A Comprehensive Approach to Support Research Processes in the CRC 1270 ELAINE

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Managing digital research artefacts (such as data, models and source code) in a convenient, comprehensive, flexible and secure way is an important issue in today's research. Many approaches, however, focus on storing, archiving and publishing only the research data but not all artefacts of the research process. In the Collaborative Research Centre (CRC) 1270 ELAINE supported by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG), instead, we aim at supporting the overall research process that begins at the definition of the hypothesis and ends at the dissemination and publication of the results and findings. While all-in-one software exists that aim at supporting the entire lifecycle, different reasons prevent researchers from using such solutions. Firstly, such all-in-one solutions are not very flexible when it comes to the individual needs of a multidisciplinary and heterogeneous research group. Secondly, if the software will no longer be developed, great effort is required to re-use and migrate the research artefacts to another solution. Furthermore, hosting all-in-one software at one own's institution, often is not easy when it comes to installation, maintenance, and extension. Finally, researchers are often not allowed to use "Software as a Service" offers that are hosted abroad. Reasons for this are for instance data privacy issues and governmental guidelines.

In the CRC ELAINE, the needs of the researchers range from documenting simulation studies and wetlab experiments, to managing and sharing data and models in different lab environments, to supporting versions, provenance and archival of research artefacts. In contrast to all-in-one software solutions, we propose a Virtual Research Environment (VRE) that builds upon simple individual services, particularly tailored for the specific needs of each research field. This enables the easy replacement of single services if e.g. requirements change or service development is discontinued. In order to determine the requirements of the individual researchers, we performed a systematic assessment by use of a questionnaire [Krüger and Spors, 2018] in addition to visits of the research groups. For the appropriate selection of each service, we additionally interviewed domain experts that are target users of the service.

With respect to the research artefacts, the research process can be structured into three major tiers: 1. Study planning and data collection, 2. Collaborative

modelling and data analysis, and 3. Reproducibility, provenance and archival. For each of these tiers, a large number of simple but specialised Open Source web-services is available. By the use of standardised interfaces, the services can be integrated into a comprehensive, flexible and secure VRE. The VRE for the CRC ELAINE which we currently implement is illustrated in Figure 1. The particular services, e.g. electronic lab notebooks, jupyter notebooks and docker are result of the requirements analysis with the researchers.
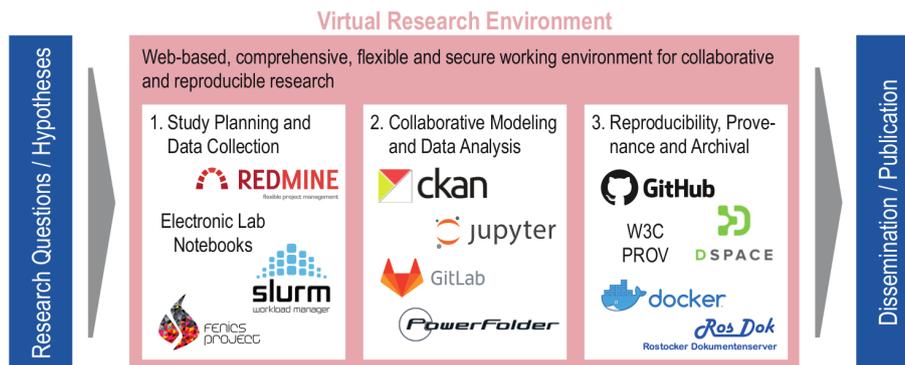

Figure 1: Virtual Research Environment in the CRC ELAINE

References

Frank Krüger and Sascha Spors. A questionnaire to estimate the needs for research data management. 2018. doi: 10.18453/rosdok_id00002290.