iLO-net
INDUSTRIAL LIAISON OFFICERS NETWORK

Position Paper on the future of Big Science

Introduction

Scientists and engineers change the world. This is a quote of Regina Dugan at the start of her TED-talk*. Convincingly she shows how science and technology have been shaping our world in the past century. Often in a way we couldn't have imagined. Imagination, curiosity and perseverance are the driving forces of this development.

Big Science is the breeding ground where scientists and engineers meet and challenge each other to great achievements. Solving scientific questions often requires the utmost of technological developments and subsequently often leads to new questions that are even more challenging. This is the natural cycle of Big Science; from scientific inspiration to technological realization, answering questions and defining new questions. Not only is it feeding our curiosity, but it is ultimately leading also to the application of new technologies for solving our societal challenges in e.g. climate change, medicine and energy production.

The high-tech industry is invaluable in this cycle. There is an increasing need to involve industry for the development of the required complex break-through technologies. From the perspective of the industry, the involvement in Big Science is motivated by the opportunities to improve capabilities and to introduce new technologies in existing or new markets. But this is not without risks; projects are getting ever more complex with the associated very long lead times; there is no short-term return on investment. Technologies for Big Science nearly always require significant investments to realize commercially viable products. To keep the cycle running we need ways to tackle these risks and still achieve the high gains at the end of the road, both for Big Science and for the industrial partners.

The Dutch network of Industrial Liaison Officers (ILO-Net) was created to support the collaborations that are required to keep Big Science running; between the scientific community and industry, and with the help of local and European authorities. June 8th, 2017 the ILO-Net took the initiative to map the relevant issues during a working conference in Brussels (at Neth-ER). We invited an international company of speakers from science organizations, industry, Big Science facilities and government agencies to present the most important issues from their perspective. These presentations were followed by a working session during which four groups addressed the specific challenges that were identified and tried to find ways to tackle them. This position paper is the reflection of the conference. It summarizes the issues involved and gives recommendations to proceed with them, hopefully in the discussions that lie ahead; in the national and international arenas.

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* https://www.ted.com/talks/regina_dugan_from_mach_20_glider_to_humming_bird_drone?language=nl

The various perspectives

The keynote speeches (ref. https://www.bigscience.nl/nl/node/282) discussed the challenges that Big Science will be confronted with in the next twenty years from the relevant perspectives; the Big Science facilities, the industry, and science.

Leonardo Biagioni, Head of Contracts and Procurement, Fusion for Energy: "Big Science in a Changing Business Context"
What could be called Big Science has been subject to an evolution over the last 50 years. For 21st century Big Science activities trends of less favorable conditions can be noticed, in particular decreasing infrastructure spending which leads to only moderate business opportunities and less industrial engagement. The appeal for industry can be improved by introducing more attractive business models and coordination between various Big Science programmes, creating a larger, more accessible and attractive market with inherent business continuity.

Markus Nordberg, Head of Resources Development of the Development and Innovation Unit at CERN: "How to organize and support large collaborations in Big Science endeavours during many years, maintaining the innovation chain, and assuring spin-off and technology transfer along the way?"
Collaboration, Innovation and Technology Transfer are the enabling elements that stimulate the return of Big Science for all parties involved. The LHC experiments at CERN can be seen as an example in which all these elements were actively pursued and where CERN tries to realize an "ecosystem" including relevant activities. This is done using the current IdeaSquare initiative at CERN and the new EU initiative ATTRACT (http://www.attract-eu.org/) as implementations.

Hans Priem, Business Manager Science & Technology at VDL ETG: "VDL & Big Science relevance"
The cross-cutting Science & Technology segment within VDL, being a larger high-tech lead industry, has various goals which fit well with participation in Big Science projects. However, the large number of projects and tenders with a high degree of inherent complexity requires priority setting. Strong partnering with Big Science agencies, national institutes and specific innovative high-tech industries is a pre-requisite. There are pros and cons of SME participation in BS. This is thought to be generally difficult unless in collaboration with larger lead industries.

Michael Wise, Head of the Astronomy Group at ASTRON: "The Square Kilometre Array - Big Science for Global Astronomy"
A new trend in Big Science is data intensive astronomy, requiring large scientific collaborations and new scientific (often global) infrastructures including large and complex central and regional Data Centers. The SKA initial data archive will be roughly 300 Petabytes, posing substantial challenges. Realizing these new infrastructures will stimulate technology development, partnerships with industry, global networks and initiation of world-wide scientific collaboration.

Concerns and Recommendations

During the conference three main areas of concern were identified. In each of these areas, which are obviously interrelated, recommendations were formulated.

Compared to the 20-th century, with relatively high public funding, the Big Science market is getting less attractive to enter for industry, especially for high-tech innovative SME's. The risks associated with (long-term) investments are relatively high.

To promote industrial participation and to lower existing barriers the following recommendations should be considered;

1. Develop specific funding programs for SME's to enter big science projects and to promote low TRL development (e.g. SBIR)
2. Create a shared (national) vision on Big Science among the involved government agencies, based on an innovation chain approach. Make strategic choices on national level. Align funding sources along the chain, involving science driven technology development, innovation and societal challenges.
3. Improve the information flow between science and industry on both a national and on a European level, for instance by creating a European database for finding technological solutions and suppliers, a common on-line forum for suppliers and Big Science programs for matchmaking
4. Promote the creation of long term roadmaps for the development of key enabling technologies for Big Science (on a European scale)

Cultural differences still prevent sustainable forms of collaboration between science and industry. The engagement of researchers with the societal and industrial context is limited.

The following recommendations should be considered;

5. Establish exchange programs; a. allow (young) scientists and industry professionals to spend time working at each other's facilities; b. create internships for scientists in industry, and c. allow for paid study leave for young industry professionals at science institutes
6. At funding level; make funding partly dependent on collaboration and (societal) innovation; allow for "in kind" contributions of scientists to contracts with industry (which should have an acceptable financial and contractual set-up themselves), instead of giving cash
7. Provide tax breaks to industry to encourage outreach and risk-taking to work with scientists/researchers
8. Organize workshops on outreach, marketing and/or business development to train interested scientists how to better connect to industry/societal actors
9. Promote transition in science/industry cooperation approach along the following lines; a. from (often too) detailed specification towards road-mapping, b. from control towards vision, c. from product-centered to technology centered, d. from "how" to "what" (a more explicit "target-orientated" approach)
10. Involve industry at the earliest possible stage in a science/industry collaboration and actively promote technology transfer

Barriers and risks prevent commitments in long term planning and investments. Especially SME's experience a high threshold in bidding on Big Science tenders. Costs/investments are relatively high compared to the size of the company and the expected return on investment

The following recommendations apply to this area;

11. Create low-cost government provisions for Big Science contract backing (to cover bank guarantee requirements)
12. Provide government insurance to cover risks in major Big Science investments (if technology solutions prove more difficult than expected)
13. Promote and fund the creation of more sustainable consortia that act on Technology Roadmap items instead of short term products or services
14. Promote the establishment of European databases in which information on required skills and competences can be easily accessed to facilitate match-making between the Big Science Organizations, research organizations and industry
15. Downsize contracts especially for SME's to decrease management load and mitigate financial and technical risks
16. Create a national agency for Big Science. Such an agency can respond to large tenders, involve SME, and bear financial risks

Next steps

Obviously, discussions are needed to ensure that all these recommendations will get the proper attention and can be picked up by the party who takes the first responsibility to start an implementation. Most likely however, this will require the collaboration of several stakeholders (Big Science facilities, research institutes, industry and government agencies). During our discussions the desire to establish a pan-European ILO-Network was mentioned several times. Surely, such a network could be a promotor to address and solve the issues at hand. In particular this refers to recommendations 3, 4, 8 and 14. The creation of a European ILO-Network could be undertaken as part of the next European Framework Program (FP9).

Moving forward with these recommendations, the Big Science Business Forum, to be held in February 2018, provides an excellent platform to discuss these topics with a wider community. The aim is to connect with both national and international policy makers to work with them towards changing and improving the boundary conditions for working with Big Science infrastructures. At the European level, one could think of focusing FP9 calls on key-enabling technologies that play a role in multiple Big Science projects and in providing funds for a European network of industrial liaison officers who could use these funds to expand their bridging experience to include multiple organizations and research areas. These two approaches together could improve the efficiency with which funds are applied and advance both science and industrial uptake for the benefit of society.

References

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- R&D Attraction Networks, A report on stakeholder co-operation and STI diplomacy to attract investments in R&D; technopolis, July 2016
- Why fund research?, A guide to why EU-funded research and innovation matters, Science|Business, June 2017
- https://aeon.co/essays/has-progress-in-science-and-technology-come-to-a-halt

Details of the keynote speakers

Leonardo Biagioni; Head of Contracts and Procurement at Fusion for Energy (F4). F4E is the European agency for ITER, where his service manages all supply chain activities for the European contribution to ITER and the Broader Approach agreement with Japan (including procurement, industrial policy, technology transfer, etc.). Before joining F4E he worked for many years in space industry (he was involved in several space science and exploration projects in Europe and the USA, including the International Space Station, Cassini-Huygens, LISA, Gaia, Bepi Colombo, SMART-1) and in academia, where he started his career in the fields of applied mathematics, hypersonic aerothermodynamics and plasma-dynamics.

Hans Priem; Business Manager Science & Technology at VDL ETG. After having finalized his Masters in Business Economics at Tilburg University, Hans started his career with ASML. Based on his experience within Finance and Product Management, he joined Assembleon to assume responsibility over the company's Installed Base Business. Since 2011 , Hans is with VDL ETG. He is, as part of VDL's company business development activities, responsible for building VDL ETG's Science & Technology-related business, all based on VDLs ultra-precision machining & metrology, vacuum, and handling competences.

Michael Wise; Head of the Astronomy Group at ASTRON and an adjunct professor in Radio Astronomy at the University of Amsterdam. He is an active research astronomer whose interests include galaxies, black holes, and the formation and evolution of large-scale structure in the universe. Along with fundamental astronomical research, his interests include a variety of topics in data-intensive astronomy. He also has over 20 years of experience supporting the construction and operation of large-scale astronomical facilities, such as the Chandra X-ray Science Center, the LOFAR telescope, and now the SKA. He is President of IAU Commission B2 on Data and Documentation and a member of the international SKA coordination group. Within Europe, he is coordinator for the H2020 project AENEAS to establish a distributed science data center to allow the astronomical community to extract scientific results from the exa-scale data sets the SKA will produce.

Markus Nordberg; Head of Resources Development of the Development and Innovation Unit at CERN, Switzerland. He is currently involved in launching a sensor and imaging R&D initiative called ATTRACT (www.attract-eu.org) aiming at both scientific and societal impact. He also manages the related IdeaSquare initiative at CERN (cern.ch/Ideasquare) that hosts detector R&D and society-driven MSc-student projects. Prior to this function, he served 12 years as the Resources Coordinator of the ATLAS project at CERN (www.atlas.ch). He has also served as Visiting Senior Research Fellow at the Centrum voor Bedrijfseconomie, Faculty ESP-Solvay Business School, University of Brussels, and as a member of the Strategic Management Society and the Association of Finnish Parliament Members and Scientists, TUTKAS. He has a degree both in Physics and in Business Administration.

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