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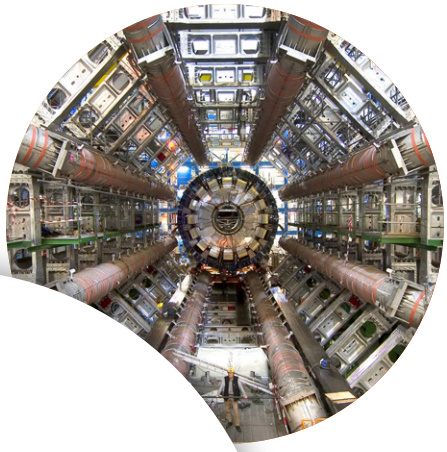


AN ECOSYSTEM FOR BIG SCIENCE

POSITION PAPER
OF THE DUTCH ILO-NET,
SEPTEMBER 2020

www.bigscience.nl

CONTENTS

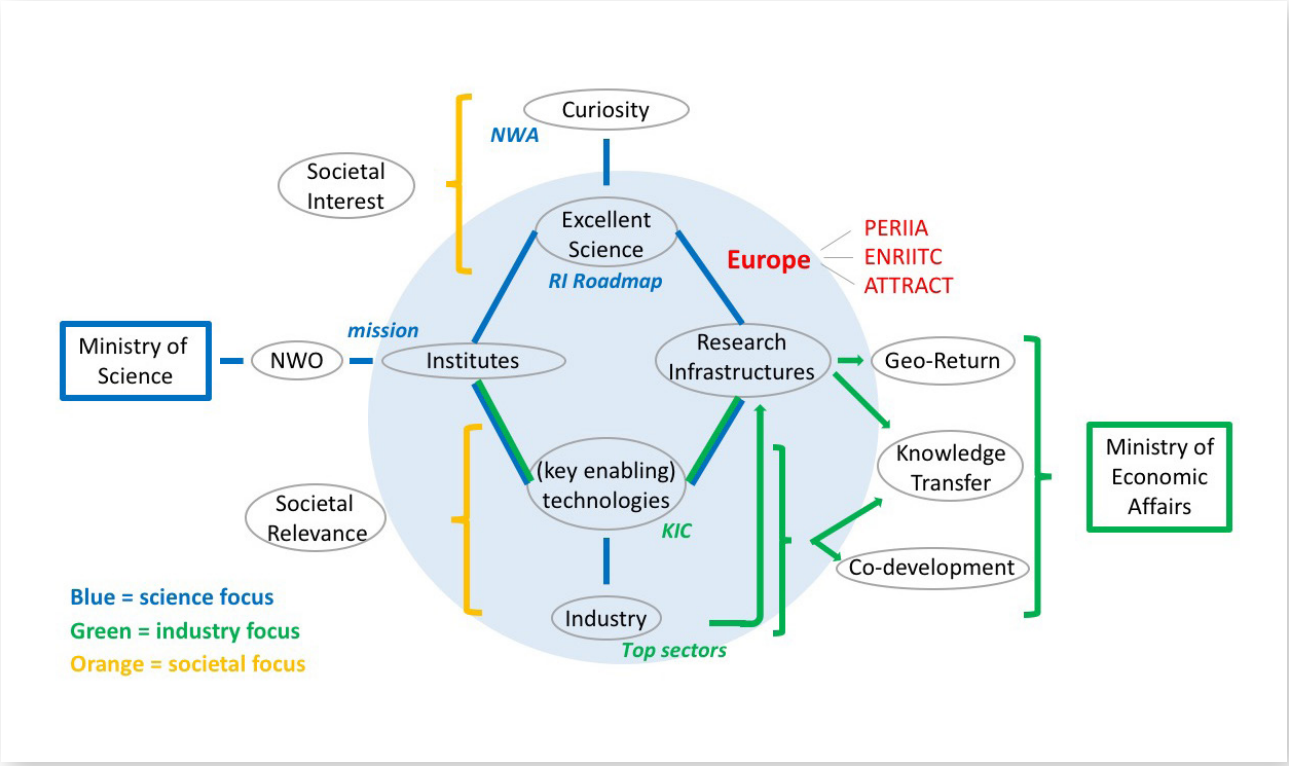
INTRODUCTION

"Big Science" in the Dutch context may be defined as fundamental research that, for its major advancements, is dependent on the availability of large, expensive or complex facilities and instrumentation, developed and shared by an international research community. The facilities can either be at a central location (like CERN) or distributed (like SKA).

Considering Big Science as an ecosystem, it is curiosity-driven, starting with fundamental questions about the origin and evolution of our universe, developing into applied science and eventually into products and services at the end of the value chain. By nature this ecosystem contains the need to collaborate with companies (from low to high technology readiness levels), promote and enable technology transfer and the ambition to raise geo-return. These are also the typical ingredients of the tasks of Industrial Liaison Officers (ILOs), employed at Dutch research institutes. The ILOs have organized themselves in the ILO-net, which has evolved as a strong counterpart for its foreign partners. Obviously, a Big Science ecosystem in the Netherlands should be part of a larger ecosystem that extends across our national borders.

The ILO-net considers itself as part of this ecosystem, which led to a team building session in the summer of 2020. In this session, we discussed the present situation in the Netherlands and tried to distinguish the most important players and stakeholders in the Big Science arena, as visualized in the diagram below. We concluded that specific measures can be taken to further develop Big Science into a strong ecosystem in which the various players adopt common goals and strategies and build up a strong profile in the context of foreign policy to serve the ambitions and goals of the ecosystem effectively.

In this position paper, we look at the present status of the Big Science ecosystem from our perspective, and present a summary of the arguments that were discussed during our team building session. We propose that these arguments are taken into consideration to develop coherent policies and strategies to achieve a strong ecosystem for Big Science. This will enhance the profile of the Netherlands as a dedicated contributor to excellent science and innovation in Europe, and give further impetus to our national ambitions to support science and innovation as a truly collaborative effort of all the players involved. Some conclusions and recommendations are added at the end of this paper.



OBSERVATIONS AND CONCLUSIONS

Societal relevance of science has become increasingly important. Curiosity driven (excellent) science goals are no longer sufficient to evaluate the performance of research institutes (ref. Standard Evaluation Protocol). Beyond the science, institutes are supposed to contribute to a wider return on investment implying technology transfer and co-creation/development with industry. However, developments at NWO have an increasing focus on (national) strategic programs and are now affecting the flexibility to support long term curiosity driven research in an international environment.

In its advisory report "Balance in the science system" (December 2019) the KNAW concludes:

"The Netherlands wants to remain a knowledge society and science actively contributes to this with scientific discoveries, societal solutions, and highly trained academics. As the relationship between unfettered and strategic research narrows, the likelihood that science can continue to make a strong long-term contribution to the knowledge society through scientific discoveries decreases."

The Big Science research institutes (like SRON, Nikhef, ASTRON, DIFFER) can have a pivotal role in establishing more balance between strategic and unfettered research, since they act as home base for large international infrastructures and are already deeply embedded in a societal and economic environment. The funding for these institutes should enable them to develop key enabling technologies in co-development with industry and the Big Science organisations, alleviating restraints and risks that prevent companies to step in at an early stage.

Existing "ecosystems" in the Netherlands are strongly based on specific societal requirements (like Health, Climate) and largely driven by short term return on investment, through roadmaps that are led by industry. Science is in a subordinate position and has to find specific niches in selected ecosystems. An ecosystem for Big Science would restore science as a strong and exclusive driver for innovation, contributing to long-term European competitiveness. Such an ecosystem does however require long term perspective and continuity, based on excellent (fundamental) science to start the innovation chain. Being part of an ecosystem will enable research institutes to raise funding much more easily for their missions, since the synergy between the relevant interests will already be explicit and can be easily recognized and supported by dedicated and effective funding instruments. An ecosystem for Big Science may also be facilitated by "single competitions" instead of "double procedures", that often interfere on the international level. Participation in ESA missions is an example; international instrument consortia that are selected by ESA in a long term and thorough procedure, are still dependent on national competitive funding procedures. (ref. annex 2)

More continuity and perspective in support instruments (base funding, SBIR and others) would enable "home base institutes" to develop strategic collaborations with high-tech industry and/or other knowledge institutes around key technology developments.

An ecosystem for Big Science would be the only ecosystem in which an added value (multiplier) can be derived from the continuous interaction between geo-return, co-development and technology transfer, driven by the ambition to push the frontiers of scientific knowledge. The ecosystem is characterized by long term roadmaps, the development of breakthrough (key) technologies and high risk/high gain opportunities. Space Science for example is an obvious and worldwide established best practice. (ref. annex 3)

Research institutes that act as the national "home base" for large research Infrastructures have the capability of creating unique science/technology combinations in their endeavour to push the frontiers of scientific knowledge. They maintain a continuous cycle of scientific inspiration and technological realisation, thereby challenging high tech industry. The Einstein Telescope for instance could be a good example. Development of the technologies required for the Einstein Telescope would ideally thrive in a well-developed Big Science environment in which funding for the development of key enabling technologies is readily available. (ref. annex 3)

Funding schemes are currently fragmented, not supporting the entire value chain. The inherent time-scale of Big Science projects is decades. Once a choice has been made to invest in a Big Science infrastructure, funding should be easily available for each phase (design, co-development, construction, technology transfer and exploitation) to optimise the return on investment of such thorough selections. (ref. annex 2)

Industrial Liaison Officers (ILOs) are already acknowledged for their role as intermediaries between science and industry. Their focus can be different depending on the specific mission of their research institutes, but ranges from technology transfer, initiating co-development to raising geo-return. An ILO-network would encompass all these capacities and be able to serve as a powerful lubricant in a Big Science ecosystem.

Typical examples, particularly set by The Netherlands, can be found growing in Spain, Sweden and Denmark while the Netherlands is losing its vanguard position.

Many publications and reports since the ILO-net issued its first Position Paper confirm that there is a high ambition of high tech companies to engage in Big Science; this market is attractive for its technological challenges, which enable the companies to raise their competitiveness on an international level. At the same time the companies are faced with high risks to invest in this market, while government support is failing to mitigate these risks. (ref. annex 4)

The new Horizon Europe program shows a definite trend towards a stronger support of breakthrough or "key (enabling) technologies" which are particularly crucial for the curiosity driven sciences, notably through the Future Emerging Technologies program (FET) and the European Innovation Council (EIC). The H2020 funded ATTRACT project is another example of a successful approach to foster imaging and detection technologies from low TRL to market applications. (ref. annex 1, 3). NWO-I should consider to seize the opportunity to connect to this trend (and regain more influence on a national and European level).

RECOMMENDATIONS

Some general recommendations to develop an ecosystem for Big Science.

- Organise a conference with all the stakeholders and identify common interests;
- Strengthen the position and status of the research institutes as the home base for the connection to Research Infrastructures, including the ability to engage with industry;
- Develop the support structure and funding schemes to promote and sustain long-term co-development between science and industry in the complex and difficult market of Big Science (low TRLs), i.e. promote and support collaborations between home base institutes and industry (by employment of ILOs),
- Reinforce the coordination between the involved ministries for Big Science (EZK, OCW, BZK) and the delegations for European policy and programming (through an interdepartmental committee?);
- Follow-up the recommendations of the ILO-net Position Paper issued in 2018 and the Rathenau report (https://www.rathenau.nl/nl/vitale-kennisecosystemen/de-impact-van-grootschalige-onderzoeksinfrastructuren)

ANNEX

1. VISIONS ON THE RELEVANCE OF RESEARCH INFRASTRUCTURES, KEY TECHNOLOGIES AND INDUSTRIAL ENGAGEMENT;

EIROforum Paper; Research Infrastructures: Value and Impact for European Science, Industry and Society, May 2020

RIs are pivotal in sustaining and enhancing the competitiveness and world-class excellence of European science, and have significant value for and impact on European industry, society and economy, as demonstrated by examples in the Annex of this paper. European Research Infrastructures:

- harness scientific expertise that drives discoveries and creation of knowledge;
- offer access to researchers from Europe and beyond to the best and in some cases, unique, state-of-the-art facilities;
- enable integration of research communities from all countries in Europe;
- maintain the world-class excellence of European science

RIs are also drivers of innovation as they need to develop advanced instruments and a variety of cutting-edge technologies. These developments are often done in close collaboration with industry, and lead to both incremental and breakthrough innovation. Knowledge and technology transfer from RIs to industry via collaborative R&D activities, procurement of goods, equipment and services, and the creation of spin-off companies is of significant benefit for European industry. RIs now become key drivers for the continuous cycle of technology developments, which can feed the cycle of innovation well beyond their respective scientific areas. Research Infrastructures provide numerous benefits to European society and economy, either directly, through addressing societal challenges or industrial needs, or indirectly through training and education, as well as knowledge and technology transfer.

A vision for the European Innovation Council: from deep-tech research to visionary innovation and scale-ups, April 2020

To be successful, the EIC must itself disrupt the way the EU supports breakthrough technology and innovation. Rather than playing it safe, EIC funding must accept high-impact ideas, which are usually considered too high a risk for common investments. The EIC must be ready to be patient and accept the failures that are inherent to breakthrough technological research, especially in science-driven deep-tech. This is not about taking "stupid" risks, but taking the investment risk that the market alone will not accept, especially in cases where novel technologies and business models have the long-term potential to bring enormous societal benefits. The EIC must bring together communities of science and entrepreneurship that have been disconnected, or only loosely linked, for too long.

destination #4; Horizon Europe Research Infrastructures Work Program 2021-2022 outline]; R&D for the next generation of scientific instruments, tools and methods

To deliver innovative scientific instrumentation, tools and methods, which advance the state-of-art of European RIs, and show transformative potential across scientific domains, serving a wide community of users and/or new areas of research and underpinning the provision of improved and advanced services. Their development should take into due account resource efficiency and environmental (including climate-related) impacts. Co-development with industry, including SMEs, as well as training of RI staff for the operation and use of new solutions are important aspects. Consideration should be given to the potential exploitation of the innovative solutions at industrial level. Cutting-edge technologies will also enhance the potential of RIs to contribute addressing EU policy objectives and socio-economic challenges.

Making Science happen, ESFRI White Paper, March 2020

ESFRI considers that the following are needed for a stronger Europe:

- Reinforce the position of Research Infrastructures as an essential pillar of the European Research Area, forming a healthy, sustainable and integrated Research Infrastructure ecosystem that strives for scientific excellence with impact, and provides transnational services, supporting education and skills development.
- Enhance the role of Research Infrastructures as truly strategic investments across borders of sectoral domains, contributing to European strategic agendas and enabling European research and innovation to address pressing and complex societal challenges.
- Develop and exploit the potential of European Research Infrastructures as knowledge and innovation hubs, integrated into local communities, forming the basis of European competitiveness, with regional impact and global outreach.
- Further strengthen the coherence between European, national and regional priorities and policies for Research Infrastructure development and funding.
- Exploit the potential of Research Infrastructures as major promoters of Open Science providing FAIR (data which meet principles of findability, accessibility, interoperability, and reusability) and quality certified Open Data, supporting their contribution to the success and impact of the European Open Science Cloud and so strengthening their capacity to serve their users.
- Better use the potential of the ESFRI to contribute to the development of coherent Research Infrastructure policy and investment in Europe, ensuring its appropriate capacity to that end

2. DISCONNECTED FUNDING PROCEDURES (EXAMPLE ESA/SRON)

The selection of one of the three M5 candidate science missions of ESA is expected in 2021. Selection of SPICA/SAFARI (led by SRON) would be the final acknowledgement of a major achievement (and investment), both scientifically and technologically thoroughly reviewed on a European level by ESA. But still, the final realization of SAFARI will not be possible without national funding based on competitive calls that are not in tune with those of ESA.

Increasing competition on the national level has eroded the flexibility of research institutes like SRON for which long-term continuity and perspective in their research programs is a sheer necessity to perform on a European level. An ecosystem for Big Science would require some kind of base funding. Base funding used to be part of the budget of research institutes to maintain their competitive edge, as well as for early investments in new promising research perspectives.

3. THE IMPORTANCE OF KEY ENABLING TECHNOLOGIES FOR SCIENCE

The initiative of the Dutch Topsectoren policy, some ten years ago, was driven by the desire to raise the level of R&D to 2,5% of the GDP and to join the top 5 of European's most knowledge intensive economies. The Netherlands still haven't reached that goal, despite the fact that the large multinationals that account for about 60% of industrial R&D also invest more than their counterparts worldwide do on average. The Rathenau institute (in a factsheet of 2 April 2020) concludes that raising R&D intensity is not a matter of industry and government investing a little more; in fact it is a call to change the economic structure of the Netherlands. The influence of the NWO physical sciences institutes on innovation policy has been limited. Despite the (late) initiative to develop a roadmap "Advanced Instrumentation" (AI) the institutes hardly profit from Topsectoren policy and neither has it been a boost for Public Private Partnerships for the development of instrumentation starting at low Technology Readiness Levels (TRL).

The development of key technologies can become a major improvement, both for the R&D intensity in general as to the competitive position of the physical sciences institutes. Thanks to the initiative of the roadmap AI and the ILO-net a "plan" for the development of key technologies was accepted in the context of the KIA, but a refinement is still a challenge. Will NWO follow the advisory report of the AWTI; "Krachtiger kiezen voor sleuteltechnologieën" (January 2020), and claim a decisive role also on behalf of its institutes?

4. ILO-ACTIVITIES IN EUROPE, THE ROLE OF THE DUTCH ILO-NET

The activities of the Dutch ILO-net, for instance in 2018 to issue a Position Paper on the future of Big Science (https://bigscience.nl/files//rapporten/Position%20Paper%20on%20the%20future%20of%20Big%20Science%202018_def_.pdf), soon raised the attention of the colleagues in Denmark and Sweden, who also organised their activities to connect science with industry; http://www.bigscience.dk and https://www.bigsciencesweden.se

The first Big Science Business Forum (BSBF) (https://www.bsbf2020.org) was organised in Copenhagen in 2018, and the ILO-net was prominently present with a large booth for the Dutch companies. The Dutch ILO-net is represented in the International Organizing Committee of BSBF and is in favour of organising one of the upcoming editions e.g. the one in 2023 as an ideal opportunity to provide the Dutch industry with local access to the majority of the European Research Infrastructures presenting their plans and technology roadmaps for the near and long term future. The plan is to organise a BSBF every two years.

The Dutch ILO-net is also member of the Board of PERIIA (www.periia.eu), which is aiming at the establishment of a formal Pan-European Research Infrastructure ILO Association. It is expected that this will be one of the results of the ENRIITC project, funded from the EU Horizon 2020 program, in which NWO/ILO-net is a partner. The primary objectives of ENRIITC (www.enriitc.eu) are:

1. Establish a sustainable European network of ILOs and ICOs which enables mutual learning,
2. Map collaboration potential between research infrastructures and industry,
3. Develop and refine strategies and best practices to foster these collaborations,
4. Raise awareness among industry for collaboration opportunities at research infrastructures, and demonstrate impact.

ENRIITC brings together 11 Partners and more than 60 Associates from around Europe. The network members represent diverse scientific areas, industrial sectors and geographical regions.

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