Informationszentrum Lebenswissenschaften
ZB MED

ZB MED/BIBI Strategy 2020-2025

Harnessing research and infrastructure to empower people and benefit the environment

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ZB MED – Information Centre for Life Sciences.

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Contact details
Scientific Director: Professor Dr Dietrich Rebholz-Schuhmann
Finance and Commercial Director: Dipl.-Volkswirtin Gabriele Herrmann-Krotz
Email: direktion@zbmed.de

1. Summary

Globalisation and digitalisation are profoundly transforming the life sciences. Today's global challenges include combating pandemics, tackling both common and rare diseases, achieving food security, helping people to live independent lives as they get older, securing energy supplies, protecting the environment and responding to climate change. The life sciences have much to offer in addressing these global challenges, but their ability to do so depends on having a solid basis of information. This can be achieved by taking a holistic view of all the various factors that influence and impact on research into nutrition and agricultural science, biology, the environment, veterinary medicine and human medicine (e.g. "one health"). Opportunities lie in data science methods and new technological possibilities such as omics technologies. ZB MED harnesses research and infrastructure to empower people and benefit the environment, thus promoting the development of rapid and sophisticated solutions.

As a national information centre that also conducts research, ZB MED – Information Centre for Life Sciences works with the Bielefeld Institute for Bioinformatics Infrastructure (BIBI) to fulfil its mandate of providing nationwide access to life sciences information, research literature and data in an efficient and sustainable manner. ZB MED/BIBI offers solutions to the technical and cultural challenges of the digital life sciences along the entire research cycle. These solutions are highlighted in a mission statement based on five key principles. They include ZB MED/BIBI's in-house research, an open and sustainable offering of data-driven infrastructures for research, a centralised supply of information, and the transfer of skills and knowledge within a robust network.

2. Vision, unique selling proposition and key role

ZB MED/BIBI combines two tasks of national significance within a single institution:

- The first is that of a national library specialising in the provision of information and literature and a key German infrastructure facility for literature, data and their analysis ("services for science")
- The second is that of an applied research institute that develops new services for utilising and exploiting data in the life sciences ("science for services")

ZB MED/BIBI's **vision** is "Harnessing research and infrastructure to empower people and benefit the environment". This stems from our aspiration to support life sciences researchers throughout the entire research cycle in accordance with the principles and practices of open science. ZB MED/BIBI is particularly committed to the ongoing development of data-supported research.

Fig. 1: The life sciences research cycle
ZB MED/BIBI offers comprehensive services to support and enhance seamless research processes based on the principles of open science

The life sciences research cycle shown in Figure 1 is a general representation of the current workflows in the various disciplines of the life sciences. To provide optimum support to researchers, specific offerings are created and established for the various methods used at different stages of the research cycle, from laboratory experiments and clinical studies right through to more heavily text-based research designs. Particular attention is paid to data-based developments and solutions. Two key tasks that constantly recur in applied research are researching literature and data and generating ideas. Ideally, these culminate in the open-source publishing of research results. The arrows extending from the last stage of the research cycle illustrate how sharing and networking are particularly important at ZB MED/BIBI, both within and between individual disciplines. Section 4 explains how this cycle is put into practice and includes examples of support provided by ZB MED/BIBI.

ZB MED/BIBI's aim is to establish itself as an "information hub" that can take on complementary tasks for researchers within the existing network of research institutions and libraries. This development is backed by ZB MED/BIBI's digital expertise and in-house research, which deepens its understanding of the research process and enables close integration of research and services. This

helps ZB MED/BIBI to address the needs of the research and academic communities as well as those working on practical applications.

ZB MED/BIBI's most important task continues to be to safeguard the nationwide provision of literature and information through digital preservation and other services. ZB MED/BIBI offers a comprehensive range of licensed content that is oriented towards users' needs. In addition, ZB MED/BIBI is heavily involved in developing publishing opportunities and disseminating open-access content, as well as transforming licensed content into open-access formats.

As a central hub in the network of academic libraries, specialised information services (SIS) and research institutions, ZB MED/BIBI strives to ensure the optimal digital provision of heterogeneous content in medicine, biology and public health as well as in the fields of nutritional, environmental and agricultural sciences, including the relevant basic sciences and related subject areas. Federal and state funding for this purpose comes from the Ministry of Innovation, Science and Research of the German state of North Rhine-Westphalia (MIWF NRW) and the German Federal Ministry of Health (BMG). BIBI is funded by Bielefeld University.

ZB MED/BIBI plays a major role in developing the national research data infrastructure (NFDI) for the life sciences with the goal of establishing an efficient and sustainable system of research data management. To help foster standard-setting practices, ZB MED/BIBI is expanding its information infrastructure and adapting it to the needs of its target groups. Working closely with users and cooperation partners, ZB MED/BIBI seeks to implement the basic concepts of Open Science and promote a cultural shift in regional, national and international networks towards Open Science and the application of FAIR principles. These principles guarantee the high quality, transparency and reusability of research across multiple disciplines.

The digital transformation is steadily expanding our opportunities to acquire scientific knowledge. For example, modern medical research benefits from digitally captured patient data and the deployment of self-learning algorithms.[1] In the life sciences, bioinformatics has established itself as a core discipline by introducing high-throughput methods that are in great demand in across all areas of the life sciences. This is the backdrop to the decision by ZB MED and BIBI to form a strategic alliance and create a research institute focused on science as a service in the life sciences – a decision that marks an important step on the road to becoming an information centre that conducts research. BIBI will add an extra level of cutting-edge infrastructure and bioinformatics expertise to ZB MED's offerings. It will also expand ZB MED's organisational remit by adding a new programme area for bioinformatics infrastructure from 2024. As shown in Figure 2, the alliance between ZB MED (orange layer) and BIBI (blue layer) will lead to numerous new services as well as expanding a number of existing services (grey layer). For example, existing services such as literature provision will be expanded to encompass a new bioinformatics target group, while the opportunities offered by cloud infrastructures (BIBI) will be combined with text and data mining skills (ZB MED) to create new data analysis services (ZB MED/BIBI). In this way, ZB MED/BIBI will work as a joint unit to maintain a dedicated commitment to open science principles and practices.

[1] cf. "The Digital Turn in the Sciences and Humanities"; white paper published by the German Research Foundation, p. 6 https://zenodo.org/record/4191345/files/20201028_Digitaler_Wandel_in_den_Wissenschaften_DFG-Impulspapier_en.pdf.

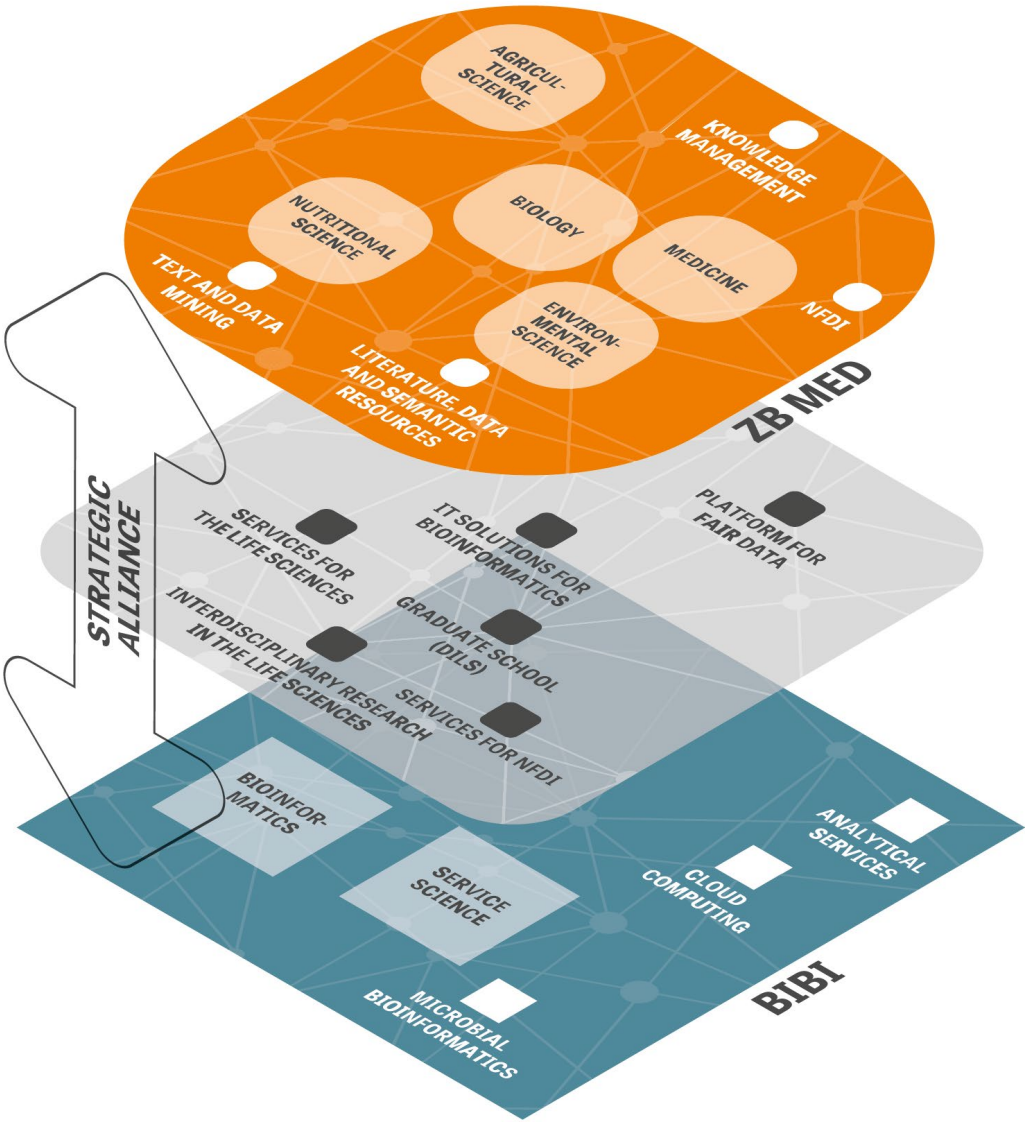

Fig. 2: How the ZB MED/BIBI strategic alliance will benefit research in the life sciences.

ZB MED/BIBI aims to position itself as a research information centre that conducts research. Its goal is to develop new services for science through its own research activities while also gaining new life-science knowledge by analysing large amounts of data. To achieve this goal, ZB MED/BIBI will forge national and international networks with researchers and act as a digital enabler to close the gap between demand and supply.

Unique selling proposition: As a central information hub for the life sciences, ZB MED/BIBI offers a combination of nationwide access to information, big data analyses and knowledge transfer. By providing researchers with extensive support for open science practices along the entire research cycle, it paves the way for new insights that generate information and knowledge for the life sciences.

By 2025, ZB MED/BIBI aims to take action and achieve specific goals within the framework of the following five strategic principles, which sum up its mission:

- (1) We conduct joint research with partners from regional, national, European and global research communities.
- (2) We facilitate data analysis and generate new insights through research.
- (3) As an information infrastructure hub, we provide reliable, long-term access to information, literature and data.
- (4) We promote open, reproducible research based on the principles of open science and FAIR data.
- (5) We pass on skills and expertise by engaging in active knowledge transfer.

ZB MED/BIBI will guarantee the provision of an efficient, modern and secure information and research infrastructure for the life sciences, thus laying one of the key foundations of outstanding science.

3. The strategic principles at the core of ZB MED/BIBI's mission

By 2025, ZB MED/BIBI will transform itself into Germany's leading provider and information hub for research and information in the life sciences. The five principles outlined above are explained in more detail below.

3.1 Research and networking

We conduct joint research with partners from regional, national, European and global research communities.

ZB MED/BIBI is a key hub for the scientific community. It leads the way in developing new standards and technical procedures and putting the principles of open science into practice. ZB MED/BIBI strives to form partnerships and networks with researchers and infrastructure facilities and use its specialist skills to identify the needs of research communities, to support the dissemination of innovations and standards, to conduct joint research and to develop new services in line with demand. Acting as a central interface, ZB MED/BIBI incorporates input from specialist research communities into its own research and into the establishment of infrastructures.

Communication on a regional level often provides the starting point for scientific research projects. ZB MED/BIBI therefore carries out joint projects in research, teaching and information infrastructure with universities in its local area (Cologne, Bonn and Bielefeld) as well as with non-university research institutions and libraries.

On a national level, ZB MED/BIBI has close ties to numerous universities, university libraries, research institutes and joint structures through a variety of projects, services and committees. ZB MED/BIBI plays a significant role in the ongoing development of the national research data infrastructure (NFDI). The coordination of NFDI4Health and other initiatives – plus its participation in other NFDI consortia – requires effective networking with key infrastructure institutions and specialist research communities in the relevant domains. ZB MED/BIBI has also set itself the goal of coordinating interdisciplinary standards in the life sciences.

ZB MED/BIBI is very well connected on an international level thanks to its research and training activities – for example through its membership of ELIXIR Germany. ZB MED/BIBI manages a de.NBI cloud site based on specialised expertise in bioinformatics data analysis. This is one example of its excellent integration in Germany's nationwide bioinformatics activities. By forging networks with the research community, ZB MED/BIBI ensures that information is provided to the life sciences in line with demand.

ZB MED/BIBI is the main European partner of the U.S. National Library of Medicine.

3.2 Data science

We facilitate data analysis and generate new insights through research.

ZB MED/BIBI enables researchers to conduct data analyses in a freely accessible cloud-based computing infrastructure which includes all the necessary software. New developments include innovative data science methods based on artificial intelligence (AI), semantic standardisation, text and data mining applications, and bioinformatics and systems biology solutions. By applying these new methods to large amounts of data in collaborative projects, researchers can gain new insights into the life sciences.

One key area of application is omics high-throughput data analysis, which is required across many life science communities. Promising analytics software from omics applications is incorporated into ZB MED/BIBI's offerings within the de.NBI network, thus expanding the range of available methods.

Furthermore, ZB MED/BIBI is evolving into a highly effective research institute in the fields of developing new methods ("science for services") and providing applications for automated literature analysis and information extraction. Within the framework of research and infrastructure projects, ZB MED/BIBI collaborates with national and international communities of specialist life sciences researchers to develop, test and embed new services.

Its research activities also include establishing semantic interoperability and creating links between data and information generated in literature or knowledge bases as well as new semantic representations. These activities result in new services for users in the realms of analysis, information and knowledge discovery.

3.3 Access to information

As an information infrastructure hub, we provide reliable, long-term access to information, literature and data.

ZB MED/BIBI curates and collects information, literature and research data and provides access to these resources throughout Germany, regardless of where its users are located.

ZB MED/BIBI integrates its digital and physical holdings and offerings into the cooperative and participatory structures of information provision in Germany's overall information infrastructure. In its role as a national specialist library, ZB MED/BIBI focuses on the specific needs of the life sciences. This makes the institution an important complement to specialist university and academic libraries and enables it to act in conjunction with higher-level bodies such as the German, Austrian and Swiss Consortia Organisation (GASCO) and the German association of medical faculties. It undertakes the digital preservation of its own holdings and open-access publications and makes them permanently available to researchers.

Other digital representations of knowledge are also becoming increasingly important. Examples include ontologies and knowledge graphs, which are offered in appropriate environments such as the semantic lookup service SemLookP and ZB MED/BIBI's graph and RDF databases. Research data standards and the integration of ontologies and knowledge graphs facilitate the use of these diverse resources as a comprehensive knowledge base. ZB MED/BIBI's data sources (e.g. the "ZB MED Knowledge Environment") are accessible to machines via open interfaces and can be used in external research projects. The availability of software objects with corresponding documentation and persistent identifiers is an important addition to the resources mentioned above.

ZB MED/BIBI´s IT infrastructure provides open access to modern search engines that make life science contents easy to find and make them available in networked configurations. The development of innovative search and analysis technologies, such as those based on AI methods, opens the door to new kinds of analyses of literature and research data.

ZB MED/BIBI is a strong partner in the national scientific community. Active throughout Germany, ZB MED/BIBI cooperates with the specialist national libraries ZBW and TIB as well as with Leibniz Association research groups that specialise in open science. ZB MED/BIBI makes nationwide agreements on the supply and provision of information. It also initiates consortia and is a reliable partner in the working groups and committees set up for standardisation initiatives, e.g. in the areas of research data, publishing infrastructures and metadata.

3.4 Open and FAIR

We promote open, reproducible research based on the principles of open science and FAIR data.

With its cloud-based IT infrastructure for big-data analyses, its open-access publishing platforms and its extensive consulting services, ZB MED/BIBI supports researchers' work at all stages of the research cycle – from the moment ideas are first researched right through to a data management plan and eventual publication. ZB MED/BIBI not only provides access to data, software, literature and services, but also preserves and maintains these resources for the long term, thereby promoting and fostering transparent and reproducible research based on open-science principles and practices.

The platforms guarantee the use of established standards that enable an open and consistent exchange of content in accordance with "FAIR principles"[2]. They are geared to the needs of researchers and benefit, in turn, from the implementation of applied research findings. A significant contribution to ZB MED/BIBI's structural networking activities is made through these platforms.

ZB MED/BIBI's commitment to open access, research data management and digital preservation extends far beyond merely creating open-access content. It also includes the provision of publishing platforms and consulting services, and it paves the way for transforming subscription journals into open-access channels through appropriate licensing models.

3.5 Knowledge and skills transfer

We pass on skills and expertise by engaging in active knowledge transfer.

Data and information literacy have an increasingly important role to play in all phases of the life-sciences research cycle. ZB MED/BIBI's services are aimed firmly at researchers at all stages of their careers, but also include train-the-trainer products that are aimed at key disseminators such as our colleagues at academic libraries.

ZB MED/BIBI collaborates with TH Köln – University of Applied Sciences to offer appropriate training and development courses for members of the library profession. These include a Bachelor's degree course in Data and Information Science, a Master's degree course in Library and Information Science, and the Data Librarian certificate course. Participants in these courses take up positions as trainees or interns during their studies, which allows them to directly apply their newly acquired expertise in day-to-day library work.

At the university campuses in Bonn and Cologne, ZB MED/BIBI offers new lecture content on semantic technologies and research data management in the faculties of medicine and agriculture and as part of the Master's degree programme in Life Science Informatics.

The "Digital Infrastructure for the Life Sciences" (DILS) graduate school, which was recently established by ZB MED/BIBI at the Bielefeld site, educates a steadily increasing number of young researchers in the fields of bioinformatics infrastructure and data analysis.

2 Acronym for the principle of making research data findable, accessible, interoperable and re-usable; see page 2 of PDF at https://www.leibniz-gemeinschaft.de/fileadmin/user_upload/Bilder_und_Downloads/Forschung/Open_Science/Leitlinie_Forschungsdaten_2018_EN.pdf.

These examples illustrate the many different formats used to transfer skills and knowledge: the sites of teaching and learning of ZB MED/BIBI itself and the DILS graduate school; a wide range of personal consulting services, conference lectures, workshops and in-house training courses; plus a wealth of digital formats such as web-based and workshop-based learning for key disseminators and multipliers, for example as a partner in the global "Carpentry" community[3] with workshops including Library Carpentry, Data Carpentry and Software Carpentry. To enable optimal use of its infrastructure and digital collections, ZB MED/BIBI relies on innovative teaching formats and methods and develops open educational resources (OER) for and with its network partner(s).

4. Services for research: concrete applications and examples along the research cycle

ZB MED/BIBI's strategic realignment has expanded the range of products and services it offers. ZB MED/BIBI is now able to support the work of researchers through all phases of the research cycle (see Fig. 1) and focus more closely on their needs. Alongside its traditional task of providing users with literature and information, ZB MED/BIBI is increasingly focusing on key products and services for data-driven research including the standardised collection and reuse of research data, effective analysis of the results, and the use of corresponding IT infrastructures. This marks an evolution in ZB MED/BIBI's services from pure "research administration" to continuous, tightly focused "research support".

Researchers who are at the stage of generating ideas and developing studies can use the LIVIVO portal to conduct efficient searches of literature and data. Research work focused on LIVIVO's ongoing development will continue to optimise the platform for multiple uses, especially in regard to searching for research data. ZB MED/BIBI's strategic licence management system forms the basis for comprehensive access to full texts and research data. In its role as Germany's national centre for information and literature in the life sciences, ZB MED/BIBI provides access to literature, data and services throughout Germany, regardless of a user's location. By providing researchers with the best possible services in each case, ZB MED/BIBI actively supports the structural changes that Germany is undergoing as a result of digitalisation and the open-access transformation. In all cases, ZB MED/BIBI analyses what information is currently needed and adapts its services to the continuously changing requirements of its users.

In the research planning phase, ZB MED/BIBI provides expertise in research data management and in the quality and reproducibility of research data. ZB MED/BIBI offers advice and support for creating data management plans and documenting the research process (e.g. using electronic lab notebooks) as well as for developing and implementing research data standards, enforcing good scientific practice, and developing support tools and services. Joint research projects are already underway with researchers in the network to continue developing these standards, tools and services, especially in regard to the development of the NFDI.

Research data is generated in the experimental phase of the research cycle. ZB MED/BIBI develops and offers suitable tools for reliable, long-term documentation of this data and offers advice and support throughout the process. Proper documentation ensures that research data is made available to a wider public for subsequent use, thereby ensuring that the research can be verified and traced. Researchers working on data-driven research projects have access to an analysis infrastructure for

[3] https://carpentries.org/.

large quantities of data (de.NBI cloud computing infrastructure) as well as appropriate analysis methods. Research projects are underway with partners from the user communities to develop new analysis methods and optimise existing ones. Training courses are also available to learn about the various analysis methods and explore the steps required to link different content and publish data.

The PUBLISSO publishing infrastructure provide useful assistance when the time comes for publication, allowing data and texts to be linked and made available under open access. ZB MED/BIBI serves traditional publishing channels – such as the publication of congress abstracts and journal articles – with the options of gold open access (immediate publication in an open access journal) and green open access (self-archiving subsequent to publication). It also caters to innovative formats such as Living Handbooks. Comprehensive advice on open-science topics is another important part of its services. This includes assistance in deciding on the most appropriate publishing format, help with licensing issues and tools for evaluating scientific reputation-building. ZB MED/BIBI works together with specialist research communities to develop new data and publication standards for research data, for example within the framework of the NFDI. It also supports the publishing of data and metadata. Its research work includes the development of new services and tools for data searches and full access to data. The aim of these services and tools is to ensure the long-term availability and interpretability of digital resources and to safeguard and maintain them on a permanent basis through digital preservation efforts.

All the services and tools that accompany and support the research cycle are aimed primarily at researchers in the life sciences. These useful tools, information and consulting services are aimed not just at end customers, but also at key disseminators. Colleagues from other academic libraries use ZB MED/BIBI's services to support researchers at their own institutions. For example, the LIVIVO search function can be used in a local view and the PUBLISSO Gold platform can be used by other institutions for their own publishing projects.

5. Concluding remarks: 2025 – Central information hub for the life sciences

By 2025, ZB MED/BIBI will have established itself as a reliable partner for life science research and a driving force in the field of information infrastructure and dissemination. Working as a unit, ZB MED and BIBI can provide comprehensive support for all the tasks encountered in the life science research cycle, and they are ideally placed to promote the data-based, digital evolution of methods and processes.

ZB MED/BIBI is the interface between life science research, literature and information provision, information science and the public. ZB MED/BIBI strives to identify trends and target group requirements at an early stage. Within the interdisciplinary field of the life sciences, ZB MED/BIBI facilitates and fosters broad-based topics in the overall research system and acts as an interface to adjacent areas of research.

Annex

A. Background and strategic alliance of ZB MED and BIBI

ZB MED was formed from two older institutions established in 1908 in Cologne and in 1847 in Bonn. Their original purpose was to respond to the demand for scientific literature in the fields of medicine and agriculture. Since its inception, ZB MED has actively pursued its mission to provide a national supply of literature and information resources. In 2014, ZB MED was converted into a foundation under public law with the name “ZB MED - Leibniz Information Centre for Life Sciences”. Since 2017, it has been known as "ZB MED - Information Centre for Life Sciences” and has been jointly funded by the Ministry of Innovation, Science and Research of the German state of North Rhine-Westphalia (MIWF NRW) and the German Federal Ministry of Health (BMG).

With the aim of strengthening research and boosting other skills in the field of data analysis, the German Federal Ministry of Education and Research (BMBF) launched a funding initiative for the "German Network for Bioinformatics Infrastructure" (de.NBI) in May 2013. This gave Germany a key piece of infrastructure comprising bioinformatics services and training courses which focuses, in particular, on solutions for dealing with big data in the life sciences. Based at Bielefeld University, the Bielefeld Institute for Bioinformatics (BIBI) runs both the de.NBI and German ELIXIR offices and coordinates the projects involving its German partners. This set-up provides a broad portfolio of resources for German researchers in the life sciences, including databases, bioinformatics software and tools, plus the necessary computing capacity via a distributed and networked cloud-based IT infrastructure.

The strategic alliance with BIBI paves the way towards realigning ZB MED as a research-focused information centre with additional data analysis and bioinformatics expertise.

B. Target groups and their needs

ZB MED/BIBI’s users have special needs and requirements based on their wide range of expertise and specialist fields and the extremely broad scope of the life sciences. ZB MED/BIBI understands that its target groups’ needs are constantly evolving, and it continuously adapts its portfolio of services to reflect these changes:

- **Researchers** expect to have quick and comprehensive access to literature, data and information, as well as globally accessible infrastructures that enable them to store, publish and archive data together with any relevant metadata.
- **Library and information science institutions** and their staff expect ZB MED/BIBI to provide them with professional, comprehensive support in serving their own customers. As a leading advocate of the field of information science, they also expect ZB MED/BIBI to help shape the digital transformation, develop products, share new findings in the community and play an active role as a partner in Germany’s jointly managed information infrastructure.
- **Teachers** are increasingly looking for consolidated, structured, editable materials in digital formats for both classroom and e-learning offerings.

- **Students** need support in overcoming the range of challenges they face at different stages of their education. Doctoral students have particularly complex needs stemming from their combination of study and research. This requires them, for example, to master research skills as well as to access subject-specific content.
- **Users working on practical applications** do most of their research under time pressure. Their need for literature and research support varies depending on the particular subject area.

C. Glossary

- BIBI – Bielefeld Institute for Bioinformatics Infrastructure
- BMBF – German Federal Ministry of Education and Research
- BMG – German Federal Ministry of Health
- de.NBI – German Network for Bioinformatics Infrastructure
- DILS – Digital Infrastructure for the Life Sciences
- ELIXIR – European life-sciences infrastructure for biological information
- FAIR – Findable, accessible, interoperable, reusable
- SIS – Specialised Information Service
- AI – Artificial intelligence
- MKW NRW – Ministry of Innovation, Science and Research of the German state of North Rhine-Westphalia
- NFDI – National Research Data Infrastructure
- NLM-NIH – National Library of Medicine - National Institutes of Health
- OER – Open educational resources
- TIB – Leibniz Information Centre for Science and Technology and university library
- ZB MED – German National Library of Medicine – Information Centre for Life Sciences
- ZBW – Leibniz Information Centre for Economics