MTA'S STRATEGIC PROPOSAL REGARDING THE ROLE OF SCIENCE IN THE REVISION OF THE HUNGARIAN INNOVATION SYSTEM

MTA's Strategic proposal regarding the role of science in the revision of the Hungarian innovation system

Background

The decision of the Hungarian Government to declare innovation as a national priority and the unveiling of its ambitious plan to make Hungary the region's leading innovator has raised high hopes throughout the Hungarian research, development and innovation (RDI) sector. The intention of the Government was reinforced by the establishment of a new Ministry of Innovation and Technology (ITM). In its resolution of 4 October 2018 (1481/2018) "on the restructuring of the institutional background and financing schemes of the Hungarian system of research, development and innovation", the Hungarian Government published a detailed action plan and timeline aimed at boosting Hungary's competitiveness in innovation.

True to its traditions, national mission, values and achievements, the Hungarian Academy of Sciences (MTA) is committed to devoting its potential and productivity to the creation and implementation of a new science policy that will result in a flourishing era for Hungarian science. In order to support this process and facilitate an agreement between ITM and MTA, the Academy has drawn up its own strategy, taking into account the working paper prepared by ITM. This document is a summary based on the input collected from the chairs of MTA's scientific sections and the directors of research institutes in MTA's research network and other sources, including the administration of the Academy. This strategic document encompasses a wide range of opinions and was created as a working paper. On 6 December the General Assembly of the Hungarian Academy of Sciences adopted this document at its extraordinary 190th meeting with an overwhelming majority.

We need to declare that leaders and members of the MTA research network have all expressed their support for a strategic peer-review of the activities of MTA. This peer review should be performed in-line with international standards and by experts equally independent from the Academy and the Government. This document will not review the principles and methods of this upcoming peer review as the preparatory work to define its scope will soon be taken up by a dedicated MTA Presidential Committee composed of seven members delegated by the Government and seven members delegated by MTA.

The performance of Hungarian universities, national research institutes and companies, being all part of the innovation system, must also be evaluated along similar lines, and their activities need to be reviewed taking into consideration the "Peer Review of the Hungarian RDI System" prepared by DG Research of the European Commission in 2016 and also the 2017 proposal of the National Research Development and Innovation Office for a renewed RDI strategy. It is unreasonable to claim that there is a need to restructure the research network of MTA without a complex evaluation of the Hungarian RDI system. Should the evaluation conclude that it is indeed necessary to restructure its operations, MTA is committed to partnering with the initiatives in the best interest of Hungarian science.

The RDI system

State of play of the Hungarian RDI system

In general the international ranking of Hungarian science and Hungarian RDI is on par with Hungary's economic performance. If we compare RDI ranking with GDP per capita ranking, it is clear that Hungary is performing in line with its economic status (See Annex 1).

The composite innovation index quoted in the working paper of ITM merges basic research and innovation performance; thus it does not highlight the fact that basic research in Hungary is in fact doing comparatively well – actually, in comparison with its European counterparts, it is using its limited resources at the highest level of efficiency and is able to attract a significant amount of foreign funding (e.g. from ERC) to Hungary's knowledge economy. More specific indicators clearly show that in the period between 2010 and 2017, Hungary in this respect improved its performance significantly (European Innovation Scoreboard, 2010-2017) (See Annex 3). Researchers in Hungary make up one of the most competitive groups in today's domestic labour market (See Annex 2).

Between 2002 and 2015, in an effort to stimulate competitiveness, EU member states, on average, increased their state RDI funding amounts, whereas in the same period state funding of RDI decreased in Hungary. Most recently, the cutback in funding was most imminent in the RDI fields of higher education, where state/government funding dropped by one-third compared to its 2011 level. Salaries are low, which induces migration, work overload, fragmentation and counterselection. In comparison with direct competitors, the number of researchers is low, and the same can be said of the number of innovators, innovation managers and research and development jobs. Research infrastructure and administrative research services have improved considerably, however, and in many aspects are still not competitive enough. The legal background areas (including public procurement procedures, rules regarding the recognition of foreign degrees or the employment of foreign researchers, etc.) are not working towards a research-friendly environment.

Science and innovation policy

On numerous occasions over the last period of almost ten years, Hungarian governments have demonstrated their intention to assign a major role to the world of science, research, development and innovation as tools for bringing economic and social prosperity to Hungary and as a means of reinforcing Hungary's position within the region, in Europe and globally. There have been significant investments in research infrastructure, and important funding schemes have been introduced to support research careers (i.e. MTA Premium Postdoctoral Research Programme, the Bolyai Scholarship, the Momentum Programme, and the "Frontline" Research Excellence Programme). These gestures of support have been returned by the scientific community in the form of highly acclaimed scientific results and achievements at the international level and also with the launch of a series of national strategic research programmes (e.g. in brain research, quantum technology, protein research, water science, education methodology).

The Hungarian Academy of Sciences as an institution is highly regarded both on a national and international level (the prestige and value of MTA as a brand is high), and the expertise and

international network of its scientists have played a decisive role in advancing the intellectual capacity and innovative development of Hungary.

In the past decades, however, no consensus-driven, comprehensive and long-term national science and innovation strategy has had a chance to evolve fully. On the contrary, periodic restructuring attempts have added an additional factor of uncertainty to a system already suffering from a lack of financial resources above all. Based on past experience and best practices already at hand, we have the opportunity now to make the RDI system evolve to its full potential and open promising new horizons for science in Hungary. For this breakthrough we are all eager to see, we need the best efforts from the political, economic and scientific spheres to come together in a long-term collaboration. We hope that such a collaboration may provide a solution to the challenges that threaten the present and future of the RDI system in Hungary.

In order to lay the foundations of a national RDI strategy, we need an in-depth evaluation of the RDI system. This process should follow international guidelines and allow for comparisons to be made at the international level. This process should not be restricted to the evaluation of MTA's research network alone; instead, it should also cover the innovation and research activities of universities, state-owned research institutes and companies looking to obtain public funding, and also the evaluation of public institutions engaged in supporting research and innovation or providing research management or other related services.

ITM's working paper addresses the research-development-innovation cycle from the perspective of direct financial benefits, claiming that it will generate new business opportunities and make our economy more competitive. This approach, however, needs to be complemented with the perspective of scientific research, and new discoveries as well, which serve to benefit humanity, society and Hungary as a nation. It must be noted that these kinds of research activities often operate according to their own rationale and processes; nevertheless, we are convinced that they must also form part of a new science policy designed for the national interest. Among others, research in innovative education methodologies, programmes to improve our population's health and demographic trends, the study of the unwanted side effects of technological development, the challenges of climate change, and the efficiency and accessibility of large healthcare and social systems are good examples for such strategic research programmes.

The role of social sciences research as a precondition for the successful implementation of the advances made in the natural sciences and engineering is becoming more and more important in European funding programmes. It is essential that Hungarian innovation activities also increase in these areas. High-level research in the social sciences is also essential to preserving our national identity and protecting our values and interests.

We must use our traditional excellence in basic research as a strategic pillar of our actions to improve the science system in Hungary. We need to empower those in applied research and corporate innovation, while preserving our capacities in basic research and allowing for an easy transfer and transition among these research areas. Basic research will continue to rely on public funding in the future as well, and in order to reach the above goals, its public funding will need to be increased significantly.

When developing new strategies to reform the Hungarian RDI system, we believe it is essential to follow the principles below:

- take into account the availability of human resources (trained researchers and inventors);
- build on existing excellence;
- increase the funding of the RDI system in a radical and systematic way;
- avoid overcentralisation and excessive bureaucracy;
- strengthen all actors within the Hungarian "innovation ecosystem" in parallel;
- encourage cooperation among the actors within the system;
- take advantage of the existing competition in RDI;
- perform a gradual, transparent and predictable transformation.

Human resources for research and innovation

There is a scarcity of people, worldwide, who are capable of carrying out research and innovation work. We need to pay special attention and adopt special approaches to appreciate, retain and reward their talent and to provide them with attractive career opportunities. We need to rely on the indispensable ability of principal investigators, scientific leaders and other influential figures in science to identify talents and to build commitment towards research and innovation among them. We also need to take advantage of the opportunities provided by international collaborations when nurturing Hungarian talent.

It is the primary task of universities to provide high-level professional training and, thus, the supply of next-generation researchers, but the role of research institutions – independent from universities – will continue to be essential in introducing young researchers to state-of-the-art science. It should be encouraged, therefore, that universities and the MTA research network cooperate in discovering and identifying talented Hungarian youth, introducing them to science and managing their systematic training. Joint research programmes from MTA and universities are also a much needed tool in improving the competiveness of our universities at an international level.

When it comes to expanding human capacities in science, we cannot do without welcoming successful researchers who have already made a career abroad and fighting the rising rate of emigration among young researchers. We must also face our weaknesses in terms of the low number of international students, scientists and engineers based in Hungary in comparison to our competitors. It is fundamental to reveal and address the reasons behind this trend (salary levels, language difficulties, administrative burden and the recognition of diplomas, and academic degrees being hampered by red tape).

When drafting strategies and planning necessary measures, it is important to consider the roles of the members of the "innovation chain" together with other stakeholders in the economy. What do we expect in terms of education, experience and motivation from the personnel engaged in scientific research, in the innovation industry, in knowledge management, in policy making or in public administration? Drawing from international examples, we should, for example, increase the number of PhD students seeking a career in the private sector instead of academia.

Development of the funding system

Overall, we find the principles and the structure of the RDI funding system outlined in the ITM working paper progressive. We add, however, that many elements of the innovation system are in need of improvement and transformation (e.g. protection of intellectual property, commercialisation, etc.).

Several decades of underfinancing in the Hungarian RDI system is severely limiting competitiveness and is threatening its sustainability. The threat is made even more alarming by the fact that it is still unclear as to what kind of resources will be available from 2020 onwards for RDI grant schemes. In the future, the increase in human and financial resources will have to be harmonised. *The amount of the proposed "Research Fund" will have to be gradually increased*, and will have to be regularly reviewed based on experience and new demands. The life-cycle of basic research is different from the cycle of applied and project-based research. As a result, it is important to guarantee the long-term stability and predictable operation of the institutions engaged in basic research.

Companies primarily finance research that brings direct measurable profit to the business venture. Thus, the funding of basic research must remain predominantly a state mandate, while applied research should be funded by the public and private sectors together. In the field of applied research, the system of targeted grant schemes can serve this end, complete with a well-organised system to support the preparation and management of patents.

Research institutions of the Hungarian Academy of Sciences

Main tasks of the institutions

The tasks of MTA research centres (and independent research institutes) may be divided into the following three highly interlinked categories:

1. Basic research (discovery research): its directions are determined by the internal development of science and the latest research results published internationally. The main criteria for funding are excellence and the expected (scientific and societal) impact. Basic research benefits society by delivering and transferring knowledge and the latest results, methods and theories of science.

2. Applied (targeted) research: Applied research is carried out upon orders from the private sector or the government and is based on results and accumulated basic research knowledge.

3. Public services based on scientific knowledge: these include science advice on policy issues (e.g. economy, environmental protection); scientific education and the training of the new generation of scientists; science popularisation; the preservation of the national scientific and cultural heritage (e.g. cataloguing, conservation and the study of national archives in literature and music); and a large number of special activities pursued in the public interest (e.g. the edition of the *National Atlas of Hungary*, *Dictionary of the Hungarian Language*; National Seismology Network). The study of the national cultural heritage is an obligation and a responsibility that must never be abandoned.

Any change proposed in relation to the research network must consider these three tasks together. MTA has a strong performance in basic research; according to some indicators (e.g. number of Q1

publications per institutional funding), it is among the most effective research networks in Europe (see Annex 2). The Academy's public services also enjoy a general public appeal. It is in our joint interest to involve MTA's research network more effectively in applied research projects and innovation processes.

Structure of the research network

We do not find that a major overhaul of the Academy's research network can be justified as a measure to improve Hungary's performance in innovation. All restructuring efforts have considerable costs – not only monetary ones but also in terms of labour, energy, trust and damaged relationships – and the results of such efforts often lag behind expectations. Any reorganisation can only be initiated if it has clearly outlined and proven the benefits and there are good examples to support expected results. It is very important to embrace and cherish personal and institutional excellence instead of jeopardising their positions. Our competiveness in terms of RDI does not suffer from a low performance in basic research, but rather in applied research and innovation.

In an ideal research centre the three main tasks described above are connected through their common field of science with an appropriate distribution of tasks and collaboration within the field. Thus the ambition to radically separate basic research from applied research and isolate them in different institutions is highly questionable. The funding procedures of these three tasks should obviously follow different principles, but dividing them at an institutional level is rarely justified, and their geographical separation clearly has negative effects.

We are convinced that MTA should continue to incorporate both basic and applied research in its operations. However, using legal, financial and other incentives, we must ensure that the institutes of the MTA research network integrate functionally with other actors in the innovation chain. National priorities could be reinforced in the same way as has already been implemented in the case of MTA's Research Groups Attached to Universities. ITM and/or the National Research, Development and Innovation Office could also establish and operate thematic research and development groups and laboratories. However, it is very important that these groups be connected both in geographical and personal terms with already well-established research institutions or university departments engaged in the study of similar research areas. *This is the only possible way to involve existing infrastructure and human capacity in development and innovation.*

Multidisciplinary research programs involving several institutions, or programmes operated on a national scale must be organised in the form of networks. In such networks, participants rely on their own expertise and resources in their scientific work, but regular meetings and internal research grant schemes help formulate and implement the common objectives of the network, at times even with the involvement of industrial partners. In organising such networks, we can build on the experience gained with existing programmes organised by the Academy and its research institutions (e.g. brain research, water science and content pedagogy). It is crucial that these programmes be led by excellent, charismatic experts who are representatives of the given scientific field and who can truly integrate everyone concerned.

The establishment of a new Hungarian "Institute for Advanced Study" would serve to intensify our relations with the global elite of scientific research. By following the international trends and objectives of research, the mission of such an institute should include the harmonisation and

coordination of the fragmented research activities of universities and research institutes. MTA is ready to take a leading role in the establishment and management of the operations of such an institute.

Financing of the research network

The three main tasks of the research institutions described above could rely partly on the funding provided in structures similar to that of the German Max Planck Society and the Fraunhofer Society. However, we need to emphasise that the German science funding example is not a real alternative to the operations of the Hungarian research institutions because of its different size, traditions and funding structure. Today, the budget of an MTA research centre or independent research institute is comprised of four elements: funding from the central state budget; revenues from the utilisation of the institution's own research results; revenues from payments received for scientific services provided by the institution; and funding from national and international grants obtained in competitive grant calls (46% of the operating expenditure of the research institutions is covered by financial support earmarked in dedicated state appropriations). This funding structure is very similar to the Fraunhofer system, however, the funding ratios must always be defined according to the different needs of different disciplines.

In basic research, the stability of funding is essential; it is impossible to operate a system in which top principal investigators are hired for short-term or even medium-term tasks with their employment suddenly discontinued once these tasks are finished. We need to allocate a basic operating budget for each research institution, which includes the wages of full-time researchers (core staff), the costs of running, maintaining and upgrading the central research infrastructure, and the costs of administrative and management services needed for the operation of the research institution. This "basic" funding should be provided through a specific funding mechanism independent of other resources and should be subject to regular revision at reasonable periods of time. In order to ensure stability, we suggest that, in terms of the planned agreement between MTA and ITM, the basic institutional funding of the Hungarian Academy of Sciences be returned to the chapter of the Hungarian Academy of Sciences in the state budget.

Applied research activities can be partially funded from research grants or based on contracts in which research topics are specified either directly by the business sector or by ITM. The funding of public services obviously cannot be solved in a uniform manner, but we recommend that the activities of the research network in education or in the promotion of science should also be recognised in terms of additional funding.

The distribution of resources among research groups within the institutes should remain the sole responsibility of the directors of the institutions. The activities of low-performing research groups – should they be revealed by a peer review – must be revised. If the research area of the group is considered important, it may need to be strengthened by inviting outstanding young researchers or even researchers from abroad. Dismissing the group is far from the only option, even in the case of low-performing research groups.

Strengthening the national role of the Hungarian Academy of Sciences

With a wide range of activities, the Hungarian Academy of Sciences has served the nation and has worked for the support of national policies for almost 250 years, and has continued to do so in a renewed format since 1990. Staying true to the intentions of its founder, Count Széchenyi, the Academy formulates its positions and issues its statements in such a way that it always respects the principles and facts of science while preserving its commitment to the Hungarian nation. The Academy plays a crucial role in promoting the participation of Hungarian science and innovation within international organisations and networks. As a public body comprising 17,000 scholars, the Academy not only represents its members and the scientists employed in its research network, but also all domestic and foreign members of the Hungarian scientific community.

"Science in all policies" (István Széchenyi)

The Academy and its institutions are engaged in various research activities which produce results that may underpin policy decisions. (These activities are not limited to the field of social sciences but are also important in environmental studies, agriculture or medical sciences, and others.) It is the right and the responsibility of elected politicians to decide how scientific facts and opinions are considered in political decisions, but it is without doubt that an understanding of scientific facts improves the quality of policymaking. It is in our common interest, therefore, that policy-relevant research findings arrive at decision-makers in their entirety, without any bias or distorted interpretation.

At present, however, it is difficult to find institutionalised mechanisms that allow for the transfer of scientific facts to policymaking, such as parliamentary scientific committees or scientific advisors at ministries. This also prevents scientific advice from fulfilling its potential in that there are no forums where representatives of political parties and other stakeholders including scientists and experts can express their opinions, which may also include preferences based on political values, in addition to unbiased scientific knowledge.

In order to support evidence-based government policies, the Hungarian Academy of Sciences offers to provide services to facilitate the transfer of "knowledge and technology" for public policies. These services would include, in addition to the provision of direct advice to policymakers, the publication of yearly strategic policy reports based on an open discussion and review of a series of national challenges, social dilemmas, development opportunities and other relevant issues for policymaking. When informing the public and policymakers, the Academy commits to presenting its activities for the benefit of the nation.

The mission of the Hungarian Academy of Sciences is not only to represent the greatest scientific minds of Hungary and not even, primarily, to represent the staff of its own institutions, but rather to stand up for the entire scientific community, whose members can equally be affiliated with universities, MTA and other research institutions or industrial research and development sites in Hungary. MTA must make every effort to ensure that they are informed properly, their opinions are taken take into account, they are represented in a fair and consistent manner, they can practice their scientific profession, and that they are not hindered in any way from carrying out their work in the nation's interest. True to this mission, MTA intends to involve the entire Hungarian scientific community in the preparation and implementation of what will be a "paradigm shift" in the fields of science and innovation.

Annexes

Annex 1 – The international status of Hungarian science and R&D, as well as the potential for progress

Annex 2 – Statistics on innovation performance and efficiency

Annex 3 – European Innovation Scoreboard, 2010-2017