

Introducing Coordinated Research Data Management at RWTH Aachen University. A Brief Project Report.

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1. Introduction

Research data shows that there has been a global open access movement since the 1970s, developing from open access publications towards open access to research and scholarship (Borgmann, 2015). Strategies for open access and open science referred to research data as special issue in the research process. While this global open access movement has made significant gains, stewardship and preservation requirements for research data have been included in the guidelines of academic organizations (Deutscher Hochschulverband, 2011; Deutsche Forschungsgemeinschaft, 2013) and universities, RWTH Aachen University being among them (RWTH Aachen University, 2011). Following the documentation of stewardship and preservation requirements, funding agencies and organizations developed further requirements for the specific handling, description and storage of raw and processed data in scientific projects (National Science Foundation (PAPPG), 2011; European Union, 2010 [Riding the Wave]).

In 2009 already, before significant attention of the open access movement from academia and politics, Deutsche Forschungsgemeinschaft posted a call for “Virtual Research Environments” that specifically addressed scientists who collaborate on digital or digitized data. RWTH Aachen University was successful and was awarded a grant for its proposal “ProjektRepository. Ein pandisziplinäres Repository für Forschungsprojekte als Komponente einer niederschweligen webbasierten Kooperationsinfrastruktur“. The project was realized from 2010 to 2012 through a collaborative project supported by professionals from the IT Center and the University Library. Specifically, the grant was used to examine data provided by researchers from the Civil Engineering Hydraulics, Medicine, and Building History departments. They took an active part in the project and made the professionals from service providers – Library and IT Center – understand the processing and usage of their specific data. Through the course of the project, infrastructure operations developed a data life cycle model for all research projects conducted at RWTH Aachen University that contains three domains: private – shared – public. Library professionals assisted with data formats and metadata standards. It was also realized that processing research data has to be specific to the discipline while generic tools can be used for publishing research data. A team specialized in research data management at the University Library is required to ensure the standards of publication for the discipline.

From 2014 on all stakeholders became involved in developing standards for open access of research data and results, specifically including university boards, funders, and funding agencies publishers (Borgmann, 2015). The German Rectors’ Conference published the statement “Research Data Management – a key strategic challenge for university management” (German Rectors’ Conference 2014-13-5). RWTH Aachen University took it as a call to action; the IT Center joined forces with the University Library and the Department for Research and Career. By the end of 2014, a preliminary design study was started on how to promote the stewardship of research data at RWTH Aachen University. The study specified four objectives to be achieved within about two years:

- Draft a RDM policy
- Calculate the resources required to store the data

- Find partners for support and networking
- Design the implementation.

After the design study an official university project on RDM was started by the rectorate in September 2015. The institutions from the design phase were also asked to execute the project.

From 2015 on, politics and funding organizations published new findings, guidelines and recommendations: Deutsche Forschungsgemeinschaft: Leitlinie zum Umgang mit Forschungsdaten (Deutsche Forschungsgemeinschaft, 2015), German Council of Science and Humanities: Empfehlungen zu Wissenschaftlicher Integrität, April 2015); Rat für Informationsinfrastrukturen (Performance Through Diversity, 2016). Most impact on universities produced Recommendations of the German Rectors' Conference: How University Management Can Guide the Development of Research Data Management. Orientation Paths, Options for Action and Scenarios. Recommendation of the 19th General Meeting of the HRK, 10 November 2015 (German Rectors' Conference, 2015); they were to guide RWTH's project.

2. Project

The project "Research Data Management (RDM) at RWTH Aachen University" ran from September 2015 to December 2017. The RDM core team consisted of 8 - 9 experts led by *Benedikt Magrean*. All team members had research experience from their previous backgrounds in various scientific disciplines, including chemistry, electrical engineering, geoscience, humanities, informatics, etc. With this well-versed team in place, a wide range of data knowledge and working methods were covered so that the best possible understanding of research questions and research processes were available.

Based on the outcome of the design study, the project target was a phased introduction of RDM services until the end of 2017. The project was focused on particular targets:

- Establish a RDM consultation service until 12/2015
- Fix the personal and material resources for the future infrastructure by 12/2015
- Develop and realize ways for awareness and acceptance in the scientific communities at RWTH Aachen University until 03/2016
- Develop training plans for researchers
- Develop services for master students at RWTH Aachen University
- Regular exchange and cooperation with the research center Jülich and the ETH Zurich
- Create a RDM guideline for the RWTH Aachen University until 03/2016
- Provide a general technical solution to support the entire RDM process.

Deduced from the targets the project was divided into 4 main building blocks – awareness, consultancy, trainings and technical infrastructure (see Figure 1).

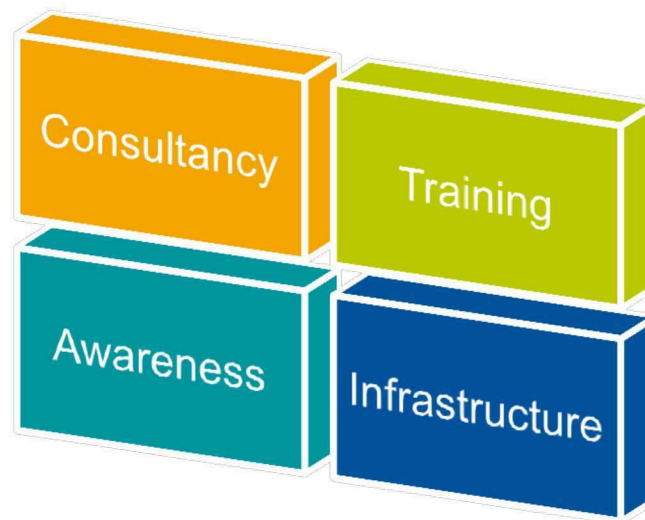


Figure 1: Building blocks of the RDM project

As another structural element, five use cases were set up, involving scientists from various disciplines. Two of them focused on the development of an action plan for RDM at two institutes to implement good scientific practice and requirements of funding agencies. Another one was a complete collaborative research center with RWTH as one of the partners. The fourth one has the challenge of long-term availability of the data and the last one of using or building a new infrastructure.

3. Project results

3.1. Awareness

Awareness is one of the links between researchers, good scientific practice and the requirements of the funders and publishers. The pressure of the funders is increasing over the time. To inform the researchers about the topic and the new requests a lot of advertising material was created and has been provided during the project time and beyond that.

The first recommendation of the 19th General Meeting of the German Rectors' Conference (German Rectors' Conference, 2015) is to provide guidance to universities and researchers on open access policies. RWTH Aachen University followed the recommendation by passing the RWTH Aachen Research Data Management (RDM) Guidelines (RWTH Aachen University, 2016) in March 2016. It consists of 10 points and includes, among other things, the "open access to research data". The guidelines emphasize under point 4 that the "researchers are [...] responsible for research data management in their research projects" and under point 5 that all "research projects [...] requires a data management plan". It should also be mentioned that the "RWTH Aachen provides and maintains a suitable infrastructure for research data management" to support the researchers by passing the good scientific practice and the funders requirements as good as possible.

As a further measure of awareness, a central web page of RDM at RWTH Aachen University was created. It provides general information about research data management at RWTH Aachen University and should answer the four questions: "What are research data?", "Why

manage data?"; "What does my funder or publisher require?" and "How do I get help?". A future task will be extending the web space following the needs of the researchers along the data life cycle and providing them the information about the specific services from RWTH.

In addition to the vast amount of information posted on the website, researchers can also find the clip "Research Data Management at RWTH Aachen University" on the website. It outlines superficially the answer to the question "Why research data management?" with the arguments security, visibility, reusability and requirements from public funders and publishers. The clip can also be found on YouTube (https://youtu.be/vULPYGj_tOE) and on "Forschungsdaten-Blog" from RWTH (<https://blog.rwth-aachen.de/forschungsdaten/>) which is used as a tool to quickly communicate information to researchers that either relates to the team's work or outcomes, or to share community news.

Besides, other advertising materials like a flyer in German and English and postcards with different slogans will promote the topic. The slogans are compounds of real and fictitious chemical elements; at the rear are short descriptions of the slogan and the fictitious elements. Examples can be found in Figure 2.

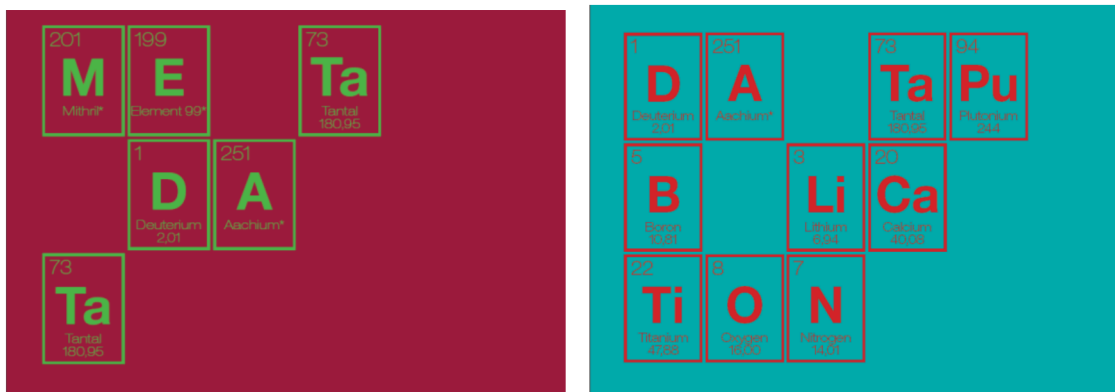


Figure 2: Postcard Examples

Supplementary to the advertising materials the minimum of one team member has represented the topic RDM on RWTH's "Welcome Event for Newly Appointed Professors" to get them acquainted with the university's main institutions and services. It is quite easy to get in touch with full and assistant professors at these events and sensitize them for the RDM topic. To reach more researchers, these activities will be continued and expanded.

3.2. Consultancy

Questions on RDM mostly cover more than one specific topic. The experts, however, belong to different facilities each of them representing a complex portfolio of knowledge and service covering IT, metadata management, legal advice, research funding etc.

During the project period these competences were identified and made accessible over this three-step consultancy structure (see Figure 3).



Figure 3: The Three Levels of Support

For the consultation, a first, second and third-level structure was developed, which offers a single point of contact in the first level support. The ServiceDesk that already exists at the university provides this structure. It works with the "helpline" ticket system, offers a variety of communication channels and has ISO certified procedures supporting the services. The advice seeking person has only one address, where he or she can turn to with any questions about RDM.

The ServiceDesk answers "simple" or recurring questions about RDM. For this purpose, it always maintains and extends its internal documentation (Wiki) on the subject of RDM. It collects possibly missing information from inquirers and forwards all unresolved questions to the second level support.

For second and third-level support, the University Library's research data department is primarily responsible and ensures that the requests are processed according to the distribution of competences of the participating institutions. Depending on the type of request, this is assigned to University Library, the IT Center or the Department of Research and Career. During processing, the respective members of the RDM team can draw on the entire competence of the facilities. For consultation in projects, the subject librarians from University Library are included. In the future they will take certain routine tasks as soon as they are established. For example, these include the identification of specialist repositories and metadata standards as well as the creation and formal review of data management plans. In order to strengthen its advisory skills, University Library financed the qualification of a member of the project group to become a "Certified Data Scientist specialized in Data Management".

Complex consulting requests are given to third-level support. Anyone who handles the consulting request gets direct support from one or more team members of the above-mentioned actors. There will be a joint consultation and analysis of the locally existing structures and processes normally by two members of the RDM team. Conceptual, individual solutions that build on national or international infrastructures provided by the university are worked out together with the researchers. Here, also the subject librarians from University Library are regularly asked to act as a consultant to establish the necessary networking and facilitate the integration of data into (inter-) national specialist infrastructures.

The consulting structure with single point of contact (first-level support), second and third-level support thus ensures easy contact for the advice seeker, at the same time competent processing through inter-institutional cooperation and connection to the entire infrastructure of RWTH Aachen University to the RDM.

3.3. Development, implementation and adjustment of training

Training of staff was considered crucial. Early on high priority was put on this topic. Due to the participation in the DFG funded project "ProjektRepository" the University Library has been developing the RDM topic and established its first consulting and further education for RDM in 2012. Since 2013, a general two-hour overview of RDM has been provided as part of the RWTH education program for doctoral candidates (CDS). In addition, a consultation service from the university library was provided.

Based on the general course and on the researchers' feedback advanced seminars were developed on the topics of "metadata and personal data management", "cooperation", "data management plans" and "archiving and publication of research data", each lasting two to four hours. The contents of the respective topics were oriented to the needs of the different target groups. Since 2016, these seminars have been integrated into the existing continuing education structure of RWTH Aachen University: Center for Doctoral Studies (CDS) and Center for Professional Leadership (CPL). The courses are also covered by RWTH's quality management system for teaching and education. All topics are available on request for institute specific training courses to project groups or working groups of five or more. Three use cases were supported by trainings on the core topics.

At the beginning, the courses did depend on each other, which allowed the participants the maximum of freedom. This advantage turned into a disadvantage, because the participants had different levels of knowledge to the specific topics. This approach resulted in many redundancies especially in the overall contents "metadata" and "data management plan". The second disadvantage was that scientists often could not relate their questions to a specific topic. The course descriptions were not helpful enough to the scientists to make their assignment. In addition, it should be mentioned that many participants attend several seminars.

According to these findings and to the researchers' feedback the concept will be shifted to a blended learning concept conveying RDM competence for the target group of researchers. The blended learning course will be divided into an online and a presence part. The content of all previous courses stays the same, but it was considered in total and all redundancies were removed.

In the online phase information of the generic and basic elements of RDM will be presented in a media mix. Knowledge transfer takes place here, which has the advantage that all participants receive the same level of knowledge. This base let the trainers be able to focus on concrete examples and solutions in a presence workshop. Important aspects of communication and networking are taken into account. After evaluation of the teaching concept and preparing the contents, they will be presented in the learning management system Moodle, as soon as it is available in the RWTH version from March 2018 on. Further training in a pure presence form will be continued as long as the blended learning course will be accepted from the researchers. The switch to the workshop format is planned for spring 2018.

As another output by the RDM team at the library, seven short movies were shot together with "Medien für die Lehre" (MfL) in autumn 2017. The movies are teaching material and explain the generic elements of RDM in a short and succinct manner. If possible, the content has been kept general so that it can be reused by other universities, research institutes, etc.

The clips will be inserted in the blended learning concept as well as presented online. The clips are currently being processed by MfdL. The finished clips will be made available on RWTH's YouTube channel in the second quarter of 2018.

For the target group of employees in technology and administration, the offer of a 90 minutes overview seminar has proven itself and will be continued. Courses are listed at the event database of RWTH Aachen University. RDM will also be part of the degree program "Data Science" specialization in MATSE (mathematical-technical software developer) / B.Sc. Scientific Programming. It is a joint offer from Aachen University of Applied Sciences and IT Center of RWTH Aachen University as a training company. Here, the new optional subject "Vermittlung von Kompetenzen im Datenmanagement" will be provided from SS2018.

To discuss at the end of this topic, it is shown that the lines between awareness, further education and consultation are or can be fluent. The creation of awareness continued to occupy a lot of time, especially during the initial phase. During the generic workshops like "Welcome Event for Newly Appointed Professors" as well as during training sessions for this group of researchers, very specific questions are popping up and a desire for more concrete solutions than what are provided online or in the workshop often lead to individual consultations. In cases of more senior researchers, or those that have not been directly targeted by these information sessions, requests for individual consultation by the researchers have led to institute specific training events. As a result of these contributing factors, there is a significant amount of crossings between the three building blocks, including awareness, consultancy and training, which will be continued for the foreseeable future. The points "strengthen data culture", "provide guidance" and "develop competences" from the recommendation of 19th General Meeting of the HRK have been some of the guiding principles of this work.

3.4. Infrastructure

The infrastructure of RWTH is the typical mixture of centralized and decentralized systems, which means that many institutions have established their own IT infrastructure tailored to their needs. This includes own IT administrators and systems to process and store research data. This decentralization addresses adequately the heterogeneous needs of researchers, but centralized solutions are normally running with a higher efficiency and offer long term availability.

Examples for central services operated by the IT Center are backup and archive infrastructure, file servers, virtual machines as well as web hosting. The University Library operates with RWTH Publications an institutional repository for university bibliography and publications of full texts.

To address the challenge to implement a concise research data management in such a heterogeneous environment the strategy was to a) implement an evolutionary approach, b) focus on integrating services and filling missing links and c) capture data early on and enable the integration into a full data life cycle.

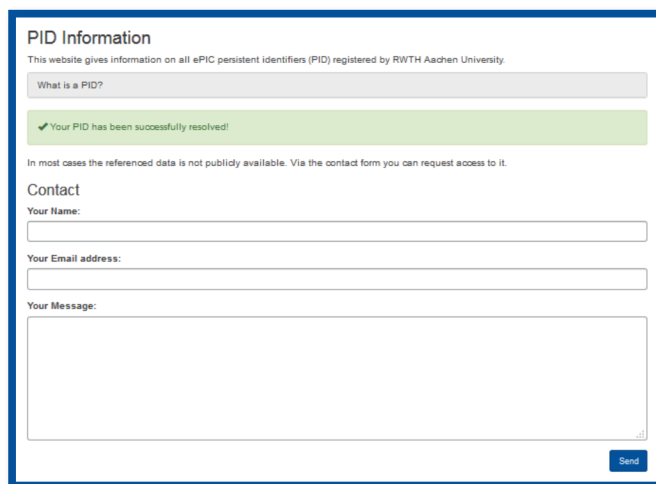
Considering the temporal factor, as well as the available resources, the university decided to focus on an evolutionary approach in the expansion of infrastructure required to deal with RDM. With these small improvements point 5 "expand infrastructure" of the 19th General Meeting of the German Rectors' Conference recommendation is seized.

Early on, the decision was made to use the PID service of the European Persistent Identifier Consortium (<http://pidconsortium.eu>) (ePIC) by buying it from the GWDG – Gesellschaft für wissenschaftliche Datenverarbeitung mbH Göttingen (<https://www.gwdg.de/>). While published data, like texts, are provided with a DOI, the ePICs serve to persistently identify unpublished data. The registration of ePICs is possible by applications such as the backup portal, simpleArchive and the metadata tool. A direct user interface does not exist.

3.4.1. RWTH Publications

The publication server of the University Library has been upgraded with additional memory to 24 terabytes and equipped with functionalities of an institutional repository. Also, the University Library has registered as a data center at DataCite (<http://www.datacite.org>) to allow the allocation of digital object identifiers (DOI) for published research data.

With these upgrades the RWTH provides the researchers the possibility to publish their research data locally and make them permanently citable, if no suitable discipline-specific repository exists. RWTH Publications can also report linked archived research data with an ePIC to the published full texts. As an example see “Line segments in homogeneous scalar turbulence” by *Gauding et al.* (DOI 10.1063/1.4929450) with ePIC 21.11102/4d9960cf-15d6-11e6-8eb3-e41f1343fb94 for the archived data, which could be found under the tab references. The ePIC results in a landing page with an anonymous contact form (see Figure 4).



The screenshot shows a web page titled "PID Information". Below the title, there is a sub-header "What is a PID?" and a green success message: "✓ Your PID has been successfully resolved!". A note states: "In most cases the referenced data is not publicly available. Via the contact form you can request access to it." Below this is a "Contact" section with three input fields: "Your Name:", "Your Email address:", and "Your Message:". A "Send" button is located at the bottom right of the form.

Figure 4: ePIC landing page

This has the advantage that researchers can link the data to the full text without publishing them.

3.4.2. simple Archive

For many years now, RWTH is running an archive service with the IBM Spectrum Protect (formerly Tivoli Storage Manager) software which ensures the store of research data for a minimum of ten years. However, the service was primarily aimed at users with technical expertise rather than at researchers themselves. To give all researchers, mainly the ones without their own IT administrator, the possibility to archive their data and carry out the good scientific practice as required, simpleArchive was developed. It is a web-based way to archive

data and link it via an ePIC. At the moment a maximum of 2 GB of any kind of data could be uploaded.

3.4.3. Metadata tool

One of the main aspects from the preliminary survey was the handling of metadata. Some researchers answered that they have the metadata in mind. Mostly metadata have been documented in an analog lab journal and/or as a readme file. A great deal of metadata has been documented in an unstructured way. To enable structured metadata, a web-based tool has been developed that validates and stores metadata according to a predefined scheme. Through a web service and an API, the application can be connected to other systems. The structured recording of metadata using the metadata tool has been tested in two use cases. Both have developed a metadata scheme. In one, it became a whole metadata scheme over all the processes, while the other set up several metadata schemes structurally meshed.

3.4.4. Research data management organizer (RDMO)

In August 2017, the decision was made for RDMO (<https://rdmorganiser.github.io/en/>), a tool supporting the generation of data management plans (DMP). Point five of the RDM guideline of RWTH Aachen University prescribes that each research project at RWTH must have a data management plan. As a proposal a general dmp template with a focus on nature and engineering science was developed. In two use cases, two institute-specific templates were also created, which are to be integrated into everyday working life. RDMO should assist the scientists in completing these templates. The exchange of templates is a big advantage, because it eliminates duplication of work.

3.4.5. Concept for a “future” infrastructure

The concept focuses on data mining through metadata (see Figure 5). It integrates the possibility of different locations for data and metadata, which are linked over persistent identifiers (PIDs). Parallel, different storage solutions could be used and, if necessary, could be exchanged. The access to metadata and data is technically separated. The functionally critical center is the PID service.

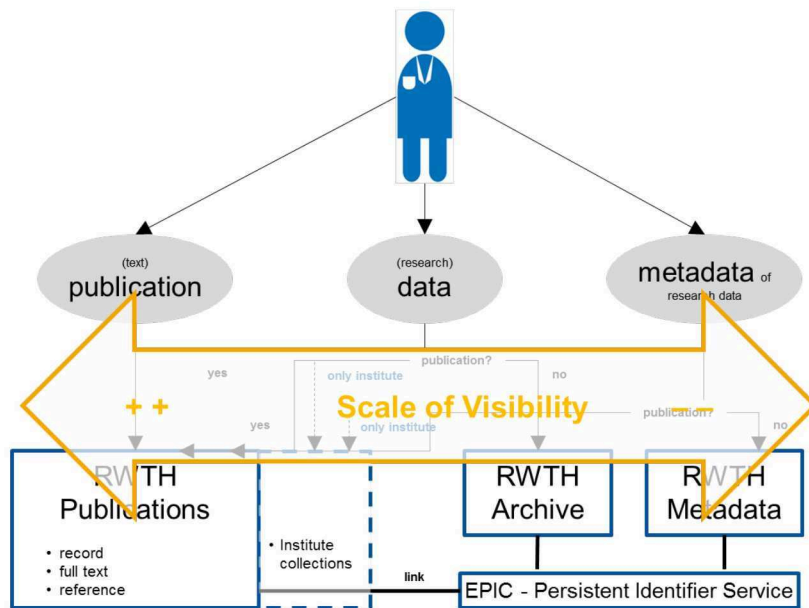


Figure 5: Infrastructure for publication and archiving research data

3.5. Collaborations

3.5.1. University Library Center NRW (hbz)

As already mentioned, the IT Center guarantees a ten-year data archiving.

The hbz based in Cologne has licensed the long-term archiving software "Rosetta" from *ExLibris* for North Rhine-Westphalia and operates a central entity. Rosetta is designed to be modular in order to meet the very different needs of the researchers and universities; it can be used in addition to local solutions or in the context of central hosting.

In 2017/2018, a pilot phase was started with three use cases, one coming from RWTH.

An institute of RWTH wanted to archive an impressive amount of data from simulations to small-scale turbulences which are not manageable for network replacement and reuse outside of HPC systems. The simulations are in the form of cubes and available as HDF5 files with a size of 609 GB to 7 TB. The cubes were additionally split into a minimum of 1 GB parts, which the researchers can request as a single section and time increments.

Currently, the first project phase has been successfully completed: The workflows for transferring data to hbz and ingest in Rosetta have been developed and successfully tested on the production system. The submission of the first production data is scheduled for the end of 2017 and will continue after the end of the implementation project.

3.5.2. Research Center Jülich

For many years now, a large number of collaborative projects (e.g. Jülich Aachen Research Alliance (JARA)) have been running between Jülich and Aachen. Resulting from this strong partnership between the two institutions, it was obvious to support each other on the development of the RDM topic. To strengthen the cooperation, one member from each institution has a position on the management committees at each institution.

As one first step, the archived data from Research Center Jülich and RWTH Aachen University are redundantly stored at both locations.

As another step, the role of a “decentralized data manager” was created and introduced at the research center. The introduction at RWTH is planned for 2018.

The software “Invenio” was the initial point for the JOIN2 (<http://join2.de>) cooperation, where the central library of the Research Center Jülich and RWTH’s University Library participate since 2011. A common infrastructure for publication records and servers is established; the applications *RWTH Publications* as well as *JuSER* in Jülich are two results from the cooperation.

The cooperation with the Research Center Jülich opens the opportunities in the further development of the tools Owncloud and Invenio, which RWTH aims to achieve. In particular, the tools of EUDAT are based on Owncloud and Invenio and are operated by Research Center Jülich within the framework of the European Open Science Cloud. The experiences with Invenio and Owncloud can be brought to bear in making the tools of EUDAT usable for the RWTH in the future.

4. New input and dynamics

Alongside the initiatives by universities and research institutes to develop their RDM infrastructure and services to assist scientists in managing their research data, political forces have extended the scope of science. The trend is significant in the Science Conferences organized by Leibniz Information Center for Economics. They started in 2014 as an annual conference “Science 2.0”. In 2017 they were renamed to “Open Science Conference”. From the very beginning, strong input came from representatives of the European Commission. Carlos Moedas, EU Commissioner (2014-2019) for Research, Science and Innovation has pushed research funding programs, especially Horizon 2020, intending “to promote the international excellence of the EU’s research and science and strengthening research capacities and innovation across Member States.”

(https://ec.europa.eu/commission/commissioners/2014-2019/moedas_en). The Commission adopted the principle of open access to research data and made the European Open Science Cloud (EOSC) the new key concept. In 2016 a High Level Expert Group of the Commission published its First Report and Recommendations (Commission High Level Expert Group, 2016). Publishing and sharing of research data are expected to promote science and innovation within, as well as across, disciplines, to improve cooperation with industry, push on technological progress, and, last but not least, to contribute to social and economic welfare. A key feature of the European Science Cloud became the FAIR principles, which demand that research data should be Findable, Accessible, Interoperable, and Reusable. The EOSC is to be realized by 2020. It is endorsed and promoted by many academic and research institutions and organizations among them CESAER: Conference of European Schools for Advanced Engineering and Research (<http://www.cesaer.org/en/home/>). In 2018, CESAER published its Statement “Shaping the European Open Science Cloud (EOSC) (CESAER, 2018) and contributed five key messages:

- Federated and decentralized approach needed
- Ensure broad definitions and scope
- Fair and secure data principles are central

- Boost interoperability and inter-disciplinary research
- Establish alternative metrics, incentivize behavior & output and train talent.

Some years before the publication of this report, CESAER had established a Task Force Open Access which was extended and specified by two subgroups: Open Access and Research Data. RWTH Aachen University as member of CESAER is engaged in both of them. EOSC will be based on existing infrastructure and services; it is mainly about interaction and standardization. Networking of service providers and professionals will become important. RWTH Aachen University can rely on good experience outcomes in that line of action. CESAER has sort of a national counterpart: TU9, nine leading universities of technology (<http://www.tu9.de/en/>). Their libraries have – among others – established a task force on research data management which is developing strategies and standards for education and training. RWTH Aachen University regularly attends meetings and workshops of Research Data Alliance in Germany (<https://www.rd-alliance.org/groups/rda-germany>) and is an active member of DINI - Deutsche Initiative für Netzwerkinformation e. V. (<https://dini.de/english/>) and its sections working on open access, publishing, and research data. No less important for shaping a research data infrastructure are tools and approaches that come from projects governed and funded by Deutsche Forschungsgemeinschaft. First to be mentioned is re3data (<https://www.re3data.org/>) as source of reference for discipline-specific research data repositories. The RDMO tool mentioned above was implemented at RWTH Aachen University in cooperation with Darmstadt Technical University, a partner from TU9. Another partner from the TU9 libraries group, TIB Leibniz Information Center for Science and Technology - University Library, provides the DOI (Digital Object Identifier) service. RWTH Aachen University is a data center registered to use this service for its members. A similar service to guarantee the long-term-accessibility of research data is the application service ePIC: European Consortium Persistent Identifiers for eResearch at GWDG – Gesellschaft für wissenschaftliche Datenverarbeitung mbH Göttingen.

5. RWTH: Ready to Start and to Lead

In 2017 policy and research organizations in Germany gave their last push to design and implement a National Infrastructure for Research Data Management (Rat für Informationsinfrastrukturen, 2017), specified at the beginning of 2018 (Rat für Informationsinfrastrukturen, 2018). They demand a bottom-up process driven by the scientific communities' needs. The upcoming German Research Data Infrastructure is to be based on existing or rising repositories, research platforms and services must be interconnected, and the system will not be designed from scratch as a well-defined system. And it will be interoperable at European (EOSC) and international level.

Immediately, RWTH Aachen University went to action. It comprehended RDM as part of its digitization strategy for the university's core processes and included it in its strategy RWTH 2030. It was recognized early on that it is important to work cooperatively with other institutions. It started an informal but strong core partnership with Darmstadt Technical University

based on an analysis of Deutsche Forschungsgemeinschaft's funding atlas that shows both universities on top of research in main disciplines of engineering. The IT or Computer Centers and the libraries at both places have built up technical systems and services for research data management; they cooperate two-sided as well as in associations as e.g. TU9 and CESAER. Rather soon Leibniz Information Center for Science and Technology / University Library at Hannover and Karlsruhe Institute of Technology joined this group and brought in their networks. They addressed renowned professors and academics of engineering sciences and started a process to identify and define the interests and needs of their communities related to research data and data management. Three workshops were organized to create a better mutual understanding of research and service institutions and to outline a disciplinary roadmap to a consortium of at least part of the engineering communities.

Based on multiple forms of successful cooperation among the service and infrastructure communities RWTH Aachen University and its partners are ready to start and to lead one of the coming processes towards the German Research Data Infrastructure.

RWTH Aachen University rather early recognized the importance of an effective research data management. From the very beginning it was based on a close collaboration between researchers and professionals from IT Center, University Library and the Department for Research and Career. The rectorate authorized a two years project to define the needs of its researchers and to develop services and infrastructure for support. It resulted in guidelines, a front office for questions and consultation, training programs and courses, as well as systems for trustworthy storage and publication of research data. Services and infrastructure are developed according to political targets and recommendations from academic organizations and research funders. Research data management facilities and services are firmly established, closely connected to other universities and research organizations and will be able to follow and assist the upcoming national and international programs and initiatives for reliable and effective research.

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