Initiative for DLR (cont.)



## DLR SE Guidelines

<https://rse.dlr.de/>

### Change Management

Recommendation	Comment	Status
<b>EÄM.2:</b> The most important information describing how to contribute to development are stored in a central location. <i>(from application class 1)</i>	Build steps are missing	todo
<b>EÄM.5:</b> Known bugs, important unresolved tasks and ideas are at least noted in bullet point form and stored centrally. <i>(from application class 1)</i>		
<b>EÄM.7:</b> A repository is set up in a version control system. The repository is adequately structured and ideally contains all artifacts for building a usable software version and for testing it. <i>(from application class 1)</i>		
<b>EÄM.8:</b> Every change of the repository ideally serves a specific purpose, contains an understandable description and leaves the software in a consistent, working state. <i>(from application class 1)</i>		



Git

Issue Tracker

Continuous  
Integration

Collaboration

...

DLR GitLab Instance

# Community Building and Experience Exchange



## Goals

- Improve collaboration across domains and hierarchies
- Enable the establishment of DLR-wide and local communities

## Challenges

- Heterogenous target group
- High fluctuation of personnel
- Culture of “working on your own”

## Current Approach

- Establish an official DLR-wide collaboration network
- Establish low-threshold opportunities for knowledge and experience exchange



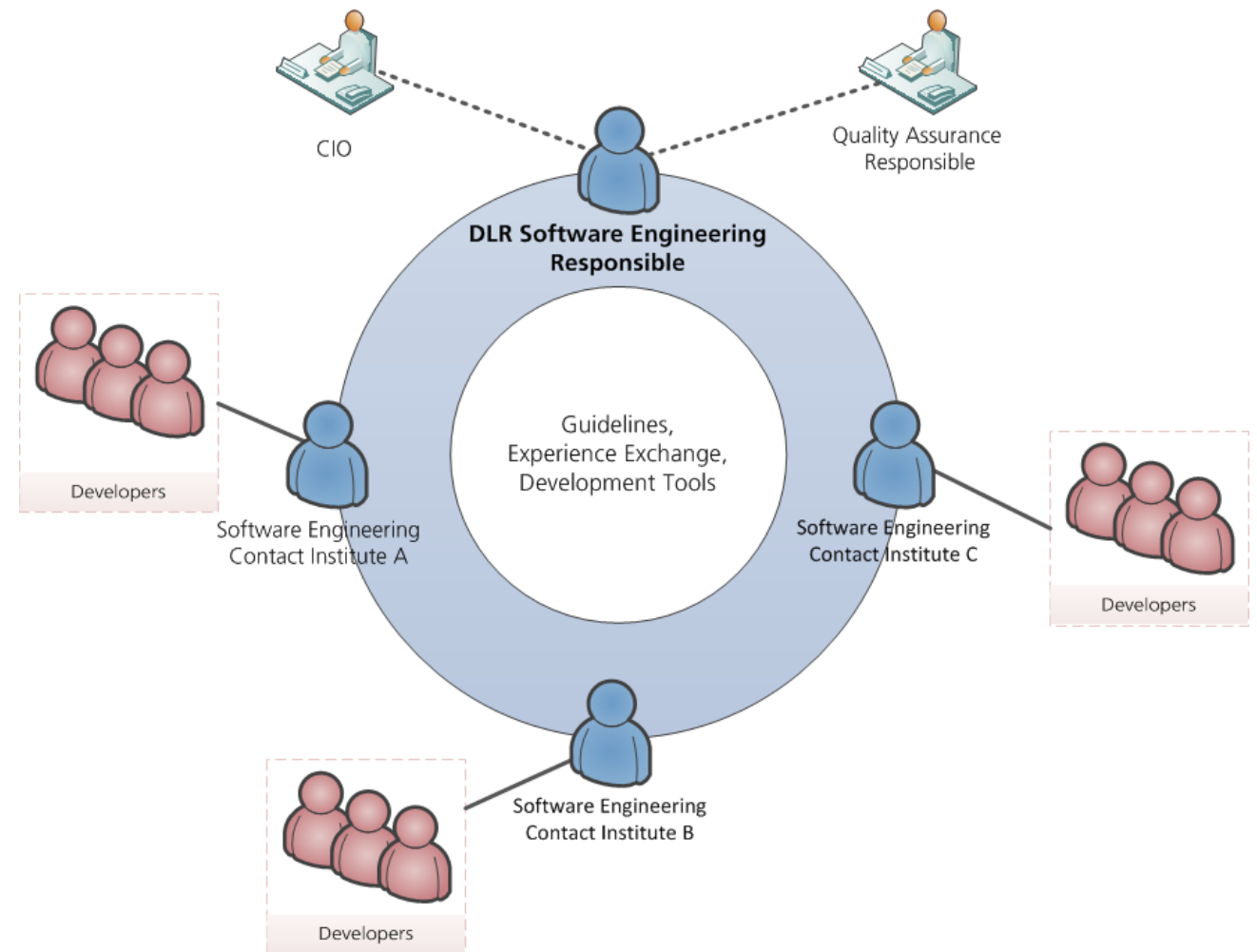
# DLR Software Engineering Network



- Consists of the **Software Engineering Contacts** and further interested persons of each institute
- Software Engineering Network and related roles are officially established via DLR`s quality policy

## Role of the Network:

- Exchange experiences and needs across the different institutes
- Discuss and work on central topics related to software engineering
- Joint decision making



# DLR Software Engineering Network

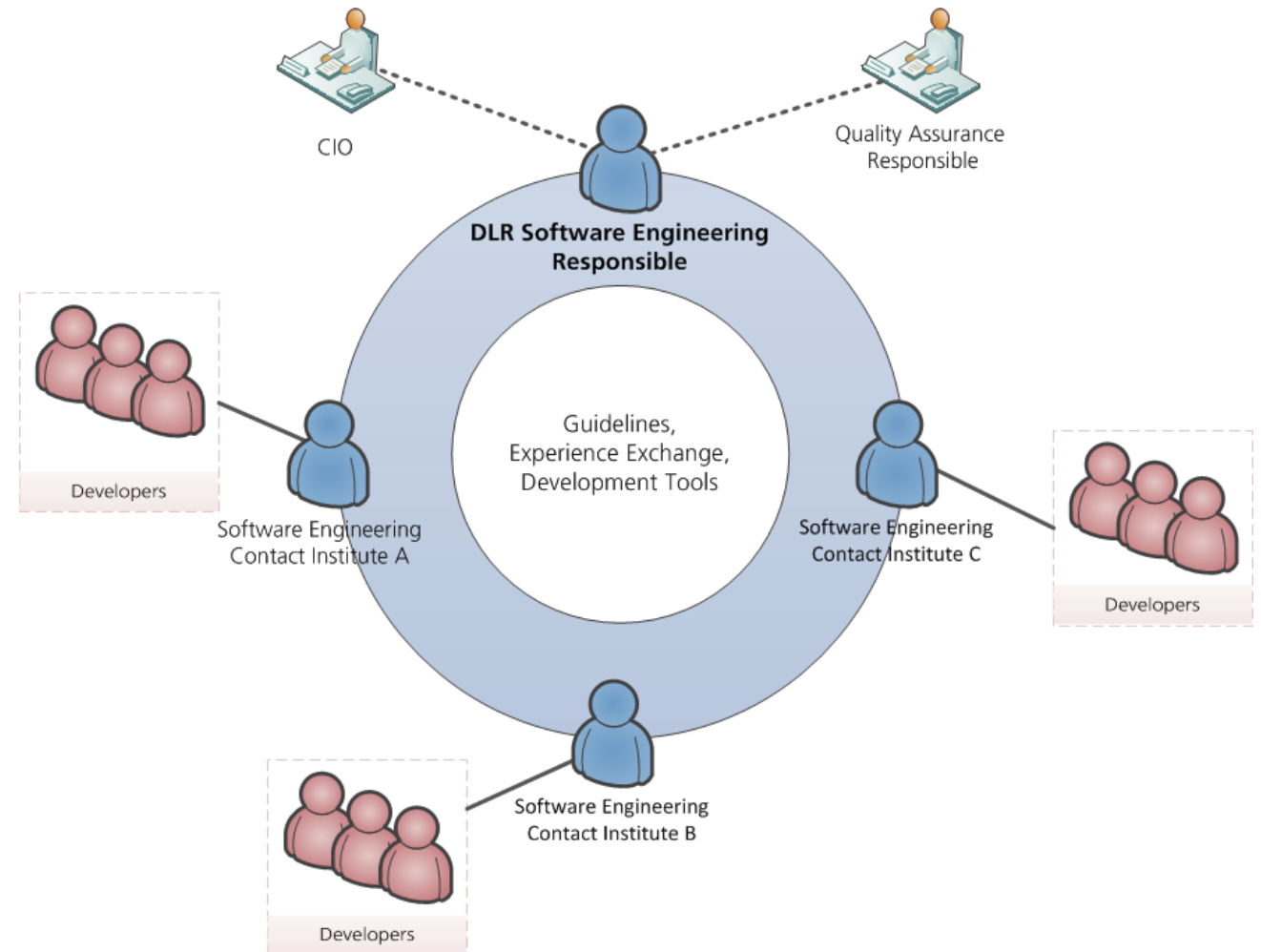


## Role of the Software Engineering Contact

- Coordinate institute-wide software engineering strategy and their practical implementation
- Organize the institute-specific knowledge exchange

## How do we collaborate?

- Yearly joint meeting, if possible in person
- Small working groups work on current topics asynchronously
- Information exchange via a shared Wiki space, GitLab group, persistent chat, and mailing list



# Software Engineering Knowledge Exchange Workshops

**Idea:** Organize a yearly software engineering event to actively involve DLR researchers and to foster exchange!

## Concept:

- Intensive 1.5 day workshop with focus on a main topic
- Active involvement of the participants through interactive formats such as posters sessions, software architecture speed dating, group work, etc.
- Social event
- Talk program consisting of DLR-internal contributions
- Invited external speakers
- Results are shared via the **DLR SoftwareEngineering.Wiki**

## WissensAustauschWorkshop

Software Engineering VIII

16. - 17. September 2021, Virtuell



Kontakt:

Tobias Schlauch  
tobias.schlauch@dlr.de

Anmeldung über das  
Bildungsprogramm im  
Intranet

Mehr Details unter:  
s.dlr.de/seviii (DLR Wiki)



# Software Engineering Knowledge Exchange Workshops (cont.)

## Overall:

- 526 participants
- 58 participants per workshop in average

#	Topic	# Participants	Date	Location
1	Kick-Off	57	November 2014	Braunschweig
2	Tools and Processes	56	April 2015	Köln
3	Open and Inner Source	53	April 2016	Oberpfaffenhofen
4	Software Architecture	52	April 2017	Berlin
5	Embedded Systems	47	May 2018	Bremen
6	Software Engineering for Data Science	55	May 2019	Jena
7	Software Development Process and Software Architecture	70	September 2020	Online
8	Software Development in distributed Teams	71	September 2021	Online
9	Inner Source and Legacy Code	65	September 2022	Online
10	??	??	2023	Berlin?

# DLR Software Engineering Network



**Idea:** Provide a central place to exchange software engineering content and find contacts at DLR!

## Concept:

- Actively moderated
- Everyone can read, contribute, and comment on content
- Pre-structured Wiki space
- Blog for announcing news
- Established in April 2013:
  - > 500 Wiki pages
  - > 250 blog posts

The screenshot shows the homepage of the Software Engineering Wiki. At the top, there is a search bar and a navigation menu. The main content area is divided into several sections:

- Welcome to the SoftwareEngineering.Wiki:** A light blue box containing a welcome message and instructions for users. It includes links to 'Get Involved!', 'Ask a Question', and 'Software Engineering Contact'.
- Get Involved!**: A section with a grid of images and the text 'Learn about specific SE Tools!'.
- Ask a Question**: A section with a thinking emoji and the text 'Ask a Question'.
- Topics**: A section with a grid of images and the text 'Learn about specific SE Topics!'.
- Literature**: A section with a stack of books and the text 'Find out about useful SE readings!'.
- Tools**: A section with a robot holding a wrench and the text 'Learn about specific SE Tools!'.
- Best Practices**: A section with a smiling emoji and the text 'Programming recommendations, how-tos and more!'.
- Software Engineering Guidelines**: A section with a stack of books and the text 'Learn how to organize your software development!'.
- Events**: A section with a calendar and the text 'Find out about upcoming workshops, presentations, or trainings!'.

On the right side, there are several widgets:

- Blog Posts:** A list of recent blog posts, including 'Free and Open Source Software Conference (FROSCON) - Call for Papers / Call for Projects' and 'DLR GitterLab - Update from 14.5 => 14.6'.
- Latest Questions:** A list of recent questions, including 'WSL2 / Windows Subsystem for Linux 2 DNS issues' and 'Sicherheitskritische Software'.
- Latest Changes:** A list of recent changes, including 'Schlauch, Tobias' and 'DLR-GitLab commented'.

# DLR Software Engineering Network



**Idea:** Make it easier to discuss software engineering related topics and ask questions!

## Concept:

- Establish the DLR Software Team using the Mattermost
- Actively moderated
- Everyone can join public channels and create public/private channels for their own purposes
- Topic channels link back to Wiki pages
- Established in early 2021:
  - > 800 participants
  - > 35 public channels,
  - > 11.000 messages

A screenshot of the Mattermost web interface. On the left is a dark blue sidebar with the 'DLR Software' header and a search bar. Below are channel options: 'Threads', 'CHANNELS', and a list of channels including 'AG wiss. Reporting für So...', 'dlr-se-guidelines', 'Open Source', 'Java', 'dare.it', 'C++', 'Containerization', 'DLR GitLab Feedback No...', 'DLR GitLab Mattermost I...', 'GitLab and Git', 'Off-Topic', 'Python', 'SE Network', 'SW Design &amp; Architecture', 'Town Square' (highlighted), and 'WAW Software Engineeri...'. The main area shows the 'Town Square' channel with a post from Tobias Schlauch (DLR) dated April 21, 11:52 AM. The post text mentions a workshop on software in research organized by a Max-Planck-Institut, with a link to the event page. Below the text is a card for 'Workshops MPI for Evolutionary Biology (Indico) Future Opportunities for Software in Research - 2022', featuring the Indico logo and details about the dates (May 12-13, 2022), venue (hybrid), and registration information. At the bottom is a text input field 'Write to Town Square' with icons for attachments and emojis.



# Summary



- The heterogenous environment and requirements for reproducibility hold some special challenges for supporting the research software development community at DLR
- **Combined top-down and bottom-up approach** with regard to community building and experience exchange from the overall DLR point of view
- **Software Engineering Network:**
  - Joint working and decisions making across the different DLR institutes
  - Software Engineering Contacts organize institute-internal collaboration
- **Low-threshold opportunities for knowledge and experience exchange:**
  - Software Engineering Knowledge Exchange Workshops
  - DLR SoftwareEngineering.Wiki
  - DLR Software Mattermost Team
- **Future Idea:** Establishing a culture of “Inner Source” to foster internal collaboration on concrete software projects

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A 3D rendering of a lunar lander on a rocky, cratered surface under a dark sky. The lander is positioned in the center-right of the frame, featuring a blue solar panel array and a yellow structural frame. The terrain is covered in numerous dark, jagged rocks of various sizes. The background shows a dark, hazy horizon with some distant lights.

**Thank you!**

**What are your Questions?**

**Email: [Tobias.Schlauch@dlr.de](mailto:Tobias.Schlauch@dlr.de)**

**Mastodon: <https://norden.social/@schlauch>**