

# Quality Assessment for Research Data Management in Research Projects

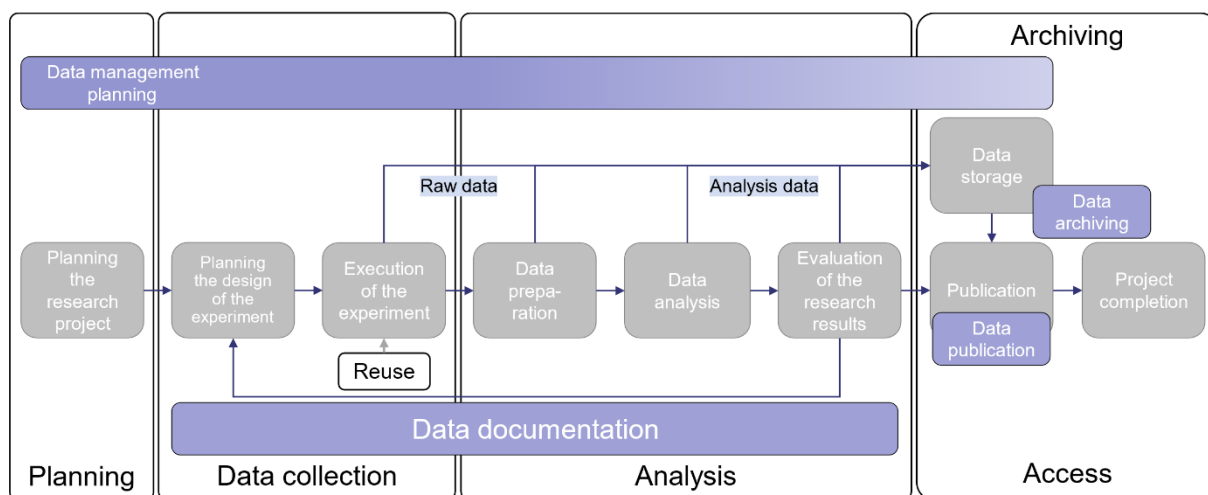
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## Extended Abstract.

In the context of research data management (RDM), researchers are confronted with a multitude of new tasks and responsibilities. The totality of all tasks to ensure the re-use of data, long-term archiving, and access to data through data management planning, further data documentation, and provinces of data collection and analysis are described as research data management [1]. Often, the process of RDM is represented with data life cycle models, which include the basic phases of *planning*, *data collection*, *analysis*, *archiving*, *access*, and *reuse* [2].

When considering an engineering research methodology of the research process, it starts with the formulation of the research goals and planning of the research concept. This is followed by the analysis of empirical data based on data collection, processing, analysis, and interpretation to detail the as-is state. Based on the empirical analysis, the development of the solution for the improvement of the existing situation follows. This is followed by the evaluation of the solution through further analysis of empirical data concerning defined evaluation criteria [3]. In the field of engineering research, there are three main approaches to data collection: experiments, simulations, and theoretical analysis. These data are either collected by the researchers themselves or gathered from other sources and reused. This is followed by further processing and analysis of the data about properties of interest. A large number of such observations are carried out and published within a research project [4]. Research results that have been collected are published and stored continuously in a research project. Re-use of the data takes place in research during data collection in the sense of data collection. Integrating the activities and tasks of RDM into the research process results in the schematic process flow shown in Figure 1.



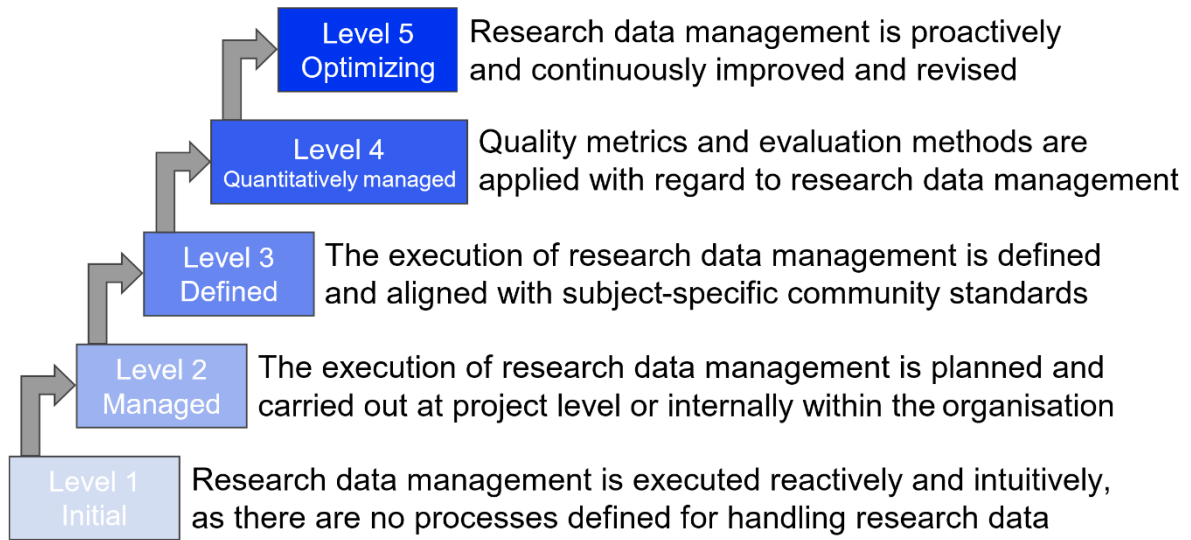
**Figure 1.** Integration of RDM into the engineering research process within a research project

In a research project, researchers are responsible for managing the data, adhering to standards of good scientific practice, preparing the data, and making it available and reusable for others throughout the life of the project. It is the researchers' responsibility to manage the data, develop contextual metadata and enable the re-use of the data. On the one hand, the quality of RDM in research projects must be ensured, and on the other hand, the quality of the data products must be guaranteed even after the end of the project. Fundamental to this is the traceability and guarantee of transparent research data [5]. In this context, guidelines for handling research data must be defined. The quality of the data always depends on the purpose and context of further processing, therefore the RDM should be oriented towards the research community and must be executed according to given standards to make comprehensible data available to the research community.

To ensure quality concerning the execution and implementation of processes, maturity models represent a method for qualitative evaluation. They enable an evaluation of objects and contents based on discrete maturity levels, from an initial to an optimized final state. Maturity models can be used to evaluate entire organizations or individual areas about defined strategic goals [6].

For the field of RDM, there are already developed maturity models that address RDM in various dimensions [7]. In these models, the RDM is considered as a whole system, and an evaluation of organizations, applications, and services is forced.

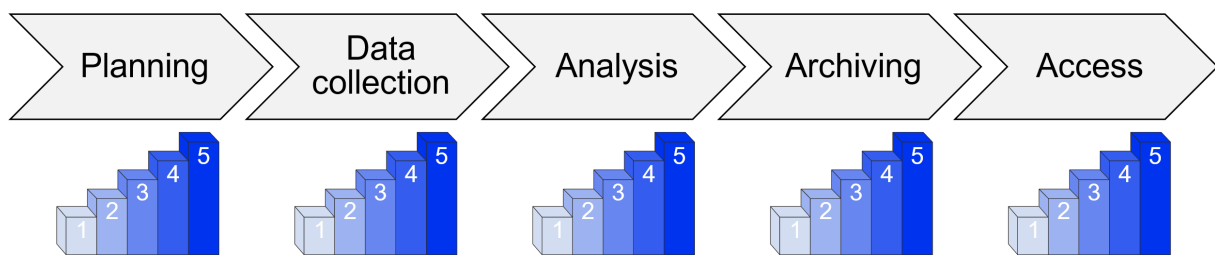
To assess the RDM in research projects, the NFDI4Ing [8] is developing maturity models oriented to the research process that enable researchers to assess the RDM independently during their research. The models focus on the research process-oriented execution of RDM towards a standardized and optimizing execution of RDM in research projects. The developed maturity characteristic of the maturity models (Figure 2) follow the contents of the Capability Maturity Model Integration (CMMI) and are aligned with the goals of RDM for execution in research projects. This ensures the traceability and integrity of research and RDM with increasing levels of maturity. The CMMI is an established maturity model that forms the basis for many developed maturity models.



**Figure 2.** Developed maturity characteristic

The first level describes the execution of RDM in research projects, which does not follow any defined procedures. The RDM is not planned, but is done reactively and intuitively and depends on the commitment of the researchers. At the next level of maturity, RDM is planned and carried out in its defined areas at the project level. Within the project, the basic content for RDM is addressed and proactively executed. To publish comprehensible research data, the next stage is to align RDM with prevailing domain-specific community standards. This should ensure the interoperability and reusability of the research data in the respective research community. In level 4, content to ensure the quality of the research data and data management is then integrated into the processes. The last level provides a continuous and active improvement of the RDM solutions and active participation in the research community regarding the contents of the RDM.

To evaluate RDM in research projects and to improve it in perspective, individual maturity models are developed for the identified process areas of RDM (Figure 3) based on the developed maturity characteristic.



**Figure 3.** Defined process areas for the development of individual maturity models

In the individual maturity models, the contents and tasks of the process areas are taken into account and, based on this, goals and associated practices are defined at the individual maturity levels, oriented towards the maturity characteristics. The processes and activities of engineering research fields that have a strong impact on the area of data collection and analysis are taken into account [9]. In this way, the developed maturity models can be used to evaluate RDM in research projects uniformly and show possibilities for improvement toward standardized and secure RDM in the research community.

**Keywords:** maturity model, quality assessment, engineering research process, research data management

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