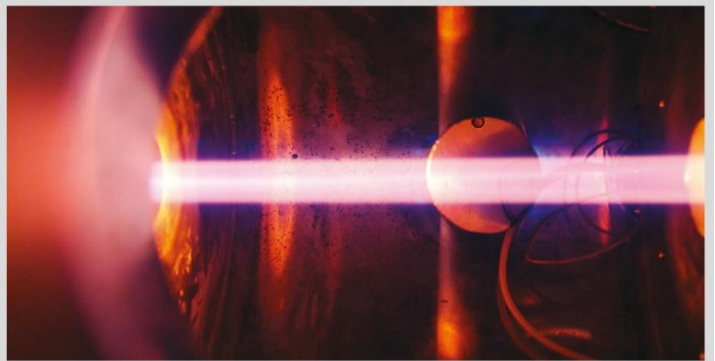


**NEW PERSPECTIVES**  
IN SCIENTIFIC  
RESEARCH  
IN HUNGARY



**REPORT**  
**TO THE HUNGARIAN PARLIAMENT**  
**REGARDING THE OPERATIONS OF THE EÖTVÖS**  
**LORÁND RESEARCH NETWORK**  
**FOR THE YEARS 2019-2020**

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## 1. FOREWORD

*"(...) there could hardly be a greater threat to our national flourishing than if we underestimate the value of the sciences according to how they serve to achieve one or another secondary goal; because just as it is true that science is power, without which no nation in Europe can survive today, it is also certain that progress in science can only be made by those who seek the truth for its own sake and not for side interests."*

*(Baron Loránd Eötvös)*



The Eötvös Loránd Research Network Secretariat (ELKH Secretariat) was established by the Hungarian Parliament as an independent public budgetary institution, effective August 1, 2019, with the aim of managing and operating the centrally funded, independent research network that constitutes a fundamental pillar of the Hungarian scientific domain. The establishment of a separate professional organization and management body for the research network has allowed for targeted, efficient, and prompt decision-making, while enhancing professional support for the research sites.

Since its establishment, the ELKH Secretariat has been working to develop the research network into one of excellence, boost its scientific achievements and improve both the transparency and efficiency of its operation. This is being done to make maximum use of our human and material resources, contributing to the development of Hungarian science, while also enhancing the country's intellectual, economic, and cultural competitiveness.

One of the most significant accomplishments has been the increase in budgetary funds allocated to the research network, as approved by Government Decree No. 1430/2020. (VII. 23.). This has allowed for the initiation of the development of the research infrastructure, expansion of resources available for research and launch the long-awaited increase of compensation for researchers. The latter meant an average 30 percent salary raise, effective July 1, 2020, for the researchers and employees working in other areas.

In addition, nearly five thousand employees of the research network were smoothly transitioned from a legal relationship of public employment to one governed by the Labor Code as of January 1, 2021, providing a more flexible employment framework for researchers.

By developing the infrastructure, improving research conditions and increasing salaries, our aim is to make it worthwhile for Hungarian researchers to stay in Hungary, and even for those working abroad to return home and build a career within the research network. Continuing to adjust the compensation system and increasing budgetary support is necessary to halt the long-term departure of talented Hungarian researchers abroad.

Another significant achievement is the establishment of a new, multi-pillar funding model replacing the previous static funding system, in which the scientific achievements of individual institutions are also considered when distributing funds for research. As a result, the process is based on objective data and transparent. The strategic goal is to continue to finetune the performance-based funds allocation system that recognizes and encourages excellence and achievements made through research thus contributes to enhancing the international competitiveness of the research network.

In our first full year of operation in 2020, the ELKH Secretariat made significant strides toward our mission of promoting transparent, efficient operations and high-quality research. We took measures to

retain talented researchers and supported efforts to utilize research results, thus contributing to solving both national and global social and environmental challenges.

In accordance with the main objectives of Hungary's national innovation policy, we place great importance on collaborating with other players in the domestic and international research, development, and innovation ecosystem, including institutions of higher education and private companies. Our aim is to encourage innovation in Hungary and maximize the practical utilization of research results in the country.

To improve scientific competitiveness, make better use of external research funding opportunities, and more effectively utilize the intellectual property portfolio within the research network, we have also decided to establish a new internal innovation system. With the establishment of this system, the aim of the ELKH Secretariat is to encourage and support research utilization activities, including knowledge and technology transfer, and ensure their transparency.

This report, prepared for the Hungarian Parliament, provides an overview of our objectives, the steps taken to achieve them, and the results we achieved in 2019 and 2020.

Miklós Maróth  
President

## 2. ELKH KEY INDICATORS

The ELKH research network comprises of 11 research centers, 7 research institutes and over 100 additional supported research groups operating at universities and other public institutions, conducting basic and applied research, exploring the most varied disciplines of mathematics and natural sciences, life sciences, social sciences and the humanities. A brief description of the [research sites](#) and [supported research groups](#) is available on the ELKH website.

### 2.1. Annual indicators from the research sites of the ELKH research network for 2019-2020

Pursuant to Act LXXVI of 2014 on scientific research, development and innovation, the ELKH is to issue a report on the results of its operations to the Hungarian Parliament every two years. This chapter presents annual indicators and data regarding the research sites for the years 2019-2020. The data series for 2019 also refer to the entire year, because it would not be practical to report on the results of the four months following the establishment of ELKH without taking into account the results and events of the previous months and years, and also because the number, composition, and research activities of the research sites remained unchanged during the reporting period even after the change in operational format.

The indicators for the year 2019 mostly reflect the results of the previous management structure, making 2020 the first full year under ELKH management. Nevertheless, some data series include longer-term, five-year timespans, since the core activities of the research centers, independent research institutes and supported research groups did not change in connection with the revamped organizational structure.

#### 2.1.1. Staff numbers at ELKH research centers and independent research institutes

The **average number of researchers**<sup>1</sup> employed at the research centers and independent research institutes was 2,464 in 2019, and 2,553 in 2020 (Figure 1), **which represents an increase of 3.6%**. Examining the data for the period between 2016-2020, the gradual increase in the number of researchers can be deemed encouraging. The average number of researchers **reached its highest value in 2020**, after the establishment of ELKH, which corresponds to a 4.8% increase compared to the 2016 data (which came to a total of 2,436 individuals). **The average number of researchers in all three scientific areas increased following the change in operational format that occurred in the fall of 2019.** Between 2019 and 2020, the average number of researchers at life science institutions increased from 801 to 813, while that at mathematics and natural science institutions increased from 948 to 970, and at humanities and social sciences institutions from 715 to 770.

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<sup>1</sup> The average headcount is the simple arithmetic average of the monthly average headcount data.

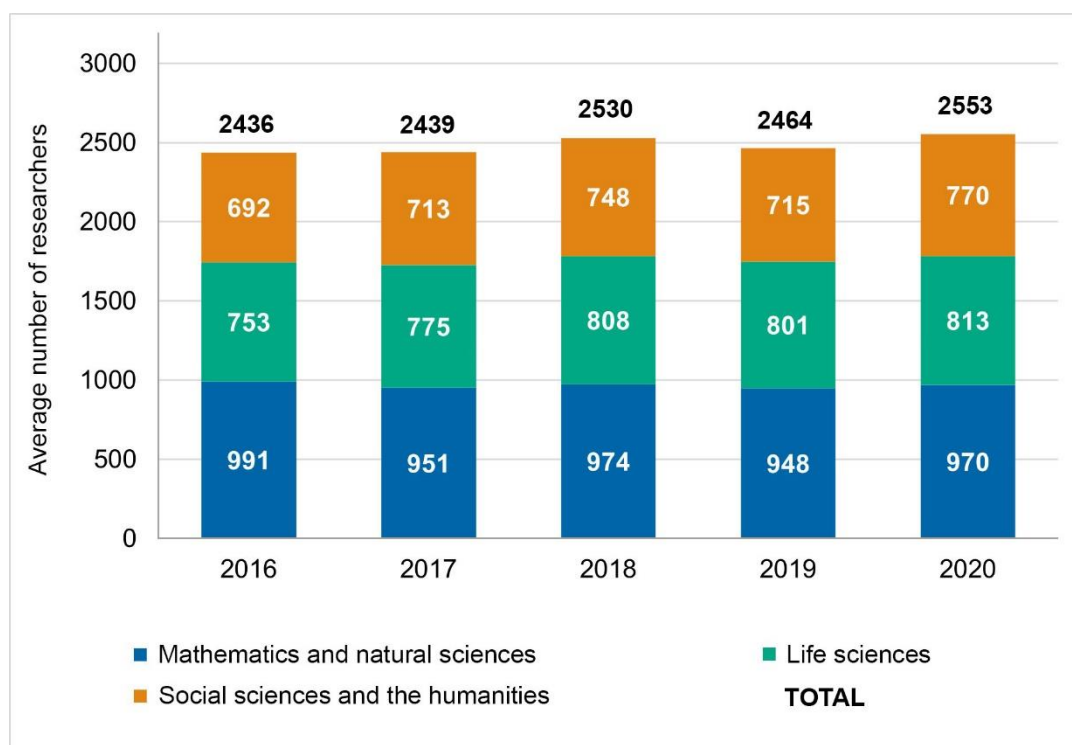


Figure 1: Changes in the average number of researchers during the period 2016-2020, both in total and separately in the three scientific areas  
(Source: data from the Hungarian Academy of Sciences (MTA) and the ELKH Secretariat)

In 2019 and 2020, the ratio of researchers to non-researchers did not change at most of the institutions (Figure 2). The average number of non-researchers includes those employed in the operation and maintenance of the research site and those working in administrative positions. It also includes professionals who greatly assist the researchers' work, such as laboratory assistants, agricultural technicians, and engineers. **At those institutions where the research involves more equipment and higher costs, the ratio of support staff to research employees is also higher.** The reason for this is the greater demand for human resources required to operate and maintain the equipment used for the research. While in the humanities and social sciences the percentage of non-researchers is on average between 22% and 29%, in the life sciences this proportion ranges from 47% to 49% on average. In the case of mathematics and natural science research centers, the average proportion of non-researchers is between 40% and 41%. In this latter category, the ratio is reduced by the Alfréd Rényi Institute of Mathematics (Rényi Institute), since in the field of mathematics, as in the humanities and social sciences, a smaller number of research support staff are required due to the reduced need for physical equipment. The increase in the number of researchers is most striking in the case of the Research Institute for Linguistics (NYTI).

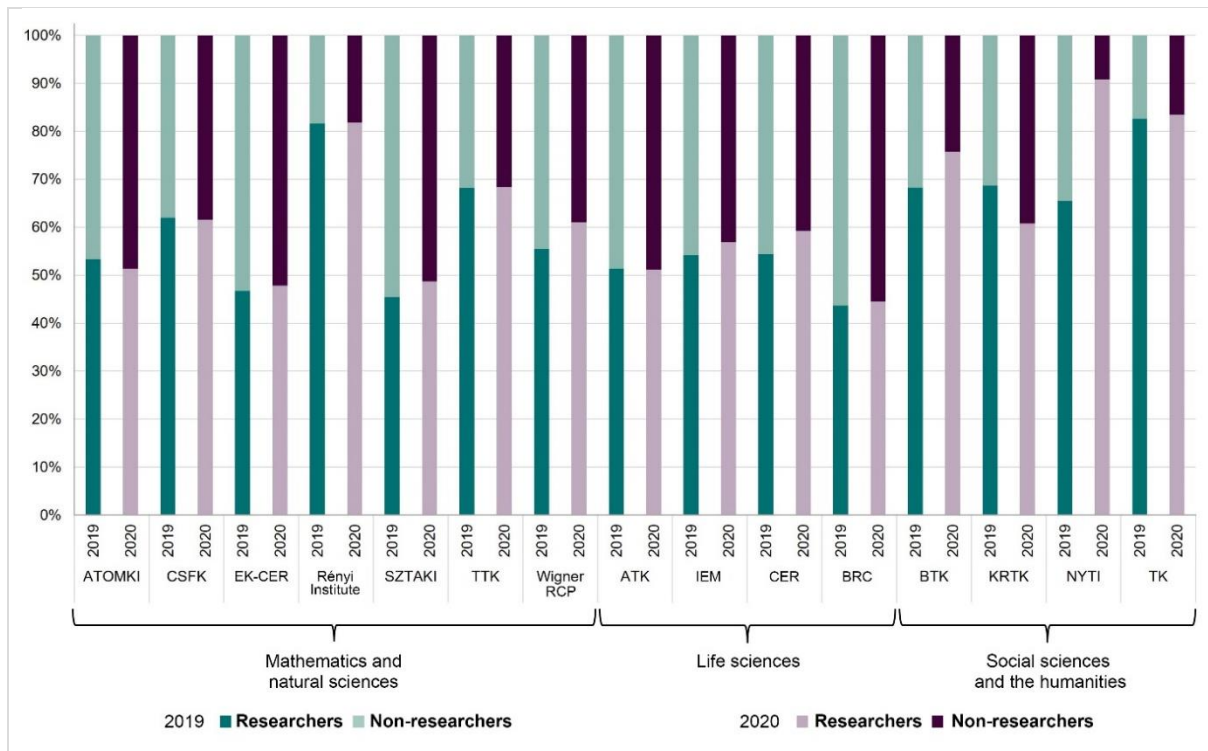


Figure 2: Breakdown by institution of the average number of researchers and non-researchers at research centers and independent research institutes in 2019 and 2020  
(Source: data provided by the ELKH Secretariat)

Figure 3 shows the gender distribution of the average number of researchers in the three main scientific areas during the reporting period. The proportion of female researchers employed at ELKH institutions rose from 35.8% in 2019 to 36.6% in 2020. The average overall increase in the proportion of female researchers at both life sciences research centers and humanities and social sciences research centers was approximately 1-2% on average (life sciences: 2019: 42.8%, 2020: 44%; humanities and social sciences: 2019: 42.9%, 2020: 44.7%). The proportion of women in the fields of mathematics and natural sciences remained unchanged during this period.

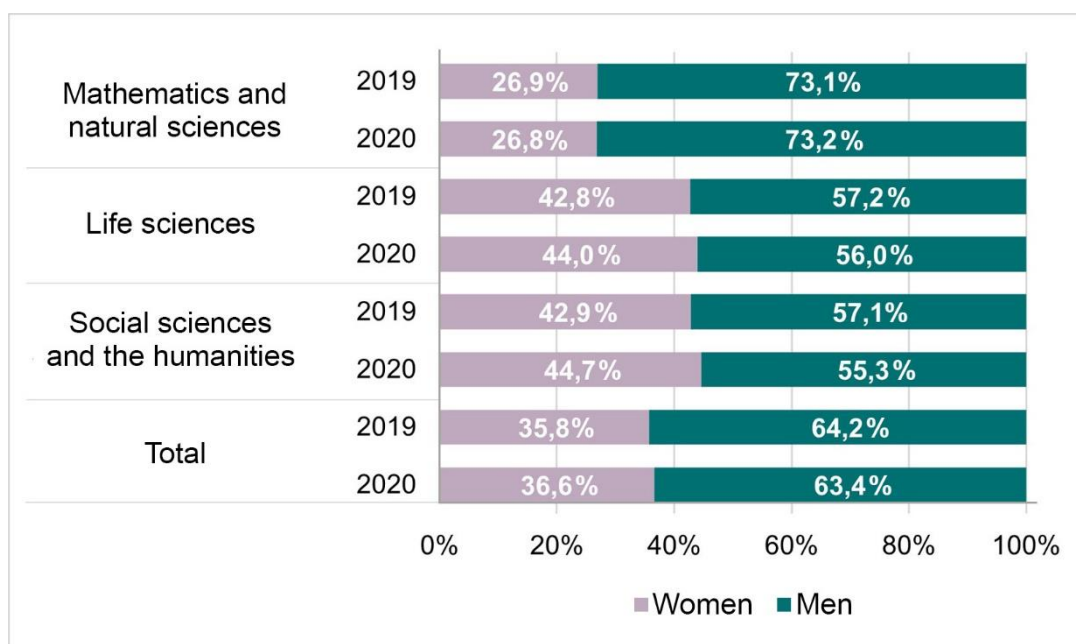


Figure 3: Breakdown by research area of the average number of researchers by gender in 2019 and 2020  
(Source: data from the ELKH Secretariat)

With regard to the breakdown by age group, the proportion of young researchers at the beginning of their careers (30-34 years old) in 2020 was the highest in the area of life sciences (23.8%), followed by mathematics and natural sciences (19.1%), with those in the area of the humanities and social sciences at the lowest level (15.4%). Figure 4 shows the changes in the age distribution of researchers by research area for the first full year of the ELKH's existence. It can also be seen from the data that, in the age group between 30 and 39, the 'brain drain' effect of the economy and of foreign and other Hungarian research centers is most evident in the areas of life sciences and mathematics and natural sciences. In the case of these two areas, the age distribution shows a perceptible decrease up to the age of 39, while in the area of the humanities and social sciences there is no decrease, but rather an increase in the number of people up to the age limit examined. **This data also supports the great need to attract and retain young researchers, something that cannot be achieved without offering competitive pay.**



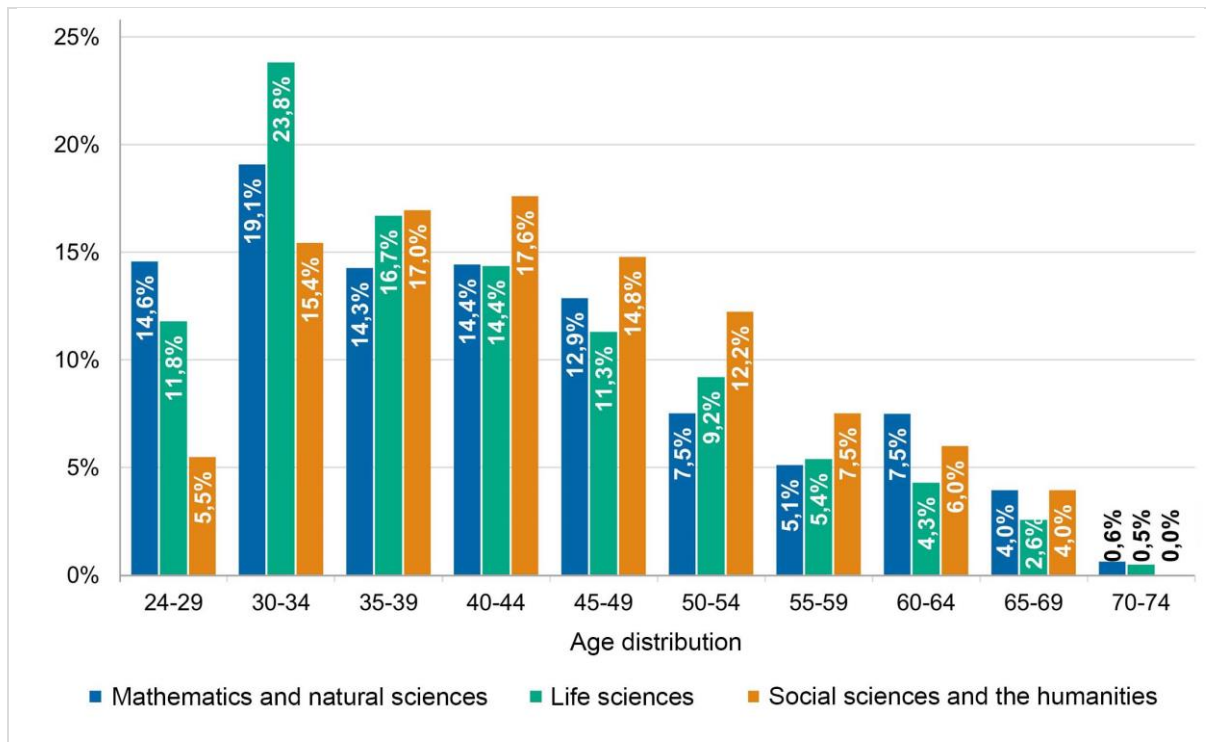


Figure 4: Age distribution of researchers by discipline in 2020  
(Source: data provided by the ELKH Secretariat)

Figure 5 shows the **composition of the average number of researchers** for the years 2019-2020 by breaking them down by their status as **public research employees**<sup>2</sup>, which is a function of the researchers' ages and reflects the results of their increased experience. For the year 2019, one can see that the proportion of scientific assistants at the beginning of their research careers is the highest at NYTI, at more than 40%, followed by the Centre for Agricultural Research (ATK), the Centre for Ecological Research (CER) and the Research Centre for Natural Sciences (TTK), as well as the Research Centre for Astronomy and Earth Sciences (CSFK) and the Institute of Experimental Medicine (IEM), with approximately 30% each. For the year 2020, it is also NYTI with the highest proportion of young researchers starting their careers, about 38%, followed by ATK, IEM, and the Institute for Computer Science and Control (SZTAKI).

For the two years under review, the proportion of senior scientific associates who carry out independent research work or lead research groups was highest at ATK and the Research Centre for the Humanities (BTK) (2019: 38%; 2020: 40%), ahead of the Centre for Energy Research (EK-CER), the Institute for Nuclear Research (ATOMKI), the Wigner Research Centre for Physics (Wigner RCP) and the Centre for Economic and Regional Studies (KRTK).

During the reporting period, the combined ratio of scientific advisors and research professors setting directions for research is the highest at the Rényi Institute, at nearly 30%. Next are Wigner RCP and ATOMKI, where the proportion of such researchers is nearly 20%.

**Overall, one can see that the breakdown according to researcher positions did not change significantly from 2019 to 2020.**

<sup>2</sup> Since January 1, 2021, it has been required to apply the provisions of Act I of 2012 on the Labor Code to the legal relationship of everyone employed at research sites belonging to the ELKH.

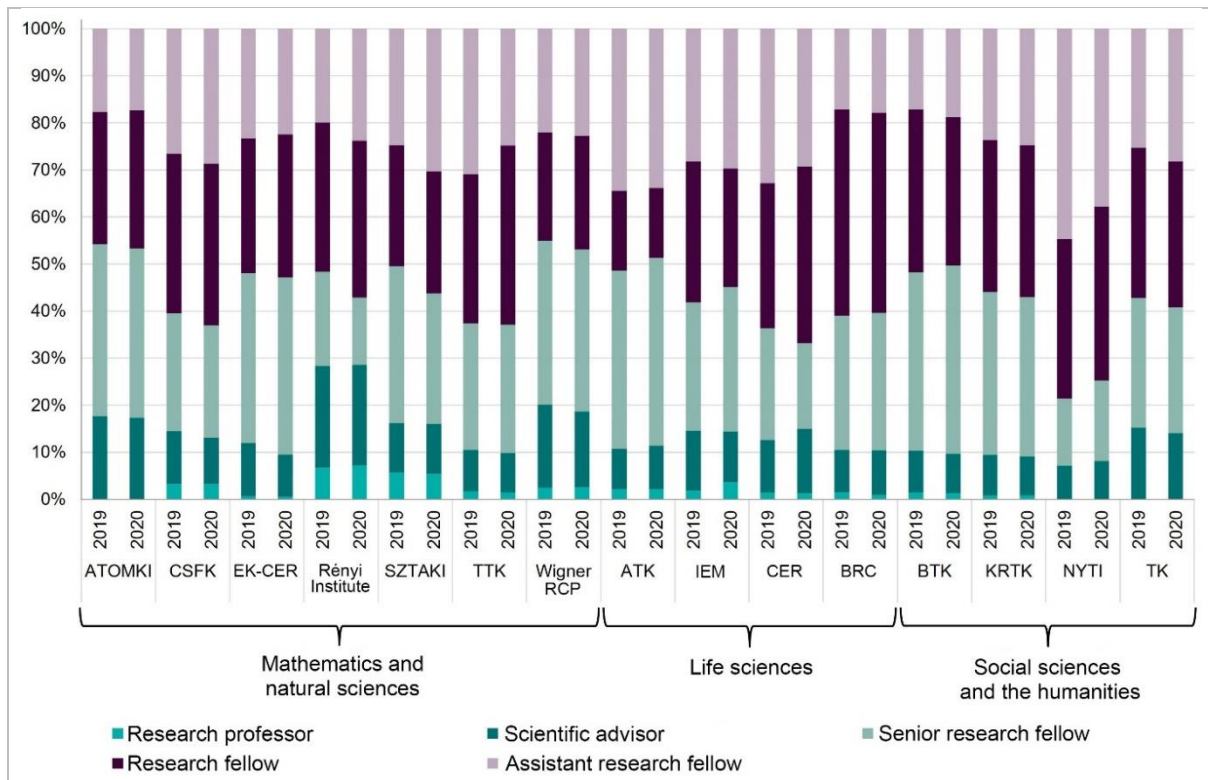


Figure 5: Research centers and independent research institutes in 2019-2020. Breakdown of the average number of researchers per year (Source: data provided by the ELKH Secretariat)

The number of researchers who obtained a PhD degree (Figure 6) increased by a total of 16% in the period between 2016 and 2020 (from 118 in 2016 to 137 in 2020), including an increase of 4.5% from 2019 to 2020. The number of researchers who obtained PhDs during the reporting period was the highest in the field of life sciences, followed by the fields of mathematics and natural sciences, and then by the humanities and social sciences.

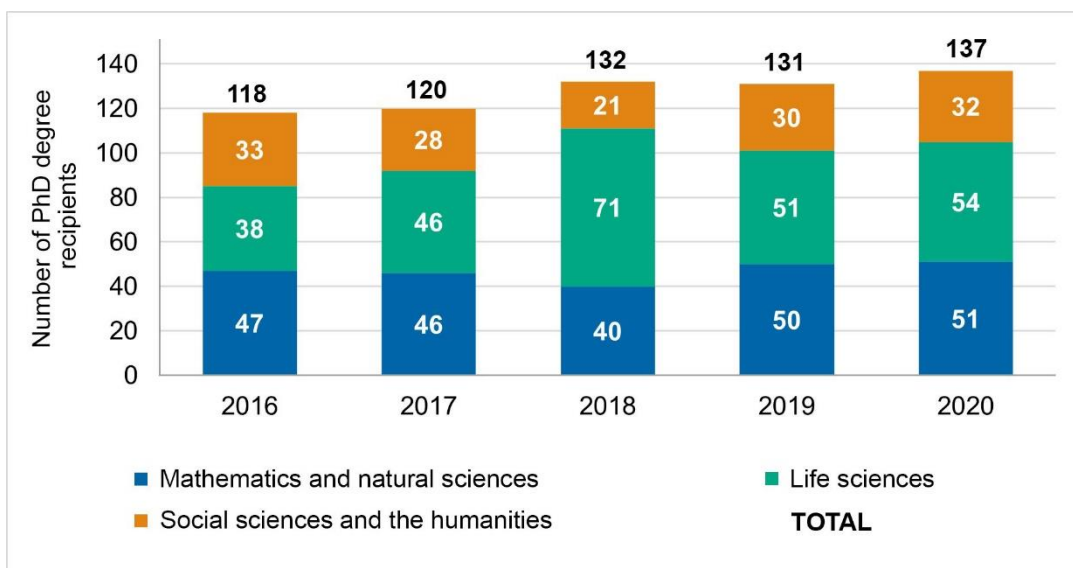


Figure 6: The number of researchers at research centers and independent research institutes who obtained PhD degrees each year between 2016-2020 by discipline (Source: data provided by MTA and the ELKH Secretariat)

### 2.1.2. Scientometric indicators for ELKH research centers and independent research institutes

Based on the usual five-year time interval for scientometric evaluations, one can see that, between 2016 and 2020, **the total number of scientific publications produced by the research network** (Figure 7) **increased slightly** (from 5,226 in 2016 to 5,416 in 2020). **Over the five years, this increase was 18.3% in the life sciences research centers and 15.9% in the area of humanities and social sciences.** However, in the area of mathematics and natural sciences, about 14.1% fewer publications were published during this period. The reason for this can be explained by the two-year technical shutdown of the Large Hadron Collider (LHC) operated by CERN (Conseil Européen pour la Recherche Nucléaire). In December 2018, it was announced that the world’s largest particle accelerator would be upgraded and undergo nearly two years of maintenance.<sup>3</sup>

The total number of scientific publications for 2019 was 5,478, and in 2020, it was 5,416, which is an insignificant difference of only about one percent.

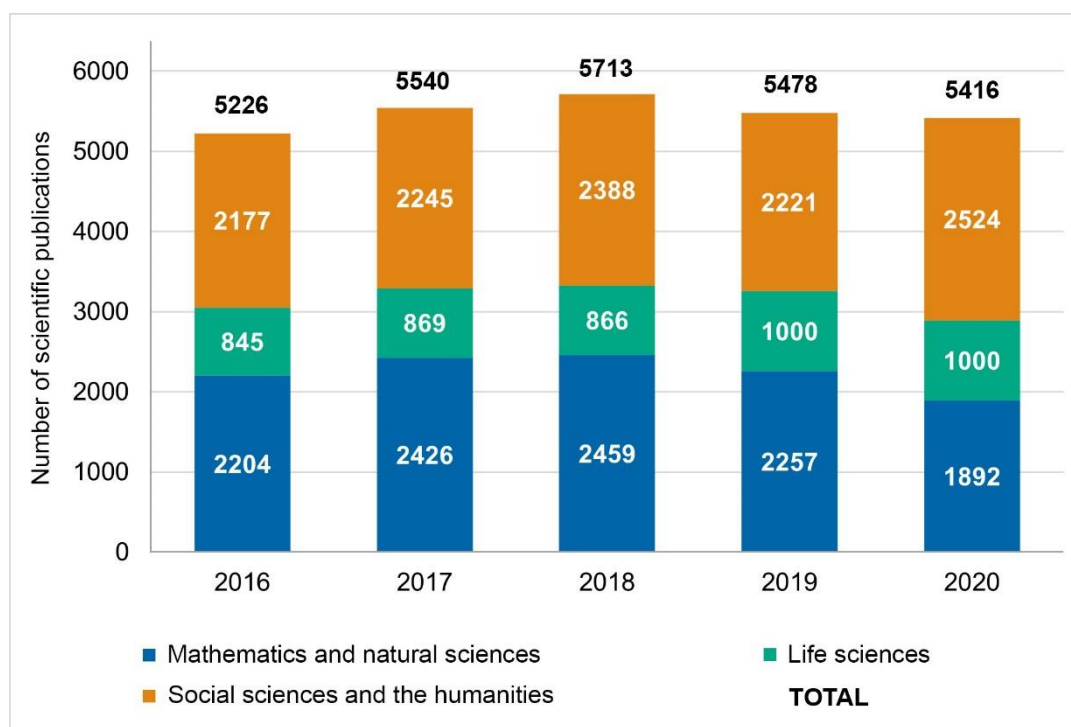


Figure 7: Total number of scientific publications produced by ELKH research centers and independent research institutions between 2016-2020 by area and in total (Source: data provided by MTMT)<sup>4</sup>

One of the main criteria for the classification of scientific publications is the quality of the journal in which they appear. In the case of scientific journals, one of the measures of this is the impact factor, showing the number of times the publication is expected to be included in citations. The current impact factor of a journal is the average number of citations generated in the current year for articles published in the given journal over the previous two years. The impact factor of each journal is published every year in the Journal Citation Reports (JCR) database. In terms of the quality of the journals, the Q and D classifications, which better reflect the ranking of the journals within their field, are now increasingly gaining in importance. Figure 8 **shows the change in the number of articles published in journals with an impact factor** between 2016 and 2020, which clearly reflects the typical differences between the scientific fields. The number of publications published in journals with

<sup>3</sup> CERN’s Large Hadron Collider was restarted in November 2021.

<sup>4</sup> The data was provided in April 2021.

an impact factor (Web of Science database) is the most significant and decisive in the area of mathematics and natural sciences, followed by life sciences, and finally by the humanities and social sciences. **In the area of life sciences, the number of publications appearing in impact-factor journals increased significantly during the examined period** (from 631 in 2016 to 823 in 2020). As a result of the scientific trend, a growth process has also started in the area of the humanities and social sciences: although the number of publications appearing in journals with an impact factor has increased (from 132 in 2016 to 189 in 2020), these types of publications are still not typical for this area of science, and in and of themselves do not demonstrate achievement in the scientific area. The number of publications with an impact factor in the area of mathematics and the natural sciences has dropped considerably, which may be due to the aforementioned technical shutdown of CERN's large hadron collider.

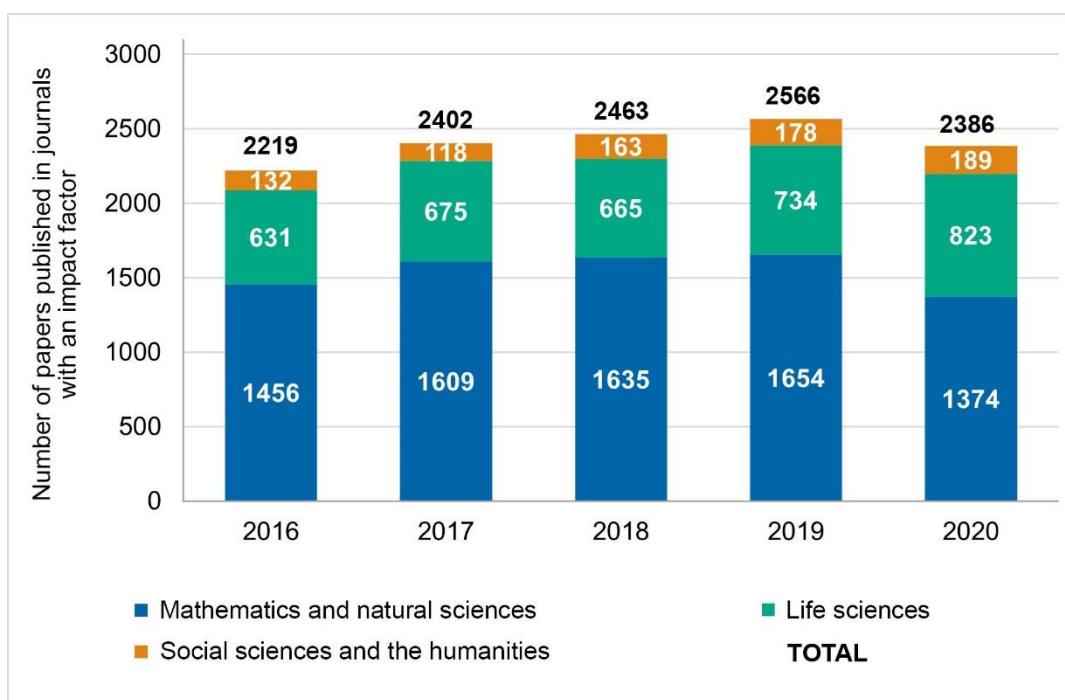


Figure 8: The number of papers published by ELKH research centers and independent research institutes in journals with an impact factor between 2016 and 2020 by discipline and in total  
(Source: data provided by MTMT)<sup>5</sup>

Scientometric performance is also defined by the Q (quartile) value, which indicates the quality of the journals publishing the papers. Q1 refers to publications appearing in the most cited quartile of scientific journals, Q2 to those appearing in the second quartile, Q3 to those appearing in the third quartile, and Q4 to those appearing in the fourth quartile. Quality publications with large readerships usually fall into the Q1 and Q2 categories. Figure 9 shows the proportion of articles published in journals classified into Q categories by the research centers and independent research institutes belonging to ELKH for the year 2020, broken down by scientific area. **According to the data, the proportion of articles published in journals classified as Q1 is the highest for ELKH research centers conducting research in mathematics and natural science research, at 74.7%, followed by the life sciences (67.9%), and the humanities and social sciences (46.5%).** The share of papers published in Q2 journals is the largest in the areas of the humanities and social sciences (27.1%), followed by life sciences (24.4%), and then by mathematics and natural sciences (15.0%). The figure also reflects the unique features of the scientific field: publishing in a foreign language in a qualified journal is a more

<sup>5</sup> The data was provided in April 2021.

typical means for communicating the results of researchers working in the areas of life sciences, mathematics and natural sciences.

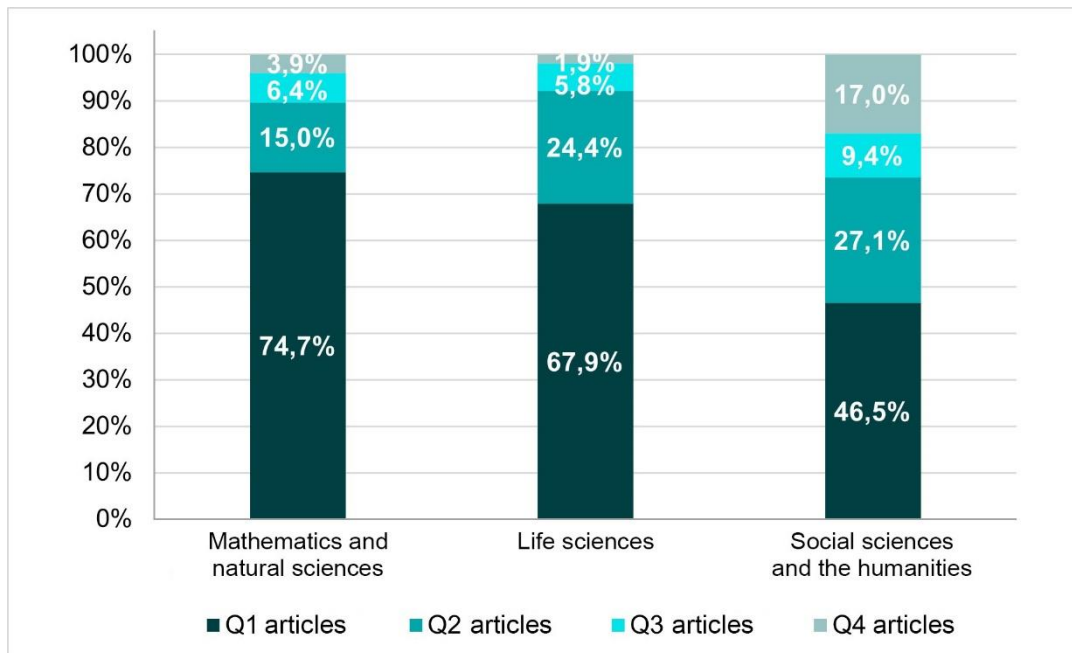


Figure 9: Distribution of the quality publications of ELKH research centers and independent research institutes by scientific area for the year 2020 (Q1: publications in journals belonging to the most cited first quartile, Q2: second quartile, Q3: third quartile, Q4: fourth quartile)  
(Source: data provided by MTMT – SCImago Journal Rank (SJR)<sup>6</sup>)

Figure 10 shows the qualitatively classified (Q1-Q4) publications from ELKH research sites, broken down by main research areas. The figure was created on the basis of the Web of Science database, the classification of scientific areas of which follows the recommendations of the Frascati Manual issued by the Organization for Economic Cooperation and Development (OECD).

**An examination of the reporting period shows that the share of papers published in Q1 journals increased slightly in almost all research areas.**

<sup>6</sup> The data was provided in December 2021.

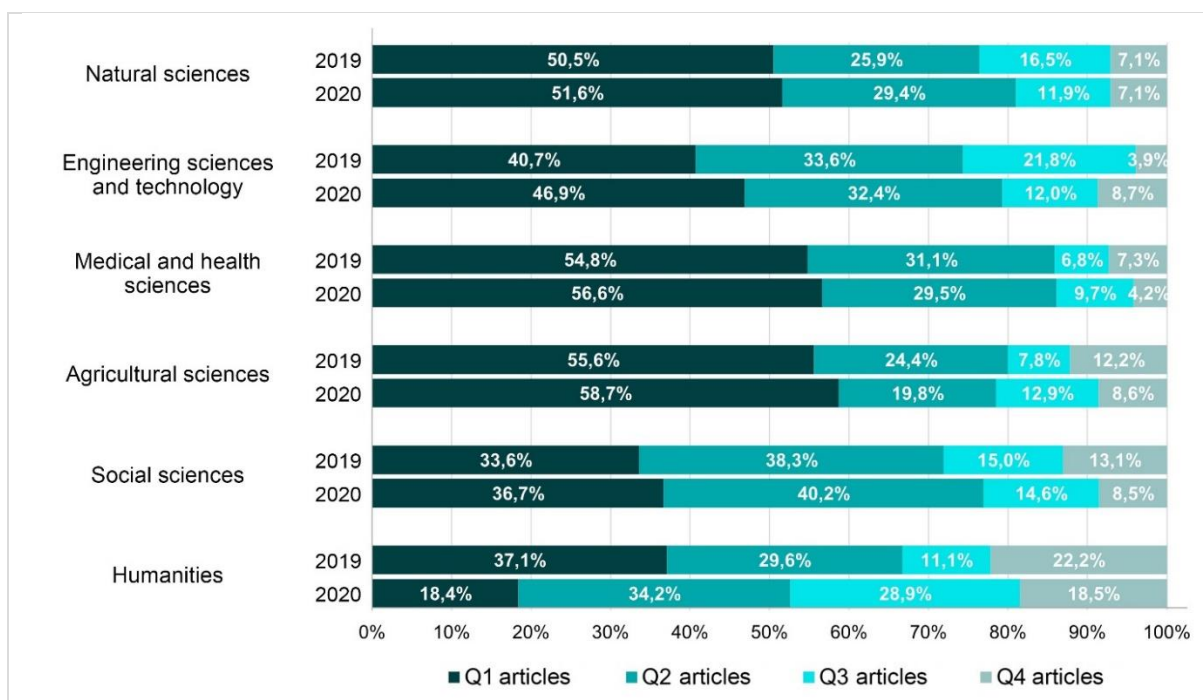


Figure 10: The proportion of articles published in Q-classified journals for the years 2019 and 2020, broken down into research areas, based on the quality papers published by research centers and independent research institutes.

(Source: Web of Science database, InCites Benchmarking & Analytics)<sup>7</sup>

**In terms of the type of papers published during the reporting period** (Figure 11), for research centers engaged in mathematics, natural sciences and life sciences, the bulk (70-90%) of the papers were published in scientific journals. In addition, the proportion of conference abstracts is a significant one in the case of SZTAKI, which is a feature of how results in computer technology, software development, and research and development are disseminated. In the area of the humanities and social sciences, in the cases of BTK, the Centre for Social Sciences (TK), KRTK and NYTI, the number of books, book chapters and monographs is almost the same as the number of publications published in scientific journals. In 2019, NYTI and BTK released the greatest number of informational and educational publications. In 2020, it was NYTI and ATK that released the most.

<sup>7</sup> The query was made in December 2021.

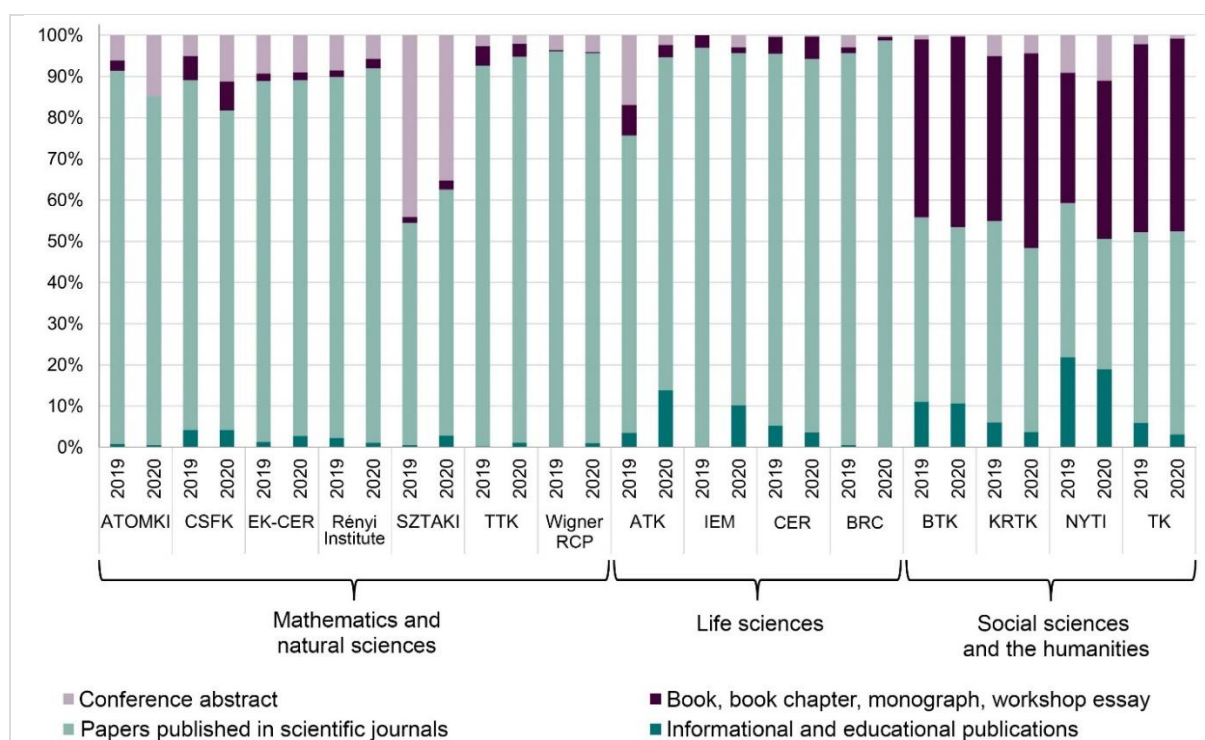


Figure 11: Distribution of different types of publications by institutions in 2019 and 2020  
(Source: data provided by MTMT)<sup>8</sup>

## Summary

- In summary of the changes in staffing data, it can be concluded that the average number of researchers in ELKH research centers and independent research institutes increased by 3.6% in the period 2019-2020, meaning that the transformation of the research network was accompanied by an increase in the average number of researchers.
- The ratio of the average numbers of researchers to non-researchers can be seen to have remained unchanged at most of the institutions during the reporting period. Furthermore, the proportion of female researchers employed at ELKH research sites increased slightly from 2019 to 2020.
- In 2020, the proportion of young researchers (ages 30-34) was greatest in the area of life sciences, followed by the area of mathematics and natural sciences, and then by the humanities and social sciences. It can also be seen from the age distribution that in the age group between 30 and 39, the 'brain drain' effect of the economy and foreign and other Hungarian research centers is most evident in the areas of life sciences and mathematics and natural sciences, while in the areas of the humanities and social sciences, we can observe an increase in staff numbers up to the age of 45. This data also supports the great need to attract and retain young researchers, an effort that can be substantially aided by the provision of competitive salaries. The breakdown of the average number of researchers by public research employee classification (scientific assistant, scientific associate, senior scientific associate, scientific advisor and research professor) does not show any significant changes between 2019 and 2020.
- The number of researchers obtaining PhD degrees increased by 4.5% from 2019 to 2020.
- In 2020, despite the technical shutdown of CERN's Large Hadron Collider, the number of all scientific publications decreased by only 1% compared to the previous year. Over the course of the five-year period between 2016 and 2020), there is a slight increase in the number of publications. From 2019 to 2020, the number of papers published in journals with an impact factor increased in

<sup>8</sup> The data was provided in April 2021.

the areas of life sciences and the humanities and social sciences, and decreased in the case of mathematics and natural sciences. In 2020, the number of papers published by ELKH research sites in Q1 quality-classified journals was highest in research sites engaged in mathematics and natural sciences, followed by those working in life sciences, then by those in the humanities and social sciences.

- Breaking down the papers published in Q1 journals into research topics and grouping them (based on the Frascati Manual) and examining the data from the reporting period, we can conclude that the proportion of such papers – with the exception of one research area – increased across all major scientific areas. The data grouping the publications according to how they are disseminated reveals that the bulk of publications released on research in the areas of mathematics, natural sciences, and life sciences are published in scientific journals, while in the case of the humanities and social sciences, the proportion published as books, book chapters, and monographs is greater.

### 2.1.3. Data on the supported research groups

In 2019, **the average number of researchers** in the supported research groups was 608, growing to 611 in 2020, which works out to an increase of 0.5%. The greatest number of researchers work in the area of mathematics and natural sciences, followed by life sciences, and then by the humanities and social sciences. This is in line with the number of research groups, as in 2020 there were 38 supported research groups in the area of mathematics and natural sciences, 35 in the life sciences, and 29 in the humanities and social sciences.

The **number of scientific publications** issued by the supported research groups in 2020 was 1,875 (Figure 12). This represents an increase of 4.5% compared to the previous year. While the number of publications increased in the area of humanities and social sciences, as well as in that of mathematics and natural sciences, it decreased in the area of life sciences.

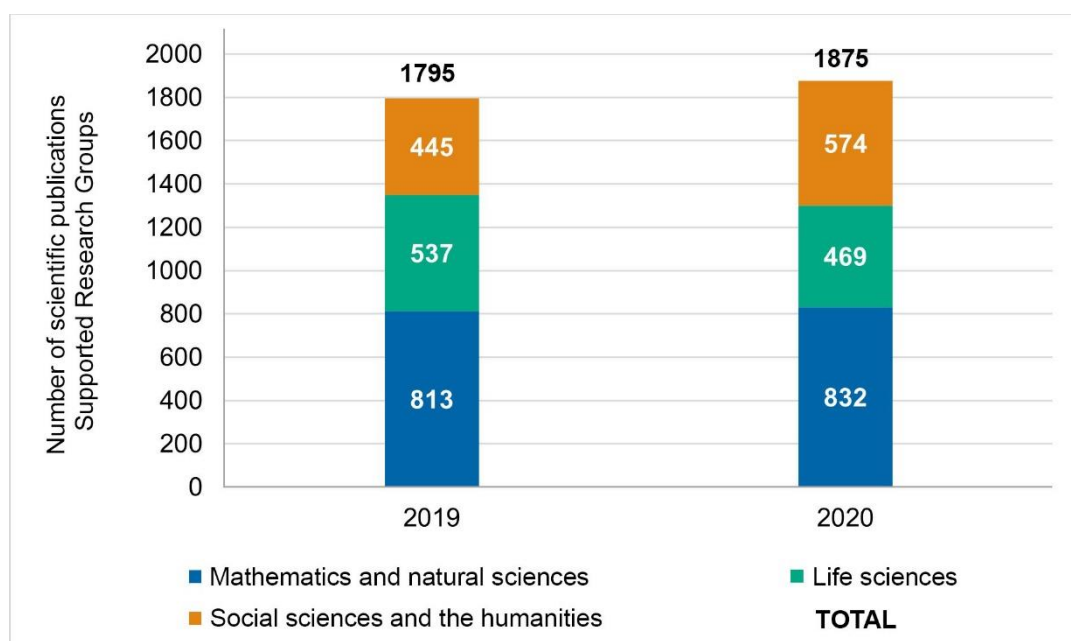


Figure 12: Number of scientific publications issued by the supported research groups in 2019 and 2020 by discipline

(Source: data provided by MTMT)<sup>9</sup>

<sup>9</sup> The data was provided in April 2021.



In 2020, the proportion of papers published in Q1 journals by the supported research groups was highest in the area of life sciences, followed by mathematics and natural sciences, then by the humanities and social sciences (Figure 13). The proportion of papers published in journals rated Q2 was greatest in the area of mathematics and natural sciences.

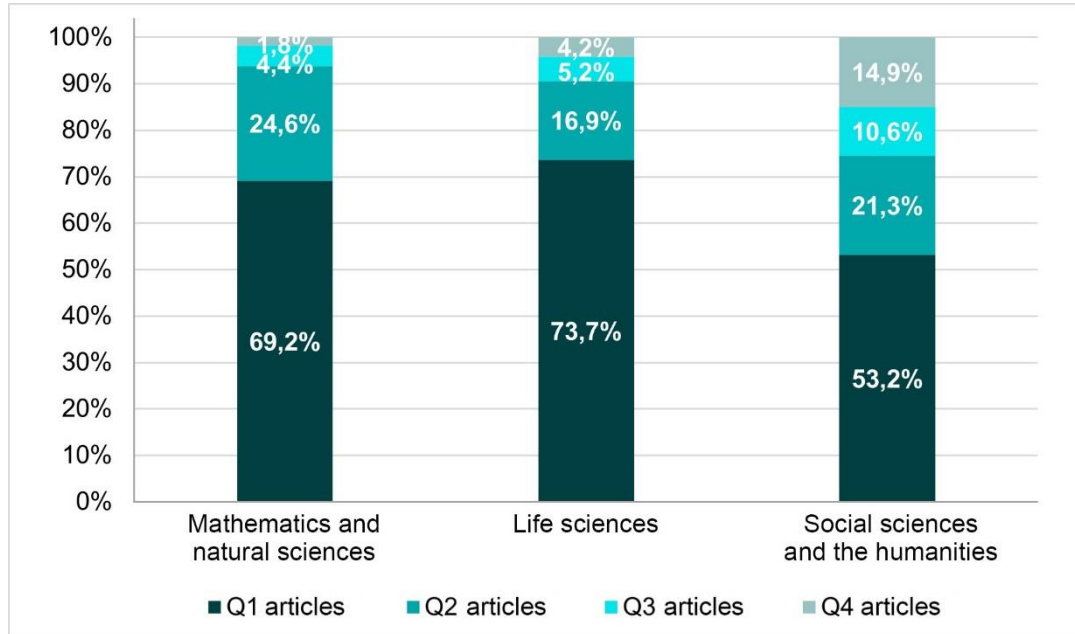


Figure 13: Distribution between the Q1-Q4 quartiles of the scientific publications issued by the supported research groups, broken down by discipline in 2020  
(Source: data provided by MTMT – SCImago Journal Rank (SJR))<sup>10</sup>

In summary, we can state that the average number of researchers employed by the supported research groups remained practically unchanged. In 2020, the number of scientific publications increased. In accordance with the standard methods of publishing research results employed in each of the scientific areas, the proportion of Q1 articles was the highest for the research groups engaged in life sciences, mathematics and natural sciences.

<sup>10</sup> The data was provided in December 2021.

### 3. STRATEGIC OBJECTIVE OF ELKH

In autumn 2020, the Governing Board of the ELKH Secretariat adopted two documents, *the ELKH Strategic Objectives* and the *Eötvös Loránd Research Network's Operating Principles*. The Strategic Objectives set out the key scientific and core value systems, while the Operational Principles describe the organizational, operational and management requirements. The updated document is available on the [ELKH website](#).

The ELKH Secretariat aims to connect the network's research as much as possible to the **world of international research partnerships**. This is primarily achieved by establishing international research agreements and joining international scientific organizations. The task of the ELKH Secretariat is to **measure and evaluate the performance and effectiveness of the research sites**, and to establish performance-centric operations. The Secretariat will therefore develop a system of performance evaluation and incentives that takes into account the specificities of science metrics and research activities. It also provides periodically monitored information in the process of measuring the scientific performance of research sites. The system of institutional and individual performance measurement is based on a common set of principles, but with practices that take into account the specificities of each research site.<sup>11</sup> The performance measurement methodology should also be suitable for international comparisons.

The Research Strategy of ELKH has been developed for a period of five years and adopted by the Governing Board on the basis of proposals from the research sites, with the involvement of the Scientific Council and the International Advisory Board, and taking into account the policy strategies and the specificities of the research sites.

The document entitled "*Operational Principles of the Eötvös Loránd Research Network*" defines the competences and responsibilities within the organization of the ELKH and the uniform processes at the network level, and provides a framework for the establishment of detailed institutional regulations, based on Section 42/C (3) 2) of Act LXXVI of 2014 on Scientific Research, Development and Innovation. It also defines the role of each department in the different decision-making processes, the procedures for the creation, restructuring and termination of research sites, the publication of the basic documents of research sites, the appointment of managers, the way strategy is adopted, the monitoring of the governing body, the management, measurement and evaluation of performance, the ELKH Innovation System, and communication within the organization.

The strategic objectives and operational principles approved in 2020 will provide the basis for the functioning of the ELKH and for drafting additional, more detailed strategic materials.

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<sup>11</sup> The individual performance measurement system has been developed in 2021, while the institutional performance assessment system will be developed at a later stage.

## 4. ELKH'S THREE-PILLAR FUNDING MODEL AND THE DEVELOPMENT OF A PERFORMANCE EVALUATION SYSTEM

### 4.1. The funding system of the Eötvös Loránd Research Network and its restructuring

The establishment of the ELKH research network has created the opportunity to transform the funding structure of its institutions. In relation to the resources provided to the research network by the governing body during the reporting period, the fact that the Government provided HUF 11 billion in additional funding to the research network in July 2020 can be considered a significant step.<sup>12</sup>

The buildings and equipment used to house the budgetary bodies under the supervision of the ELKH Secretariat continued to be in the ownership of the Hungarian Academy of Sciences (HAS) (and will remain its property during the reporting period). Thanks to the agreement between the ELKH Secretariat and the HAS, the operation and maintenance of the research infrastructure remained uninterrupted through the implementation of small-scale real estate investments in and amendments to the research network. Government Decision 1430/2020 (VII. 23.) on the provision of the necessary resources for the financing of the research sites of the Eötvös Loránd Research Network on a pro rata basis provides for the planned investments on Academy-owned real estates totaling HUF 36.5 billion.

#### 4.1.1. The budget of the ELKH heading in 2019 and 2020

In 2019, the ELKH heading had a total budget of HUF 93.1 billion, of which only 15 percent (HUF 14.3 billion) was direct budgetary support, because this year, unusually, the majority of the governing body's support came from the Ministry of Technology and Industry as revenue. In 2020, 44 percent (HUF 45 billion) of the total resources of HUF 101.7 billion were direct budgetary support.

#### 4.1.2. Utilization of the 2019 and 2020 headings of the ELKH research sites

2019 was a transition year, but the Governing Board still had the opportunity to decide on **supporting infrastructure improvements** totaling HUF 758.8 million. The remaining HUF 545 million from the support for infrastructure development and centrally managed renovations was used by ELKH to finance the tender announced and decided by the Hungarian Academy of Sciences in 2018. In 2019, the funds allocated for infrastructure development enabled the improvement of infrastructure conditions for research at the institutions of the research network and the necessary renovation of buildings. The infrastructure needs supported included acquisitions, improvements, and renovations (e.g. automated isolation and library technology, induced coupling plasma analysis equipment, flow cytometer).

In 2020, the **basic funding** for research sites and independent research institutes compared to previous years was increased by HUF 1.5 billion from the beginning of the year, increasing each institutions' resources by HUF 100 million. The year 2020 started with base-rate funding, while the internal tendering system was restructured.

In 2019, prior to the transfer to the newly created budget heading and in addition to the core grant, an internal allocation system was in place for EU grant co-financing and preparation, conference participation, conference organization, young researcher posts, infrastructure investments, and internal calls for proposals. In 2020, the ELKH Secretariat allocated targeted grants for infrastructure support and young researcher posts based on the decision of the Governing Board. In the same year, the ELKH

<sup>12</sup> The measure was adopted by Government Decision No. 1397/2020 (VII. 14) on the modification of the headings of the central budget, transfers of appropriations between and within headings from the appropriations for economic protection programs, the Central Reserve Settlement Fund, the reserve for extraordinary government measures and the modification of certain Government Decisions.

Secretariat allocated HUF 1.02 billion from the appropriation of HUF 1.9 billion for Infrastructure Development and Centrally Managed Renovations to expand the cloud computing capacity of ELKH, which was the largest infrastructure investment decision in 2020.

Following a decision by the Governing Board, the ELKH Secretariat allocated a total of HUF 1.7 billion for the development of research infrastructure to ensure the conditions for outstanding scientific activity from the remaining balance of the budget (HUF 880 million) and from the additional resources received by the network (HUF 875.3 million).

The Government agreed on the need to introduce a system of pro rata resource allocation to replace base-rate funding, taking into account research performance, and provided additional resources for the operation of the network in the second half of the year. Based on Government Decision 1397/2020 (VII. 14.), HUF 11 billion was reallocated to support the research network, which, due to its ongoing integration, will amount to HUF 22 billion per year in the coming years.

Funding based on research performance was first implemented in the 2020 allocation of the 2021 budgetary support. Based on the decision of the Governing Board, the HUF 11 billion additional resources for 2020 were allocated by the ELKH Secretariat to the non-recurrent tasks listed in Figure 14.

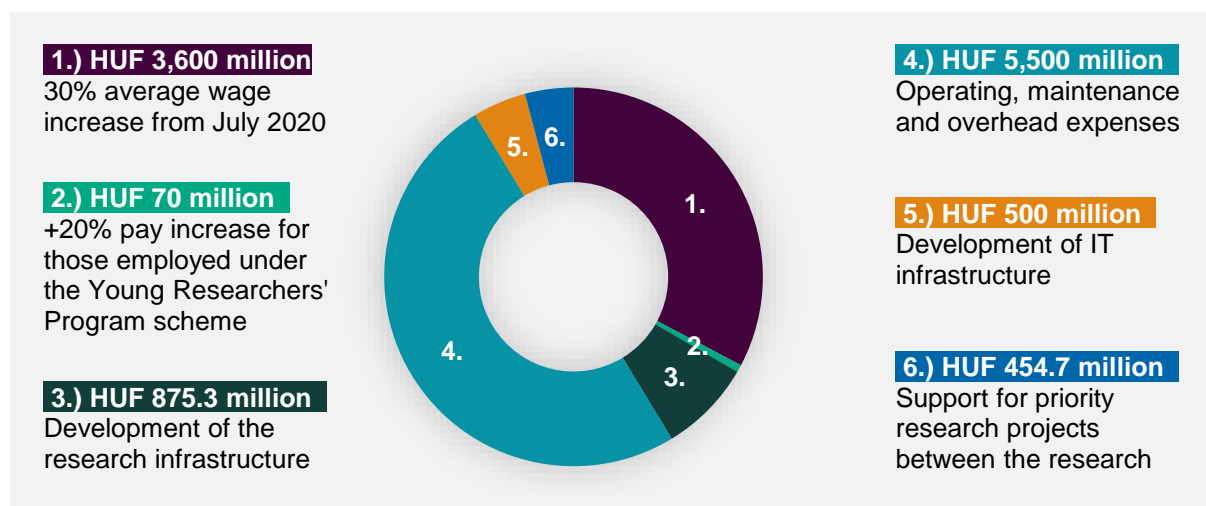


Figure 14: Use of the additional resources of HUF 11 billion in 2020  
(Source: data provided by the ELKH Secretariat)

This additional mid-year funding allowed the launch of a long-awaited new compensation system for researchers and other staff of ELKH, as well as a one-off assistance for the network of institutions facing an operating subsidy deficit.

At its meeting on October 6, 2020, the Governing Board decided to significantly increase the salary pool for the staff of the ELKH institutions being employed as of February 1, 2020. Thanks to this decision, which has retroactive effect until July 1, 2020, researchers' salaries increased by an average of 30%. The degree of salary increase was determined by the heads of the institutions on a differentiated basis at the research sites.

#### 4.1.3. Performance-based resource allocation

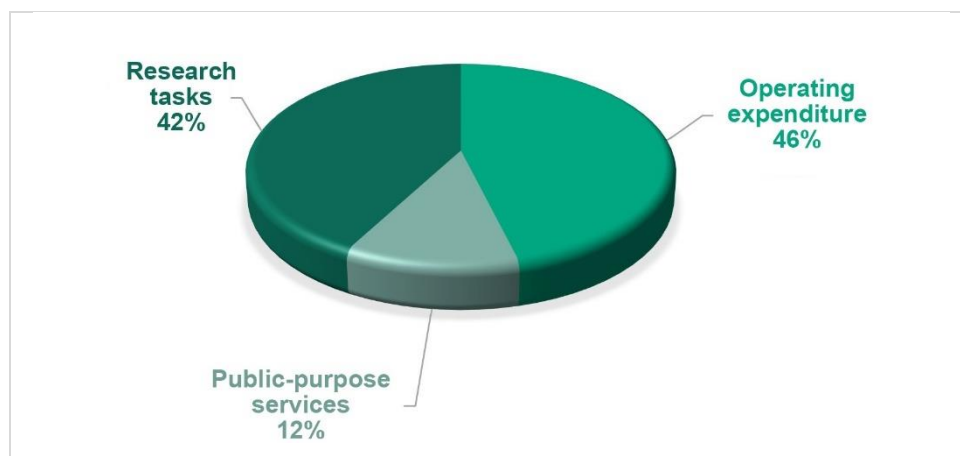
Government Decision 1430/2020 (VII. 23.) on the provision of the necessary resources for the pro rata funding of the research sites of ELKH also states that the Government agrees with the institutional strategic guidelines presented by the Eötvös Loránd Research Network and the need to introduce a pro rata resource allocation system for the research sites, which takes into account research performance

and replaces the base-rate funding. **The 2021 resources were determined in 2020 on the basis of this approach, in a new three-tier funding model.** The outdated, underfunded basic funding system was thus replaced by a predictable, dynamic allocation of resources that allows for the launch of a new compensation system for researchers.

The performance and task-based funding scheme aims to encourage research institutions to

- carry out excellent research work that is highly recognized internationally
- employ as many qualified researchers as possible in order to create effective scientific workshops
- improve the network's international tender application performance

The new multi-pillar research funding scheme, which also takes into account scientific performance, consisted of the parts shown in Figure 15 in the ELKH budget for 2021 and was approved in 2020. The allocation of institutional resources was divided into three tasks: operational, public service and research. Operational expenditure and public services are specific in nature and are funded on the basis of overhead costs incurred or on a task-by-task basis, while the funding of research tasks is calculated on the basis of quantitative and qualitative indicators linked to research effectiveness.



*Figure 15: Breakdown of 2021 budgetary resources between the pillars, as decided by the Governing Board on December 15, 2020 (Source: data provided by the ELKH Secretariat)*

Part of the budget is allocated to priority research themes. The Governing Board is responsible for selecting and supporting research that is relevant to the national economy. Of the topics proposed by researchers, the Governing Board supported the most promising new research funding requests.

#### 4.1.4. The resource allocation system

##### I. Operating expenditure

Decades of resource gaps have meant that the network of institutions has struggled to cover its operating expenditure, with a specific grant or other income being used for this rather than for research. Operating expenditure includes the full costs of running the buildings and the costs of non-research staff – legal, administrative, economic, and managerial jobs. The amount of support for the operating expenditure of research sites is determined on the basis of an assessment of the actual institutional expenditure incurred in previous years, which constitutes the first pillar of resource allocation.

## II. Public-purpose services

ELKH laboratories carry out a range of related (but not R&D) activities in addition to their core research activities. The second pillar of resource allocation supports public services separately from other research.

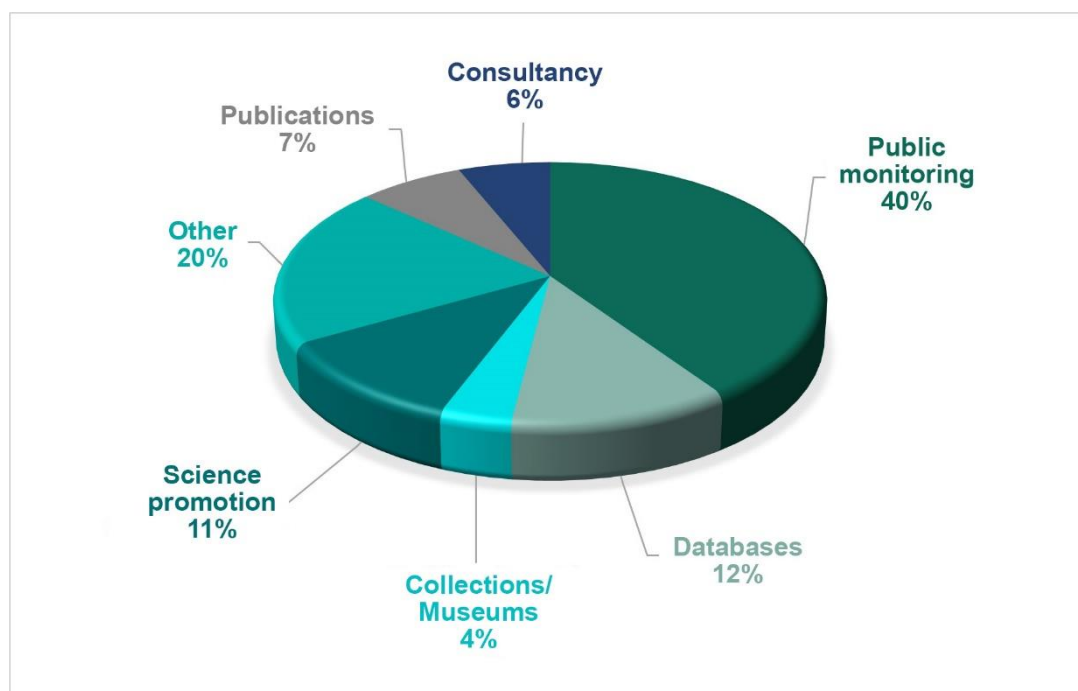


Figure 16: Breakdown of public services provided by ELKH research sites and independent research institutes based on 2020 funding  
(Source: data provided by the ELKH Secretariat)

## III. Research tasks

The third pillar provides the necessary resources for research. The ELKH Secretariat has developed indicators for the allocation of resources to research tasks on a performance basis. These are relevant to all disciplines and, as far as possible, eliminate inter-disciplinary variations. The allocation of resources for research tasks is based on the following criteria in line with the strategic objectives of the research network:

### a) Scientometric performance

The purpose of using this parameter is to encourage excellence in research and to recognize the recent achievements of research institutions. Scientometric indicators, used to measure scientific impact and quality, are more suited to reviewing larger units than assessing researchers individually. The scientific performance of an institution is properly characterized by the quality of its publications. This is shown, on the one hand, by the ranking of the journals publishing the papers by discipline, and on the other hand, by the quality of the publication as measured by the ranking of the references received.

### b) Number of people with an academic qualification (degree or title)

To encourage as many researchers as possible to reach the level required to obtain the title of Doctor of Science (DSc), the number of DSc title holders employed at research sites is a key factor in the allocation of resources. The combined figure weights the number of researchers with a DSc title twice as highly as the number of researchers with a PhD.

### c) International tender application performance

This criterion is intended to recognize the grant-winning performance of ELKH researchers in *Horizon 2020* and other prestigious international R&D&I programs, as well as the participation of ELKH researchers in these programs, thus encouraging future grant applications. In addition to the contribution of external sources to research funding, the increase in application activity and performance has also had a positive impact on the international visibility and recognition of the research network, and on closer cooperation. To this end, the ELKH Secretariat will support each research site in proportion to the total the grants awarded in the three years preceding the year concerned. Through effective application activity, research sites can add significant external funds to the network research funding, which is assessed under this criterion of resource allocation.

#### 4.1.5. Priority research topics

The Governing Board considers it a priority to support research that is relevant to the national economy. On the one hand, this means research relevant to the country and related to the thematic areas approved by the Governing Board, where utilization is the primary expectation. On the other hand, these are researcher-driven topics proposed by the institutions, from which the most promising research proposals are selected by the Governing Board. In 2020, HUF 1.8 billion was earmarked for this purpose in the 2021 budget.

## 4.2. The scientific performance incentive scheme of ELKH

In autumn 2020, the Governing Board adopted *the Eötvös Loránd Research Network Operating Principles*, the document which set out the scope and responsibilities for performance measurement and evaluation. Under the Policy, organizational and individual performance measurement schemes are linked and form the basis of the funding system. To ensure a performance-driven approach, the Governing Board has adopted a performance appraisal and incentive system that takes into account the specificities of the research activity.

Parts of the performance incentive scheme:

### 4.2.1. Performance-based resource allocation

Each institution strives to improve the values of the indicators used for resource allocation in order to maximize its resources. A transparent system of resource allocation is an appropriate and traceable incentive for the institutions.

### 4.2.2. Performance assessment within the institutions

In order to ensure the effective functioning of the research network, the ELKH Secretariat considers the motivation of research work as a priority, and has therefore studied the performance evaluation practices of the research sites. On this basis, it was found that each research site had a performance appraisal policy and a set of requirements for scientific ratings, which had been used to assess the individual performance of researchers in the past.

## Summary

One of the key achievements in 2020 is the transformation of the funding structure of the research network. The renewal of the internal tendering system began and was followed by a significant increase in budgetary resources, which allowed the development of research infrastructure, the increase of resources for research and the launch of the long-awaited compensation adjustment for researchers. Thanks to the latter, the salaries of the network's researchers and other staff increased by an average of 30%.

Instead of the previous static, base-rate funding system, the ELKH Secretariat has designed and implemented a new multi-pillar funding model for research sites that takes into account their scientific performance.<sup>13</sup>

In allocating research funding, the Governing Board has also taken into account the key scientific metrics and other measurable factors of the scientific performance of each institution, making the process transparent and based on verifiable, objective data. The strategic goal of the ELKH Secretariat is to further optimize the allocation of resources on the basis of performance, with an increasing emphasis on recognizing and encouraging research performance, thus contributing to the international competitiveness of the research network.

The increase in the resources allocated to ELKH from the state budget has led to a significant increase in the basic subsidy for all institutions (Figure 17).

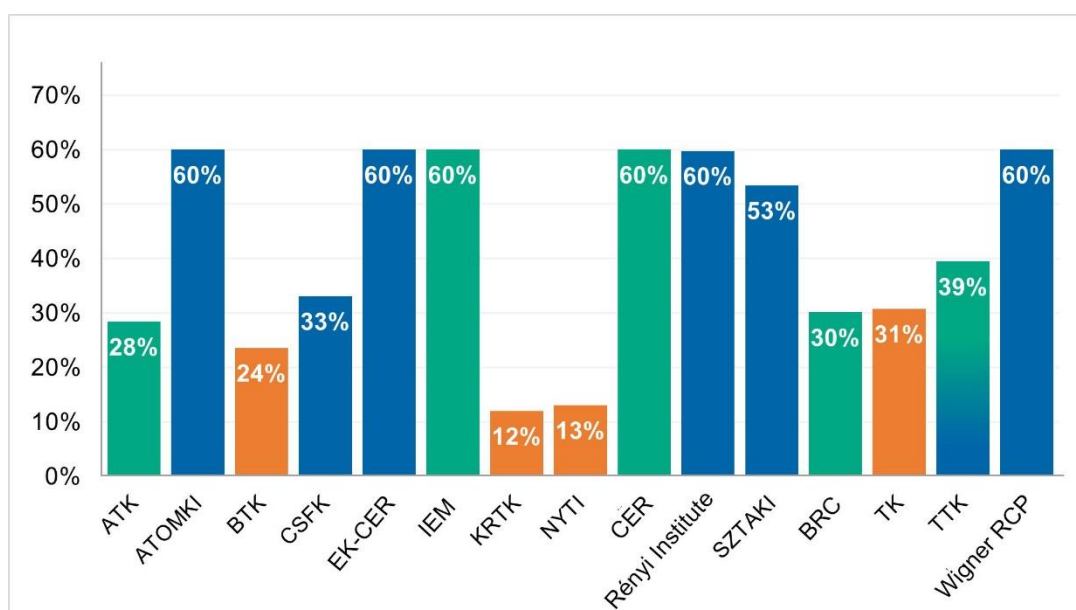


Figure 17: Increase in resources of institutions compared to the base increased by the 2020 salary increase (green for life sciences, blue for mathematics and natural sciences, orange for social sciences and the humanities)

(Source: data provided by the ELKH Secretariat)

<sup>13</sup> From 2021 onwards, the budgetary support for research sites will fully cover their operating costs, in addition to providing the necessary resources for specific research. Heads of institutions can decide on the use of their resources, calculated for subtasks, which has significantly increased their autonomy.



## 5. NATIONAL AND INTERNATIONAL RELATIONS, R&D&I PARTNERSHIPS AND RELATED INFRASTRUCTURE DEVELOPMENTS

### 5.1. International partnerships and relations of ELKH

#### 5.1.1. ELKH's international presence and visibility

As a key player in Hungarian science and basic research, ELKH considers it a priority to strengthen its international reputation, visibility and embeddedness. In line with this, **ELKH has sought to gradually enter the international arena from the outset**, so that international research and innovation actors can become familiar with the research network and research programs, the results of which may deserve international recognition.

In line with these efforts, the **aim** is to continue to **increase the influence, outreach and international visibility of ELKH**. In particular, it is important to support and develop the existing international relations of the research network and to increase their effectiveness.

Unfounded and erroneous information has been published in several cases in connection with the restructuring of the academic research network and the establishment of the ELKH Secretariat, to which the ELKH Secretariat has responded with its continuous international presence, providing factual data and engaging in credible dialogue. In its communication with international partners, ELKH has repeatedly advocated freedom of research, stressing that under the guidance of the ELKH Secretariat, research sites can operate more effectively and free from political influence due to the measures taken. The International Division prepared a brochure in English describing the research network and the main research areas, which was sent to Hungarian foreign representatives, science and technology attachés, and its national and international partner organizations.

#### 5.1.2. Admission of the ELKH Secretariat to international organizations

One of the first steps taken to increase ELKH's international visibility was to initiate and organize the process of becoming a member of international organizations. The ELKH Secretariat initiated membership procedures with European and global scientific organizations relevant to ELKH.

##### Science Europe

Science Europe, founded in October 2011 and based in Brussels, is the main association bringing together organizations funding research with organizations performing research. The organization jointly represents the interests of large public research institutions and research funding organizations. It serves as a platform for developing positions on research policy issues and helps to communicate science policy messages to European institutions, researchers, national governments, and the public. Science Europe carries out a wide range of advocacy and policy activities in a number of areas, including cross-border cooperation, the EU Framework Programs – Horizon 2020 and Horizon Europe – open access to scientific publications, and support for open science.

The ELKH Secretariat's formal application for membership to Science Europe was submitted in January 2020. In May 2020, Science Europe asked the ELKH Secretariat to draft a summary of the activities of the research network to date, with a special focus on research freedom and independence from Government, for the first anniversary of its establishment. The ELKH Secretariat complied with the request.<sup>14</sup>

<sup>14</sup> The ELKH Secretariat officially joined Science Europe on May 19, 2021, after the reporting period.

### International Science Council (ISC)

The International Science Council (ISC) is the only **international non-governmental organization with global membership** that brings together the natural and social sciences. The Council aims to promote science as a global public good. The ISC vision is that scientific knowledge, data and expertise should be universally accessible and that the benefits deriving from them should be universally shared. The admission process started during the reporting period.<sup>15</sup>

### European Association of Research & Technology Organisations (EARTO)

The main objectives of the Association are to represent and defend the interests of European research and technology organizations, to strengthen their position in the EU decision-making process and to ensure that European research and innovation programs are in line with the interests of the participating organizations. On September 17, 2020, the **ELKH Secretariat became an associate member of the Association**, and as such the ELKH Secretariat participates in the working groups of the Alliance. In 2020, EARTO focused on the following topics: the multiannual financial framework and the EU budget for research and innovation; the European Horizon program; technology infrastructures; RDI ecosystems and innovation hubs; Digital Europe.

### European Association of Research Managers and Administrators (EARMA)

EARMA was established in Italy in 1995 in recognition of the need to provide a forum for research managers and administrators to meet, network and share experiences. As a testimony to its success, it has grown over the years to become the **primary European association representing research managers and administrators. The ELKH Secretariat is a full member of the organization and actively participates in its activities.**

### EuroScience

EuroScience is a pan-European association for the advancement of science and technology. As a grassroots institution, EuroScience's mission is, among other things, to provide a European interface for policy makers, scholars and scientific institutions. Its members include the European Organization for Nuclear Research (CERN), the European Molecular Biology Laboratory (EMBL) and Elsevier, a leading publisher of scientific journals and science metrics data. **The ELKH Secretariat is a full member of the association, which gives the research network excellent international visibility.**

### 5.1.3. Participation in projects supported by the European Strategy Forum on Research Infrastructures (ESFRI)

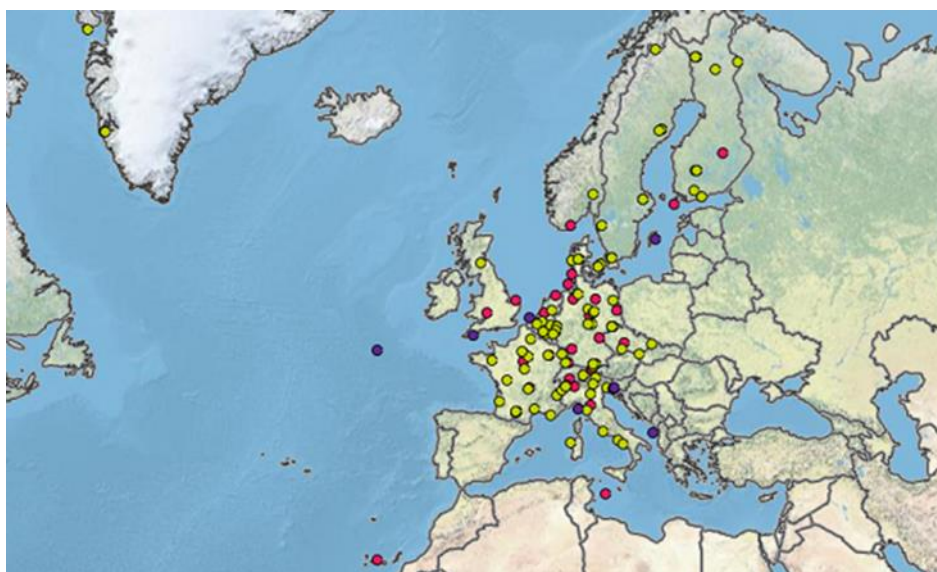
To reinforce excellence at the international level, ELKH contributes to the development and operation of assets **at its research sites** required to participate in the European Strategy Forum on Research Infrastructures (ESFRI).

Hungarian participation in ESFRI research infrastructures is vital to the strengthening of the international embeddedness of Hungarian researchers, to facilitate their integration into key professional networks, to ensure their access to the research infrastructures needed to achieve internationally significant research results, and to increase their scientific and economic competitiveness. **By using world-class equipment and participating in research programs, new opportunities will emerge to exploit R&D results and develop innovative products, processes, and services.**

The **ELKH Secretariat**, upon the request of the Hungarian National Research, Development and Innovation Office, and taking into account the strategic ambitions of the ELKH and the availability of the ELKH Secretariat's budgetary resources, supported the accession to the **ICOS ERIC** (Integrated Carbon Observation System – European Research Infrastructure Consortium) and **EPOS ERIC** (European Plate

<sup>15</sup> The ISC admitted the ELKH Secretariat as a member on January 22, 2021.

Observing System) research infrastructures. The ELKH Secretariat also undertook to reimburse the related domestic development costs as well as the operating costs. **The above two research infrastructures are of particular importance for ELKH, as they are integral to the strategic priorities of ELKH.** The mission of ICOS ERIC is to conduct long-term studies through the coordinated operation of a number of state-of-the-art measurement sites and the use of standardized measurement methods, which will both contribute to understanding the global carbon cycle and provide reliable information on greenhouse gas changes. EPOS ERIC aims to provide integrated data access to existing, but isolated, geophysical observation networks (seismology, volcanology, GNSS) and satellite technologies, thus providing the opportunity to generate cutting-edge information and create new infrastructures and databases (Image 1).



*Image 1: ICOS ERIC stations network: atmospheric (red), ecological (yellow) and oceanic (dark blue)  
(There are also additional stations outside the map. The stations in Hungary will be added to the map after it has  
joined ICOS ERIC)  
(Source: [www.icos-cp.eu](http://www.icos-cp.eu))*

#### 5.1.4. International activities of the ELKH research sites

In 2020, the International Relations Department of the ELKH Secretariat conducted a detailed survey of the international relations of its research institutions. The survey shows that the international connections of the research network are highly diversified, and that **the international activity of individual research sites is very extensive.** The research sites reported a high number of international memberships and partnerships, with **a total of 315 at institutional and individual level.** It should be noted that the Research Centre for the Humanities has 62 and the Centre for Economic and Regional Studies has 45 memberships. Although some ELKH research sites (e.g. the Research Centre for Astronomy and Earth Sciences) do not have institutional membership of an international organization, they do cooperate with a number of international organizations through individual researcher membership.

Looking at the international research cooperation network of the ELKH research sites, it can be seen that the most important partner countries are **Germany, the United Kingdom, and the United States.** Other important areas of research collaboration include **France, Italy, Spain and Austria.** **54% of ELKH research sites collaborate with foreign universities,** and 32% with foreign – mainly public – research institutions. The share of industrial cooperation is estimated at 6 percent. International research collaboration can result in a joint article, publication, bilateral or multilateral research project, joint international grant application, or conference. The evolution of the international research relationships of research sites is shown in Figure 18.

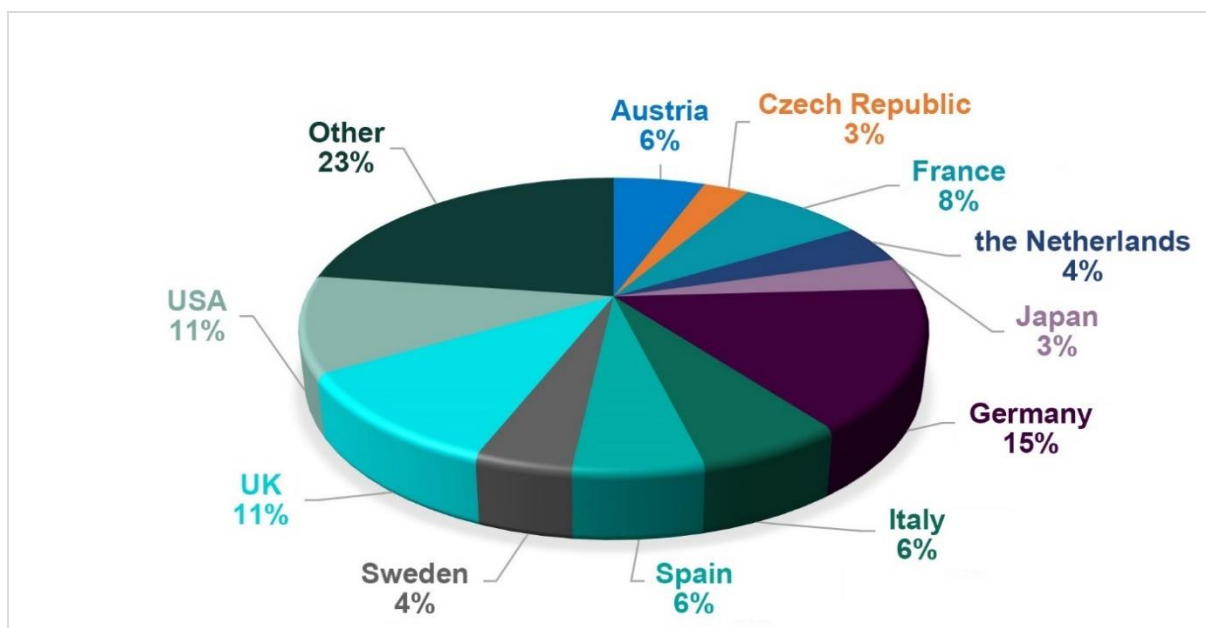


Figure 18: Distribution of the international relations of research sites  
(Source: data provided by the ELKH Secretariat)

**As for international grant application activity**, 60 percent of the projects implemented by ELKH research sites were funded through Horizon 2020, 3 percent through the European Cooperation in Science and Technology (COST) and 37 percent through other, non-Hungarian funding programs. In particular, international direct grant programs include grants from the Alliance of International Scientific Organisations (ANSO), the UK National Library, the European Space Agency, the Australian Research Council, the Max Planck Institute, the European Climate Foundation and the American Philosophical Society.

#### ELKH's participation in Horizon 2020

**ELKH research sites have won a total of €79 million in funding under Horizon 2020, with 178 successful applications. This represents around 22% of the total grant money received by Hungary.**

Most of the grants awarded to ELKH research sites under Horizon 2020 fall under the "**Excellent Science**" category (these include European Research Council grants, Marie Skłodowska-Curie Actions and Research Infrastructure programs). In total, the research sites were successful in **98** of these calls for proposals, accounting for **around €50 million** in funding. The second most important source of funding was the "Societal Challenges" grant scheme, where the research sites received more than €10 million in grants for 38 successful applications. This is followed by Euratom, then the "Industrial Leadership" work program, and finally the "Widening Participation and Spreading Excellence" call for proposals (Figure 19).

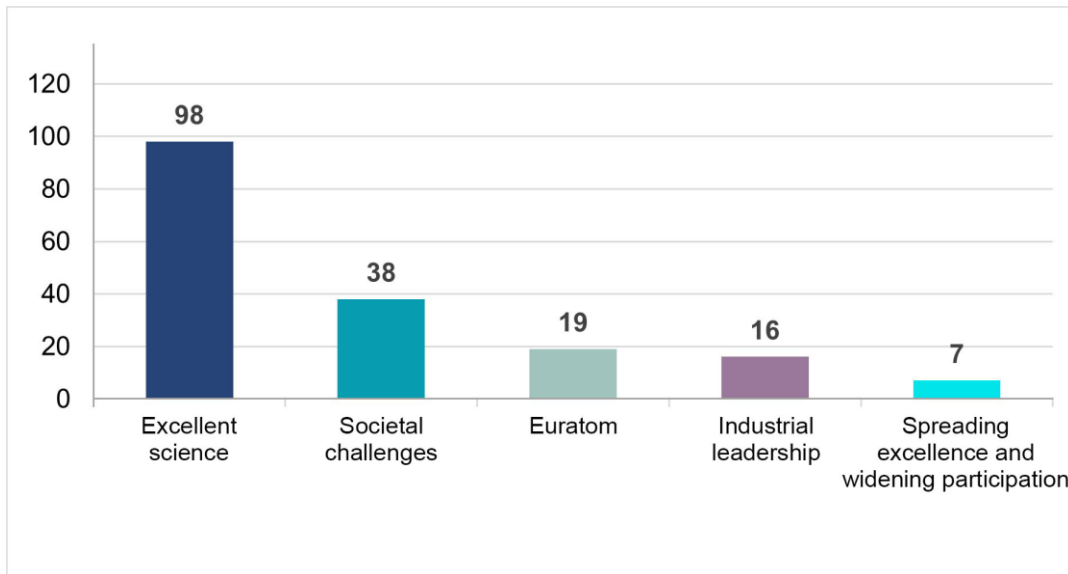


Figure 19: Number of Horizon 2020 grants awarded to ELKH research sites by work program  
(Source: data provided by the ELKH Secretariat)

In terms of the amount of grants awarded, the Institute of Experimental Medicine leads the way with almost €17 million, followed by the Institute for Computer Science and Control (SZTAKI) with more than €12 million, with the Alfréd Rényi Institute of Mathematics in third place with more than €10 million. The Centre for Energy Research was involved in the largest number of applications funded by ELKH, with 33 in total. The Institute for Computer Science and Control was involved in 24 funded projects and the Wigner Research Centre for Physics in 21. Figure 20 shows in more detail the share of Horizon 2020 grants awarded to research sites.

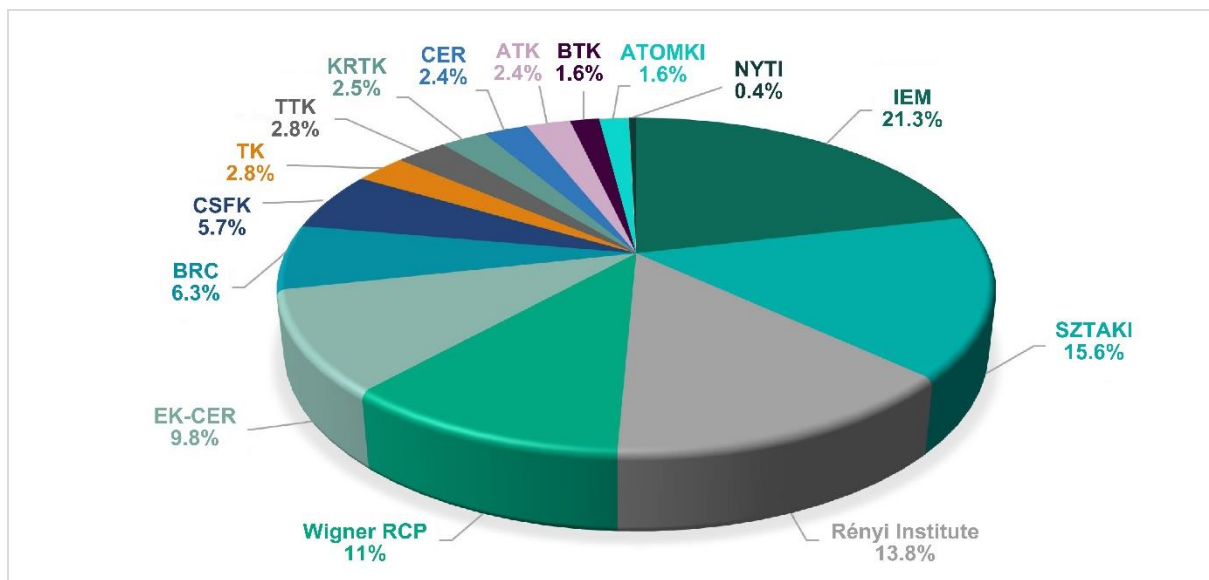


Figure 20: Share of ELKH research sites awarded with Horizon 2020 grants  
(Source: data provided by the ELKH Secretariat)

**Of the successful examples of Horizon 2020 grants**, it should be noted that an EU project **led by ELKH's SZTAKI, with 21 members** and €5.37 million in funding, was launched to make European manufacturing systems and supply chains more flexible and to facilitate the transition to medical device manufacturing when a pandemic requires it (<https://elkh.org/en/news/eu-provides-extraordinary-funds-for-the-international-covid-project-led-by-sztaki>).

#### 5.1.5. Promoting the participation of research organizations in the European Research Framework Programs

The ELKH Secretariat helps research sites participate in European and international programs and projects in order to increase the research and innovation performance of the research network. **To significantly increase the participation of the research network in the EU Research Framework Programs and other funding programs that are not open to national applicants**, the ELKH Secretariat started planning targeted measures in 2020 by drawing up an action plan.

**A training program was launched** to help ELKH researchers learn about the EU funding system, prepare and implement successful research projects, and develop project management skills. The first interactive and practice-oriented Horizon 2020 training in English was held in autumn 2020 and was organized for the staff involved in application management at the research sites. In addition to theoretical knowledge, the training also offered practical advice and suggestions on how to deal with the issues that arise during the application process.

The ELKH Secretariat cooperates with the Hungarian National Research, Development and Innovation Office to ensure that research sites are adequately prepared and to launch incentive and support programs. It seeks to build active ties with the key institutions of the European Union in science policy. The ELKH Secretariat considers **its associate membership in the European Association of Research and Technology Organisations (EARTO)** to be of particular importance for the European Horizon Program, as it allows the Secretariat to participate in the EARTO Research Framework Program Working Group. EARTO is actively involved in the development of the work programs that form the basis of the European Horizon calls for proposals, and through its membership, ELKH is kept up to date with the latest opportunities for applications under the Framework Programs.

#### 5.1.6. Bilateral relations with the French National Centre for Scientific Research (CNRS)

The National Centre for Scientific Research in France (CNRS) is the largest French institution with a network of research institutes. It is overseen by the French Ministry of Research and Higher Education. The institutes are managed by the CNRS research office. CNRS comprises ten institutes with a research profile as heterogeneous as that of the ELKH research sites. In addition to research institutes, it has more than 1,100 research units in France, 93% of them in close collaboration with a higher education institution, and nearly 40 international research units worldwide. It employs around 33 thousand people.

CNRS has an annual budget of €3.3 billion, of which €250 million is spent on international cooperation. **Its achievements in research has put CNRS at the forefront of the world.** CNRS is a **model institution** for ELKH, in particular in terms of the network structure of the center, its governance and strategic operating model, its performance-based funding scheme, its cooperation with higher education institutions, and its commercial exploitation of research results. Therefore, the establishment of long-term, close cooperation with the organization is in the fundamental interest of the ELKH Secretariat.

The text of the agreement with CNRS was under negotiation at the end of the reporting period. The signature of the agreement opens up new perspectives for French-Hungarian scientific and technological cooperation and further extends international relations between the parties.<sup>16</sup>

### 5.1.7. Cooperation with the Hungarian scientific community in the Carpathian Basin and the diaspora

In building ELKH's international relations, **researchers with Hungarian ties and significant achievements in the Carpathian Basin and the diaspora cannot be ignored.** The network of relations with scientific workshops in the Carpathian Basin can also **serve as a bridge to the majority-language scientific community of the region**, which is an important milestone in building multi-centered relations and networking.

Taking all this into account, the international department of the ELKH Secretariat has launched a priority project to establish contacts with the Hungarian academic world abroad. The ELKH Secretariat intends to carry out this work **in cooperation with the experts of the Hungarian Academy of Sciences responsible for cross-border relations**, with the objective of mutually supporting and strengthening each other's work and avoiding unnecessary duplication. Consolidated thinking has begun to identify the points where ELKH may become involved in this work by exploiting synergies and opportunities for cooperation (joint projects, visiting researcher programs, support for researcher mobility, presentation of scientific results in international forums, etc.).

### 5.1.8. International Advisory Board

**In 2020, the International Advisory Board, one of the pillars of the ELKH Secretariat, was established and its members were elected.** The Governing Board and the Scientific Council of the ELKH Secretariat are assisted by an International Advisory Board of internationally recognized foreign researchers. The International Advisory Board **provides recommendations on strategic issues affecting the research sites of ELKH** and on strengthening the international embeddedness of Hungarian researchers. The Board also **facilitates the expansion of the ELKH Secretariat's relations with international research organizations.**

The Governing Board has set the number of members of the International Advisory Board at ten and agreed that two members should represent each of the five broad scientific themes (health; environment and security; human resources; energy; digitalization) defined in the structure of the European Horizon program and the national science policy objectives.

Researchers from countries at the forefront of scientific excellence and research and development (including the United States, Germany and the Netherlands) were invited to join the International Advisory Board.

### 5.1.9. The ELKH International Coordination Working Group

The **ELKH International Coordination Working Group** was established in order to develop the international relations of ELKH and to ensure, in this context, a better and more efficient flow of information and communication between the ELKH Secretariat and the institutes of the research network.

The work of the International Coordination Working Group promotes the development of international relations of research institutions and their participation in EU and other international programs.

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<sup>16</sup> The agreement was signed after the reporting period, on March 29, 2021, partly virtually and partly in person, with the participation of representatives of CNRS at the Embassy of Hungary in Paris and of ELKH at the French Ambassador's residence in Budapest.

In addition to the information received directly by the ELKH Secretariat, members of the ELKH International Coordination Working Group **are informed about all calls for proposals, webinars, online conferences and workshops, and cooperation opportunities published by ELKH's international partner organizations.**

## 5.2. Relations with the corporate, public budget, non-profit, and government sectors

In 2019 and 2020, ELKH research sites were involved in a number of corporate collaborations with business actors, ranging from small and medium-sized enterprises to Hungarian subsidiaries of large international companies. The forms of collaboration were quite diverse: the research sites worked with business partners in various areas, ranging from the provision of research services to joint R&D and innovation projects.

However, a number of factors influenced the extent of the relations of research sites with companies, the number of collaborations and the complexity of the projects. A key feature of these is that the research activities of ELKH research sites are not primarily applied research aimed at generating results that can be directly applied or used for commercial applications, but mostly exploratory research aimed at gaining new knowledge about the background of phenomena or observable facts. As a consequence, the activities of research sites were less focused on experimental development or product and service innovation, which also significantly influenced the nature of their industrial relations.

The discipline in which a research site conducts its research is also an important factor of its relations with companies. Accordingly, the number and intensity of business collaborations in the humanities, social sciences and mathematics is much lower than in the natural and life sciences.

However, applied research and development also featured, though less prominently, in the activities of the ELKH research sites. Intellectual resources and extensive research infrastructure were also harnessed through knowledge exchange with the business sector, collaborative tendering, research and other scientific services.

The collaboration of ELKH research and development sites with the competitive sector offers many opportunities for both parties, but also brings significant challenges. The most obvious benefits for research sites include the involvement of additional resources and the opportunity for researchers to participate in applied research, experimental development and actual innovation activities. Researchers have the added advantage of gaining application-oriented knowledge and experience closely related to their research area, and in many cases the possibility of opening up new avenues of research.

In terms of R&D collaborations between ELKH research sites and the business sector, a number of forward-looking examples from 2020 can be highlighted, including the following:

### Centre for Energy Research

Since 1996, the Centre for Energy Research has been providing general consultancy services to **MVM Paks Nuclear Power Plant Zrt.** The institute's researchers provide expertise to support the safe operation of existing Paks units and provide the essential technical and scientific background for the construction of new Paks units. EK-CER researchers participated as independent experts in the preparatory activities related to the **Paks II** project.

In cooperation with **MIRROTRON Kft**, EK-CER researchers are developing a compact neutron source device, and in 2020 they also started developing an accelerator technology for ion source. This work is closely related to the institute's fusion plasma physics research in the EUROfusion consortium.

With the development of transmission electron microscopy and the widespread use of microscopes with a resolution around the angstrom level or better, the need to produce extremely thin cross-sections free



from any artificial materials has increased. In 2020, EK-CER researchers, in collaboration with **TECHNOORG-LINDA Kft**, worked together successfully in this field.

On behalf of the **Prime Minister's Office**, the staff of the Centre participated as a subcontractor of a foreign nuclear energy consultancy in the development of the conceptual design of a new nuclear fuel element testing laboratory.

The cooperation of the EK-CER Microsystems Laboratory with **77 Elektronika Kft** is characterized by numerous national and international projects and joint research work, which was further strengthened by a strategic cooperation agreement made in 2018. In collaboration with a Hungarian company, EK-CER researchers developed and manufactured unique sintered ceramic products in 2020.

### **Alfréd Rényi Institute of Mathematics**

The main profile of the Alfréd Rényi Institute of Mathematics is to pursue foundational research in mathematics, in which it usually collaborates with other research centres and research universities. The institute's researchers have worked together predominantly in the fields of computer science and artificial intelligence with companies with whom they have submitted joint R&D proposals, building on the institute's basic research results. Noteworthy among these is the joint project with **ALTEO Zrt**, which aims to develop a highly automated, artificial intelligence-based energy IT system capable of making autonomous production and commercial decisions, and managing and optimizing the 'smart' power plant's electricity production.

During research on the SARS-CoV-2 virus, the institute's researchers collaborated with **several small and medium-sized enterprises**, Semmelweis University and the University of Szeged to develop PCR testing protocols based on artificial intelligence and other mathematical algorithms.

### **Institute for Computer Science and Control**

On November 19, 2019, an aircraft developed as part of the FLEXOP international project led by the Institute for Computer Science and Control flew in a real environment for the first time in the world. In addition to **Airbus**, Europe's largest aircraft manufacturer, the FLEXOP consortium includes the **German Aerospace Center**, several prestigious European universities (Bristol, Munich, Delft, Aachen) and major aerospace suppliers (**FACC** in Austria and **INASCO** in Greece). Research on the subject has already resulted in several industrial projects.

Designing and optimizing industrially complex manufacturing systems and processes requires a multi-level, multi-competency approach. The researchers of the institute have developed a constraint-based model for solving the macro-level process design problem, taking into account the cuts generated by the subtasks, in a logical Benders decomposition procedure. In manual assembly, the possibility of customizing instructions and selecting the best instruction in a given context was investigated in collaboration with **Hitachi Ltd**. The above processes and the methods they have developed in the field of production and manufacturing system design have been demonstrated in a **learning factory program** in their Industry 4.0 pilot manufacturing system.

The institute has also successfully cooperated with **MVM Paks Nuclear Power Plant Zrt** for several decades, providing independent expert assistance for the implementation of the Paks control solutions.

### **Research Centre for Natural Sciences**

Researchers from the Research Centre for Natural Sciences (TTK), in collaboration with researchers from **Richter Gedeon Plc**, participated in several joint research projects in 2020, for tasks such as the optimization of biologics manufacturing technology.

As part of the collaboration, TTK researchers performed cell biology experiments for **SOLVO Zrt.** In collaboration with **TOXI – COOP** Toxicological Research Centre Zrt., they participated in research on drug candidates.

### **Institute of Experimental Medicine**

The Molecular Pharmacology Research Group of the Institute of Experimental Medicine has further expanded its long-standing and fruitful collaboration with **Richter Gedeon Plc.** in the field of drug discovery and development.

### **Biological Research Centre**

The Biomolecular Electronics Research Group of the Biological Research Centre in Szeged, in collaboration with **77 Elektronika Kft**, participated in a project to develop a measuring system for the rapid detection of bacteria from bodily fluids.

The Neurovascular Unit Research Group uses several *in vitro* neurovascular unit models based on cell culture. These models are suitable for studying the interactions between different drug candidate molecules and the neurovascular unit (blood-brain barrier). Taking advantage of this opportunity, the research group has established close cooperation with **SOLVO Zrt** in the field of drug discovery.

### **Centre for Economic and Regional Studies**

In 2020, researchers from the Institute of Economics of the Centre for Economic and Regional Studies worked with location data consultancies and conducted joint research with the **Hungarian National Bank** and the **EC Joint Research Centre**. In order to investigate the health consequences of the coronavirus and the inconsistencies in health outcomes in childhood, KRTK researchers are working together with the **National Health Insurance Fund**.

Members of the Mechanism Design Research Group have been involved in the development of simulation software to study national and international kidney exchange programs within the framework of the ENCKEP (European Network for Collaboration on Kidney Exchange Programmes) COST Action. The use of the software has been agreed with ScandiTransplant, which coordinates the international kidney exchange programs of Sweden, Denmark, Norway, Finland and Estonia.

### **Research Institute for Linguistics**

Researchers from the Research Institute for Linguistics have participated in a Hungarian-Polish-Bulgarian research collaboration led by the R&D department of an international company. The aim of the research was to investigate the developmental impact of a new infant formula containing breast milk oligosaccharides (HMO). MacArthur-Bates CDI questionnaires, adapted for national languages in accordance with the project's objectives, are used to assess the linguistic-cognitive development of 15-month-old children (<https://www.nestle.com/randd/nutrition-health>).

NYTI's Language Technology Research Group has formed a consortium called HILANCO with the Applied Data Science and AI Group of the University of Pécs to conduct natural language processing research based on neural network technology. Among several other language models, the consortium has jointly developed HILBERT, the development and market launch of which is supported by **Microsoft Hungary Kft.**

From these few examples, it can be seen that the ELKH research sites cooperate with economic actors in a wide range of areas and ways. In the context of the development of the national innovation system, the social and economic utilization of the research results generated by the research sites and the use of research capacities can be intensified through these collaborations.

## 5.3. Knowledge management and research infrastructure

### 5.3.1. IT developments

#### Open science I: research data management, data repository

The scientific world is increasingly embracing the **open science** movement, where research is collaborative, and research data and information generated in the process of research are freely usable, transparent and accessible.

Open Science includes the much-vaunted **open or free access**<sup>17</sup> in scientific publishing, **open data**, open science infrastructures **and** openness / open engagement of social actors in science. The schematic structure of Open Science is shown in Figure 21.

ELKH should be at the forefront of the open science movement as a central actor in Hungarian research with central allocation and funding. Recognizing this,

- the **ELKH Secretariat joined the Hungarian Node of Research Data Alliance (HRDA)**, the Hungarian section of the European Research Data Alliance in the spring of 2020, the main objective of which is to train researchers and standardize the management of research data
- established the ELKH Data Repository Working Group, within the framework of which various data repository pilot projects were launched in ELKH institutions with the assistance of SZTAKI
- in Hungary, the management of research data and the development of institutional rules still need significant improvement, so it is important to raise them to a higher level and to promote the management of research data according to FAIR (Findable, Accessible, Interoperable and Reusable) principles. In this process, the ELKH Secretariat has received significant assistance from HRDA and the Library and Information Center of the Hungarian Academy of Sciences. **As an initial step in developing the ELKH data repository infrastructure, the ELKH Secretariat has awarded HUF 50 million in 2020 to HRDA** for the following activities:
  - assessing competences in research data management within the ELKH institutions and evaluating the results
  - organizing informative presentations on research data management and the use of data repositories for representatives of different disciplines
  - supporting the research network in developing its research data management policies
  - developing data repository infrastructure, supporting the creation of databases

<sup>17</sup> Elements of Open Science based on the UNESCO presentation of February 17, 2021 (<https://osc2021.cventevents.com>).

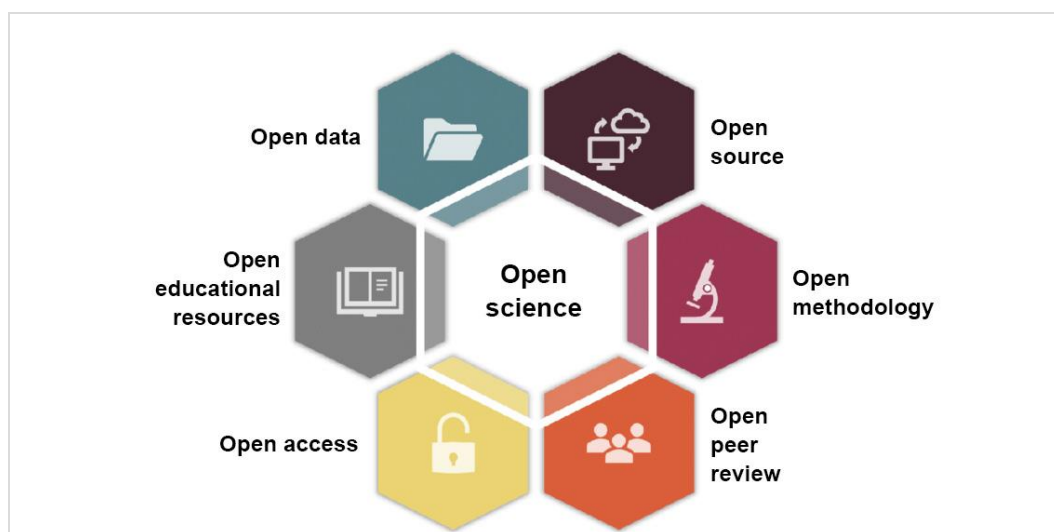


Figure 21: Schematic diagram of Open Science  
(Source: The six core principles of Open Science which guide the Open Traits (researchgate.net))

## Open Science II: ELKH Cloud

In recent years, there has been a growing demand for the use of cloud computing among scientific research and innovation actors. Recognizing this need, the HAS Cloud was created in 2016 as a result of the joint work of SZTAKI and the Wigner Data Center (WDC), which provides a research- and innovation-friendly solution for computationally intensive tasks of researchers that are free of business interests, thus greatly supporting researchers' competitiveness in the domestic and international field, and helping them participate in international projects.

The service is used by all the institutions in the network and has served 174 research projects since its creation, of which 70 have been completed. The Cloud has contributed to a number of internationally significant peer-reviewed publications (<https://science-cloud.hu/en/publikaciok>). Based on the results of user surveys, both the quality and usability of the service are outstanding.

The rapid development of IT technology, the growth in demand and the emergence of new research trends – such as machine learning requiring GPGPU cards<sup>18</sup> and data-driven research requiring large back-up storage capacity – require continuous development and expansion of the system.

The experts from SZTAKI and Wigner RCP, as well as the managers of the ELKH Secretariat, examined the sustainability and future vision of the Cloud and concluded that, in order to maintain and leverage the accumulated knowledge, to operate the uniform and flexible infrastructure economically and to remain competitive, the Cloud infrastructure must be maintained and further developed in a direction that meets the needs of the users. To this end, the Secretariat of the ELKH allocated HUF 1.02 billion in 2020 for the creation of the ELKH Cloud project.<sup>19</sup>

## Consolidation of the IT infrastructure

The IT infrastructures supporting the basic ICT services of ELKH research sites have developed in isolation and in different ways, resulting in a heterogeneous environment both in terms of hardware and mostly open source software, and in terms of operation. These systems are at different levels of maturity

<sup>18</sup> GPGPU: General-Purpose Graphics Processing Unit – the use of graphics processors for general-purpose computing.

<sup>19</sup> In the ELKH Cloud project, both SZTAKI and WDC made improvements of equal proportion in 2021, with a significant expansion of the existing IT infrastructure and a major systemic upgrade of higher value-added services, including enhanced support for users.

and amortization, and their maintenance and development depend on the financial situation of the research site.

IT tasks and projects that can be integrated into a unified system are a top priority in the workflow of the ELKH Secretariat. This will in turn enable the creation and development of an information technology environment for the research network that is sophisticated, of internationally high quality, and securely sustainable.

The basis for this is the consolidation of fundamental ICT services based on the creation of a centrally managed, highly reliable and economically sustainable data center service system for the entire research network.

**In the autumn of 2020, the ELKH Secretariat granted HUF 90 million to SZTAKI and Wigner RCP to design and build the Research Network Information Infrastructure – Kinin – service system during 2021**, and to commence the gradual integration of the institutes into the service. In the coming years, the ELKH Secretariat aims to bring as many research sites as possible into the system with additional support.

### 5.3.2. Research infrastructure development

In order to ensure the long-term effectiveness of the institutions, the development of the research network as a whole, and the promotion of maximum use of research tools and equipment, the ELKH Secretariat announced grants in 2019 and 2020 to improve the infrastructural conditions of research at the institutions of the research network.

In 2019, HUF 758.8 million was allocated for the development of general institutional infrastructure and the renovation of real estate and related investments, and HUF 1.7 billion for the development of research infrastructure to ensure conditions for outstanding scientific activity in 2020.

Infrastructure needs supported in 2019 included acquisitions, improvements and renovations (e.g. automated isolation and library technology, induced coupled plasma (ICP) analyzers, and flow cytometers)<sup>20</sup>, while, in 2020, institutions received support for higher-value acquisitions and improvements (e.g. computer-controlled thermo-vacuum chamber and a collaborative reconfigurable robotic manufacturing cell for industrial needs).

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<sup>20</sup> A flow cytometer can measure (provide the metrics of) the different properties of separate cells (cyto) flowing in a cell suspension. Importantly, this produces not only an average value, but also the properties of all the cells tested separately, so that different cell populations can be distinguished.

## 6. ELKH'S DOMESTIC TENDER APPLICATION AND INNOVATION ACTIVITIES

### 6.1. Domestic tenders

Project-based grants, available through calls for proposals, have always played an important role in the funding of research centers by providing incentives to research centers and researchers, while also leading to long-term and short-term specialist collaborations.

In 2019 and 2020, members of the ELKH research network have been very active in national and international calls for proposals. Of the proposals submitted by ELKH research sites, more than 780 were successful during this period. The number of proposals funded is evenly spread across the three disciplines – mathematics and natural sciences, life sciences, and humanities and social sciences.

Research sites in the humanities and social sciences typically applied for and won lower amounts of funds than those in the other two disciplines. In 2019, the average value of funding applied for and total funding awarded per project was below HUF 15 million for research sites in the humanities and social sciences, while the average value was around HUF 18 million for those in the life sciences and above HUF 20 million for those in the mathematics and natural sciences. The difference can be explained mainly by differences in the equipment and resources needed for research in each discipline.

This relationship between research sites continued in 2020, but there was a significant increase in both the number and amount of grants awarded and the amount of funding per project.

There was a significant increase in the amount of funding granted to research sites in the field of mathematics and natural sciences, mainly thanks to the National Laboratories 2020 Program launched by the Ministry of Innovation and Technology, the Hungarian National Research, Development and Innovation Fund, and the *Center for Higher Education and Industrial Cooperation – Research Infrastructure Development*, launched under the Economic Development and Innovation Operational Program.

In the 2019-2020 period, the Research Centre for the Humanities and the Research Centre for Natural Sciences stand out in terms of the number of winning proposals, while, in terms of the amount of funding awarded, the Institute for Computer Science and Control, the Biological Research Centre and the Research Centre for Natural Sciences won the largest number of grants.

Grants awarded to members of the ELKH research network typically come from the following sponsors:

- Ministry of Innovation and Technology
- Hungarian National Research, Development and Innovation Office
- Eötvös Loránd Research Network Secretariat
- Hungarian Academy of Sciences
- Ministry of Finance

In 2020, nearly 80 percent of the funding approved for the ELKH research sites was provided by the above sponsors.

One of the most popular opportunities for members of the network is to participate in OTKA research applications, with more than 120 projects funded in 2019-2020, resulting in more than HUF 4.4 billion in grants awarded. Within the network, OTKA grants also provide substantial support to experienced and talented researchers in independent research teams and who have outstanding publication records, are recognized as international experts in their fields, and who wish to further develop their successful basic research topics and explore new avenues.

In addition to the number of grants awarded, an important indicator is the value of the grants received. In total, the research sites received more than HUF 25 billion in grants in the 2019-2020 period. Of these, most funds were recorded under "Foreign research income – EU grants" by research centres and independent research institutes, but a similar amount was also received from domestic research and development grants, such as those financed by the Hungarian National Research, Development and Innovation Fund.

In the 2019-2020 period, most of the funding went to research sites in mathematics and natural sciences (accounting for more than 50 percent of all ELKH research centres), while life sciences, the humanities and social sciences also received significant funding (nearly HUF 9 billion and HUF 2.5 billion respectively).

The National Laboratories Program was a particularly important call for proposals for the ELKH research sites in 2020. These projects – primarily based on broad collaboration – will create knowledge hubs in priority areas of the national economy, which can then become prominent scientific hubs for specific disciplines. ELKH research sites are members and in many cases leaders of several National Laboratories. In 2020, 17 National Laboratories have been launched in the R&D areas of industry and digitalization, culture and family, health, safe society and environment, of which five are led by an ELKH research site:

- the National Laboratory for Autonomous Systems and
- the National Laboratory for Artificial Intelligence are headed by the Institute for Computer Science and Control;
- the Nanoplasmonic Laser Fusion Research Laboratory and
- the Quantum Computing National Laboratory are headed by the Wigner Research Centre for Physics;
- and the National Biotechnology Laboratory is headed by the Biological Research Centre

In addition to the above, ELKH research sites are involved as collaborating partners in the work of the National Multidisciplinary Laboratory on Climate Change, the National Laboratory on Digital Heritage, and the National Laboratory on Artificial Intelligence. In addition, the Biological Research Centre supports the professional implementation of the HCEMM Teaming National Laboratory.

ELKH research centers have actively collaborated with other organizations through funding programs launched by national organizations. The scope of the partnerships for funding is quite broad, ranging from collaborations between research sites, to business, civil society and academic partnerships, and other public actors.

Almost one-fifth of the more than 780 proposals awarded to ELKH research centers during the reporting period were submitted and planned to be implemented as part of some form of cooperation. More than 30% of these consortium projects were set up in partnership with national actors, the vast majority of them involving other research organizations, universities and, to a lesser extent, companies and NGOs. In the three major research areas of ELKH, the majority of collaborative projects submitted and awarded in the 2019-2020 period were in mathematics and natural sciences, but a significant number of joint proposals were submitted and awarded by life sciences research sites, while joint projects in the humanities and social sciences were less common.

It is also important to note that several of the grant projects awarded in this period were specifically targeted at business collaboration and the development of marketable products. For example, such projects awarded in 2020, which were directly driven by business needs, were projects awarded under the call for proposals announced by the Hungarian National Research, Development and Innovation Fund for *Market-driven R&D and innovation projects*. The projects supported under this scheme before

December 31, 2020, include the following projects implemented with the collaboration of ELKH research sites:

- Building a new multi-omics diagnostic platform for the investigation of women with infertility of unknown origin and exploring therapeutic options, *in collaboration between MAB Pharma Zrt and the Institute of Biochemistry of the Biological Research Centre*
- *Development of value-added biomass utilization technology from agricultural and forestry by-products in the mushroom-biogas complex system as part of the consortium comprising PILZE-NAGY Kft, AGRÁR-BÉTA Kft, Bay Zoltán Kft. and the Institute of Plant Biology of the Biological Research Centre*
- *Development of biomarkers for toxicological and safety studies in cooperation with TOXI – COOP Zrt and the Institute of Enzymology and the Institute of Materials and Environmental Chemistry of the Research Centre for Natural Sciences*
- *Development of innovative, high added-value oncology drugs for personalized therapies in a consortium made up of EGIS Zrt and the Institute of Organic Chemistry of the Research Centre for Natural Sciences*

ELKH remains committed to supporting excellent independent research and to promoting collaboration between research centres and national and international organizations. The ELKH Secretariat will continue to support the activities of research sites in this area with a wide range of instruments.

## 6.2. Activities for research utilization

The main circumstances determining the activities of the ELKH research sites in 2019 and 2020 regarding intellectual property rights were – due to the specifics of industrial property protection procedures – mainly the provisions, objectives and activities of previous years. In 2019 and 2020, the intellectual property rights portfolio of the ELKH research sites grew by around 70 national and international IPRs. In terms of the number of newly granted IPRs, the life sciences, including the Centre for Agricultural Research and the Biological Research Centre, were the top performers.

It is important to note, however, that the IPR activity of research sites is largely determined by the field of science in which they are active. Thus, patenting and other industrial property protection procedures are obviously less relevant for research results in the humanities and social sciences, and the patent portfolio in these fields of science did not grow with newly granted protection during the reporting period. Likewise, the scope for IP protection in the field of software is quite limited. In these cases, copyright protection or, in certain narrow areas, trade secret rights ensure the protection of intellectual works.

Research at ELKH research sites is not primarily concerned with generating results that can be directly applied or used for business purposes, but mostly with exploratory research to gain new knowledge about the background of phenomena or observable facts. This also significantly limits the potential for utilization of research by research sites.

In 2020, the Centre for Agricultural Research and the Institute for Computer Science and Control also benefited from considerable research utilization activity related to its own intellectual creation. Compared to other research sites, the position of the latter is unique among the research centers of ELKH as its research areas, and consequently its operation, are characterized by a high degree of application orientation and the generation of results that meet market needs. The following is a presentation of the results related to the research utilization activities of ATK and SZTAKI.

### Centre for Agricultural Research

One of the main tasks of the Agricultural Institute of the Centre for Agricultural Research (ATK) is the breeding of new plant varieties, and the success of this activity is demonstrated by the fact that ATK



currently holds 125 national and EU patents, as well as several cases of plant variety and trademark protection. The wheat varieties bred at the institute are considered market leaders in the domestic production of wheat grain. These varieties occupied more than 30 percent of the national seed land in 2020, based on the size of the seed-breeding area.

The main task of the Maize Breeding Department is the breeding of new maize hybrids, the success of which is demonstrated by the number of varieties that have been recognized in recent years. In total, two maize hybrids have been granted national recognition in EU countries and four more outside the EU, while five domestic line patents (PVPs) were registered in 2020. The number of hybrids submitted for state recognition was 30 (18 in the EU and 12 outside the EU). In 2020, 18 combinations were undergoing the registration process, 13 in the EU and five outside the EU.

The purpose of their announcement outside the European Union is to introduce them with their hybrids to the Russian, Ukrainian, Belarusian, Serbian and Kosovar markets. This has led to the need for official certification of maize hybrids in these states. Four hybrids were granted state recognition in Ukraine in 2020 and four more were announced in Kosovo. During the reporting period, three hybrids were tested in state trials in Russia and five state-recognized hybrids were on the Russian official variety list.

Royalties from the commercial sale of seeds of varieties, as well as royalties from farm-saved seeds, are an important part of the budget of ATK and the maintenance and development of the breeding program.

Researchers at the Agricultural Institute of the Centre for Agricultural Research have further developed the research site's cost- and environment-friendly fertilization advisory system and the ProPlanta software based on it. With a focus on the needs of organic farming, its domestic applications have been further expanded. In addition to numerous smaller and larger economic and consultancy firms and the Hungarian Chamber of Agriculture, three of the most important companies in the Hungarian agricultural sector – Nitrogénművek Zrt., KITE Zrt. and AXIÁL Kft. – also use the ProPlanta software.

In 1993, researchers at the Centre for Agricultural Research created the CSALOMON product line of pheromone traps. The development and production of these was carried out by 11 different SMEs and one large company, which served the center as suppliers in 2020. In 2020, around 3,500 individuals and businesses in Hungary and 250 companies abroad used the center's trap developments for their own activities. In addition to small, medium and large domestic agricultural enterprises, CSALOMON traps are used by the National Food Chain Safety Office from the public sector for quarantine pest detection and annual pest forecasting, and by the National Chamber of Agriculture and the Hungarian Chamber of Plant Protection Engineers and Plant Physicians for monitoring the swarming of a number of pests.

### **Institute for Computer Science and Control**

For many years, the applied research and development activities of the Institute for Computer Science and Control (SZTAKI) have focused on cyber-physical systems. Cyber-physical systems are computational structures that are intensively connected to the surrounding physical world and to physical processes, while at the same time serving and exploiting the data access and processing services available on the Internet. One of the key features of this research area is the close interaction between theoretical research and engineering to yield innovation based on basic research results and a wide range of industrial applications.

In accordance with this, the Institute for Computer Science and Control is able to provide its business partners with R&D services based on a wide range of research results (e.g. in computer science, engineering and business intelligence, machine sensing and interaction, and production informatics and logistics). Another unique element of SZTAKI's activities is the development of software and applications. The results of these activities cannot be protected, or can be protected only to a limited

extent, by industrial property rights, but SZTAKI also makes significant use of the copyright protection of software by licensing software developed to order.

In addition to supporting the social utilization of the scientific results generated at the ELKH research sites, the aim of the ELKH Secretariat is to contribute more intensively to the strengthening of the national economy and to increasing the innovation and income-generating capacity of Hungarian industry, agriculture and the service sector.

## 7. CLOSING REMARKS

The ELKH Secretariat was established by the Hungarian Parliament effective August 1, 2019, to manage and operate the publicly funded research network. The creation of a separate professional organization and management for the research network has enabled targeted, efficient, and rapid decision-making, and has boosted professional support for the institutions.

The mission and objective of the ELKH Secretariat is to develop the research network towards excellence in order to maximize its contribution to increasing the intellectual, economic, and cultural competitiveness of the country by making the best use of its human and material resources. To achieve this, in addition to increasing researchers' salaries and improving research conditions, it is important to identify topics in which the network has the capacity, competences and resources to achieve cutting-edge results internationally, while serving the country's interests.

Through the professional development of its organization, the recruitment of the right professionals and the establishment of internal rules and regulations, the ELKH Secretariat has become an efficient organization. By defining the strategic objectives and operational principles of ELKH, the foundation for achieving its goals and accomplishing its mission has been laid.

One of the most significant recent achievements has been the increase in state funds for the research network by HUF 11 billion in 2020. This has made it possible to commence development of the research infrastructure, increase research funding, and raise salaries for researchers. As of July 1, 2020, the salaries of the research network's employees grew by an average of 30 percent.

The previous static funding system has been replaced by a new three-pillar funding model, according to which institutions receive annual funding specifically for operations, research, and public services. The budget for research in 2021, which was allocated in 2020, includes key scientometric and other measurable scientific performance indicators of each institution over the previous three years, making the process based on verifiable, objective data and transparent. The new scheme is designed to promote scientific excellence and support the research network in increasing its international competitiveness.

The structure of the research network was reviewed with the aim of increasing its efficiency and optimizing its operations. As a result, in November 2020, the Governing Board decided that three institutes that primarily perform key public tasks will continue to operate independently within the research network. These are the Institute for Veterinary Medical Research (ÁOTI), part of the Centre for Agricultural Research (ATK); the Balaton Limnological Institute (BLI), part of the Centre for Ecological Research (CER); and the Geodetic and Geophysical Institute (GGI), part of the Research Centre for Astronomy and Earth Sciences (CSFK).

Since its establishment, the ELKH Secretariat has become a member of several major international organizations. The most significant of these is Science Europe, which brings together organizations involved in research funding and conducting research. Membership in the International Science Council, which focuses on natural and social sciences, is also important, as is the framework cooperation agreement with the French National Centre for Scientific Research (CNRS) to strengthen and further develop scientific cooperation.

To recognize researchers who have achieved outstanding results, the Governing Board has decided to award prizes and titles, such as the Róbert Bárány Prize for young researchers and the title of Research Professor Emeritus. Significant steps have been taken to increase the reputation and recognition of ELKH, including the development of the ELKH Secretariat's branding, the launch of its Hungarian and English bilingual website and social media platforms, and intensive scientific dissemination and promotional activities through these channels and the media.

In 2020, the ELKH Cloud infrastructure was significantly upgraded. It provides a research- and innovation-friendly solution for computationally intensive tasks and greatly supports researchers' competitiveness in both the Hungarian and international arenas, helping them to participate in international projects.

One of the key challenges ahead is to further reduce the brain drain of researchers by improving infrastructure, research conditions, and further increasing researchers' salaries, which will require further budgetary support.

Another key priority is to launch new research topics within the network that can ensure ELKH's research activities become internationally competitive and at the forefront of new areas.

To encourage and support research utilization, the ELKH Secretariat has started to build a new internal innovation system. Already incorporated into the operating principles, this system is designed to improve scientific competitiveness, make better use of external research funding opportunities, and more effectively leverage the intellectual property portfolio of the research network.

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