Towards a world-class Integrated Life Science Research Infrastructure

Proposal for the establishment of a unique multidisciplinary research infrastructure, enabling excellent integrated data-intensive research across life science sectors.

Field: life science research – Throughout this document the term *life science research* is used in its broadest meaning, referring to research in the biomedical field and in the clinic, in plant/animal biology and in crop/livestock breeding, in nutritional research, in microbiology and in industrial biotechnology, and in ecology.

Vision: a world-class infrastructure enabling integrated life science research – We propose to develop a unique multi-disciplinary research infrastructure, involving all Dutch top-quality expert groups that have well-sustained and open research facilities in technology areas of genomics, proteomics, metabolomics, bioimaging and the data sciences bioinformatics, e-science and systems biology. Clinical biobanks and genetic collections of international value will be included. All these valuable resources will be closely connected in a nation-wide life science technology platform with a federated set up, and with a professional common data and ICT infrastructure for advanced big data analytics and data stewardship. The resulting infrastructure, governed by a collective, but operated as a single unit as of 2020, will enable integrated research across life sciences fields and sectors at an unprecedented level. It will attract international top scientists and strengthen the competitiveness of Dutch life science sectors.

Challenges in life science research – Biology is at the heart of solutions to societal challenges such as personalised health, high quality nutrition to feed the growing world population, renewable resources and energy, and safeguarding our biodiversity. Globally, progress in biology is severely hampered by the fact that international-level technology expertise and facilities are highly dispersed, operated in isolation, and all have their own access procedures. Consequently, it is difficult to combine top quality technologies in integrated life sciences research projects. Combining technologies will be crucial to:

- adequately measure life at all relevant levels of functional and structural organisation and study the regulation of the underlying processes – each level (e.g. DNA, proteins, metabolites and their spatial and temporal localization) requires dedicated specialists, and individual groups do not have easy access to their essential know-how and infrastructures;
- professionally combine and analyse data generated in in-house experimental set ups, and with external sources of information to unravel the complexity of biological systems – this requires expert data analytics and stewardship beyond the skills of most research labs;
- fully employ the power of computational techniques to link structured and unstructured information and to develop predictive mathematical models – employing these capacities to their full potential is crucial if we want to find breakthroughs in the complexity of biology.

Strong basis to build on: Dutch Techcentre for Life Sciences (*www.dtls.nl*) – The Netherlands has an excellent starting position to lead by example in global integrated life sciences research, capitalising on major investments in the life science sectors and collaborative public–private initiatives. In recent years, expert networks of scientists, technology experts, data experts and engineers have initiated the formation of a common platform: DTL, the Dutch Techcentre for

Life Sciences. DTL connects Dutch technology expert communities that already operate at the international forefront of technology innovations and participate in international networks and infrastructure initiatives (e.g. ESFRI). Of these communities, over 80 expert groups[1] in genomics/next generation sequencing, proteomics, metabolomics, bioimaging, bioinformatics, ICT and systems biology are meanwhile involved in DTL. This community also involves major biobank collections across different sectors. First steps are now being taken to work towards a common approach for (FAIR)[2] data stewardship and establishing a common data and ICT infrastructure involving all partners, and building from experienced nodes and best practices (e.g. SURF, 3TU-Data Centre, cross-UMC data4lifescience programme).

DTL has meanwhile been implemented as a formalised structure with strong executive support of academia and industry to drive the realisation of an integrated research infrastructure. Already, 26 public and private research organisations contribute as formal partners, since its formal start early 2014[3], and DTL is expected to involve over 35 partners by the end of 2015.

The proposed infrastructure will enable life scientists across sectors to study the complexity of biology at a qualitative and quantitative level. The following steps will be taken:

- Select existing and emerging top quality facilities in the Netherlands, based upon both their scientific track record, their quality procedures and open accessibility;
- Design and implement a common life science data stewardship and ICT infrastructure based upon international standards, connecting all involved facilities and research groups;
- Harmonise access to dedicated research facilities and biomaterial collections and develop a sustainability model for the integrated research infrastructure;
- Create best practices in integrated life science research in multi-disciplinary teams of biology and technology experts, from experimental design to data analysis and data stewardship;
- Promote the exchange of expertise and training of scientists, data experts and engineers;
- Optimise local investments in expertise and equipment to minimise needless duplication;
- Arrange for a secure interface between universities, institutes, SMEs and large companies, to exchange and provide access to data, algorithms, software and computational power.

Approach – In the coming months we plan to establish a detailed roadmap and an investment and exploitation plan. Thereafter we will work out a funding strategy, including (inter)national funding options (e.g. H2020, EFRO and the 'Roadmap Grootschalige Onderzoeksfaciliteiten').

Support to this vision and proposal – This proposal is supported by experts who represent a broad range of Dutch research and infrastructure initiatives of national value, and who represent their field in international networks. Also, the DTL board supports this proposal. See attached overview of names.

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[1] See: http://www.dtls.nl/expertise-facilities/
[2] See: http://www.dtls.nl/fair-data/
[3] See: http://www.dtls.nl/about/partnership/

Annex: The following persons support this vision and proposal

Name	Field	Representing
Prof. dr. Edwin Cuppen	cancer genomics	UMCU, Hubrecht, CPCT
Prof. dr. Dorus Gadella	microscopy	UvA, NL-bioimaging AM
Prof. dr. Thomas Hankemeijer	metabolomics	LU, NL Metabolomics Centre
Prof. dr. Jaap Heringa	bioinformatics	VU, ELIXIR-NL
Dr. Connie Jimenez	oncoproteomics	VUMC, NL Proteomics Platform
Prof. dr. Folkert Kuipers	pediatrics	UMCG, NFU Research Infrastructure
Prof. dr. Peter Luijten	medical imaging, transl. med.	UMCU, EATRIS, CTMM-TI-Pharma
Prof. dr. Gerrit Meijer	pathology, pers. medicine	NKI-AVL, Person. Precision Med. Init
Prof. dr. Barend Mons	biosemantics, data stewardship	LUMC, ELIXIR-NL
Prof. dr. Marcel Reinders	bioinformatics, informatics	TUDelft, NBIC
Dr. Hans Roubos	biotech, systems biology	DSM
Prof. dr. Ronald Stolk	epidemiology, popul. biobanking	UMCG, BBMRI, LifeLines
Dr. Jeroen Rouppe vd Voort	agrogenomics/agrobiotech	ENZA Zaden
Prof. dr. Cisca Wijmenga	human genetics, clin. biobanking	UMCG, BBMRI-NL

DTL Board members:	Organisation
Dr. Ir. J.E. Ernst van den Ende	Director Plant Sciences Group Wageningen UR
Dr. Ir. C.D. Kees de Gooijer	Chief Inspiration Officer Topsector TKI's Agri&Food and Biobased Economy
Drs. J. Jan de Jeu (MSc/MA)	Vice president executive board University of Groningen; member SURF board, chairman NLeSC board
Prof. Ir. K. Ch.A.M. Karel Luyben (Chair)	Vice president & rector magnificus TU-Delft
Prof. dr. ir. K.I.J. Karen Maex	Dean of the faculties of science of the University of Amsterdam and the Amsterdam Free University
Prof. dr. F. Frank Miedema	Dean University Medical Centre Utrecht
Dr. G.C. Gerhard Wagner	Global R&D director DSM Biotechnology Center