# EXECUTIVE SUMMARY

The digital revolution is fundamentally transforming research data and methods; indeed, science on the whole is in a state of flux. Mastering this transformation poses major challenges for actors in the domains of science and policy, in part because the precise nature of the transformation is not yet clear. The process of digitalization creates immense opportunities, but it must be structured pro-actively. To this end, the establishment of effective governance mechanisms for research data management (RDM) is of fundamental importance and will be one key driver for successful research and innovation in the future.

In its position paper, the German Council for Scientific Information Infrastructures (RfII) makes a series of recommendations concerning how research data should be managed in the future. The RfII was tasked by Germany's Joint Science Conference (GWK) with formulating broad-based recommendations for the science system in Germany as a whole. Consequently, the recommendations presented here have ramifications for a variety of actors in the domains of politics and science. The RfII is convinced that the adoption of new ways in dealing with research data as well as long-term preservation and accessibility will be a significant, common challenge for all actors in the years ahead.

The position paper describes current policies and practices for managing research data and discusses a number of conflicting priorities in science policy. While there are several good examples of research data management[1] in Germany, there is an overall absence of coordination, and current efforts often take the form of parallel, project-based initiatives. Universal access to services for data management is lacking, as the key actors at present are individual institutions and organisations, and their efforts often suffer from limited financing and/ or excessive niche focus. High staff turnover means that valuable know-how is frequently lost. Furthermore, the range of services being provided is impaired by the absence of governance mechanisms which could impart greater strategic direction. In addition, there is a risk of international competitive disadvantage for Germany due to unresolved issues in the domains of quality assurance, legal compliance, data privacy, and data security. In this way, there is a clear need for action in a variety of areas.

Based on the foregoing findings, the RfII has developed a series of recommendations:

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[1]    The RfII has a broad conception of research data that encompasses both analogue and digital collections.

**Adjusting funding mechanisms**

With regard to funding policy, the RfII recommends implementing long-term funding mechanisms in line with the long-term nature of research data management. Current project funding schemes do not foster long-term sustainability, thus jeopardizing the development of services needed in the long run. Policy-makers need to establish clear pathways for institutions and organizations to obtain the resources they require over the long term. Without tying up subsidies in a fixed manner, funding phases for RDM infrastructures should be designed so that applicants have a clear understanding of their chances for securing long-term financing and the steps that are necessary to obtain it. This will boost the value that is derived from public investment. The goal of funding policy should be to develop an ecosystem of sustainable infrastructures that provides researchers in Germany with universal and reliable access to data management services. Such an ecosystem should also be designed to grow dynamically over time.

**Efficiency and coordination based on a (distributed) national infrastructure**

The RfII recommends the establishment of a *Nationale Forschungsdateninfrastruktur* (National Research Data Infrastructure, or NFDI), which will serve as the backbone for research data management in Germany. The NFDI should be implemented as a national collaborative network that grows over time and is composed of various specialized nodes. The establishment of such a network is recommended on a step-by-step basis, as this will ensure the overall management system remains flexible while also facilitating the productive integration of diverse resources. The NFDI will provide for coordination, cooperation, and common standards. As a network-based, dynamic organizational structure, the NFDI will be composed of nodes of various sizes. Some of these nodes will take the form of broad-based "service centres", while others will be specialized "centres of excellence" for specific subareas. These centres can be established within various existing organisations and institutions. The difficult issue of developing intelligent solutions for the long-term archiving/provisioning of research data will be among the areas addressed by the NFDI.

**Responsible data culture**

**Monitoring and quality assurance**

The current transition to digital processes means that nearly all of the "soft" factors for scientific activity are in a state of flux. The responsibilities that fall to researchers have to be recalibrated. The RfII thus makes various recommendations regarding data quality assurance, the adoption of a legal framework for data reuse (based on the Open Science model), and data privacy and protection. These recommendations aim to define the responsibilities borne by researchers and their organisations during all phases of the "data life cycle". Accordingly, policy-makers and scientists need to understand and set forth good scientific practice for research in the digital age. Scientific organisations also have a clear role to play in this area: monitoring and evaluation systems should be designed to create incentives for good research data management while also

engendering trust among researchers and the lay public. Good data management practices go hand in hand with research that is cutting edge and has a strong practical value for society as a whole.

The RfII additionally recommends that due attention be devoted at all levels to human resources development. Adequately qualified individuals are required in large numbers for data-intensive research and teaching. The German labour market is dangerously lagging behind global developments in this area. Accordingly, the RfII sees a pressing need to educate a new generation of highly capable researchers and specialist employees for new occupations in the area of data management. At the same time, new skills and greater awareness need to be promoted at management levels, as communication and process management are frequently decisive for solving infrastructure problems. Consequently, there is an urgent need to develop new occupational profiles and fields of study. Ultimately, it is the individuals behind the system, with their skills and aptitudes, who generate new scientific knowledge and added value by integrating data, information, and knowledge from heterogeneous sources.

The RfII attaches particular importance to international collaboration, for the flow of digital information (like research) knows no borders. The RDM ecosystem in Germany will have to develop within a broader European and global context. This does not only mean competition, but more importantly active collaboration and mutual learning. The RfII believes that Germany has a particular role to play in this area, and calls upon policy-makers and scientists to develop closer networking ties to their counterparts in other nations.

Changing course requires time, cost, and effort. The RfII believes that considerable investments are required at various levels of the German scientific system in order to ensure its future efficacy. The tasks in need of attention will require a long transition process. The scientific system will need to change in nearly all areas if research data and methods are to become truly digital in coming years. The need for change also applies to existing infrastructures, repositories, and archives, which need to reorient towards new tasks. At this current tipping point, the RfII calls upon decision-makers in the domains of science and policy to make vigorous efforts to facilitate the necessary transition phase. This call for action extends to Germany's *Länder* and the national government, which are urged to undertake effective and rapid measures to overcome the current fragmentation of efforts in the area of research data management. This fragmentation cannot be overcome without mobilizing substantial resources within the science system, including its funders.

The RfII emphasizes that the challenges are complex and that collaboration will be decisive for success. Scientific policy-makers and the scientific community are equally responsible for ensuring that joint action takes place.

For all those involved, the overarching concern should be to support the international competitiveness of German scientific research and make efficient use of public funding. With effective collaboration Germany can actively push the digital transformation to ensure maximum benefit for science, industry, and society.