

Leibniz Strategic Forum on Digital Change



Executive summary

Few societal changes in the early 21st century are affecting society and research across disciplines as much as the extensive use of digital technology. Communication, collaboration, information flows, decision-making, responsibility and problem-solving: technological transformations have fundamentally altered the ways in which we perceive and interact with our surroundings. Individuals' priorities may differ radically across diverse areas of society as well as in different disciplines and interdisciplinary research fields. The ability to make good use of digital technology emerges from divergent (personal) experiences, (structural) support and (professional) expertise. It is, however, important to recall that these transformations are not simply technology driven; they do not only reflect the 'impact of' digital technology. They are also fundamentally shaped by the ethical, legal and political choices that we make and by the extent of public deliberation on technological issues that is enabled. Participating in the processes that shape the (digital) environment is only possible if individual actors are enabled to do so.

To date, public discussions and educational endeavours in Germany have centred on individual 'competencies' in using digital technology. This white paper shifts the focus away from competencies and towards 'digital capabilities'. In this perspective, the key to the Leibniz Association's successful and dynamic digital future is not just the ability of *individual* researchers and other staff members. It is also, and perhaps more importantly, the *organisational* context in which this ability is fostered. A capabilities approach foregrounds the *design of sociotechnical systems and practices* that enable individuals to develop and enact the various skills, proficiencies and literacies required today.

This paper formulates three strategic priorities for the Leibniz Association and identifies key measures to foster digital capabilities in line with these strategic priorities. The first priority is to develop the digital capabilities of the *individuals* employed across the Leibniz Association. The second priority is to boost the digital capabilities of the Leibniz Association as an *organisation*. The third priority is to promote digital capabilities through knowledge exchange with *external partners*. The following textbox summarises key elements of the more detailed recommendations in the white paper.

To stimulate individual digital capability, the Leibniz Association should:

- **Foster an awareness** of the need to develop capabilities, **encourage** all staff members to further develop their own digital capabilities and **enable** staff to engage in this professional development **by allocating sufficient resources**.

To boost its organisational digital capabilities, the Leibniz Association should:

- Recruit a consultant to conduct an **in-depth SWOT analysis** of digital capabilities in the six core activities across the member institutions and in the Leibniz Association's headquarters and **make recommendations for an implementation plan**, i.e. by (i) identifying the instruments that selected institutions use to support the institutions' capabilities, (ii) analysing which information and communications technology (ICT) infrastructures the headquarters should improve, design or implement to boost capabilities across the association; and (iii) specifying which mechanisms need to be established and enhanced to make member institutions fit for the digital transformation.

To promote digital capabilities among its strategic partners, including civil society, politics and other research organisations, the Leibniz Association should:

- Direct sufficient resources to expand partnerships, initiate joint training programmes and explore participatory knowledge exchange formats in order to **deliberate** on which capabilities can best be fostered and how this can occur with a view to enhancing our **shared digital future**;
- Affirm that its core activities include (i) cultivating and promoting the availability of **digital cultural heritage** in the **public domain**, and (ii) providing **FAIR digital infrastructures** for research data.

Introduction

Rapid technical advances, paired with an ever-growing use of information and communication technology (ICT), is leading to radical changes in many societal processes, which are having a great impact on individuals, society and the research community. These processes are commonly described using the umbrella term of digital transformation. There are few contemporary societal processes that are affecting people's professional and personal lives as much as digital transformation. Whether this refers to how we communicate, how we look for and get information, or how we work, learn, shop, migrate, plan, educate and conduct research – the extensive use of digital technology has fundamentally altered the ways in which we perceive and interact with our surroundings. While this process relies on the increasing global dispersion of digital information and communication technologies, it is not simply technology driven; it is shaped by individuals, communities and by the societal choices and political decisions we make.

The *Leibniz Strategic Forum on Digital Change* has identified several major areas of tension in contemporary research. For the purposes of this white paper, we focus on two key challenges that require urgent attention: (1) the use of digital tools and (2) the production of big data known as datafication. These serve to illustrate the radical changes that are arising alongside the increasing use of digital technology and the symptoms of these changes that are impacting individual lives, society at large, the research community, and, most specifically, the Leibniz Association. These examples thus serve as a practise-based grounding for our proposal for the Leibniz Association's strategic direction. Within all topics discussed, we have identified common skills, practices and structures that are lacking across disciplines. We refer to these as 'digital capabilities'.

This white paper raises awareness of why it is increasingly important to tackle this deficit in interdisciplinary capabilities as soon as possible. It proposes steps for immediate action and also identifies priority steps for a long-term implementation strategy. After describing the two key challenges, this paper introduces the concept of digital capabilities, explains why digital capabilities can provide solutions to the current challenges we face and why we see the Leibniz Association as uniquely placed to investigate and develop the future digital capabilities of research and society. The paper concludes with several recommendations and measures through which the Leibniz Association can take action.

Key Challenge I: The Current Use of Digital Tools Reveals a Lack of Digital Capabilities

An important aspect of the digital transformation is the ever-increasing availability and usage of digital tools in all areas of life. Researchers are benefitting from tools and services that allow for,

- Remote group communication, web meetings and telepresences,
- Secure access to, exchange of and sharing of research outputs,
- Encryption for communication technologies and cloud solutions,
- Data backup and archiving,
- Modelling of complex processes and analysis of big data,
- Project and team management,
- Collaborative coding, testing and writing.

Such tools are of major importance for facilitating communication within the Leibniz Association and among its member institutions. They are also particularly prominent in required reporting and evaluation processes, for instance, those for pact monitoring.

This requires an adequate infrastructure. For many popular tools, the infrastructure is provided by private companies, sometimes at no or low cost. In research, access to the necessary infrastructure is a problematic issue in its own right, as operating such infrastructure is expensive. This is especially true in cases of smaller, distributed scientific groups that receive independent funding for their own research but not for the underlying infrastructure. For example, complex process-based simulation models, such as climate models and integrated assessment models (IAMs), are computationally very demanding and create large amounts of data. This is a challenge with regard to data storage, archiving and the availability of pure processing power, which require sufficient infrastructural support. Hence, Leibniz member institutions need options to jointly run digital infrastructures independently of their individual scientific purpose.

The use of digital tools promises and is already delivering significant boosts in the efficiency and efficacy of scientific work and allows researchers to access information and data beyond the borders of their home institutions, for example, data in open access repositories such as Econstor, developed and hosted by the Deutsche Zentralbibliothek für Wirtschaftswissenschaften (ZBW). At the same time, researchers are often overwhelmed by the multitude of tools on offer for a certain task, challenged by compatibility difficulties, including different policies at different institutions, influenced by disciplinary standards, frustrated by sudden malfunctions, or worried about privacy violations. Often, they struggle to use their private ICT hardware in combination with their institution's IT infrastructure, an issue not to be underestimated: increasingly, and especially in distributed research teams, the digital environments used to communicate and collaborate stem from private operators, e.g. Dropbox or Google. Easy use and free availability are the two aspects that currently dominate individual selection processes. Hence, the boundaries between private and professional life become blurred, leading to uncertainty about the appropriateness of such tools or a lack of acknowledgement of the issues the use of such tools may imply.

This may be amplified by movements like the open science movement. Such movements raise even more questions regarding what tools researchers should use if they would like to adopt the key aspects of openness and add them to their daily work routines. Hence, being subject to digital transformation themselves, researchers are often worried about what constitutes good scientific practice in the digital age. In addition, some researchers simply may not be aware of which digital tools could help them in their work and how such tools can help them.

OPEN SCIENCE aims at sharing research products as early as possible in the research lifecycle and allowing their reuse. See also the definition from the Leibniz Research Alliance for Open Science: <https://www.leibniz-openscience.de>

Key Challenge II: Increased Datafication and Availability of Big Data Require Digital Capabilities

Research in the sciences has become data driven in many respects, with huge implications for the overall objectives and strategies of research projects. Exponentially increasing amounts of data enable new scientific approaches that have enormous potential but impose new challenges (e.g. faster and cheaper DNA sequencing, new satellite-based remote sensors and increasing computer power for climate models). In the arts and humanities, large corpora of literature and other cultural heritage have been made available in digitised form, e.g. GEI-Digital, developed and hosted by the Georg Eckert Institute for International Textbook Research, which has digitised over one million historic textbook pages. Together with distant reading and related methods, this has opened up entirely new kinds of research questions.

DATAFICATION describes the tendency to increasingly track and collect data on every action in real and digital life – e.g. via fitness trackers – and to use this information for automated prediction, decision making or monitoring of user behaviour.

BIG DATA is a term used to describe large and/or complex data sets that require extensive computing power for processing and large storage volumes. Often, big data is characterised by its enormous volume, variety, velocity, veracity and value.

This datafication of research supports the transparency, reproducibility and even transferability of research methods and results into other fields of application. This might make it easier to hold researchers responsible for their work, as well as to give ordinary citizens the opportunity to educate themselves on the research tools and data openly available online; ultimately, this might even allow them to actively participate in the process of research. The transfer of data-science-related tools and methods from academia into industrial and broad societal application areas is currently underway. The high demand for data-science-related skills on the labour market today is an obvious indicator of this development – and is similarly reflected in job descriptions from academia. Automated decision-making, self-learning processes and big data analyses that build on datafication not only influence research but also provide a large public benefit. Medical and climate research, traffic control systems or economic analyses are good examples here. Yet, the way in which datafication interlinks previously unrelated spheres of life, leading to the personalisation of informational environments, can be viewed critically. For example, recommendation algorithms influence individuals' digital behaviour and can impact their life chances and personal and societal development. All such developments are happening without the knowledge or attention of the individuals concerned. Hence, mastering the methods, or at least having a broad understanding of the potential, challenges and consequences of datafication, big data and algorithmic manipulation of data streams has become a key knowledge resource in modern societies.

Besides integrating such knowledge into its own work, the research community has to acknowledge the crucial role it plays as a major producer of publicly available big data, e.g. by producing and sharing research data and workflows in order to ensure the reproducibility of analyses and scientific results.

Due to its role, these responsibilities are particularly relevant for the Leibniz Association. For example, because of its highly diverse and acknowledged range of research libraries, museums and special collections, which also produce data, i.e. digitised documents of cultural heritage, it should take responsibility for those kinds of digital scholarly artefacts – especially by making them available in the public domain. The kind of strategic focus taken by the Leibniz Association guarantees that unique digital or digitised collections are made available to everybody by means of the internet, that they are discoverable through commercial search engines and via communities like Wikipedia, and that they are curated by global expert communities. It also allows for effective leveraging of this big data. The Leibniz Association is an optimal authority for not only openly providing this cultural data but also for informing society at large about free and open information.

Digital Capabilities

Across the Leibniz Association's disciplines, researchers and support staff are concerned about the differential capabilities of individuals, the lack of high-quality tools and the dearth of structural resources to upskill and implement substantial changes. One issue is the identification of problems at an institutional level and the dedication of resources to developing insular solutions, a strategy that significantly hinders successful transformative practice. Focusing on digital capabilities – or in other words, on the contextualised ability to make good use of technology – offers solutions and pathways forward. By bringing perspectives together from across the Leibniz Association's five research sections, the *Leibniz Strategic Forum on Digital Change* has identified three future strategic areas that can drive the development of digital capabilities. Before turning to this digital future, this section outlines the concept and its potential advantages.

Debates in Germany have drawn heavily on the concept of 'digital competencies'. Although many competing definitions exist, they tend to align with the European Digital Competence Framework for Citizens (DigComp 2.1), which understands being digitally competent as the ability to use digital technologies in a confident and safe way for various purposes, including working, learning, shopping online, informing oneself about health, being entertained, and participating actively in society.

Alongside this narrow focus on an instrumental basic use of digital technologies, several competing concepts are emerging. These include:

- **DIGITAL LITERACY,**
emphasising the combination of access, use, understanding and creating required for individuals to innovate with digital technologies, contribute to constructive social action and think creatively and critically;
- **DIGITAL FLUENCY,**
emphasising the contextual nature of using digital technologies to communicate with ease in creative and critical ways, which always also depends on socio-economic inequality and material opportunity;
- **DATA LITERACY,**
algorithmic literacy or artificial intelligence literacy, emphasising the key role that specific formats and technologies play in the digital society;
- **DIGITAL INTELLIGENCE (DQ),**
emphasising the dimensions alongside digital literacy and digital use that are necessary to live a successful life today, including digital identity, digital rights, digital safety, digital security, digital communication and digital emotional intelligence;
- **21st CENTURY SKILLS,**
emphasising that the use of digital technology is embedded within broader skills necessary for this century, e.g. collaboration, communication, creativity and critical thinking;
- **DIGITAL MATURITY,**
emphasising that digitalisation is a process of growth and development, and highlighting the role of management in steering (commercial) organisations towards new practices;
- **DIGITAL CAPABILITIES,**
emphasising the skills, knowledge and structures developed within social, cultural, political, economic and organisational contexts, which enable individuals to live, learn and work in a digital society.

Each of these concepts highlights aspects of digital life that have so far been neglected by a narrow understanding of 'competence'. This white paper prioritises the concept of 'digital capabilities' in order to highlight that the key is not only people's individual abilities, but also the structural underpinnings of (research) communities and (research) organisations such as the Leibniz Association. This concept emphasises that the contexts in which capabilities are fos-

tered are crucial. An approach focusing on capabilities foregrounds the design of appropriate sociotechnical systems and practices to enable the development of the various skills, proficiencies and literacies that are required today.

The Digital Future of the Leibniz Association: Developing Digital Capabilities

A core strategic goal envisioned by the Leibniz Association entails driving the successful establishment and development of digital capabilities in research and society. To address the challenges noted above and ensure a dynamic digital future, we propose three key areas on which the Leibniz Association should focus. First, the association should build the digital capabilities of individual researchers, management, administration, technical and other employees in the Leibniz Association. The second priority is building the Leibniz Association's organisational capabilities. The third task is building capabilities beyond the Leibniz Association through cooperation with key stakeholders.

Objective I: Individual Digital Capabilities

A central pressing question is how to grow the digital capabilities of individuals who are, as noted above, deeply embedded in social, cultural, economic and organisational contexts. From apprentices to postgraduates, from new entrants to experienced scientists, the question is how to foster the desire to expand digital capabilities and learn new skills. The **first strategic focus** is to build up the digital capabilities of individuals employed across the different members of the Leibniz Association.

Three dimensions are particularly relevant:

The **first dimension** is instrumental and pertains to *the confident use of available digital products and tools*. Researchers share their findings on social media and make their research data available in repositories for reuse; support staff enter research output into current research information systems (CRIS), and staff look for high-quality (open access) tools for collaborative writing and project management. There are individual differences in experience with these tools, and research shows how the matrix of advantage and disadvantage relates to access and ability to use digital technologies and online services.

The **second dimension** is critical and pertains to *the capacity to reflect on and question conventional use of technology*. Recent data scandals have raised public awareness of data surveillance and the misuse of individual data. There is an increasing appreciation of the need for critical data literacy – e.g. an increasing understanding of data legacies ('the internet does not forget') – and of the vast range of possible pathways through which a person can be influenced or exploited through digital technology practices, including by predatory publishers.

The **third dimension** is creative and pertains to *a generative capability to design and redesign technology to shape the future*. We do not merely react to the transformation of the world through digital technology; we also shape the digital future. The coding of research software and online portals influences what kind of research can be conducted, which kind of research output is valued, and whether relations of competition or collaboration are prioritised. Generative and creative digital capabilities entail the ability to adapt technology to serve unexpected ends, to understand how code works in order to adapt available products or to model different kinds of worlds in the software we use.

To promote the expansion of individual researchers' digital capabilities, we recommend the following measures.

Leibniz institutions should:

- Foster an awareness of the need to develop capabilities in areas of particular relevance to their (working) lives, e.g. by including the issue in job descriptions und annual appraisals;
- Encourage all members of staff to further develop their own digital capabilities, e.g. by participating in workshops or training sessions; and
- Enable staff to participate in workshops by allocating sufficient resources to cover costs and by ensuring that capacity building is integrated into the regular workload and is not regarded as an additional task.

Objective II: Organisational Digital Capabilities

While the preceding section focused on individuals' (socially embedded) digital capabilities, this section expands the focus to organisations. The second strategic focus is the identification of concrete measures to promote the Leibniz Association's digital capabilities, both within the member institutions and in mechanisms that are implemented across the association. Internationally, organisations are beginning to realise that individual competencies are not enough. Organisations' digital capabilities are also coming under scrutiny, for instance, in terms of whether their policies, structures, infrastructures and identities enable (or hinder) digital practices. The UK's Joint Information Systems-Committee (JISC), for instance, has developed a model of six core elements of organisational capabilities, relating to research organisations' core activities (see Fig. 1).

The elements range from 'ICT infrastructure' (including basic provision of computers, mobile devices and Wi-Fi, but also more complex infrastructures such as repositories, open archives, hybrid libraries and current research information systems (CRIS)), through 'content and information', 'research and innovation', 'communication', 'learning, teaching and assessment' (e.g. students, doctoral researchers, apprentices, professional development, management training), to an organisation's self-understanding of its proactive digital culture. Drawing on these core elements, organisations have developed and fine-tuned their strategic planning and quality enhancement measures, their provision of and investment in infrastructure, their content management systems, their innovation processes and their communication culture. Resources are available to systematically develop organisational digital capabilities. JISC, for instance, suggests four steps for embedding digital practice: It aims to help organisations such as the Leibniz Association to create a model of digital capabilities appropriate to their size and scope, moving from (i) establishing a vision that will drive the development of digital capabilities, (ii) designing and constructing mechanisms to bring the vision

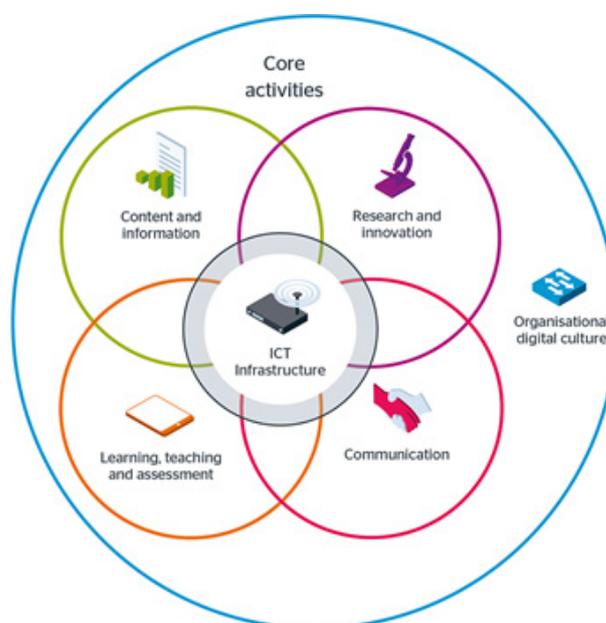


Fig 1. The digitally capable organisation (JISC 2017)

to life, (iii) exploring specific teams and needs to build a contextualised implementation plan, to (iv) supporting and consolidating the capabilities across the organisation.

To boost the organisation's digital capabilities, we recommend the following measures:

- Recruiting a consultant to conduct an in-depth SWOT analysis of digital capabilities in the six core activities across the member institutions and Leibniz Association's headquarters and to make recommendations for an implementation plan, i.e., to identify the instruments that selected institutions use to support the institutions' capabilities and analyse which ICT infrastructures the headquarters should improve, design or implement to boost capabilities across the association; the advisor should also specify which mechanisms need to be established and enhanced to get member institutions ready for the digital transformation.

In parallel to the SWOT analysis, we recommend the following measures:

For the Leibniz Association's organisational digital culture:

- Establishing a clear position on digital capabilities within the Leibniz Association, which should be reflected in its long-term strategy;
- Designing guidelines for building digital capabilities and integrating compliance with these guidelines in regular evaluation processes.

For ICT infrastructure and communication:

- Establishing a working group on digital tools with representatives from Leibniz institutions to enable the regular exchange of information and sharing of expertise across the association;
- Maintaining, updating and evaluating an inventory of existing tools (e.g. via the German National Research and Education Network (DFN)) and best practices to be made available to all institutions (e.g. on a wiki);
- Assessing options for joint purchasing/licensing agreements to enable the flexible management of key ICT infrastructure (e.g. computing clusters, CRIS).

For research and innovation:

- Prioritising interdisciplinary research on digitalisation in the Leibniz Competition, ScienceCampi and/or Research Alliances;
- Fostering exchange among member institutions regarding research on digitality and improving cross-sectional or interdisciplinary networks, e.g. via regular events.

Objective III: Digital Capabilities beyond the Leibniz Association

The third strategic focus aims to increase the benefits from digital capabilities not only within the Leibniz Association but also through participatory knowledge exchange with partners. We envisage the Leibniz Association as a pro-active supporter of digital capabilities in research and across society that aspires to attain a position as a thought leader in mechanisms for the effective structural support of digital capabilities.

Synergies are emerging through multi-stakeholder collaborations. These require sustained resources if they are to actively contribute to the design of the digital future. For instance, the Alliance of Science Organisations in Germany, of which the Leibniz Association is a member, launched a Digital Information Initiative over ten years ago (<http://doi.org/10.2312/allianzoa.016>). The German National Research and Education Network (DFN) connects universities and research institutions and offers a multitude of communication services and training courses at no extra cost; these include an online scheduler and a video conference platform. More specific in scope, the Research Software Engineers (RSE) organisation addresses challenges and needs arising when programming software in a research environment. A further joint initiative pertains to a National Research Data Infrastructure (NFDI).

A key challenge is to design and govern platforms that enhance the potential of data and other digital research products for society. Free accessibility and sustainability have become widely agreed upon standards in research and are implicit in the FAIR (findable, accessible, interoperable, reusable) data principles. Similarly, libraries, archives and research museums – both within the Leibniz Association and in its network of partners – are increasingly becoming aware of the inherent value of keeping the artefacts of digital cultural heritage in the public domain as long as possible and of their duty to do so. Society as a whole will benefit from a sustained investment of resources in digital and data infrastructures. This will support the preservation of and access to cultural artefacts (also from digital culture) and will also foster the development, implementation and maintenance of services and data-intensive research for the good of humanity.

Accessibility and access are also key in public knowledge exchange activities. Feedback from public engagement can be incorporated into research and aid the further development of knowledge. Accessibility can be improved by eliminating technical, structural and conceptual barriers.

To enhance digital capabilities across society, we recommend the following:

- Directing personnel and material resources to expand strategic partnerships with other initiatives on digitalisation, e.g. the Alliance of Science Organisations;
- Developing joint training programmes to enhance digital capabilities in cooperation with educational organisations (e.g. schools, universities);
- Establishing participatory formats to engage with citizens' priorities and assessments of digital capabilities, e.g. by conducting regular stakeholder workshops, in particular with the use of novel methods and locations in order to include disadvantaged groups.

To demonstrate the benefit of digital capabilities, including the provision and maintenance of open digital infrastructures across society, we recommend the following:

- Affirming that a unique core activity of the Leibniz Association is cultivating and promoting the availability of digital cultural heritage in the public domain;
- Providing digital infrastructures for access, preservation and processing of research data in all forms (e.g. cultural heritage, computer models);
- Following the FAIR principles with regard to all data, solutions and knowledge that are produced by the member institutions.

Background Information

The Leibniz Strategic Forum on Digital Change was created in 2017. Its tasks are to assess the Leibniz Association's existing expertise, to generate new ideas regarding the usage, shaping and research analysis of the digital transformation, and to evaluate the risks and opportunities associated with it. The members of this forum discussed past, current and potential challenges that are arising from these new and changing processes, taking into account the very different expertise from the various research areas, ranging from life sciences, engineering, physical and environmental sciences to economics, spatial sciences, social sciences and the humanities as well as technical perspectives and individual experiences from daily life.

The composition of the group, which included members from all sections, reflected the disciplinary diversity of the various Leibniz institutions and made it possible to address the implications of the digital transformation for the Leibniz Association, research in general, and society from an interdisciplinary perspective. This report is the result of this undertaking.

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