



HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF

How to find and evaluate good research software - a field report

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Helmholtz Research Software Engineering

Goals and Milestones

- The Helmholtz Association as the largest scientific organization in Germany, has Sustainability, Open Science and Good scientific practice as key values.
- Software is both a prerequisite and a result of modern research and creates an important basis for implementing these values.
- Since 2016 important milestones for state-of-the-art **Research Software Engineering** have been achieved:
 - 2017: Helmholtz recommendations for the use of scientific software
 - 2019: Model policy for the sustainable use of research software
 - 2019: Helmholtz Federated IT Services (HIFIS) platform
 - 2020: First Helmholtz Software Forum
 - 2023: Call for the First Helmholtz Software Award



Why should a Helmholtz Software Prize be awarded?

- Prizes are an important indicator of outstanding achievements in research
- Software developers and engineers often need years to show highquality scientific results
- Achievements of research software developers and -engineers are barely visible
- Sustainable research software development must be stimulated and rewarded, research software must meet the FAIR criteria
- Research software must be known and used in the communities
- New ideas and initiatives must be supported

s in	Results and Findings
high-	Visibility and Motivation
s are ed and	Quality and Sustainability
ies	Outreach and Application
	Partner and Community

Process and Timeline



Criteria for a Research Software Award

No.	Criteria	Range and Description	Indicators	Relevance for Price Category
A	Scientific Impact	1 specific solution with low scientific impact 5 broadly applicable solution with high impact	impact, originality, citations, uniqueness, awards	A Best Software B Reproducibility
В	Use and Adoption in the community	1 only limited use in communities 5: broad and intense use	users, references, download statistics, GitHub stars	A Best Software B Reproducibility
С	Software Engineering Level	1 only basic RSE principles implemented 5 very professional & reproducible engineering,	development process, documentation, test automation, Cl	A Best Software B Reproducibility
D	Implementation of FAIR Principles	1 rudimentary implemented 5 excellently implemented	meta data quality, release continuity, registration, easy to use	A Best Software B Reproducibility
E	Novelty and growth potential	1 proven solution, long development history 5 new idea, high growth rate	age, motivation letter, git statistics, user feedback	C: Newcomer

All quality criteria have been weighted equally!

Applications and Review

Helmholtz Research Software Award Applications for the Award

- **Nomination**: each center can nominate max. 3 candidates visibility to boards of directors!
- 42 software solutions from 16 Helmholtz centers
- Research fields "Earth and Environment" and "Health" with strongest participation
- Modeling/Simulation and Data Analysis software occurred most frequently, but also Machine Learning
- All types of software, all ages, all communities and partners
- **16 experts delivered 84 written reviews**, 6 international and 8 national





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Helmholtz Research Software Award Review of the Evaluation - Ratings

Each software was evaluated by two experts Points in Categories

- Mostly very good up to outstanding ratings
- Balanced mixture for different categories
- Some low and standard ratings

Sum of points of 4 categories to select the top 15

- Highest rating was 100 % (20 out of 20 points)
- Lowest rating was 20% (4 out of 20 Points)
- Deviation of the two individual experts ratings: 90% < 10% and 10% < 20%



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Helmholtz Research Software Award Review of the Evaluations - Ratings

- Fairly **balanced use of the range** of ratings of the quality criteria (19+20 points is top)
- Criterion "scientific impact", which seemed difficult to assess, shows no anomalies
- Only **Top 15 ranked** solutions of cat. 1-4 have been **considered for the prices** in all three categories
- The points of the quality criteria 1 is decisive for the Best research software award
- The points of the quality criteria 2-4 is decisive for the Sustainability Award
- Criterion 5 is decisive for the Newcomer Award

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Helmholtz Research Software Award and the winners 2023/24 are:

Best Scientific Software Prize (5.000€):

- CellRank (dynamics from multi-view single-cell data)
- Representative: Philipp Weiler (HMGU Munich)
- https://helmholtz.software/software/cellrank
- Sustainability Prize (3.000€)
- ESMValTool (Earth System Model Evaluation Tool)
- Representative: Birgit Hassler (DLR Cologne)
- https://helmholtz.software/software/earth-system-model-evaluation-tool-esmvaltool

Newcomer Award (2.000€)

- openCARP (Cardiac Electrophysiology Simulator)
- Representative: Axel Löwe (KIT Karlsruhe)
- https://helmholtz.software/software/opencarp

CellRank





Earth System Model Evaluation Tool



How to find and evaluate good research software?

How to find and evaluate good research software

The role of th Helmholtz Research SW Directory

- The Research Software Directory is extremely helpful for the evaluation of research software.
- It provides key indicators, references, user stories and links to the Git and publication repositories.
- The SW award call pushes new entries & new partners.







https://os.helmholtz.de 13

How to find and evaluate good research software Key Software Indicators

Intensive coordination is currently underway on Key Indicators for research software on the national (e.g. in Helmholtz) as well as international level.

Indicator Dimensions that can be considered (ELIXIR / EVERSE: DOI 10.5281/zenodo.14852424):

- Science & Innovation: ?...Citations...?
- Community: Community, Contribution, Fundability, Usability, Security
- RSE: Source code, Versioning, Licensing, Issue Tracking, Testing, Documentation, Monitoring
- FAIR: Accessibility, Findability, Interoperability, Sustainability



How to find and evaluate good research software Key Software Indicators

• Technical Indicators from the Git / RSD (examples) ...



How to find and evaluate good research software Key Software Indicators

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Did quality indicators match with results of the human evaluation for the Award?

- The top 15 solutions have more mentions than average, but not necessarily the most.
- Releases, age, licenses, contributors and many other tech. parameters do not show significant correlations.
- 17% of all software solutions had **not reached the release 1.0**, even after years of success.
- There is no clear correlation between age and no. of releases, but there is one to the **number of partners**.
- Human (expert) ratings show acceptable deviations, with >90% less than 10% deviation between the two experts.



Summary

How to find and evaluate good research software

Summary

- Many activities are currently being undertaken to define quality criteria for research software
- Based on data of the Helmholtz Software Award a comparison of numerical indicators and expert ratings was made.
- Each software is unique, because:
 - Applications fields and -environmments are different
 - Research communities are different
 - Development projects are different (incl. funding)
 - Developers and **development culture** are different
- The **expert panel was able to evaluate** solutions, even those not in their own field of research
- If the rating had been done based on a pure numerical indicator approach the result was very different!

Helmholtz Research Software Award Acknowledgements



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- The Helmholtz Open Science Task Group Software for their support
- The Helmholtz Initiative and Networking Fund

 And to all the hard-working SW developers and software engineers who have created these fantastic and unique solutions that make world-class research possible!



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Further Readings

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Thank you! What are your Questions?

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