SciLifeLab

Report to the SciLifeLab International Advisory Board

2021

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1. Welcome and Introduction

We very much look forward to the upcoming meeting with the International Advisory Board (IAB) and warmly wish the IAB members welcome to the digital meeting on October 19–22, 2021. This IAB meeting is important in the light of SciLifeLab now being more than 10 years old and having served as a national research infrastructure for life sciences since 2013. A lot has happened since the last IAB meeting. SciLifeLab has assumed an expanded role in the Swedish life science ecosystem and we have just received a new higher four-year budget from the government and substantial external funding from Knut and Alice Wallenberg (KAW) Foundation.

The biannual visits of the IAB and the constructive comments received have been critically important to the development of our organization. We are thankful for the feedback and helpful recommendations from the 2019 IAB meeting, and have implemented most of these recommendations. Some points remain difficult to execute due to e.g., the national role of SciLifeLab, its status as a collaborative program and the formal remit to SciLifeLab from the government. We will report about the actions taken so far in response to the previous IAB recommendations.

Since the last IAB visit in 2019, many other important developments have taken place. Based on the input from the IAB, the SciLifeLab community, and other national stakeholders, a 10-year Roadmap for SciLifeLab was formulated and launched. The Roadmap is based on three pillars: Infrastructure, Research, and Data-driven life science. During the COVID-19 pandemic, we received 213 MSEK extra funding from the KAW Foundation enabling SciLifeLab to play an active role in supporting research across Sweden on COVID-19, as well as in launching improved virus and antibody testing in the clinical setting. In the 2020 research bill from the government, SciLifeLab received a significant increase in its yearly basic budget, which has enabled us to strengthen the support to the national infrastructure across the country. In addition, SciLifeLab received governmental funding and a commission to establish a national program for laboratory preparedness for future pandemics. Taken together, this represents approximately a 25% increase of the governmental 4-year budget of SciLifeLab. Perhaps the most significant new development is the establishment of a 3.1 BSEK (about 300 MEUR) KAW-supported 12-year national program in data-driven life science (DDLS), which is coordinated by SciLifeLab.

All these developments, and many more, will be described in detail in this report as well as during the meeting. Taken together, the various new initiatives significantly expand the traditional role of SciLifeLab as a national life science actor. We would very much value the input from the IAB on how to develop these various initiatives optimally and how to derive synergies from the separately funded programs.

We hope you will have read this report before the meeting, as we will have limited time available to go through everything in the presentations during the meeting. We very much look forward to the discussions, and your recommendations for the further development of SciLifeLab.

Carl-Henrik Heldin, Chair of the Board
Olli Kallioniemi, Director
Mia Phillipson, Co-Director

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1.1 Abbreviations

BSEK	Billion SEK Swedish crowns
CS	Campus Solna
CSC	Campus Solna Committee
CSD	Campus Solna Director
CTH	Chalmers University of Technology
DC	SciLifeLab Data Centre
DDD	Drug Discovery and Development platform
DDLS	SciLifeLab & Wallenberg National Program for Data-Driven Life Science
EBI	European Bioinformatics Institute
ELSI	Ethical, legal, and social implications
EMBL	European Molecular Biology Laboratory
ERC	European Research Council
ERO	SciLifeLab External Relations Office (part of SciLifeLab Operations Office)
ESS	European Spallation Source
FAIR	FAIR: for data to be Findable, Accessible, Interoperable and Reusable
FTE	Full-time equivalent (staff)
GMS	Genomic Medicine Sweden
GU	University of Gothenburg
HOP	Head of Operations
IEC	International Evaluation Committee
ID	SciLifeLab Integration Director
InfraLife	Infra Access for Life Science Sweden
JIF	Journal Impact Factor
KAW	Knut and Alice Wallenberg Foundation (the largest private funder of scientific research in Sweden)
KI	Karolinska Institutet
KPI	Key Performance Indicator
KS	Karolinska University Hospital (Karolinska Sjukhuset)
KTH	Royal Institute of Technology (Kungliga tekniska högskolan)
LiU	Linköping University
LOI	Letter of intent
LU	Lund University
MAX IV	Max IV Laboratory
MCSA	Marie Curie Support Action
MG	SciLifeLab Management Group
MoU	Memorandum of Understanding
MNCS	Mean normalized citation score
MSEK	Million SEK
NBIS	National Bioinformatics Infrastructure (equal to SciLifeLab Bioinformatics platform)
NGI	National Genomics Infrastructure
NGS	Next-Generation Sequencing
NMMP	National Molecular Medicine Fellows Program
NRM	Swedish Museum of Natural History
NSC	National SciLifeLab Committee
OO	SciLifeLab Operations Office
ORCID	Open researcher and contributor ID
ORU	Örebro University
PD	Platform Director
PCO	Platform Coordination Officer
PI	Principal Investigator
PLP	Pandemic Laboratory Preparedness
PM	Precision Medicine
PP(top10%)	Percentage of papers in the top 10% most cited
PSD	Platform Scientific Director
RCP	Research Community Program (SFO + national funding)
RED	Research Environment and Development
SLU	Swedish University of Agricultural Sciences
SU	Stockholm University
UmU	Umeå University
UU	Uppsala University

▶ 1.2 International Advisory Board members

Jan Ellenberg (Chair)
EMBL Heidelberg, Germany

Søren Brunak
Technical University of Denmark and University of Copenhagen, Denmark

Jo Bury
VIB, Belgium

Yoshihide Hayashizaki
RIKEN Omics Science Center, Japan

Sirpa Jalkanen
University of Turku, Finland

Janet Jansson
Pacific Northwest National Laboratory, USA

Jonathan Knowles
FIMM, University of Helsinki, Finland

Svante Pääbo
MPI for Evolutionary Anthropology, Germany, and Okinawa Institute of Science and Technology Graduate University, Japan

Aviv Regev
Genentech, USA

Sarah Teichmann
Wellcome Sanger Institute, UK

2. Executive Summary

Including SciLifeLab key developments 2019–2021.

SciLifeLab has been assigned by the Swedish government to be a national life science infrastructure resource, and to serve as a center for large-scale molecular biosciences. The overall goal of SciLifeLab is to facilitate cutting-edge, multi-disciplinary life science research. This is achieved through a state-of-the-art research infrastructure and by promoting research capabilities and communities. Starting 2021, a growing focus has been on data-driven life science. Via these actions SciLifeLab contributes to ground-breaking scientific discoveries and continuous technological progress, with eventual societal benefits in healthcare and industry as well as in environmental sustainability.

In this report we are presenting SciLifeLab's progress and key events over the last 2.5 years (January 2019 to June 2021) (*Figure 1*), as well as the plans and strategies moving into the second decade for our organization. We outline the activities that have been carried out in response to the comments and recommendations from the last IAB visit, and present other major developments.

With the IAB recommendations from 2019 as a starting point, SciLifeLab set out to develop a long-term strategy for 2020–2030. SciLifeLab leadership and the entire organization were engaged, including the infrastructure platforms and the wider SciLifeLab community. As part of the process, in September 2019 a national hearing was arranged and hosted by SciLifeLab with key stakeholders from Swedish life science. SciLifeLab's 10-year Roadmap 2020–2030 was published in February 2020, based on the three pillars: Infrastructure, Research and Data-driven life science (*Figure 2*). These three pillars make the base for SciLifeLab's additional three strategic objectives; Recruitment and Training, Collaboration and Development of Translational Capabilities.

At the national hearing in 2019, SciLifeLab advocated the importance of strengthening the Swedish life science research infrastructure, research, and data-driven life science. Already then KAW expressed its strong support for a data-driven life science program in Sweden. This eventually resulted in the 3.1 BSEK 12-year SciLifeLab & Wallenberg National Program for Data-Driven Life Science (DDLS) launched in 2021. Furthermore, the Swedish government research proposition for 2021–24, announced in December 2020, contained increased infrastructure funding for SciLifeLab with 150 MSEK through 2021–24, as well as commissioned SciLifeLab to set up laboratory preparedness for future pandemics capacity with 130 MSEK of funding over the same four-year period. Taken together, these funds represent an approximately 25% increase of governmental support for SciLifeLab infrastructure in the four-year period 2021–24.

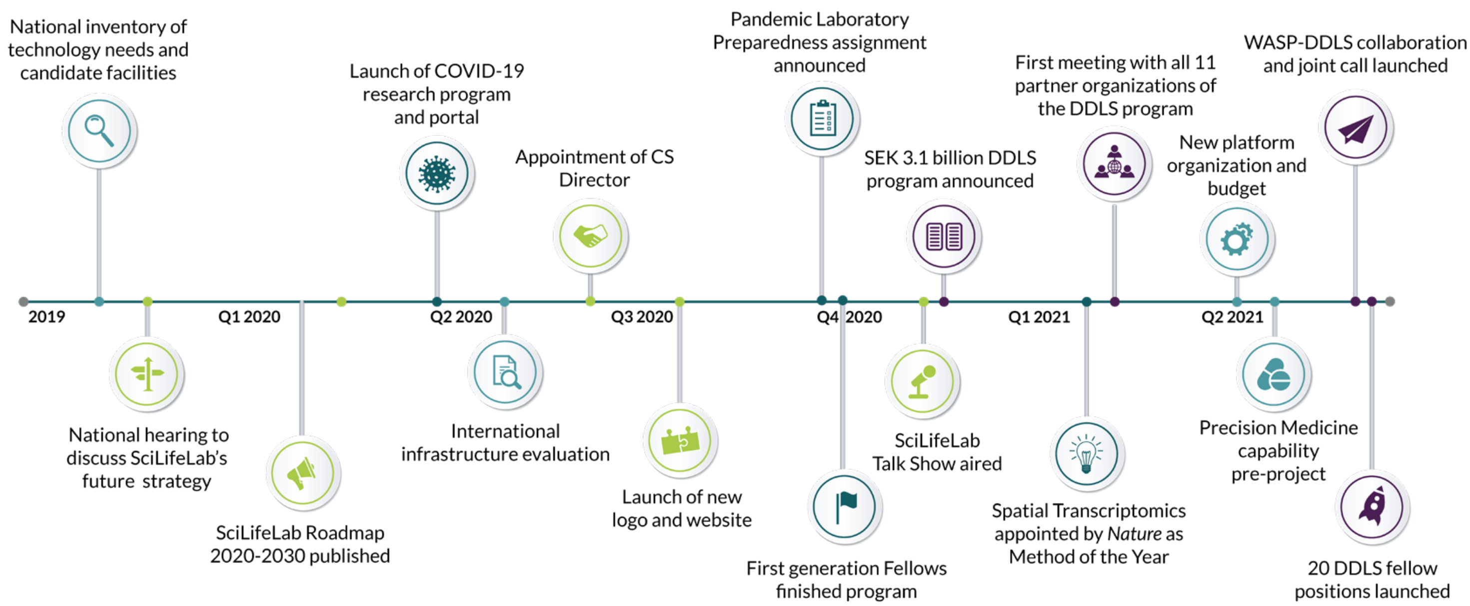

Figure 1. Timeline with key SciLifeLab achievements 2019–2021.

Since 2019, major work has focused on many other topics, such as 1) infrastructure evaluation in 2020 and the resulting new platform organization, 2) Campus Solna research and infrastructure community, 3) establishment of national SciLifeLab sites outside Stockholm/Uppsala, 4) establishment of formal collaborations with other national and international research infrastructures (e.g., MAX IV, ESS, and EMBL). SciLifeLab's research community is steadily growing; since the last IAB visit 16 young researchers have been recruited to the SciLifeLab Fellows' program. SciLifeLab Group Leader definition has been established with nominations open throughout the year. The scientific output and impact of the SciLifeLab infrastructure and research community remains high as documented in the report. Through the development and implementation of SciLifeLab capabilities (*Section* 7.5), our infrastructure and research communities are getting more tightly connected. A major example of a cutting-edge achievement at the intersection of research, technology development and infrastructure was the nomination of Spatially Resolved Transcriptomics as the method of the year in 2020 by Nature Methods. KTH-Lundeberg lab at SciLifeLab has developed the Spatial Transcriptomics technology, with SU-Nilsson lab contributing with in situ sequencing technology (*Section* 7.8). Both technologies received Technology Development support from SciLifeLab and have been subsequently patented and adapted globally via successful technology transfer and they are now offered as part of a new Spatial Biology service within the new SciLifeLab infrastructure.

The COVID-19 pandemic had a major impact on SciLifeLab activities in 2020–21. Through active initiative and dedicated funding from KAW for COVID-19 research, the entire SciLifeLab research and infrastructure communities were engaged in fighting COVID-19. The build-up and coordination of research programs and the launch of the Swedish COVID-19 Data Portal were carried out – placing SciLifeLab in the national forefront in efforts combating COVID-19. At the request of the Swedish government, SciLifeLab is now developing these efforts towards long-term laboratory preparedness for future pandemics, built on the interaction between our infrastructure, clinical microbiology labs, governmental agencies, biobanks, research, and the COVID-19 Data Portal.

We look forward to the input from the IAB on these actions and on all our future plans outlined in this report. This report is a comprehensive account of SciLifeLab activities 2019–2021, with more details provided in the appendices. Key challenges for the future and questions for the IAB are summarized at the end of this report, including how we can best combine and synergize across the three pillars of SciLifeLab activities: Infrastructure, Research, and Data-driven life science.

We strongly recommend the IAB to review this material in advance to facilitate a productive dialog during the upcoming meeting.

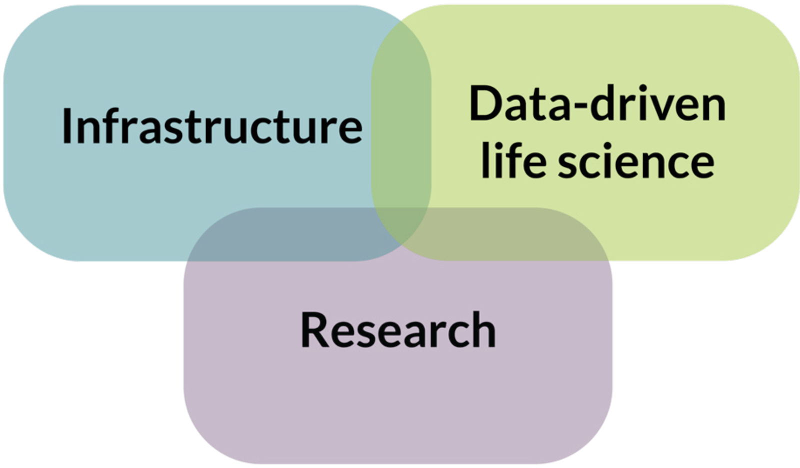

Figure 2. SciLifeLab's three pillars.

3. Stakeholders - IAB Meetings

This report details activities in response to the comments from IAB in 2019, highlight major actions since the last meeting, and present SciLifeLab's plans and strategies for the future. The IAB will meet in a digital format with the SciLifeLab leadership, rectors, and many other key representatives and stakeholders:

- **SciLifeLab Board:** The IAB reports to the SciLifeLab Board, and it is important that the SciLifeLab Board can help to set the stage for the IAB meeting 2021. The IAB will meet with the SciLifeLab Board on October 19 as part of the preparatory meeting.
- **Founding Universities Rectors' Council:** The rectors (vice-chancellors) of KI, KTH, SU and UU will meet with the IAB to ensure a high-level integration of the SciLifeLab strategies with the plans, future interests, and overall priorities of the four universities. The IAB will meet with the Rectors on October 21.
- **SciLifeLab Management Group (MG) and Integration Directors (IDs):** Led by the SciLifeLab Director, who reports to the Board, the group includes the Co-Director, the Infrastructure Director, the four Scientific Directors (SDs), representing each of our founding universities. In addition, the Campus Solna Director is an adjunct member of the MG. The Co-Director, the Campus Solna Director and three of the SDs have been appointed after the last IAB visit in 2019. Links to the four founding universities are the responsibility of the four integration directors (IDs). MG members and IDs are present during the majority of the sessions with the IAB.
- **DDLS Steering Group:** As the decision-making body for the DDLS program, the SciLifeLab Board has appointed the DDLS steering group consisting of the Program Director and ten steering group members. The group also includes an observer from the Knut and Alice Wallenberg (KAW) Foundation. Meeting with IAB is on the last day.
- **Campus Solna Committee and Director:** Many IAB comments from 2019 concerned the SciLifeLab Campus Solna. The newly appointed Campus Solna Director will present a Campus Solna action plan. The Campus Solna Committee members (SDs and IDs) are present.
- **SciLifeLab Platforms:** As a result of the national and international evaluation in 2020, the infrastructure is now organized into ten platforms for the period of 2021–2024. The new Platform Directors will present a short overview of the current technologies, services, operations and plans forward.
- **National Sites:** This is a new concept arising from IAB suggestions and discussions. We have just launched the first three SciLifeLab national sites in Lund, Gothenburg, and Umeå, which will be presented to the IAB.
- **SciLifeLab Operations Office (OO):** OO supports the Board, Directors, the Management Group, the infrastructure, and research community with coordination, administration, and execution of proposed actions. From 2020 OO has also supported the National COVID-19 Research Program and from 2021, the DDLS Steering Group and the DDLS program. The responsible OO members will be present in the relevant sessions with the IAB.
- **SciLifeLab Data Centre (DC):** Coordinates and supports activities throughout the SciLifeLab infrastructure data life cycle: from project planning, data production, data analysis, data sharing, to publishing and reuse of data. DC also functions as a key coordinator of data support in the DDLS program.
- **SciLifeLab Training Platform:** We wish to increase SciLifeLab's national role as a coordinator of advanced training and education for the life science community and will present plans to establish a SciLifeLab training platform to promote this.
- **SciLifeLab Fellows:** The IAB will meet with the SciLifeLab Fellows in a closed session, including a dialogue about the current situation as well as SciLifeLab responses to issues previously addressed by the IAB in 2019 and before.
- **SciLifeLab National COVID-19 Research Program:** This program was launched in April 2020, with strong focus on openness, data sharing and team science. The program now includes 101 connected research projects coordinated by SciLifeLab and supported by KAW.
- **Pandemic Laboratory Preparedness (PLP) Capability:** At the end of 2020, SciLifeLab was commissioned by the Swedish government to establish a capability for improved laboratory support during future pandemics. In 2021, the program has been set up and will launch during the fall 2021 and in 2022. This program will be described by the scientific leader of the PLP.
- **Precision Medicine (PM) Capability:** The establishment of a SciLifeLab capability in Precision Medicine has recently been initiated by engaging all infrastructure platforms, the research community, health care, industry, and data management. During spring 2021, a panel of four researchers was assigned to lead this effort and to formulate the SciLifeLab strategy and roadmap, with early plans discussed with the IAB.
- **Knut and Alice Wallenberg (KAW) Foundation:** KAW is the largest private financier of research in Sweden. The support from KAW is instrumental for many SciLifeLab activities, including the SciLifeLab & Wallenberg National Program for Data-Driven Life Science (DDLS), and the SciLifeLab National COVID-19 Research Program, as well as co-funding of parts of the infrastructure operations. We will invite KAW representatives to some of the sessions with the IAB.

4. Meeting Program

October 19–22, 2021, Zoom

CEST (Central European Summer time = UTC + 2) Stockholm

Preparatory Meeting, Zoom, Tuesday, October 19

14:30 **Internal IAB Preparation Meeting**

Session chair: *Jan Ellenberg, Chair of the IAB*
Participants, IAB: *Søren Brunak, Jo Bury, Yoshihide Hayashizaki, Sirpa Jalkanen, Janet Jansson, Jonathan Knowles, Svante Pääbo, Aviv Regev, Sarah Teichmann and Stephanie Alexander (support of IAB chair)*

15:15 **IAB Preparation Meeting with SciLifeLab Representatives**

Session chair: *Jan Ellenberg, Chair of the IAB*
Participants: *IAB, Chair of the SciLifeLab Board (Chair of the Board), Director (Dir), Co-Director (Co-Dir), Infrastructure Director (Infra Dir)*

16:00 **Meeting with the SciLifeLab Board**

Session chair: *Carl-Henrik Heldin, Chair of the SciLifeLab Board*
Participants: *IAB, SciLifeLab Board*

16:45 **End of day 1**

Wednesday, October 20

12:30 **Welcome; SciLifeLab Recent Developments and Ongoing Plans 2020–2030**

(45 min overview, 45 min discussion)

Session chair: *Carl-Henrik Heldin, Chair of the Board*
Presenter: *Olli Kallioniemi, Dir*
Participants: *IAB, SciLifeLab Board, Dir, Co-Dir, Infra Dir, Integration Directors (IDs), Scientific Directors (SDs), Head of Data centre (HDC), Head of Operations (HOP), vice-Head of Operations (vHOP), Operations Office (OO) representatives*

14:00 **Break**

SESSION 1: NATIONAL INFRASTRUCTURE

14:15 **Infrastructure: Future Strategies and Organization**
(15 min presentation)

14:30 **Short Presentations (5') of SciLifeLab Platforms**

- Bioinformatics, *Bengt Persson*
- Genomics, *Tuuli Lappalainen*
- Clinical Genomics, *Thoas Fioretos*
- Clinical Proteomics and Immunology, *Masood Kamali-Moghaddam*
- Metabolomics, *Anders Nordström*
- Spatial and Single Cell Biology, *Mats Nilsson*

15:00 **Break**

15:10

- Cellular and Molecular Imaging, *Marta Carroni*
- Integrated Structural Biology, *Göran Karlsson*
- Chemical Biology and Genome Engineering, *Anna-Lena Gustavsson*
- Drug Discovery and Development, *Per Arvidsson*

15:30 40 min discussion

Session chair: *Annika Jenmalm Jensen, Infra Dir*
Presenter: *Annika Jenmalm Jensen, Infra Dir, Platform Directors (PD) of the respective Platforms*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Infra Dir, PD, HDC, IDs, SDs, HOP, vHOP, OO representatives and members of the NSC*

16:10 Break

16:30 SciLifeLab Sites in Lund, Gothenburg and Umeå

(15 min presentation, 5 min discussion)

Session chair: *Annika Jenmalm Jensen, Infra Dir*
Presenter: *Thoas Fioretos (Lund), Elisabet Carlsohn (Gothenburg), Linda Sandblad (Umeå)*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Infra Dir, PD, HDC, IDs, SDs, HOP, vHOP, OO representatives and members of the NSC*

16:50 Data Centre

(5 min presentation, 10 min discussion)

Session Chair: *Annika Jenmalm Jensen, Infra Dir*
Presenter: *Johan Rung, Head of Data centre*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Infra Dir, PD, HDC, IDs, SDs, HOP, vHOP, OO representatives and members of the NSC*

17:05 Campus Solna

(20 min presentation, 20 min discussion)

Session Chair: *Amelie Eriksson-Karlsson, Integration Director, KTH, Chair of the Campus Solna Committee (CSC)*
Presenter: *Per Ljungdahl, Director of Campus Solna*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Infra Dir, HDC, IDs, SDs, HOP, vHOP, Campus Solna Committee (CSC)*

17:45 Break

18:00 IAB internal work

18:20 End of day 2

Thursday, October 21

SESSION 2: RESEARCH

4.

13:00 Introduction Research

(10 min presentation, 20 min discussion)

Session chair: *Olli Kallioniemi, Dir*
Presenter: *Mia Phillipson, Co-Dir*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Infra Dir, HDC, IDs, SDs, HOP, vHOP, OO representatives*

13:30 Highlights and Survey of the Fellows Program

(20 min Scientific Highlights, 10 min Survey of the Fellows program, 10 min discussion)

Session chair: *TBD*
Presenter: *Mia Phillipson, Co-Dir, TBD Fellows*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Fellows*

14:10 Meeting with the SciLifeLab Fellows

(30 min, IAB members, divided in three groups)

Participants: *IAB, Fellows*

14:40 Break

14:55 Meeting with the IDs and SDs

(20 min discussion)

Participants: *IAB, IDs, SDs, Campus Solna Director*

15:15 National COVID-19 Research Program and Pandemic Laboratory Preparedness Capability

(10 min presentation COVID-19, 15 min presentation Pandemic Laboratory Preparedness (PLP), 20 min discussion)

Session chair: *Mia Phillipson, Co-Dir*
Presenter: *Olli Kallioniemi, Dir, Johan Rung, HDC, Staffan Svärd, Scientific lead PLP*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Infra Dir, PLP lead, HDC, HOP, vHOP, OO representatives*

16:00 Coffee break

16:15 Meeting with the Rectors

(45 min discussion)

Session chairs: *Jan Ellenberg, Chair of the IAB, Carl-Henrik Heldin, Chair of the Board*
Participants: *IAB, Chair of the Board, Rectors*

17:00 Break

17:10 Precision Medicine Capability

(15 min presentation, 15 min discussion)

Session chair: *Olli Kallioniemi, Dir*
Presenter: *Päivi Östling, Åsa Johansson, Petter Brodin, Janne Lehtiö, National SciLifeLab Precision Medicine panel*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Infra Dir*

17:40 IAB Internal Work

18:00 End of day 3

Friday, October 22

SESSION 3: DATA-DRIVEN LIFE SCIENCE

12:30 **Presentation DDLS; Towards Technology- and Data-Driven Life Science**

(60 min presentation of DDLS)

Session chair: *Carl-Henrik Heldin, Chair of the Board*
Presenter: *Siv Andersson/Göran Sandberg, KAW, Olli Kallioniemi, Dir, Oliver Billker, Janne Lehtiö, Emma Lundberg, Fredrik Ronquist, Research Area Leads, Johan Rung, HDC*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Infra Dir, HDC, DDLS Steering group, HOP, vHOP, OO representatives, KAW*

13:30 **Break**

13:45 60 min discussion

Session chair: *Carl-Henrik Heldin, Chair of the Board*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Infra Dir, HDC, DDLS Steering group, HOP, vHOP, OO representatives, KAW*

14:45 **Break**

15:00 **Training and Education**

(5 min presentation, 10 min discussion)

Session chair: *Mia Phillipson, Co-Dir*
Presenter: *Jessica M Lindvall, Training coordinator*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Infra Dir, IDs, SDs, HDC, Training coordinator, HOP, vHOP, OO representatives*

15:15 **Writing and Discussion incl. Short Breaks when Necessary**

Session chair: *Jan Ellenberg, Chair of the IAB*
Participants: *IAB*

16:00 **Break**

16:30 **Initial Feedback and Questions**

Session chair: *Jan Ellenberg, Chair of the IAB*
Participants: *IAB, Chair of the Board, Dir, Co-Dir, Infra Dir*

17:00 **Additional Writing Session**

Session chair: *Jan Ellenberg, Chair of the IAB*
Participants: *IAB*

18:30 **End of day 4**

Contacts

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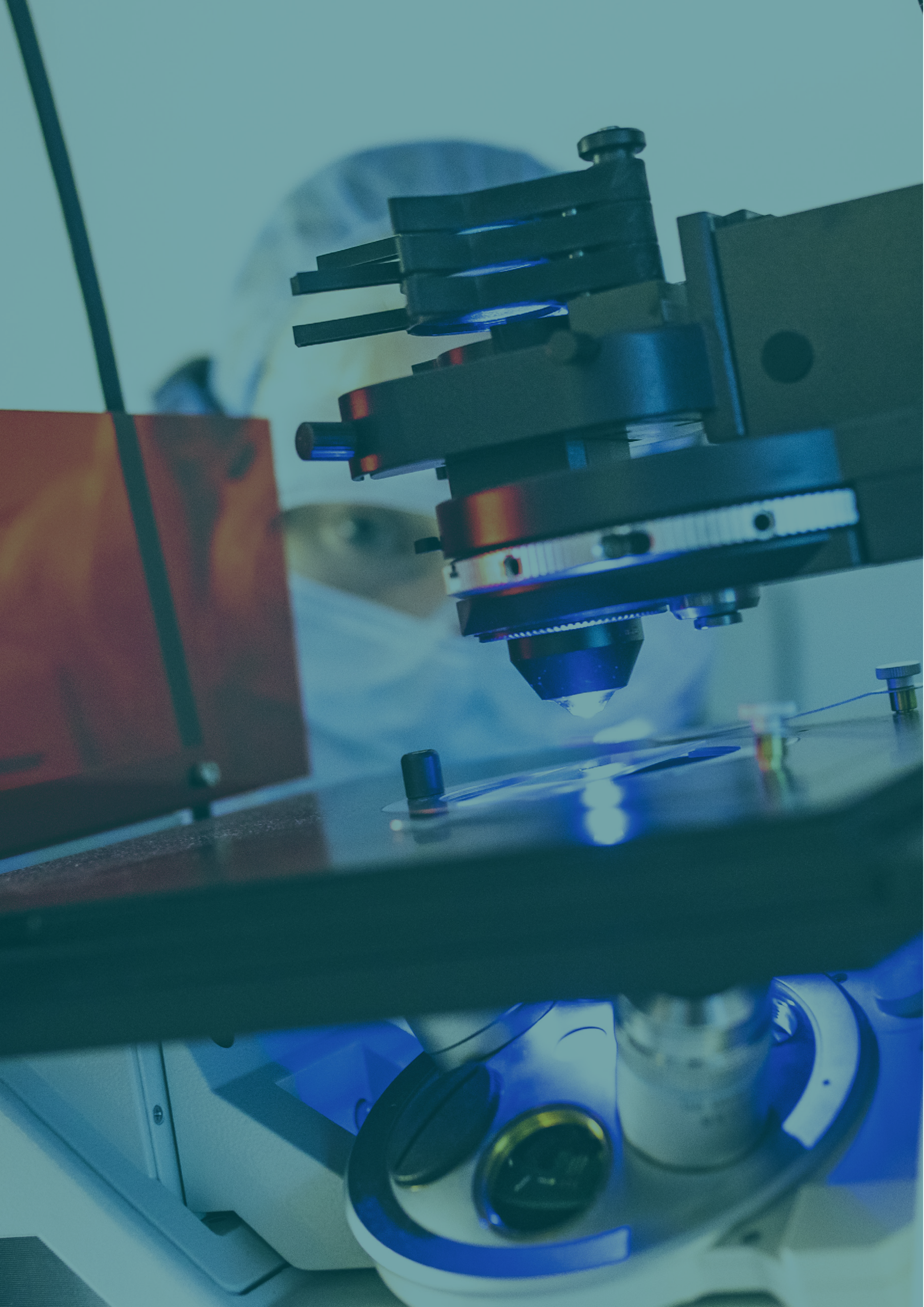


5. Responses to the IAB Recommendations (2019)

This section contains SciLifeLab's response to the recommendations given by the IAB after the site visit in March 2019.

We want to thank the IAB for truly insightful, constructive and on some occasions, provocative comments about the future of SciLifeLab. The IAB review attracted a lot of attention and discussion, and directly or indirectly influenced many subsequent developments, such as the 10-year strategy for SciLifeLab, plans for the new 4-year budget period, development of Campus Solna, emphasis on data handling, the launch of the Data-Driven Life Science Program (DDLS) and many other things. A preliminary response to the IAB comments was already sent to the IAB three months after receipt of the IAB report and published on the SciLifeLab website in late 2019. This response text has been updated and re-written by the SciLifeLab Management Group and Operations Office and it is based on discussions with many stakeholders and will be formally approved by the SciLifeLab Board before it is now presented to the IAB. Given the major changes that have happened in 2020–2021, including expansion of the role and funding provided to SciLifeLab, we will in many topics refer to the rest of the IAB report for more detailed description. Many of the items brought up by the IAB have already been actioned upon, while others are still underway, and some have not been acted upon, for reasons that we will elaborate in this section.

IAB recommendations are indicated in *italics*.

▶ 5.1 General Recommendations

The IAB prepared the following six general strategic recommendations:

1) Renew the strong commitment to the synergistic dual mission of SciLifeLab as an international center of research excellence and a national research infrastructure.

Re: In preparing the 10-year plan for SciLifeLab, the Management Group (MG) worked with the Board, rectors, the four founding universities, governmental agencies, ministries, and funders and other stakeholders. A national hearing on SciLifeLab was held on September 20, 2019, with about 100 key national stakeholders attending. The IAB comments were taken into account when preparing the 10-year plans for SciLifeLab and the chair of the IAB presented a supportive statement by video. All the stakeholders provided input to the final strategy, which was then revised and published as a Roadmap.

Data-driven life science was introduced as a key strategic area already in the national SciLifeLab hearing in 2019. Subsequently, the KAW-supported DDLS program, to be coordinated by SciLifeLab, was launched with a total budget of 3.1 BSEK (about 300 MEUR, 400 MUSD) for the 12-year period 2021–2032. Therefore, as of today, SciLifeLab strategy and funding rests on three separate pillars, 1) the national infrastructure, 2) founding university SFO support for research and 3) data-driven life science. As a result of this strategy, together with the new KAW support, the SciLifeLab actions during COVID-19, the excellent track record of national infrastructure, and the growing realization of the importance of life science, SciLifeLab also received an increase of government funding for the 2021–2024 period of 280 MSEK (150 MSEK of additional basic national funding and 130 MSEK of funds for Pandemic Laboratory Preparedness). Taken together with the DDLS funding from KAW (and assuming that the SFO funding will remain the same), SciLifeLab's annual budget in the five-year period from 2020 to 2024 will almost double. It is important to note that all new funds to SciLifeLab have arisen from the fact that SciLifeLab has a uniquely prominent national role in Sweden. Hence, it is unlikely that we would have been able to raise these funds (and hence double the budget), if we had focused only on Campus Solna or Uppsala research.

In 2020–2021, there has been a major review of the national infrastructures, their steering and funding models (so-called Tobias Krantz investigation, SOU 2021:65, in Swedish). This governmental investigation suggested major changes for the overall national infrastructure policy and steering as well as for e-infrastructures, but was very positive for SciLifeLab. For example, a statement in the investigation read: ”Most stakeholders believe that SciLifeLab works well and has achieved fantastic results in research”. The investigation suggested that the structure, administrative model, and funding should continue in the future largely as today. Changes were suggested to the role of KTH as the primary responsible host organization of SciLifeLab, and particularly to the role of the KTH board. This will need more discussion and is not a decision yet. SciLifeLab also still needs better ways to deal with e.g., legal matters (contracting challenges) and these are being addressed already.

2) Develop the national infrastructure to an inclusive Hub and Nodes model with all Swedish universities.

Re: In the new four-year funding period of 2021–2024, we have placed increasing emphasis towards expanding SciLifeLab infrastructure presence across the country. The new infrastructure platforms and units were selected based on an open national call and comments by the International Evaluation Committee and university representatives in March 2020. All funding decisions were allocated to the units with the best expertise wherever they were located. At the end 10 new infrastructure units were selected, many from outside the four universities. Also, 3 facilities were scaled down or reorganized and a new infrastructure based on 10 platforms was launched for the 2021–2024 period. Thus, today all major universities in Sweden have units that belong to the SciLifeLab infrastructure and provide national services. We are also now formally launching SciLifeLab sites in Umeå, Lund and Gothenburg (and probably in 2022 in Linköping) to unite the individual units and to complete the national organization of SciLifeLab infrastructure by addition of four new sites to the existing major sites Campus Solna and Navet in Uppsala.

3) Create a truly integrated international center of research excellence focused on technology development and data science in Stockholm and Uppsala

Re: As mentioned, SciLifeLab's recent success in fundraising relies on its respected and valued role as a national operator of infrastructure and data as well as a facilitator of research. The major sites for research at SciLifeLab are in Stockholm (Campus Solna (CS), to be discussed elsewhere in this section) and in Uppsala (Navet at Uppsala University). Government SFO-funding to the four universities at these two sites has facilitated the buildup of centers of research excellence. The SFO support has been used for experimental research (Fellows) as well as the technology development (see *Section* 10). With the launch of the DDLS, SciLifeLab research in data sciences, covers 11 different partners (10 universities and the Swedish Museum of Natural History). Hence it is important that we balance the substantially strengthened and expanded national role with the interest to promote strong, collaborative SciLifeLab research hubs in Stockholm and Uppsala. Indeed, technology development at these sites has been one crucial factor in SciLifeLab's success.

4) Provide the mandate and delegated authority to the SciLifeLab research director to run an internationally competitive center and support especially its excellent junior Fellows adequately.

Re: SciLifeLab Director(s) and the Management Group are responsible for the national infrastructure funding, but not for the SFO support that is given to each founding university. Following the IAB recommendations, the Board appointed a task force to make recommendations regarding the optimal organization of CS as a joint research and infrastructure center. The three universities in Stockholm subsequently launched a new position of a Campus Solna Director (CSD) and Prof. Per Ljungdahl from SU was nominated as the first CSD following an open call. His role and update on CS will be described in more detail below and elsewhere in this report. After the steering documents for SciLifeLab will be revised (expected by Dec 2021), we expect that CSD will be given a clearer mandate and responsibility for the practical matters at Campus Solna (space, services, research environment). CSD will report to the SciLifeLab Director in strategic matters and otherwise to the CS Committee (CSC) that has an authority to allocate part of each university's SFO funding to support CS and integrate the actions of the three Stockholm universities. Each university retains independent control of their SFO funding. Hence the CSD does not have a budgetary mandate to decide research directions, but rather works to facilitate coordination across universities to promote and strengthen the strong joint research environment. Currently, in addition to funding Fellows and university specific initiatives, the SFO committees allocate 4 MSEK/year, i.e., total 12 MSEK/year, to directly support the experimental capabilities at CS.

In summary, no single individual leader has a comprehensive mandate for directing research at SciLifeLab, at CS, at UU, or across the 11 partners in the DDLS program. Thus, this IAB recommendation is difficult to accommodate due to the inherent complicated organizational structure of SciLifeLab. Research profiles and their funding belong to each university (and each faculty and department engaged) at CS and at UU under the SFO funding model. The overall goal of SciLifeLab is to enable life science research that is not otherwise possible by providing state-of-the-art techniques and fostering a strong research environment that enables recruitment of young excellent talents (SFO funding) and collaborations by coordinating external funding (such as the COVID-19 and DDLS support from KAW).

Even if SciLifeLab national funding is not meant for research purposes, we can still indirectly have a major influence within the community. DDLS has four research areas (RAs) and these match quite well with the recently launched capability areas in SciLifeLab infrastructure, such as 1) DDLS infection biology and epidemiology RA (with links to the COVID-19 research program and the Pandemic Laboratory Preparedness capability), 2) DDLS precision medicine and diagnostics RA (with links to the SciLifeLab Precision Medicine capability, involving all infrastructure platforms and the research community and GMS), 3) DDLS biodiversity and evolution RA (with links to the to-be launched Planetary Biology capability) and 4) molecular and cell biology RA (with links to the capabilities for e.g., integrated structural biology, spatial and single cell biology). Thus, we have taken concrete steps towards promoting a more coherent SciLifeLab research profile.

In the DDLS program, SciLifeLab Board also has a role in accepting group leader calls and the final PI nominations. However, all SciLifeLab and DDLS Fellows are tenure-track nominations for each university, and thus legal employment responsibilities and conditions rest with the universities only and not under the control of SciLifeLab Management or Board. Thus, while we have made major progress in e.g., coordinating the SciLifeLab Fellows program, it is still consisting of four separate parts, each run with university-specific regulations. For DDLS Fellows, the Board has more influence on their selection, and the aim is to form joint national research programs with the nominated DDLS Fellows, who do, however, still have their own local research environment and employment contracts at 11 different locations. The role of SciLifeLab Board in DDLS is to oversee the program and its funding and to ensure its scientific profile, training and data actions at the national level.

5) Make a compelling bid for a significant increase in government funding to fulfil the infrastructure mission for all of Sweden.

Re: As stated above, such a major and systematic effort was carried out and succeeded even beyond expectations. We have now 280 MSEK of new government funding for 2021–2024, which is approximately a 20% increase. Half of this additional funding is earmarked for Pandemic Laboratory Preparedness.

6) Truly integrate the complementary research strengths of the four host universities in a joint center and renew the commitment of the hosts to support SciLifeLab research with their SFO funds.

Re: The four SciLifeLab founding universities have tentatively committed to continue to support research at SciLifeLab, even if the government SFO funding may not continue in its present format. Efforts are underway at Campus Solna to build on the existing strategic 3-party Stockholm-based research collaboration. CS is the largest single site for SciLifeLab and the only site, where the research and infrastructure from the different universities are co-located. SciLifeLab CS is also the most significant research collaboration for the three Stockholm universities (so-called Stockholm Trio), highlighting the importance of CS to the founding universities. Research collaboration with Uppsala has also intensified, such as in the context of the SciLifeLab-KAW COVID-19 research program. At the same time, the DDLS program will engage 11 partners, not just the four universities.

5.2 Evaluation of the Period 2017–2019

The IAB was happy to see many changes and improvements in response to the comments from the IAB 2017 visit and listed several highlights (chapter 3.2) as achievements. IAB also pointed out several issues that have not yet been resolved. These are listed below, and many of these will be also further pointed out in other parts of this report.

Although conditions are somewhat more aligned among the SciLifeLab Fellows, support and integration of the Fellows (at Campus Solna, but also at Uppsala University) including a lack of general scientific infrastructure and a working community network and mentoring and support by the SciLifeLab senior faculty remains a major concern

- *No joint/coordinated recruitment of Fellows*
- *No turnover of SciLifeLab faculty, no useful common definition of SciLifeLab faculty*
- *Insufficient priority to the international research center of excellence mission, no aligned research strategy between the host universities, not enough empowerment to SciLifeLab Management Group to implement this mission and the agreed strategy on behalf of the host universities.*
- *No aligned scientific and/or technology strategy for the research carried out at SciLifeLab*
- *An effective organizational authority and leadership of the Solna SciLifeLab campus is not established*
- *Joint postdoc/predoc program still missing, establishment appears likely among Stockholm universities (currently a joint Master program exists)*

Re: The recruitment of Fellows and identification of their respective field is up to each founding university. It is important to realize that the SFO programs only fund the first 5 years of the Fellows employment and thereafter the Fellows funding is the host university's responsibility, potentially for a life-long commitment in the case of tenure-track appointments. Attempts to engage the universities in each other's recruitment processes are currently carried out. As an example, the Fellows called for interviews are invited to give open seminars that are then announced to the entire SciLifeLab community. Also, in the new DDLS program, SciLifeLab can try to achieve a more uniform and nationally coordinated recruitment process and also influence conditions for Fellows across all the 11 universities.

We have now established and approved the first round of SciLifeLab group leader appointments under uniform new criteria, as well as conditions on how more group leaders can join in the future from both within and outside the four founding universities (see *Section* 8.1). The first phase resulted in the nomination of 189 affiliated research groups from these universities, with affiliations at KI 32, KTH 47, SU 27 and UU 83. This is the first step in the definition of the SciLifeLab Group Leader concept, which facilitates e.g., systematic bibliometric studies and defining the research community. After the first wave of nominations was completed in early 2020, the expansion of this community has been slow because of the COVID-19, and the major changes underway at SciLifeLab in 2021.

The 10-year strategy for SciLifeLab is based on promoting the use of infrastructure, to create research capabilities and research communities, as well as technology development and data management. Research continues to depend primarily on each founding university, which make decisions on their SFO funding and their Fellows, as well as their support to the local research environment, such as at the CS. However, major progress regarding integration has taken place at CS, as explained below.

There are some differences in policy and opinion, when it comes to attitudes towards turnover of faculty at CS, which then also influences the policies for SciLifeLab Fellows. The CS founding documents set the rules and priorities of group relocations to and from CS, with priority of space being provided to national infrastructure and SciLifeLab Fellows. There is also the intention that Fellows should return to host departments after their 5–6-year initial period is over. Exemption to this rule requires an extension request signed by the Fellow and the department head and approval by the CSC. SU and KI have individual PI scientists from different departments at CS, while KTH has entire departments located almost exclusively at CS, and hence there is no other site available for these investigators (or Fellows) to relocate to. Hence, some SU and KI Fellows have moved out at the end of their Fellow period, and some have requested (and been granted) an extension to stay, while KTH Fellows typically continue to stay at CS, which is understandable as SciLifeLab CS is an official KTH campus and their host departments cannot host them elsewhere. Thus, criteria for PI localization are difficult to harmonize across universities.

5.3 Strategic Advice for the Future Development of SciLifeLab

a) The commitment to the dual SciLifeLab mission of national infrastructure platform and international center of research excellence needs to be renewed and strengthened and then jointly supported and implemented.

Re: See comments above for the actions underway at the research policy level, including the 10-year strategy, the new 4-year infrastructure budget, and the DDLS funding and launch of a new national program. Overall, SciLifeLab in 2021–2024 will double its budget and its future depends on three pillars, Infrastructure, Research and Data-driven life science. However, the future funding level for the research support remains more uncertain (future SFO funding levels will be decided by the end of 2021).

b) Communication and Coordination: SciLifeLab to hosts. *Although communication between SciLifeLab and the host universities has improved, closer coordination among SDs and IDs is still needed and their key partners in SciLifeLab (e.g., Fellows) and universities (department heads and rectors) still have to be more aware of this mechanism to achieve better coordination, joint planning and support for implementation by SciLifeLab Management Group.*

Re: We agree and have continued efforts underway. Besides the regular Management Group (MG) meetings every other week where SDs participate, many other regular meetings are also being held to promote engagement and collaboration with the four universities. The MG meets IDs (so-called Strategic Council) 6 times a year and there are also joint meetings between MG and all SciLifeLab committees of the founding universities as well as other meetings with department heads. The 4 SciLifeLab university committees are chaired by the ID and include the SD as a member. These committees meet approximately monthly to decide on their SFO funding and local SciLifeLab activities. SDs and IDs at each of the four universities ensure links between SciLifeLab committees and the national infrastructure. Campus Solna Committee has regular monthly meetings that are attended by the three IDs and SDs. The UU SciLifeLab committee follows the same meeting pattern and additionally allocates two committee members to support the SD via weekly meetings and daily (whenever necessary) communications. There are regular meetings between the leadership of SciLifeLab and the rectors (4 times per year). MG also meets regularly with Fellows. In 2021, the DDLS steering group started, and this engages all 11 partners via the DDLS national reference group, in addition several working groups have been formed to coordinate specific operative areas (see DDLS description). Finally, there are decision meetings for the SciLifeLab Board about 4 times a year.

Due to the number of stakeholders and the new actions at SciLifeLab (such as the launch of the DDLS, COVID-19 research programs and increased intensity of CS actions), we are approaching the limit in the number of meetings that can be held. Therefore, we should also consider streamlining our organizational structure. However, as long as there are many separate funding streams that require their own management as well as different participants/stakeholders in these programs, it is hard to keep everything under a single and simple organizational structure. For example, today we have a 3-party collaboration at CS, a 4-party collaboration across the four founding universities, national infrastructure collaboration (10 universities), and national research collaborations such as the DDLS program (with 11 partners).

SciLifeLab has been a success, largely as a result of the fact that it is a flexible and adaptive collaborative organization with multiple roles and tasks and a multitude of interacting programs. IAB has often suggested that SciLifeLab should be more like a coherent single research institute or center. However, efforts directed towards this goal have proved to be administratively, legally and/or politically complicated given the nature of SciLifeLab´s national role and mandate. The support of the four universities is also stronger when they are directly hosting SciLifeLab, and not such that SciLifeLab would be gaining full independence.

During the last ten years, SciLifeLab has successfully proven to the founding universities the benefits of jointly pooling high technology infrastructures and building a strong associated research environment to promote a thriving research community We are now aligning the recruitment of Fellows better with the infrastructure capabilities, and we will use the Strategic Council (MG+IDs) meetings to create joint strategies between the university SFO committees. The rectors have been jointly communicating the importance of SciLifeLab to the Swedish Life Science sector and to the government. Thus, we believe that there is a joint view at multiple levels of the organization to work together.

c) Coordination and Synergies: Among hosts of SciLifeLab. *In our opinion, SciLifeLab provides a fantastic opportunity for improved communication and collaboration in the life science between the host universities. [...] We thus recommend that the hosts fully embrace this opportunity and utilize the connections SciLifeLab has established between their rectors, life science department heads, integration directors and scientific directors to align their strategy and jointly take the responsibility for developing SciLifeLab into an internationally leading center they jointly take pride in and do their utmost to support.*

Re: We agree and to a large extent the last sentence is already starting to be realized. The three Stockholm universities have also started a “Stockholm Trio” collaboration, across all fields of research. SciLifeLab collaboration and CS in Stockholm are critical parts of this effort. Depending on the future of the SFO funding, the four party collaborations will continue alongside this. On the other hand, the progress in national infrastructure, COVID-19 research programs, as well as the new DDLS collaborations have all increased the national role of SciLifeLab. Further, during the pandemic, research collaborations between the universities as well as university hospitals were being formed, as complementary expertise within the SciLifeLab network of researchers was required to address the urgent COVID crisis. The capabilities within Pandemic Laboratory Preparedness and Precision Medicine now being formed within SciLifeLab build on these networks. Lastly, the SciLifeLab efforts during the pandemic have been nationally recognized and appreciated, and this has been a source of pride at the founding universities as well.

d) Inclusive governance of the national infrastructure mission. *We applaud the formation of the NSC and recommend to continue the representation of external universities on the SciLifeLab Board regarding its national mission. To simplify the governance as much as possible and limit the number of people involved, this may be best done by having the chair and vice chair of NSC be part of the SciLifeLab Board ex officio.*

Re: The role and governance of the national infrastructure organization are straightforward and well accepted. The NSC played a major role in the planning of the new infrastructure. The NSC chair is now adjunct SciLifeLab Board member and was participating in all the final funding consensus discussions before the national infrastructure budget was presented to the Board. The national role of SciLifeLab is also being promoted by the new platforms having more autonomy, the launch of national capabilities (Pandemic Laboratory Preparedness, Precision Medicine and Planetary Biology), the launch of national SciLifeLab sites at GU, LU, UmU and LiU, the national role of the Data Centre (DC) and most recently, the launch of the DDLS.

5.4 National Infrastructure Mission

a) Overall direction. *The IAB is very impressed by the many positive developments since 2017. This area makes it clear that when SciLifeLab Management Group has a clear mandate, it is very effective in formulating and implementing a strategy. The IAB is also very supportive of the proposed future plans for the development of the national infrastructure, to become even more clearly organized, evolve by regular and synchronized evaluation and even better alignment with the structuring and evaluation processes.*

b) Platforms. *The platforms are well-organized, and we support the simplification into six major areas. However, we would advise to avoid re-organizing the high-level platform designations too frequently, but rather let the system settle and stabilize. It may be worth thinking about calling the "translation" platform "of life" or "from life", rather than "for life". It is important that the platforms are presented consistently in all SciLifeLab media once a change is agreed. Currently on the homepage or in flyers we find nine or even ten platforms listed, while the IAB report referred to seven and the new proposal is to reduce to six.*

Re: The SciLifeLab platform structure changed in response to the detailed evaluation in April 2020 by the IEC and national stakeholders ranking and evaluating each facility and the new suggested units. The new infrastructure organization now contains 10 platforms, with most previous units continuing, and 8 new units being launched. The platforms and the services they provide are now better united, and we will strive to retain this structure in the future. Also, platforms are now given more autonomy to plan their activities over the 4-year period. Overall, we will describe the new infrastructure organization and the new operational principles to the IAB during the upcoming meeting.

c) Capabilities. *The IAB supports to move from individual technologies to capabilities, to support the research questions their users have better and to integrate technologies across facilities and platforms even more seamlessly into the most commonly requested workflows in a modular fashion. This is a forward looking and sustainable concept. We advise however, to take more advantage of Sweden's unique strengths in several areas, such as advanced protein technologies or Genomic Medicine, to avoid that the capabilities' denominations become too generic.*

Re: We have realized that launching the concept of capabilities requires careful planning. Each of the three capabilities planned will be launched in a slightly different way, trying to also learn from each effort for the launch of the next one. The current order of these is that Pandemic Laboratory Preparedness (phase I) was prepared first based on a letter of interest (LOI) call. A scientific leader and a coordinator were recruited in February 2021 and in June 2021 8 projects were started from the LOIs (to be described separately). The Precision Medicine capability has 4 scientific leaders starting also in June of 2021, while the Planetary Biology will start later in 2021 or early 2022. All capabilities will link up not only with the infrastructure, but also with the DDLS research areas.

d) Life-cycle management of facilities. *The IAB welcomes the 4-year review cycle of national platforms with a mid-term check-up after two years. The 2016, 2020, 2024 cycle will also synchronize well with the 2-yearly IAB visits 2017, 2019, 2021, as the results of review or checkup are then available for the IAB. We strongly advise to keep the international and independent nature of the platform review from 2016 and continue to involve selected IAB members as observers, to ensure good coordination and continuity of strategic planning.*

Re: Two IAB members joined as observers in the 2020 international evaluation of the infrastructure. The role of the IAB members was important to make the ad-hoc international reviewers understand the role of SciLifeLab and its national infrastructure mission. The 2020 evaluation engaged the scientific community, as all major universities and the NSC acted as observers and ranked the facilities. Thus, each SciLifeLab unit obtained an international grade (focusing on international scientific excellence and future opportunity) and a national grade (focusing more on national importance and past track record).

These reviews will benefit from the criteria for what defines a national infrastructure, that were developed in 2016. However, they need additional guidance on the life cycle management of SciLifeLab facilities. We suggest to set-up something akin to a four-step system used by other infrastructures. Initially, new facilities are likely to be small with only few users and receive most of their funding from SciLifeLab. If successful, the facilities will grow and start to attract significant funding from user fees as well as support by external funders, as is true for example for the genomics platforms. Finally, at some point, facilities may need to be phased out, if their services are no longer demanded, or if they provide readily available commodities that are as effectively available commercially to the community.

For each of the four steps of this life cycle, strong SciLifeLab coordination is essential to integrate the activities within each technology/platform across the country, promote the use of consistent and high-quality standards, promote cross-platform workflows, and integrate and maximize the value of the produced data. SciLifeLab Management should develop clear criteria for changing the status of a facility from one step to another and allow independent evaluators to help guide these decisions. We propose that SciLifeLab Management should have the strategic decision on the *facility life cycle, upon proposals made by the platform directors based on external evaluations.*

Re: We agree fully with the principles of the life cycle guidance. The life cycle management is something for which SciLifeLab has already been receiving positive comments (such as from the rectors and the national infrastructure review by Tobias Krantz). Future guidance and coordination of the infrastructure will be more platform-centric, but we will also promote the three cross-platform capabilities and data integration. SciLifeLab Management Group oversees the process and makes sure that the outcome of the international review will be executed at the platform level. The four steps of the life cycle are in principle already defined exactly as the IAB delineated, but in the future, we anticipate that the facility/unit boundaries within a platform decrease or even disappear.

e) National facility networks*. The IAB in principle supports this idea, as it is a good mechanism for being more inclusive and bring non-host universities into the national research infrastructure not just as users, but also as service providers and therefore become co-owners and supporters of SciLifeLab. That being said, care needs to be taken that each part of these networks has national significance and is well linked and integrated with the major hubs in each domain. It goes without saying that this will require transparent criteria for how to join into a network and being subject to the same review process that all SciLifeLab platforms adhere to. The IAB notes that some individual facilities in the networks presented appeared to have either very few or exclusively local users and also did not seem to add much value to the network in terms of data integration and that this needs to be looked at carefully to preserve the integrity and national significance of SciLifeLab platforms. In the long run, we recommend to develop the national infrastructure along a Hub and Nodes concept (see next point).*

Re: We agree with these views, and this has influenced the planning of the new infrastructure organization. The Diagnostic Development platform (now called Clinical Genomics) is the platform with the most prominent national network organization, where each unit promotes translational genomic research and PM diagnostics in its own health care region, together forming a national platform. Also, the bioinformatics (NBIS) has a network across all universities. DDD has a different type of a national organization, where each of the sites (Stockholm, Uppsala, Gothenburg and Lund) has distinct responsibilities. Other platforms are now asked to consider national networking, and to reach out to the whole country, engage in training and form links with a national user base. For example, Genomics (NGI) and Cryo-EM are now forming national networks that work with their central hubs.

The national network of nodes discussion was particularly active in the translational platform of Clinical Genomics in 2019–2020, where national implementation to health care across the nation is critically important to patients and society, but then also a key new question for SciLifeLab to support a unit at each site, like we have now done. The Genome Medicine Sweden (GMS) project has created a network of clinical genomics centers on top of the Clinical Genomics platform. GMS enables translation of technologies to health care across the nation. SciLifeLab's role in this process is to support the translation of genomic technologies from SciLifeLab to the translational research and to the health care diagnostics at each center. Hence, we have chosen to support a fully distributed model of seven nodes (Stockholm, Uppsala, Gothenburg, Lund, Linköping, Umeå and Örebro). In the next 4-year period, we will work to expand such work with other technologies than genomics by launching the SciLifeLab Precision Medicine capability.

f) Towards a Hub and Nodes organization of the national infrastructure*. There is a trend and community demand towards a more inclusive national infrastructure, that will increasingly contain facilities located elsewhere than Uppsala or Stockholm. This is positive, as it brings the non-host universities into a service provider role, but it also bears the risk of fragmentation of SciLifeLab into smaller independent sub-networks, while it is very clear that strong overall coordination by SciLifeLab is hugely beneficial and needs to be strengthened further. To address this challenge, we recommend to organize SciLifeLab in a Hub and Nodes model, that together form the national infrastructure. In such a model, the Uppsala and Stockholm universities would host the coordinating and supporting Hub while the national universities would host service providing Nodes.*

Re: We fully agree with the hub and node model being appropriate in many cases and many units and platforms are already organized in this manner. As mentioned above, this model is already applied in several platforms, and increasingly will be applied in the future. The principle of hub and nodes is good, but this nomenclature has also attracted criticism in that many sites that do not want to be called a node. For example, in the diagnostic development/clinical genomics platform, each node is in principle considered an equal part of a network.

Regarding the two Hub sites, we recommend to organize their coordinating activities along their complementary strengths. Examples of a complementary coordination profile could be new experimental technology development and testing for service in Stockholm, while bioinformatics, data management and training coordination would be a focus in Uppsala. This complementary profile should of course be developed jointly by the two sites. The overall administrative coordination would be performed jointly, for which the successful integration of the SciLifeLab operations *office across the two sites forms an excellent basis. We realize this cannot be achieved overnight, but view it as a unifying organizational model to strive for in the medium term. Once achieved, most if not all Swedish Universities would be an integral part of the national infrastructure and the NSC could become a Heads of Nodes committee, that advises the SciLifeLab Board and has permanent representation in it.*

Re: There is already some division of responsibilities and certainly several unique service profiles between Stockholm and Uppsala. Having said that, three of the biggest platforms at SciLifeLab, Genomics, Bioinformatics and DDD (covering about half of SciLifeLab budget), have their activities shared across the two hubs. Uppsala is the formal coordinator and a major site in Bioinformatics and DDD. This overlap has continued for years and over several funding periods. We see this as a strength and an opportunity to make use of the talent and capabilities in both cities, provide a buffer for instrumentation failures and other downtime, and this also divides the financial burden and risks associated with continued employment of a large group of infrastructure scientists serving a national mandate. In some cases, it is hard to e.g., keep the cost-structures similar across different universities or locations, for example, rent and local overhead costs are higher at CS than in Uppsala. At CS, infrastructure units may even be subject to double overheads, which leads to unfair operational conditions and cost structures as compared to other sites.

***g) Career development of technical and service staff**. The national platforms' and facilities' most valuable asset are the expert staff that operate them and support the users. It is very important to recognize the key contribution of these staff members and to evaluate them with suitable key performance indicators (KPIs) in order to provide adequate career paths and career development support to them. Much too often such staff are forced into academic research career development procedures, that are inadequate, as they evaluate quality by the wrong indicators such as publication track record, number of students supervised etc. SciLifeLab should establish appropriate KPIs for facility staff, that could include for example user satisfaction, number of user publications, grants and patents supported, engagement in user training, engagement in technology development and renewal etc. Based on this, the career of these staff can be evaluated, developed (for example with managerial or new technology training) and where appropriate also provided with a long-term perspective. SciLifeLab is an opportunity for the host universities and eventually all Swedish universities to test such a system jointly, limited to SciLifeLab platforms, before considering whether it could be applied more broadly.*

Re: We agree, and career planning efforts are being actively discussed and options explored. For example, an exploration of these issues was recently published by URFI (Swedish universities' reference group for research infrastructure), which focused on major national infrastructures. This effort identified one major challenge at SciLifeLab, which is the very diverse range of position titles that infrastructure staff employed at the different host universities have. This underlies the challenges to introduce clear career paths. Recently Swedish universities, such as KI, have started to introduce senior research specialist positions that could be suitable for "staff scientists" at infrastructure units, but the criteria are still not fully defined and hopefully will converge across universities. SciLifeLab infrastructure staff members are subject to regular employment conditions at each of their host universities and SciLifeLab cannot directly influence these. However, we are very keen to promote training and career development of infrastructure personnel as well as harmonization of career steps across universities.

***h) Data Centre.** As stated already in the Section 5.2, the Data Centre is one of the highlights of the last two years and it is amazing what it has achieved given the very small team behind it. This area has huge potential and we encourage SciLifeLab to embrace the data management challenge fully and become the national leader in developing solutions for the whole life science research data life cycle, in close coordination with the Bioinformatics Platform. Given the key role a good view of the infrastructure data and usage has for SciLifeLab's strategy, we suggest to consider to have a data center representative ex officio present in the SciLifeLab Management Group, similar to the head of the operations office. We note that the DC could have done more to allow a better stratification of the publication statistics (see 5.5d below) and expect this long-standing issue to be addressed at our next visit.*

Re: We agree, and we are already engaged in the implementation of these suggestions.

***i) Become the service provider for the whole life science data life cycle**. Beyond the DC, we see a strategic opportunity for SciLifeLab to become the leading service provider for the whole life science data life cycle, from planning data production to data management during production, quality control, primary data analysis, mining and knowledge extraction and submission to public repositories. With the platform-facing DC and the user-facing Bioinformatics Platform, SciLifeLab has all the ingredients to do this and fulfil a major need of the Swedish universities and life science community at large. However, it will take significant additional resources and strategic planning and recruitment to grasp this opportunity, which we strongly* *recommend to establish SciLifeLab as an irreplaceable data infrastructure provider for all Swedish universities. It goes without saying, that this should be done in close coordination with existing national efforts and infrastructures in the research data domain.*

Re: We agree, and we have implemented many of these suggestions together with all laboratory and bioinformatics platforms, Data Centre and the universities. The data-centric efforts of SciLifeLab in 2017–2020, will now be followed by the Data-Driven Life Science program (DDLS), not just over the next 4 years, but 12 years onwards.

***5.4j Collaboration with other large-scale infrastructures* (MAX IV, ESS)**. *It is an important achievement for life science in Sweden that SciLifeLab is recognized as a large-scale infrastructure at the same level of status (even if not of funding) to the large-scale physics infrastructures. We encourage SciLifeLab to identify opportunities for collaboration with these infrastructure partners. In structural biology with* MAX IV *this is self-evident, especially given the convergence and complementarity of electron-microscopy and synchrotron radiation- based structure determination technologies. We would recommend that the Structure and Imaging platforms of SciLifeLab develop a strategy for future collaborations with both* MAX IV *and in the longer term also* ESS.

Re: We agree and have now designed an integrated structural biology platform as a new SciLifeLab platform (to be presented to the IAB), which has links to the MAX IV and ESS. We also have an infrastructure-platform access collaboration (InfraLife) funded by VR, together with ESS and MAX IV, and this has allowed us to hire one joint person in Stockholm to represent the infrastructure-trio, and another one in Lund. This has also allowed us to discuss shared issues of interest, such as infrastructure policy nationally and internationally, career questions for infrastructure personnel, industrial collaborations, and data management issues.

5.4k Training. *User training is a key aspect of the national research infrastructure and highly valued by both host and non-host universities. This is a particular strength of the Uppsala site, especially, but also going beyond, bioinformatics. We suggest to strengthen and better integrate the SciLifeLab training portfolio and develop it into a national hub for training activities. Some of these should of course be carried out locally and the national facility networks provide new opportunities for potential additional training sites. Taking advantage of the European opportunities, including for example* EMBO *workshops, and the training efforts of the* ESFRI *infrastructures such as in* ELXIR *regarding bioinformatics, but also in Euro-BioImaging and* INSTRUCT *for imaging and structural biology, is also important.*

Re: We agree and have now hired a training coordinator to create a systematic training plan at SciLifeLab, together with the DDLS initiative. The early steps and plans will be described in the training session (see *Section* 6.5) and discussed during the meeting. We also will explore possibilities for future international training collaborations.

5.4l Non-academic users. *An important aspect of demonstrating societal impact is to keep track of how industry and health care users are benefiting from SciLifeLab platform services of SciLifeLab technologies. We recommend that management evaluates if there are any obstacles in these users accessing SciLifeLab services and remove them and that the data center takes special care to track these important data.*

Re: We agree, and this has been a major focus of the infrastructure access VR application for the national infrastructure-trio (InfraLife). There are a variety of issues already identified for industrial and health care access, and we have ongoing plans to improve these. One major effort is linked to the launch of the capabilities at each platform (more comprehensive services, including data analysis, which is usually needed by health care/industry) and at the SciLifeLab-level (e.g., Precision Medicine and Pandemic Laboratory Preparedness) that will span actions across platforms.

5.5 Centre of Research Excellence Mission

We see with great concern that the difficulties to delegate sufficient authority from the host universities to SciLifeLab Management to coordinate and integrate their joint research activities among the core SciLifeLab research faculty and Fellows especially at Campus Solna, continues to prevent SciLifeLab from fully delivering on its research excellence mission.

While small positive steps have been taken, we have unfortunately seen relatively little overall progress since 2017, when we already expressed sincere concerns regarding the ability of SciLifeLab Management to implement the vision of a joint center of research excellence and the difficult situation faced by the internationally recruited faculty, especially the junior Fellows.

Re: Scientific excellence is key to everything that SciLifeLab does, but it is challenging for the Board, for the Director(s), and the Management Group to direct a research center agenda for the bigger SciLifeLab organization. SciLifeLab has no national funds under the Board's control available for research purposes, except for the new DDLS program starting in 2021. Therefore research profiles and research funding belong to each university (and each faculty and department that are engaged) at CS and at UU (under the SFO funding model). The fact that SciLifeLab infrastructure funding is under the Board and research funding is given to the founding universities is an important way to avoid conflicts of interest and provide the same level of infrastructure access to every university or scientist in Sweden. Most of the research actions, such as recruitment of SciLifeLab Fellows, will happen independently at each university, supported by the SFO funding. Some major developments have, however, happened: 1) harmonized criteria for SciLifeLab group leader assignments have been agreed upon and 189 SciLifeLab group leaders nominated, 2) CSD position has been launched and CS action plan developed (*Appendix* C) that will eventually also link to research profiling, 3) CS actions include improvement of the Fellows' conditions, iv) there have been other major research efforts coordinated by SciLifeLab, such as the national COVID-19 research program and the launch of the entire DDLS program, whose coordination does happen directly under the SciLifeLab Board and where many of the IAB's points could be realized over the next 12 years.

This is a unique opportunity for the host universities to realize jointly. They must no longer allow it to be set on hold by administrative concerns, historic grievances, or the cultural ambivalence to the concept of "excellence". We have seen a large level of appreciation, enthusiasm, and trust among the host universities up to and especially among their rectors. We strongly recommend them to unite behind the research mission and remove the barriers to realize the dream of a Swedish jointly owned center equivalent to the Crick or Broad institutes internationally. Such a vision, promoted together by the four hosts, will form a compelling basis to ensure sustained and ideally even increased funding of SciLifeLab research from the government SFO allocation to the universities for the next decade.

Re: We fully agree about the opportunity, and this has been the goal since the original SFO funded Stockholm and Uppsala nodes of SciLifeLab. While the original period of SFO funding is now ending, the expectation is that such support will continue in one form or another. We hope that some decisions will be made by late 2021. SciLifeLab is primarily known as a national infrastructure, surrounded by an excellent research environment in Uppsala and Stockholm. To make the research excellence mission a driver will require common vision and motivation, as well as matching funding and support. Funding such a mission in Stockholm and/or Uppsala may be politically challenging, since there is already the strong Stockholm Trio of world class universities (KI, KTH and SU). Government research policy emphasizes the importance of all regions of the country as well as equal access to the infrastructure. In 2019–2020, discussions on the concept of the DDLS program started and it became apparent that it was only possible to get funding for DDLS as a truly national initiative across 11 partners. Hence, developing a single life science center in the capital region or in Uppsala was not a possibility. In addition, the new funding provided to SciLifeLab from the government in 2021–2024 is meant for 1) a national Pandemic Laboratory Preparedness mission and 2) a national expansion of SciLifeLab infrastructure. Therefore, SciLifeLab has received significant additional resources because it is one of the few truly national players in the life science area, and hence trusted as such. "Political support" for funding a "single center" national research excellence mission is therefore not easy to acquire. However, this does not deter the fact that the Stockholm Trio collaboration at CS is proving highly successful and creating world-class results as well as the fact that the founding university-centric four-university collaboration is also highly powerful. Both need to be developed further under the new SFO period starting 2022.

Our recommendations below may seem radical, compared to the rather conservative proposals on the research excellence mission in the future plans section of the SciLifeLab report. We make them on purpose to stimulate discussion and help create an ambitious long-term vision which we hope the stakeholders can develop and support together. We realize that some aspects may take more and some less time and some will be need to be modified and implemented according to the Swedish system. Nevertheless, we believe that if such a vision is formulated and promoted jointly by the founding universities, the necessary funding and the mechanisms to realize it will follow naturally from it.

Re: We appreciate the "radical" IAB ideas. These suggestions have caused wide-spread discussions about the future plans, which have promoted positive developments, 1) Stockholm Trio universities have come together to support a stronger CS, 2) it has activated the search for additional funding options, which then eventually has led to an almost doubling of SciLifeLab total funds in the 2021–2024 period. However, in contrast to the IAB plans of a single center, the focus has expanded from the 3- and 4-party university collaboration towards fully national plans, such as the DDLS, which includes 11 partners.

5.5*a) A research strategy: new technologies and their application*. *To the IAB, the natural focus of the in-house research activities at SciLifeLab is new technology development and new breakthrough applications of such technologies to the life sciences. Such a focus is pursued successfully by comparable international institutions (Sanger, Broad, EMBL) and perfectly nurtures the national research infrastructure mission. Being an institution with strong openly accessible infrastructure services, SciLifeLab would not be subject to the criticism of concentrating resources without giving back to the community that pure research institutions such as Crick or Janelia have experienced.*

Re: We strongly agree about the importance of technology development, which is and will be a major topic for SciLifeLab research at the founding universities. This has been facilitated by the Technology Development Projects (TDP) funding over the years, co-supported by national funds and SFO funds from the four founding universities. In 2021 and onwards SFO funding is also applied to promote RED (CS)/Technology Development Projects (UU) aiming to link researchers and infrastructure and to develop the next generation technologies. National funding continues to support TDPs, directed more directly to infrastructure units across the nation.

5.5*b) Focus on the complementarity and strengths of the host universities*. *The four host universities make an excellent combination, as they have very complementary strengths regarding life science. In Stockholm, KTH has strong expertise in engineering and technology development, while KI needs them to drive biomedical applications ahead and SU applies them to basic research. While UU is a comprehensive university, in addition to genome science it provides particular strength in computation and bioinformatics. We suggest to focus on combining these strengths for maximum synergy, collaboration and integration among the host universities.*

Re: We agree, and we are working to define the research profiles for SciLifeLab, given the strong areas at each university and the synergistic opportunities by leveraging the infrastructure. At the same time, DDLS has been formed, with four broad national research areas predefined 1) cell and molecular biology, 2) precision medicine and diagnostics, 3) infection biology and epidemiology and iv) biodiversity and evolution. The three capabilities founded based on the infrastructure also highlight three somewhat related areas of emphasis; Pandemic Laboratory Preparedness, Precision Medicine and Planetary Biology. Therefore, some steps towards research profiling are starting to take shape.

5.5c) *Two sites – one integrated center*. *We recommend to truly integrate the experimental in-house research activities of SciLifeLab senior faculty and Fellows from all host universities at the Solna Campus, in order to create a physically shared and stimulating interdisciplinary environment and achieve critical mass for technology development and pioneering application development. In the medium term, this would allow most of the experimental SciLifeLab Fellows to take advantage of this environment for their first six years of junior training, before taking up long-term positions (if successfully obtaining tenure) at a university department. Achieving this, would likely necessitate reorganization of the Solna Campus to prioritize resources and space to faculty and Fellows that are primarily focused on SciLifeLab research in line with the strategy outlined in 4.3.a. It would also mean that a mechanism for turnover of senior faculty must be possible, if they no longer make key contributions to SciLifeLab's research strategy. The Uppsala site could focus its in-house research mainly on aspects that are especially strong there, such as for example data science, as the compute facilities and bioinformatics expertise are located largely there already. More theoretical Fellows and faculty from Uppsala University could then work initially either physically "embedded" in Solna, or virtually linked in Uppsala, depending on the nature of their research, but in either case be closely interlinked scientifically with the more experimentally focused groups in Stockholm. Data may in the long-term well become the most important aspect of SciLifeLab's impact. Thus, while it may be difficult for UU to give up the notion that all of its life science faculty somehow belongs to SciLifeLab (see below), they would gain responsibility over one of the most important areas of its research strategy. We recommend that UU considers to spatially cluster its SciLifeLab Fellows around Navet, which for dry groups would be less challenging to achieve than for wet groups due to less demanding space and infrastructure requirements.*

Re: We agree with the concept to creating a dual center between Stockholm and Uppsala, as well as with the many suggestions concerning CS, turnover of faculty, etc. These have been extensively discussed. However, the four universities are not positive to the idea to create a research profile for Uppsala that is more focused on bioinformatics and one that is more focusing on experimental research in Stockholm. Stockholm is also very strong in bioinformatics and Uppsala has some of the most profiled experimental "wet lab" research in the SciLifeLab community. The overlap of these capabilities is a strength for SciLifeLab research that we would not like to un-do. Also, as discussed earlier, many other developments are now underway. Most importantly, the launch of the DDLS program has fundamentally changed the focus and profile of SciLifeLab. Besides four founding universities, the focus is currently strongly also on national coordination of data-driven life science research. In addition to serving as a national infrastructure, SciLifeLab has therefore acquired a unique national role also in research. We would like to emphasize, however, that this does not mean that fouding universities and CS-specific research would be less important. CS is still the only physical site for collaboration across multiple universities and it has been energized a lot from the research actions via the new CS leadership. On the other hand, COVID-19 has impeded the promotion of physical research environments and networking events, while promoting new opportunities for digital interactions nationally and internationally.

5.5*d) Define SciLifeLab faculty unambiguously.* *From the start, the different nature of the Solna (integrated research center) and Uppsala sites (collaborative and training space for more distributed faculty) has made the definition of SciLifeLab faculty very confusing. Even for the 2019 report it was still impossible to stratify the publication statistics (except for the highlights) by what was done by SciLifeLab in-house research, what was done by heads of facilities as their own technology development or user collaboration and what was published by loosely affiliated PIs, that were essentially regular users of SciLifeLab's platforms but happened to be located at a host university, especially in Uppsala.*

We strongly recommend to come clear on this long-standing issue and aim for a definition along the following principles:

- *SciLifeLab research faculty*
- *SciLifeLab service faculty*
- *SciLifeLab user*

In addition, it will of course be very important for SciLifeLab to keep good track of its alumni in all three categories, as they will be an important metric for its long-term impact.

Re: 189 SciLifeLab research group leaders have now been nominated at the three universities at CS and the one in Uppsala, all under uniform conditions and criteria (see *Appendix K* for a list and a policy document). Thus, this is the first time that such a transparent approach has been accomplished. The idea is to continue this towards infrastructure group leaders, as well as for PIs at other sites who want to be part of the community. This process has been quiet during the COVID-19 pandemic.

5.5*e) A functional center needs a director with authority*. *SciLifeLab Management in charge of Solna campus urgently needs to obtain more delegated authority from the host universities to run a functional research center.*

Re: This has been accomplished with the appointment of a CS Director, and the selection of Per Ljungdahl as the first director. See description elsewhere in this report, along a list of major achievements during the first year of CSD employment, which was of course highly impacted by the COVID-19 pandemic.

It was suggested by some stakeholders to change the name of SciLifeLab into "SciLifeSweden". We do not support this change for the center of research excellence mission as the SciLifeLab brand is extremely successful and well established internationally and we recommend to keep it and strengthen it further.

Re: We agree.

5.5*f) Consider strengthening the leadership for the research mission of SciLifeLab*

Re: This has been discussed extensively above already and links to the CS matters and the Fellows matters. There are clear actions underway to coordinate research programs at CS, but beyond that, all PI recruitments, and research actions are driven by each university and their SciLifeLab committees, by the different faculties and departments involved, as well as by the individual PIs. In DDLS, the role of SciLifeLab is to coordinate a national program at 11 sites, and hence clearly more opportunities to strengthen the role of the SciLifeLab Board and Management in data-driven life science research mission.

5.5*g) Extending the Solna campus.* *Installing a turnover system and providing better support to integration and core facilities for the junior faculty will be very difficult with the currently available space, which is already at its limit. While we do see turnover as an essential component of the Solna campus, we therefore at the same time recommend to proactively use any opportunity that may come up in the coming years to plan a space extension of SciLifeLab in Solna. This would allow the necessary reorganization to be planned and carried out without major disruption of business continuity.*

Re: The turnover policy has been discussed actively and repeatedly, particularly since space at CS has been and continues to be limiting. We wish to emphasize that the space planning at CS is decided by the three universities in Stockholm, who also bear the operational responsibility and most of the financial costs involved in CS. SciLifeLab Board and Management Group do not therefore have direct influence on these matters. One could say that CS is in many ways more like a joint site for Stockholm Trio universities and their departments, hosting a significant number of national infrastructure units at the same time. The practical decision party regarding the space questions is the CSC, to whom the CSD reports, and whose members are the SDs and IDs of the three universities, as well as the Infrastructure Director of SciLifeLab (who represents the interests of the infrastructure platforms that are located at CS). With some space arrangements, CSC and CSD now hope to be able to accommodate the first wave of DDLS Fellows in early 2022, but space is running out, unless a turnover system is activated, groups are substantially condensed or more space is acquired. As indicated already, KTH has departments that only exist at the CS, and hence there is no space for such PIs to rotate anywhere else or space for those departments to move to. Hence, it is preferable for the Stockholm Trio universities and CSC to consider acquiring more space at CS than enforcing turnover. There are ongoing plans to investigate how to rent the entire third six-story "tower" at CS, and hence expand the space considerably. This would enable flexibility in planning future expansion of CS and relieve the space pressure. However, no formal strategic decision has been made. Decisions are also waiting for the future SFO funding, expected by the end of 2021.

5.5h) Fellows*. After our 2017 discussion with the Fellows, we took great care to try to obtain a representative picture of the Fellows situation in 2019 and discussed with two extended groups of them, also addressing each host university and the two sites Solna and Uppsala separately. Unfortunately, the IAB was still shocked to see that the situations of the Fellows had essentially not very much improved compared to 2017 and that the Fellows research coordinator had not had too much impact because of turnover and recent re-appointment in this position.*

- *SciLifeLab directors and senior faculty needs to take responsibility for proactive Fellow mentoring, with clearly assigned responsibilities for each Fellow (currently mentoring works only partially but far from well within the host university departments) and a formalized mentoring system in place.*
- *Provide core facility support, access to shared scientific equipment (also in senior labs); a specific university affiliation should not be required for groups to obtain access and support within the Solna research center.*
- *Provide open access also to advanced technologies in senior faculty labs or platforms, so Fellows can engage effectively in technology development.*
- *Coordinate the recruitment of Fellows among host universities (the four rectors expressed a willingness to do this, for example with joint candidate symposia) and select the best Fellows mindful of the overall SciLifeLab research strategy with involvement of the SciLifeLab directors; avoid overlapping recruitments, aim for synergistic recruitments that maximize collaborative potential among Fellows and with SciLifeLab faculty.*
- *Create transparent and harmonized procedures for tenure track independent of university affiliation, aiming for the first six years physically integrated and mixed between the universities in the center and the possibility of tenure after evaluation in host university departments afterwards.*

Re: Many of these issues concern the CS and are therefore being addressed by the CSC, the CSD and the three universities in Stockholm. While some of the points raised above are also relevant to UU, and in the future also to DDLS, this response is given with a CS angle.

- First, we have now created a systematic survey of the SciLifeLab Fellow program that should provide a more systematic overview of the Fellows program, the achievements but also the challenges from the Fellows, their host universities and from SciLifeLab's side. This survey will be included in the *Appendix L* and described in *Section 8.2*. This will be useful to plan specific and systematic actions. Also, despite of the criticism about the scientific environment, the Fellows have had many research successes, raised more than a 1 BSEK (100 MEUR) worth of grants and at the end of their 5–6 year terms, most Fellows want to continue to stay at CS. Also, in many cases the research of the Fellows is linked to the infrastructure and their research capabilities depend on the local research environment and collaborations.

- Second, there is certainly a need for more mentoring, and this has been and continues to be improved. We have also created a formal process document to better guide new group leaders selected to the SciLifeLab Fellows program. There are also now better mentoring systems in place within CS, exercised by the SDs and host departments, and we will work to assign additional mentors to Fellows when needed. Obviously, all mentoring programs have been a bit difficult to set up during the COVID-19 years 2020–2021.

- Third, local core facility support and shortage of shared equipment at CS (beyond the national infrastructure) have been common complaints and they are now being addressed by the CSC, which is also making available grants to apply funding for such shared CS-specific equipment and other needs.

- Fourth, access of Fellows to national infrastructure has also been a recurrent challenge being addressed. The systematic survey indicated that there are now many interactions between infrastructure and Fellows and listed many suggestions for improvement. Management has encouraged the infrastructure units to actively identify opportunities to interact with SciLifeLab Fellows, WCMM Fellows, DDLS Fellows, ERC grant recipients and other promising young PIs. In addition, we will start collecting statistics on the collaboration, services and publications between infrastructure units and Fellows. The SciLifeLab Board has so far not provided Fellows a systematic advantage or expedited access to routine infrastructure services, in order to not endanger the national infrastructure mission and prioritization process. Access to equipment at national infrastructure has been possible to arrange in some cases, while in others equipment warranties, complex access rules (due to patient samples, GDPR, data storage etc.) have not allowed Fellows open access. However, all these questions are case-specific, and some Fellows work continuously physically close to infrastructure and make direct use of it. In such cases, their host universities and departments usually own the equipment and have arranged access to research (e.g., microscopy and Cryo-EM have such arrangements, and have 50% of the capacity paid and reserved by the host university and hence available for their own research). We have also suggested that SFO funding can be used to expedite access and e.g., provide a dedicated FTE to support local access to national infrastructure units.

- Fifth, there has been more coordination in the recruitment of the last round of Fellows. Universities have updated each other about their planned recruitments, and UU has made candidates' scientific talks available to the whole community. Many SciLifeLab Fellow recruitments recently have concerned computational topics, thus preparing universities and the SciLifeLab environment/community for the DDLS recruitments. DDLS recruitments from the 11 parties will happen all at the same time, under a common branding.

- Sixth, the tenure evaluation is deeply embedded in the routines at each university and at the host university department, which then will assume long-term (life-long) commitment to that particular Fellow. They are understandably wishing to have ownership of such critical decisions and hence it is difficult to override with a SciLifeLab-specific evaluation. Maybe this could be an additional (advisory) evaluation, but the decision will happen at the universities. Also, tenure evaluation and moving out from CS are considered as two specific steps, and as mentioned before, there are significant differences in the policies of the departments in terms of their localization plans at CS.

IF the above issues for the Fellows can be addressed successfully, we additionally recommend to: grow the Fellows program as it is strongly supported by all hosts and adds huge value to them, and in the long-term, potentially open the Fellows program to non-host universities, with the long-term vision that the best international faculty would receive their first six-years of training at the SciLifeLab research center.

Re: The future of the Fellows program is a critical strategic question for the future of SciLifeLab and will depend on if and how the SFO-funding from the government to the founding universities will continue. Provided that funds are available, the four universities have declared that they will continue to support the Fellow program. In addition, we have been presented with the opportunity to start the national DDLS Fellows program. Thus, the SciLifeLab Fellow program will hopefully continue as before at CS and at UU, and be complemented by the DDLS Fellows program as a fully national program. In addition, we have a collaboration with the Wallenberg Centers for Molecular Medicine (WCMM), hosting Fellows in Umeå, Lund, Gothenburg and Linköping.

Linking to the research community. We very much welcome the first open call initiatives of RCPs and TDPs to allow researchers in the whole national system outside to become linked more closely to SciLifeLab infrastructure (RCPs) and technology development activities (TDPs). This will grow a national community that participates in SciLifeLab and becomes prominent users of its services or developers of its next generation technologies. We would suggest that SciLifeLab could help these initiatives even more by coordinating their interactions with each other and providing them with outreach and communication expertise to make their cases effectively and avoid having to reinvent the wheel multiple times. As a concrete example, the excellent aquatic microbiome initiative could probably easily increase its funding with help from SciLifeLab PR experts.

Re: We agree, and we will continue the TDP program, hopefully both in connection with the infrastructure, as well as a more research-oriented technology development program. RCPs have not received a lot of support from their host universities and may not be continued. Their role has also been hampered by the COVID-19 pandemic. The three capability areas, as well as the DDLS program will now likely at least partly replace or complement the RCPs.

5.5*i) Flagship projects.* *The 2017 IAB comment that triggered the RCP calls was to foster flagship projects on the scale of the HPA that have the potential to address grand societal challenges and/or would be internationally unique and leading efforts, as these can be powerful drivers of unique technology development and new infrastructures.*

We still believe that SciLifeLab should be a driver to allow such projects to come to fruition in Sweden more frequently, by creating the environment where they can make their first pioneering steps. Such projects could come from SciLifeLab's own in house faculty, from successful RCPs and TDPs or from a combination of the two. In our opinion, one such flagship has essentially already happened, with catalyzing the Genomic Medicine Sweden project nationwide and we expect more to come in the future.

Re: We agree and continue to be positive towards identification and incubation of grand challenge initiatives in the SciLifeLab community. GMS has now largely expanded to a national program in the health care, beyond its SciLifeLab origin, but the SciLifeLab Clinical Genomics platform continues to be deeply involved. The DDLS program could be considered as a new flagship grand challenge program at SciLifeLab. Specific action areas therein will be defined in the near future. Also, there are ongoing big programs in e.g., proteomics (Protein Atlas and others), spatial and single cell biology (e.g., cell atlas programs), sequencing 1,000 trees and many other biodiversity and environmental (planetary) biology programs are being considered, often as part of international consortia.

5.6 Drug Discovery and Development Platform

The comments regarding the DDD concern specific issues regarding specific programs and these have now largely become of historical importance, since these projects have finished a long time ago. It is important to consider the future of the DDD in the light of new developments, such as the start of a KAW-supported program on oligo-nucleotide therapeutics (OligoNova) at GU. These developments will be further described elsewhere in this report. One example of a specific question is the one below that was answered by the DDD platform representatives:

[...] "The first, a program on Acute myeloid leukemia (AML) improving a known compound with significant medicinal chemistry effort, apparently already generated interest from Pharma and Venture Capital investors. It was not made clear however, what properties of the new molecule were required for this new indication, and we were not shown any toxicology. The second program discussed antibodies against a novel target for inflammatory diseases. This is showing promising activity in a couple of animal models; however we were not shown the rationale for which patient group this might be effective. The biology presented was of classical animal models that are not always predictive, and it was not clear to the IAB that the team had seriously considered ex vivo or topical tests in order to understand the mechanism in man. It would have been helpful to understand the rationale behind the proposed initial clinical studies as this would show how much is understood about the mechanism in real patients."

Re: DDD platform response: Unfortunately, the IAB may have misunderstood the specific project presentation from the DDD platform. We regret that we were not able to convey the complex information in a sufficiently clear way. The AML program does not involve any known compounds – it concerns development of a completely new lead series. The AML program, as this specific drug discovery project was called then, has now been licensed by an international VC company that has started a new company around the project. The antibody program towards inflammatory disease became the foundation for a new company Lipum AB that have attracted substantial funding and that was listed on Nasdaq in 2021. Lipum AB has generated additional preclinical data and is projected to go into clinical trials during 2022 with juvenile idiopathic arthritis as first indication.

The IAB recommends that DDD should be able to receive funding via clearer partnerships with its users. To enable this, one of the universities could create an office that represents all universities and is able to sign contracts with investigators and/or funders. The investigators clearly would continue to own the IP but could then share future funds of their drug discovery research with the DDD platform. Such a solution would significantly enhance the ability of DDD to support more and better programs and should ideally be done in a way that helps SciLifeLab to coordinate and represent its different platforms in general.

Re: We are very happy to inform the IAB that, since April 1, 2019, the SciLifeLab Drug Discovery and Development platform has an office function under Uppsala University to represent DDD and sign contracts with investigators and funders – in line with the recommendations from IAB. The potential to implement a revenue sharing model is planned to be investigated in collaboration with SciLifeLab externalization office, but it is important to be realistic about the timelines for such a drastic change in the infrastructures mandate.

The IAB recommends that the DDD platform engages more with European projects and other international projects, including for example IMI toxicology-oriented projects, or drug discovery projects like "Illuminating the Druggable Genome" in the US.

Re: We embrace the IAB recommendations to engage more with European projects and we are actively pursuing this. As an example, since the meeting in March 2019, DDD is involved in a new IMI project, "ConcePTION", to evaluate how drug treatment affects pregnant and breastfeeding women. From 2021, we also formalized our part in the "EUbOPEN" IMI project, where we identify monoclonal antibodies as part of the effort to create an open source of "tool compounds" vs. 1,000 proteins. Thanks to the office function described above, DDD is now also member of the European Advanced Translational Research InfraStructure, EATRIS.

The risks of toxicity, lack of specificity or therapeutic efficacy of small molecules are high and often only detected in late phase clinical studies. Pharma companies have thus reduced efforts on small molecules, and are refocusing on biological and cell agents. The DDD program should review its resource distribution across different drug classes, and consider focusing more on biological agents such as novel antibodies, proteins, peptides, modified nucleic acids and cells, as this area is now full of new opportunities for highly specific and effective agents and also represents a strength in Sweden's and SciLifeLab's academic research and would offer close links with other SciLifeLab platforms.

Re: We agree to the obstacles using traditional small molecule drugs as pointed out by IAB. In the review process, the DDD steering group favors projects with new modality approaches and technology development projects that aim to increase the competence and capacity to work with these new modality approaches. Most projects supported by DDD are either novel antibodies, proteins, peptides, modified nucleic acids and cells or technology development for new approaches for drug development. We also agree that there still are untapped resources and competence within other platforms to address these opportunities. To engage a wider spectrum of SciLifeLab platforms in our supported projects is one of our priorities.

Some of the small molecule screening activity to discover new drugs could be redirected towards testing existing registered medicines on novel biological targets as in the AML example that was presented. Many existing medicines have several activities that may prove useful in novel indications. There is an important synergy here with rare disease genomics work, since by screening all registered drugs against targets or cells derived from rare disease patients, it is sometimes possible to find existing medicines that can quickly be repurposed to alleviate certain rare diseases.

Re: Repurposing is a valid approach to find new therapies. The current viewpoint at DDD is that these projects are better suited at the CBGE platform with their expertise in phenotypic assays and screening combined with target deconvolution. There is a close collaboration between the DDD and CBGE platforms and projects can shuttle between them depending on how they progress.

5.7 Closing Remarks

We recommend to think big and make an ambitious and forward looking strategic plan, similar to when SciLifeLab was founded almost 10 years ago. We hope that our recommendations help to formulate the roadmap for the next decade and we are very optimistic that all of SciLifeLab's enthusiastic and supportive stakeholders will embrace, jointly own and promote it. United together behind the common SciLifeLab goal, they can create the powerful lobby with the government and make their own commitments to make it happen. Probably no other area of research will have such an impact on society in the next decade as life science. With SciLifeLab, Sweden has the opportunity to be at the forefront of this development internationally if the right choices are made now.

Re: We fully agree and thank the IAB for the positive words and encouragement that tremendously helped to prepare for the national hearing of SciLifeLab, the subsequent 10-year strategy, increased budget allocation from the government, the new national role SciLifeLab played in the COVID-19 pandemic, as well as the launch of the DDLS program. These items will now highlight a new start and a bright future for SciLifeLab in a multitude of ways.

Given the imminent strategic negotiations for SciLifeLab and the potential need to consult the IAB on aspects of the process as well as in the next national infrastructure evaluation, we would request a summary response to our recommendations by the SciLifeLab Board within three months after its receipt. This would provide the IAB with an orientation on the Board´s general vision for the future development of SciLifeLab prior to our next formal engagement in the platform reviews and ahead of the next IAB site visit. Finally, we very much value the strategic importance of our dialogue with the university rectors. We would therefore also highly appreciate a joint statement from the rectors regarding the alignment of our recommendations with their vision for SciLifeLab's future.

Re: We prepared the initial response to the IAB report 3 months after we received it. We have now completely revised this response in the summer of 2021, reflecting the tremendous developments and changes that have taken place at SciLifeLab and in the community during the last 1–2 years.


SampleXpress

6. Overarching SciLifeLab Activities

Activities impacting the whole SciLifeLab organization. This section aims to give the IAB a summary of the significant developments in 2019–2021 and describes plans and strategies for the future.

▶ 6.1 The SciLifeLab Roadmap 2020-2030

The overall **mission** for SciLifeLab is to enable life science research in Sweden that is beyond what is possible for an individual researcher, department, faculty or even an individual university. Also, it is important that we can provide the same infrastructure to serve across different research disciplines that otherwise would each need to set up their own infrastructure efforts. We provide access to the latest key technologies through SciLifeLab's infrastructure which creates prerequisites for cutting edge research, but also enables new forms of collaboration between individuals, groups and organizations through directed initiatives by SciLifeLab. Our **vision** is for Sweden to be a world-leading nation in life science, which follows the government's key ambition for Swedish life science.

The first outline of a 10-year strategy plan 2020–2030 was already included as part of the report to the IAB in 2019. With input on these plans from the IAB at the last visit, the SciLifeLab Management Group worked on a first draft of the SciLifeLab Roadmap 2020–2030 (*Appendix B*). In September 2019, a National Hearing was organized to which all the major stakeholders of Swedish life science were invited, such as Minister of Education, rectors of the four founding universities, the KAW leadership and representatives of all universities, industry and health care. IAB chair Jan Ellenberg delivered a strong message on the importance of life science and SciLifeLab. After the hearing, the participants and the entire scientific community were encouraged to submit comments on the draft strategy document which were taken into account when finalizing the roadmap. A next to final draft version of the roadmap was also the base for the input submitted by SciLifeLab to the Government research bill late in the autumn of 2019. The final version of the SciLifeLab Roadmap 2020–2030 was approved by the SciLifeLab Board in February 2020.

The Roadmap takes into account changes in both academia and the society over the past five to ten years that impact on our operational environment, such as funding available for research infrastructures, increased need for national coordination and collaborations also between sectors and disciplines, the scientific community's need for cutting-edge technologies, and the increasing dependency of life science on e-infrastructure and processes for big data management, data sharing, integration and analysis. The SciLifeLab Roadmap 2020–2030 is entitled "*A technology- and data-driven approach to life science*" and it consists of six strategic objectives or building blocks (*Figure* 3).

When the Government research bill for the period 2021–2024 was announced in December 2020, SciLifeLab received increased base funding by a total of 150 MSEK over this four-year period. The research bill stated that

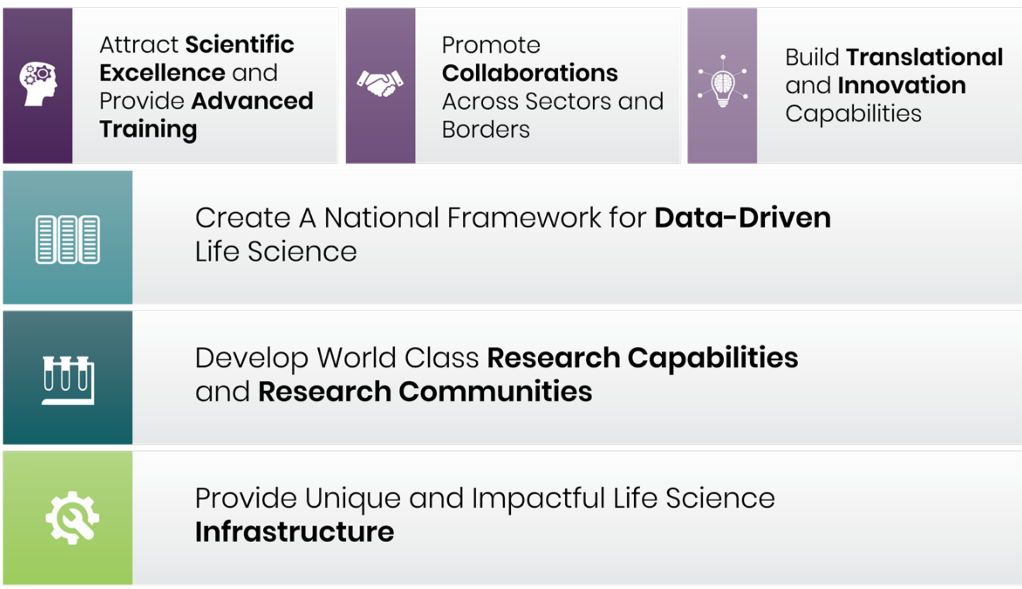


Figure 3. SciLifeLab's six strategic objectives outlined in Roadmap 2020–2030.

"SciLifeLab has recently been evaluated by an international panel of experts that compares the laboratory with the leading laboratories in the world. [...] In order to maintain and strengthen Sweden's competitiveness as a leading research nation, Swedish researchers need to have access to the most advanced technologies and expertise also in the future. This type of research infrastructure is resource-intensive both in terms of investment costs and associated expertise. The Government therefore intends to strengthen the basic financing of SciLifeLab." In addition, SciLifeLab was also commissioned to set up laboratory preparedness for future pandemics with additional dedicated funding of 130 MSEK for the same period. The funding of SciLifeLab is covered in more detail in Section 6.2.

6.2 The SciLifeLab Organization and Funding

Organization

SciLifeLab is a collaborative effort but is formally represented by KTH. The current SciLifeLab organization structure is outlined in *Figure* 4, which now includes the new DDLS program. DDLS is featured as a separate part of the organization closely connected to and synergistic with the SciLifeLab infrastructure. However, DDLS is privately funded, and involves 11 equal partners across the nation.

Board. The SciLifeLab Board is the highest deciding body with the overall responsibility for national coordination and infrastructure funding. The Board also controls the DDLS funding, as stipulated in the donation letter from KAW. The Board is composed of the Chair and eight additional members of whom four are representing the founding universities KTH Royal Institute of Technology (KTH), Karolinska Institutet (KI), Stockholm University (SU) and Uppsala University (UU), three other Swedish universities, and one industry. The Chair and industry representative are appointed by the government, while remaining members are appointed by the KTH Board.

Founding University SciLifeLab Committees. Each of the four universities have dedicated SciLifeLab Committees, either chaired by or with the SciLifeLab Integration Director as committee member, that govern the strategic research funding (SFO) at the respective university and coordinate interactions with the national infrastructure, other founding universities, Campus Solna, and in the future also the DDLS program.

National SciLifeLab Committee (NSC). The NSC consists of representatives from the non-founding universities across Sweden, with the task to oversee the national perspective of SciLifeLab infrastructure.

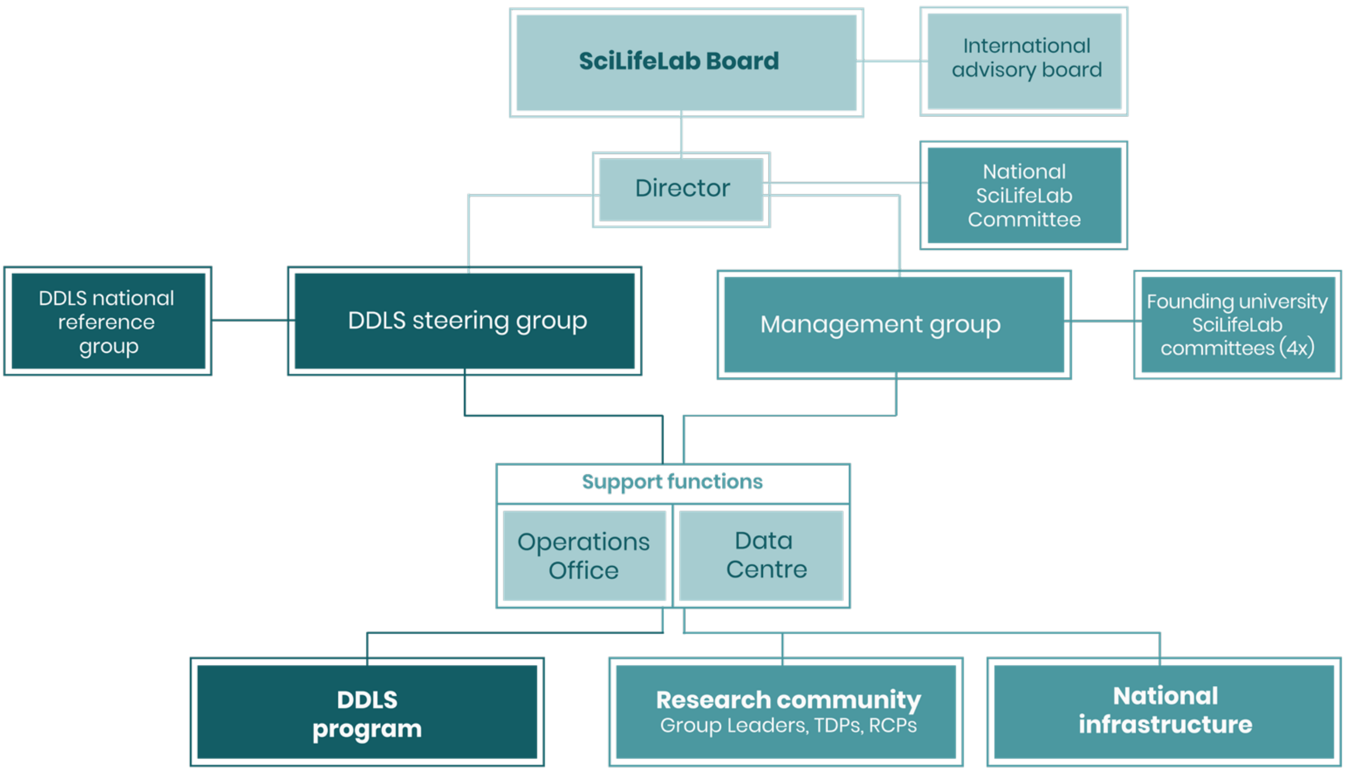


Figure 4. SciLifeLab organization.

Figure 5. Operations Office (OO) support areas and responsibilities.

Management Group (MG). The MG consists of the SciLifeLab Director, Co-Director, the Infrastructure Director, and the four Scientific Directors, representing each of the founding universities. In addition, co-opted members are the Campus Solna Director (CSD), Acting Head of Operations, Acting Vice Head of Operations and Head of Data Centre.

DDLS Steering Group (SG). The governance of the DDLS program was established in 2020–2021. The DDLS Director leads the steering group, which is the executive DDLS leadership that prepares decisions for the SciLifeLab Board. The DDLS SG also has close links with the eleven partner organizations through a national reference group with members close to the leadership at these organizations. Currently the SciLifeLab Director and the DDLS Director is the same person but may not necessarily be so.

Campus Solna Committee (CSC). The CSC is responsible for Campus Solna campus-specific operations and consists of IDs and SDs linked to KI, KTH, SU, the Infrastructure Director. Co-opted member is the CS Director.

Operations Office (OO). The Operations Office supports the SciLifeLab Board, Directors, MG, the infrastructure, and the research community in coordinating, administering and the execution of proposed actions. From 2020 OO also supports the National COVID-19 Research Program and from 2021, the DDLS Steering Group and the DDLS program. The OO personnel, about 30 FTEs in total, are employed either at KI, KTH or UU and are physically located at either Campus Solna or Navet in Uppsala. OO supports the organization in ten operational support areas (*Figure 5*).

OO is run by the Head of Operations (HOP) and vice Head of Operations (vHOP), and the OO personnel are gathered in inter-university teams based on the needs of assignments and projects. During 2019–2020 a support area coordinators function was implemented, and coordinators were assigned for each of the ten operational support areas in *Figure 5*.

A major task for the area coordinators is to assist the OO management with making the yearly operational plan and budget. The OO personnel are grouped according to the support area of which they mainly work within, but some individuals work in several of the support areas. Implementation of this new structure has enabled the OO management to spend more time on overarching strategic and overall operational issues, but most importantly increased the quality and efficiency and enabled easier prioritization and allocation of resources.

Data Centre (DC). SciLifeLab Data Centre coordinates and supports activities throughout the SciLifeLab infrastructure life cycle of data; from project planning, data production, data analysis, data sharing, to publishing and reuse of data. DC works closely with MG, OO, all platforms and with the universities and the broad research community on data management and training. DC also has a major role in DDLS and its functions are described in more detail in *Sections 7.9* and *11.4*.

Members of SciLifeLab's current leadership and stakeholders are outlined in *Table 1* and *Appendix A*.

6.

Table 1. SciLifeLab leadership 2021.

SciLifeLab Board

Name	Affiliation	Role
Carl-Henrik Heldin	Uppsala University	Chair, until September 30, 2021
Lotta Ljungqvist	Cytiva	Industry representative
Annika Stensson Trigell	KTH Royal Institute of Technology	KTH representative
Anders Gustafsson	Karolinska Institutet	KI representative
Anders Karlhede	Stockholm University	SU representative
Stellan Sandler	Uppsala University	UU representative
Göran Landberg	University of Gothenburg	Other university representative
Fredrik Elinder	Linköping University	Other university representative
Katrine Riklund	Umeå University	Other university representative
Gunilla Westergren-Thorsson	Lund University	Co-opted, Chair NSC

SciLifeLab Management Group (MG)

Name	Affiliation	Role
Olli Kallioniemi	Karolinska Institutet	Director
Mia Phillipson	Uppsala University	Co-Director
Annika Jenmalm Jensen	Karolinska Institutet	Infrastructure Director
Hjalmar Brismar	KTH Royal Institute of Technology	Scientific Director (SD)
Janne Lehtiö	Karolinska Institutet	Scientific Director (SD)
Christos Samakovlis	Stockholm University	Scientific Director (SD)
Staffan Svärd	Uppsala University	Scientific Director (SD)
Jenny Alfredsson	Uppsala University	Co-opted, acting Head of Operations
Sandra Falck	KTH Royal Institute of Technology	Co-opted, acting Vice Head of Operations
Per Ljungdahl	Stockholm University	Co-opted, Campus Solna Director
Johan Rung	Uppsala University	Co-opted, Head of Data Centre

DDLS Steering Group (DDLS-SG)

Name	Affiliation	Role
Olli Kallioniemi	Karolinska Institutet	Program Director
Siv Andersson	Uppsala University, Knut and Alice Wallenberg Foundation	KAW representative
Oliver Billker	Umeå University	Steering group member
Niklas Blomberg	ELIXIR	Steering group member
Matts Karlsson	Linköping University	Steering group member
Erik Kristiansson	Chalmers/University of Gothenburg	Steering group member
Janne Lehtiö	Karolinska Institutet	Steering group member
Erik Lindahl	Stockholm University	Steering group member
Emma Lundberg	KTH Royal Institute of Technology	Steering group member
Fredrik Ronquist	Museum of Natural History	Steering group member
Gunilla Westergren-Thorsson	Lund University/WCMM	Steering group member
Carolina Wählby	Uppsala University	Steering group member

Funding

Up until 2019, the core SciLifeLab funding consisted of three separate funding sources from the government: national infrastructure funding (National), Drug Discovery and Development funding (DDD), and strategic research area funding (SFO) to the four founding universities. The SciLifeLab Board is the deciding body for the National and DDD funding, while the SFO funding is distributed directly to each of the four universities and is controlled by the SciLifeLab committees at these universities.

The new four-year SciLifeLab budget from the government increased for the 2021–2024 budget period. SciLifeLab, in addition to increased base funding to the infrastructure of 150 MSEK for 2021–2024, obtained additional funding from the government for Pandemic Laboratory Preparedness, 130 MSEK over 4 years (2021–2024). Thus, the total national infrastructure funding, including the DDD, is 309 MSEK for 2021, and will gradually increase to 344 MSEK in 2024. The SFO funding has been about 165 MSEK/year (distributed across the four universities), and while its future levels are not known, we are positive towards its continuation as well. In 2020, new non-governmental funding sources were also introduced thanks to generous donations from KAW. The first funding was given in response to the global COVID-19 pandemic and enabled SciLifeLab to set up e.g., clinical diagnostics, method development of high sensitivity and specificity serology tests, biobanks, and to create and coordinate a national team-science research program to support COVID-19 research (see *Section* 6.8). This program was extended in late 2020 to continue for two more years. In the fall of 2020, KAW announced a new major 3.1 BSEK donation to initiate and coordinate a national program on data-driven life science (DDLS) which was then launched in 2021 (see *Section* 11). Thus, taken all sources of funding together, and expecting the SFO funding to continue, we will almost see doubling of the SciLifeLab baseline funding by 2024, as compared to the level in 2020 (*Table* 2).

In addition to the funding streams described above, the SciLifeLab infrastructure is also supported by considerable funding from additional sources, including grants from VR, non-governmental funding agencies, universities and user fees. External funding to SciLifeLab infrastructure units is described in more detail in *Section* 7.3.

For SciLifeLab to operate seamlessly, these independent funding streams need to be managed according to the regulations from the source. This has required significantly increased and improved financial coordination processes (e.g., dedicated financial controllers for the government, SFO and DDLS parts), as well as an intensive and transparent dialogue with the SciLifeLab Management Group, DDLS Steering Group, founding universities and the Board. In *Figure* 6 is explained how the distinct funding flows, the recipient universities and how the funds are managed.

Table 2. Funding to SciLifeLab 2020–2024 (MSEK). *SFO funding is not confirmed from 2022 and onwards.

	2020	2021	2022	2023	2024
Governmental funding (MSEK)					
Base funding NAT incl DDD	274.7	279.5	284.3	289.2	294.1
New NAT		30	30	40	50
PLP		40	30	30	30
SFO*	161.8	164.5	164.5	164.5	164.5
Sum	*436.5*	*514*	*508.8*	*523.7*	*538.7*
Non-governmental funding (MSEK)					
COVID-19 program	35	87.5	52.5		
DDLS		21.4	185.8	185.8	294.1
Sum	*35*	*108.9*	*238.3*	*185.8*	*294.1*
Total	*471.5*	*622.9*	*747.1*	*709.5*	*832.8*

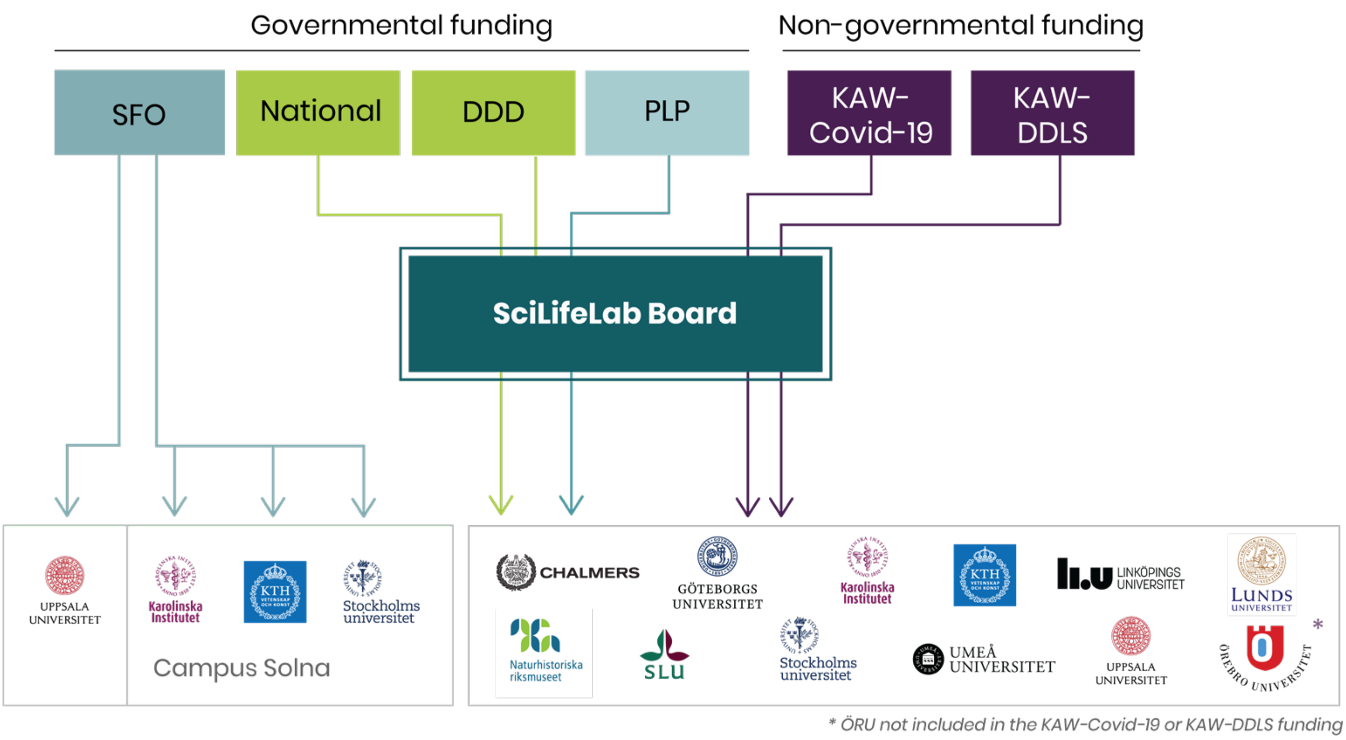


Figure 6. Funding streams to SciLifeLab.

6.3 SciLifeLab Sites

Background

In 2008 the government research bill allocated 5.3 BSEK of strategic research funding starting from 2009 as long-term support for building strong research environments across all research disciplines. The aim was to enable research of the highest international standard. Following a call in 2009, the funds (denoted SFO-funds) were distributed to 43 defined strategic research areas of which SciLifeLab was one. This funding has continued now for over 10 years, and its future format and level of support is likely to become clear by the end of 2021.

The SFO funds to SciLifeLab (*Table* 2) come in two streams (*Figure* 6). One goes directly to UU while the other goes to KTH after which it is divided equally between the three Stockholm universities. These dedicated SFO funds have had major importance for building the strong local SciLifeLab research environments at these four universities. The largest proportion of these funds have been used for financing the SciLifeLab Fellows program (described in detail in *Section* 8.2). Moreover, they have been used to strategically strengthen life science research at each university and collaborations between universities (e.g., creation and support to the Campus Solna in Stockholm, see below), support to local research infrastructure through i.e., co-funding of national SciLifeLab infrastructure, postdoc programs, and projects for setting up and developing new techniques and services. For example, SFO funds have been used for co-funding national technology development projects, and the SciLifeLab Research Community Programs together with national funding. More details on the use and impact of the SFO funding at the four founding universities are found in *Section* 10.

The three Stockholm universities, KTH, KI and SU, together cover running costs for the joint initiative Campus Solna and a large portion of their SFO funds have been used to co-finance the daily operations and running of the campus. In Uppsala, SFO funds are also used for running and operating Navet, the joint meeting place for the Uppsala and national SciLifeLab community. Navet and Campus Solna are described in detail in the sections below.

The SFO funds have been central for the success in building strong local research environments where the nationally financed SciLifeLab infrastructure is embedded. This collaboration model challenges and feeds expertise into the infrastructure, making it continually evolve and improve. In parallel, the usage of the SciLifeLab infrastructure generates high impact research from the local research environment, as demonstrated by the number of high impact publications (see *Section* 7.4) and leverages the quality of research at the founding universities. The continuation of these SFO funds is therefore vital for the success and further development of SciLifeLab to meet research needs and for remaining at the cutting edge.

As a first step towards creating similar SciLifeLab environments outside of the Stockholm-Uppsala region, national funds have from 2021 been allocated for building SciLifeLab sites at Lund, Gothenburg and Umeå, and from 2022 at Linköping (see below). This will then set up a model where SciLifeLab is present across Sweden as a collaborative network, with links from national infrastructure and the DDLS program to the local research environment. This provides a powerful model to promote a strong national research ecosystem in life sciences, something that the IAB has also encouraged SciLifeLab to do.

Campus Solna

Campus Solna (CS) is the largest SciLifeLab site and houses almost 50% of the national infrastructures. It is also the main site for the national management and operations personnel as well as a major site for meetings and training activities. CS serves as a showcase for visitors to the SciLifeLab (locally, nationally, and internationally). All daily operations at CS are the responsibility of the Stockholm Trio universities (KI, KTH and SU). Campus Solna has grown steadily, and currently over 1,000 persons are working in the Alfa and Gamma buildings. All activities at CS are aligned with its dual mission: hosting national infrastructures accessible to scientists across Sweden and being a strong environment with a life science research community. Technical innovations developed at CS, most recently spatial transcriptomics, have enhanced SciLifeLab's international reputation at the forefront of molecular biosciences. By collaborating, the Stockholm Trio universities have created one of the highest concentrations of bioinformaticians and computational biologists in the EU, making CS a vibrant research environment well equipped to meet the needs of the newly launched DDLS era of SciLifeLab.

Although Campus Solna is hugely successful as a joint community of researchers and as a host of well-functioning national infrastructure units, the 2019 IAB report raised several major concerns. These primarily reflected practical issues arising from CS growing very rapidly with the need to better coordinate activities of the three universities, each with their own traditions and administrative routines. To address the primary concerns, the SciLifeLab Board appointed a Campus Solna Action Group consisting of the Director, Co-Director, and the four Integration Directors. The CS Action Group recommended to establish a Campus Solna Director position, and drafted a 2-year action plan with the following five goals defined to enhance the national impact of SciLifeLab (*Appendix C*):

1. Clarify the role of Campus Solna as a vital component of SciLifeLab.
2. Improve governance of Campus Solna and its resources.
3. Improve and enhance the academic environment.
4. Establish processes to ensure proper level of support services, space allocations and rebuilding.
5. Optimize SciLifeLab Fellows program and support career development. Progress towards this goal led to harmonizing the processes associated with recruiting and career development of SciLifeLab Fellows (*Section 8.2*).

The CS Director was appointed in May 2020 through an open call and has the mandate to run Campus Solna as an internationally competitive SciLifeLab site. The CS Director reports to the Campus Solna Committee (CSC) and in strategic matters to the SciLifeLab Director. Since Per Ljungdahl started as the first CS Director, he has worked to coordinate and create a more centralized management structure for CS. The CS Director works closely with the CS Unit Manager, who has played a key role in establishing processes to plan and implement space allocation, budget decisions and IT infrastructure. More strategically, the CS Director has worked to secure long-term financial commitment by the CSC in three areas: 1) physical improvements to Campus Solna research laboratories; 2) Research Environment and Development (RED) Grants; and 3) Core Community events. The RED grants aim to enhance the general research capabilities at Campus Solna by providing funding for new shared instruments, funds for novel technical solutions facilitating future next-generation technical innovations, and a joint CS postdoc program. The "new start" for CS has been challenging due to the COVID-19 pandemic, but the advances have had a discernable effect.

Although laboratory space at Campus Solna is currently limited, some space exists to accommodate a few new computational groups. The space limitation is being forcefully addressed by implementing a more dynamic use of resources, including office and laboratory space, and equipment. Due to the increased level of sharing, an even more collaborative and joint research environment is evolving. Based on these efforts Campus Solna will have the capacity to house the first six DDLS Fellows to be recruited in Phase I of the DDLS program described by the Stockholm Trio universities (see *Section 11.3*).

Two strategic challenges require extra focus. First, full occupancy of the Alfa and Gamma buildings is restricting the expansion of research groups and the development of new national infrastructure units, e.g., Spatial Transcriptomics and Exposomics. Clear mechanisms to facilitate the flow of research groups in and out of Campus Solna have not yet been established. However, efforts are underway to address this and a policy is being drafted requiring all research groups to renew space allocations at Campus Solna every 5 years. Second, the central KTH facility office is preparing a development plan for Campus Solna to expand into the Beta building, which would add almost 50% more space. This opportunity could be leveraged to create an even stronger research environment that is also more representative of the strengths of the Stockholm Trio universities and the national infrastructure. The long term SFO funding is important for the continued development of Campus Solna. Hence, a strong formal commitment by the Stockholm Trio universities to continue to prioritize Campus Solna is critically important for future planning.

Navet Uppsala

In Uppsala, SciLifeLab's other main infrastructure location, the national infrastructure is embedded in the local research environment. The site is located at five campus areas across UU, and engages researchers from nine different departments at UU. The SciLifeLab building Navet is part of Uppsala's Biomedical Center (BMC) and is an important local and national meeting place for SciLifeLab researchers. BMC houses most of SciLifeLab operations in Uppsala and Navet is a hub in various aspects: many of the national infrastructure units are placed in close vicinity of Navet, many of the SciLifeLab bioinformaticians have offices there, and a broad range of meetings, conferences and social activities take place in this environment. Navet is also the other site for SciLifeLab Operations Office and is the formal responsibility of the Director for the Office for SciLifeLab Uppsala (currently also Acting Head of Operations), but the daily operations and strategic planning for Navet is delegated to the Deputy Director for the Office for SciLifeLab Uppsala. SFO, directed funds from the two disciplinary domains, Medicin and Phamacy and Science and Technology, and national funds jointly finance Navet and activities at the Uppsala site, including a successful 2-year postdoctoral program, funding of selected TDPs and COVID-19 projects that received high ranking but were not selected for national funds, and funding for emerging infrastructure facilities that aim at potential incorporation into the SciLifeLab infrastructure system. Currently, there are no major challenges with Navet as a meeting place.

New SciLifeLab Sites in Lund, Gothenburg and Umeå

To strengthen the SciLifeLab presence, coordination, and branding across the country, as well as engagement of universities in cities outside the Stockholm and Uppsala region, the concept of national SciLifeLab sites was launched in 2021. The basic idea is to bring national SciLifeLab infrastructure operations closer to the research communities at each site, along with integration of local university core facilities, training efforts, the DDLS program, as well as the Wallenberg Centers for Molecular Medicine (WCMM) communities at each site. The sites will be supported by a modest 1 MSEK/year from the national SciLifeLab funding in addition to co-funding/in-kind contributions from the local universities. Each site will shape its own organization, by bottom-up processes regarding content and concept, where stakeholders at each site have been given the task to identify the local needs and develop concrete action plans. The national sites concept and their suggested funding were approved by the SciLifeLab Board in May 2021 for Lund, Gothenburg and Umeå, cities where significant SciLifeLab infrastructure operations are located and to some extent already are co-localized. The funding from SciLifeLab can be used to appoint a coordinator in charge of developing the concept, for community building activities, to increase the SciLifeLab visibility, and to guide and support infrastructure users locally. We envision the establishment of local SciLifeLab offices to serve as central entry points for the activities (*Figure 7*). If proven successful, long-term SciLifeLab funding will be allocated for the purpose and the concept will be expanded to other relevant cities, e.g., Linköping, expected to start in 2022. A hub-and-nodes model has previously been suggested by IAB for increased national status of SciLifeLab, and we believe that the initiative of national SciLifeLab sites described above is well in line with the IAB recommendations.

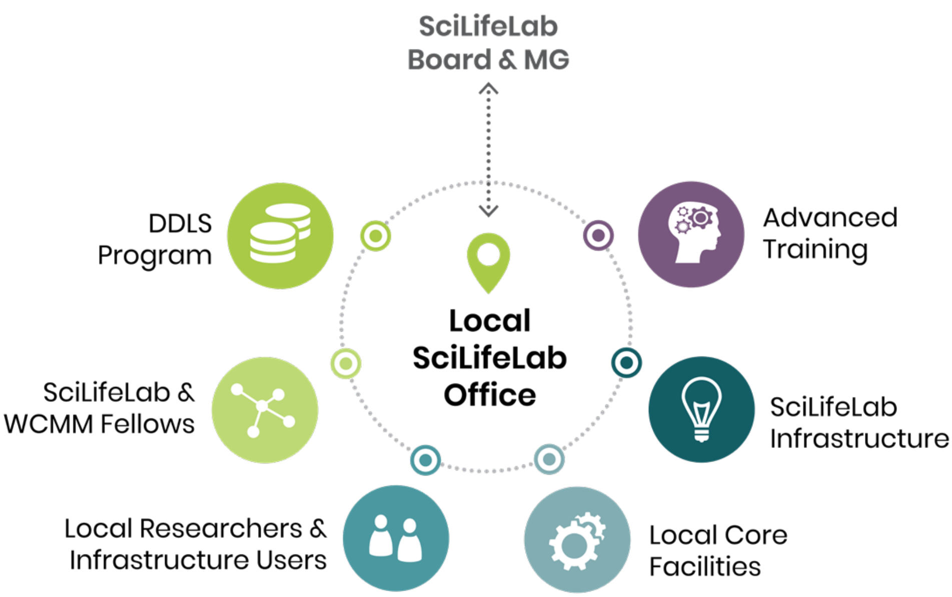


Figure 7. The SciLifeLab national site concept.

6.4 External Collaborations

When striving for accelerated implementation of novel research technologies and findings of societal benefit, both the National Life Science strategy and the SciLifeLab Roadmap emphasize the importance of increased interactions between research infrastructure and sectors outside of academia. As part of the Operations Office, the External Relations Office (ERO) works strategically to increase such collaborations. With external funding, the ERO has in 2021 grown to a team of four individuals that focus on identifying models for multi-stakeholder collaborations and connecting the local and national innovation system closer to the research infrastructure, as well as engaging in activities aimed to stimulate multi- and cross sector interactions, including e.g., health care, environment and data communities as well as other infrastructures. Two prominent examples are featured below.

Infralife: The InfraLife hub (Infra Access for Life Science Sweden) is a novel national collaborative initiative between the three large-scale research infrastructures in Sweden: MAX IV, ESS and SciLifeLab. This initiative is managed by the ERO and currently has funding for four years (2021–24) from the Swedish Research Council. It aims to increase knowledge and accessibility to the infrastructures for academia, industry, and health care by linking up the large-scale research infrastructures in life sciences. It also provides a format for sharing experience in managing national infrastructures as well as forming a strong collaborative voice in e.g., national policy, legal, regulation and funding matters.

EMBL: International collaborations have been strengthened through a Memorandum of Understanding (MoU) between SciLifeLab and The European Molecular Biology Laboratory (EMBL), signed in May 2021. The collaboration was kicked off with a workshop on May 31, 2021, with existing research topics identified that already tie the two organizations together and which may be jointly developed in the future. There are major similarities and synergy opportunities in the EMBL's Program for 2022–2026 "*Molecules to Ecosystems*" and the SciLifeLab Roadmap for 2020–2030. Tentative areas of joint interest include e.g., planetary biology, structural biology and data-driven life science. Joint initiatives between EMBL and the InfraLife community (SciLifeLab, MAX IV and ESS) also look promising.

In line with the expectations by the Government and its Life Science Office, SciLifeLab promotes increased international engagement as well as participation in larger funding calls (e.g., in EU: Horizon Europe, DIGITAL, in US: NIH Moonshot, DOE). The ERO keeps a dialogue with central stakeholders, such as Government offices, the Swedish Research Council, the Swedish Innovation agency Vinnova etc., to discuss a potential role for SciLifeLab to contribute towards Swedish participation in larger consortia and funding calls.

SciLifeLab has now assumed entirely new roles as a national research coordinator (e.g., national infrastructure, PLP, COVID-19, DDLS, etc.). As a result, the previously discussed challenges arising from the organizational structure of SciLifeLab are now more acute and limit the ability of SciLifeLab to act as a partner or as a formal national node in collaborations with external stakeholders. To counter this, a legal team is being set up between the four founding universities to work with SciLifeLab matters to facilitate and streamline processes for drafting contracts and enabling agreements to be signed more quickly. KTH is recruiting a SciLifeLab-dedicated lawyer to lead this team of designated lawyers from the four founding universities.

The recent Government commissioned investigation (SOU 2021:65) focused on organization and mandate of research infrastructures in Sweden, led by Tobias Krantz, discusses the legal and organizational challenges, but concludes that the current organizational structure of SciLifeLab should not be changed. The Krantz investigation concludes that the present structure and funding model are likely optimal for SciLifeLab, and any major change could interfere with the important ongoing mission. However, adjustments are suggested including a clearer role for KTH as primary host. SciLifeLab will continue to take active part in the discussions towards implementation of the suggestions put forward in the report.

The ERO also supports innovation and implementation of SciLifeLab research and technologies in a national context and together with other stakeholders. One pilot project run by the Drug Discovery and Development (DDD) platform that the ERO has supported, InnoPharma, gathers experts from industry, the innovation systems, as well as academic drug discovery researchers, to define roles and responsibilities for all partners to achieve an effective joint work process to select and advance drug development in Sweden. Finally, the Open Innovation Coaching program is another initiative, led and coordinated by the ERO on a national level. It aims to stimulate and create value and innovation from SciLifeLab research, through enabling researchers to speed date with business coaches from the innovation offices across the country.

6.5 Training and Education

SciLifeLab is already a major training hub in Sweden and arranges over 170 courses per year (albeit less during COVID-19 times), training over 4,000 persons yearly from all major universities (and elsewhere in the society). Many platforms have been very active in training, for example, SciLifeLab Bioinformatics Platform (NBIS) organizes nearly 30 bioinformatics courses per year, reaching more than 700 participants. SciLifeLab Training historically builds from a bottom-up approach where platforms and research groups, depending on their interest and time, individually provide training to the community. In May 2021, Jessica Lindvall was assigned as coordinator (40%) with the mission to plan for a future national training platform including the DDLS training and a research school. Activities for the fall include a survey to the SciLifeLab community and discussions with groups across the three SciLifeLab pillars (Infrastructure, Research and Data-driven life science). This planning has therefore just been formally started and hence this new activity is something we would like to present to the IAB for consideration. Below is a short summary of current plans for this transition needed to set up a SciLifeLab Training Platform.

A National SciLifeLab Training Platform will be established to:

- Coordinate and consolidate the training delivered by the three pillars of SciLifeLab.
- Coordinate and strengthen the integration of training activities across all the SciLifeLab sites.
- Establish of a community of trainers (from the SciLifeLab and DDLS communities i.e., SciLifeLab and DDLS Fellows and staff scientists) that will design and deliver courses for SciLifeLab.
- Secure sustainable course catalogues where (core) courses are delivered regularly.
- Facilitate various types of training activities e.g., self-paced courses, project-based workshops and hackathons, online synchronous and hybrid courses etc.
- Build and provide sustainable training infrastructures e.g., learning management system, registration tool and other administrative tools.
- Build synergies with external partners such as EMBL, ELIXIR, EOSC and international training programs to jointly deliver training.
- Promote all SciLifeLab training and materials to be open and FAIR.
- Set-up the DDLS education and training including the graduate school.

The transition from delivery of traditional bioinformatics training to a data-driven life science training is a major challenge. Training in topics across the data life cycle and data science coupled to medicine, biology and industry is a major shift affecting all of the educational chain. There is a need to upskill stakeholders from the whole of society, from grade- and high school, basic science, and medical education through PhD training and then in the trajectory as a researcher, health care practitioner and/or industry staff. For the SciLifeLab community this transition will affect both researchers and staff scientists in the wet-labs and dry-labs. For success, this demands synergies across the three SciLifeLab pillars and SciLifeLab sites in addition to collaboration with other stakeholders. Education is needed in a multi- and cross-disciplinary fashion where SciLifeLab can coordinate training within the domains of data science combined with advanced training in e.g., medical informatics, translational medicine, bioimaging, biodiversity, drug discovery, precision medicine etc.

Continuous objectives. Thematic course catalogues will be set-up in 1) data life cycle topics, core agnostic topics that targets and involves both data producing and data using researchers and staff scientists. 2) advanced research/ methodology skills with courses mirroring state-of-the-art activities from the three pillars of SciLifeLab and 3) complementary scientific skills e.g., building multi-disciplinary teams, lab leadership, grant writing etc. With the support of the SciLifeLab Training Platform, the three pillars will, in a synergistic and collaborative way, design and deliver the training needed. Part of these efforts will be in collaboration with international training providers e.g ELIXIR and EMBO. We envision much of the training within the data life cycle domains can be delivered online or as hybrid.

DDLS specific efforts. In addition to the continuation to build and grow on the objectives described above, the Training Platform will promote the delivery of courses in data-driven topics. With the intention to upskill newly recruited DDLS Fellows in Open science and data handling, we intend to launch in 2022 a course package with training on reproducible research, data management etc. A more long-term initiative is the planned DDLS research school (launch 2024–2025). The graduate school aims to design multi- and cross-disciplinary training activities and courses across scientific fields targeted to researchers within the data-driven life science domain. The research school will (partly) build from the activities established by the national Training Platform and the PhD students and postdocs of the DDLS research school will be trained in advanced data science topics coupled to advanced training in respective DDLS strategic research areas (cell and molecular biology, precision medicine and diagnostics, evolution and biodiversity, infection biology and epidemiology). Key aspects to be considered; 1) Interaction possibilities with DDLS partner organizations, SciLifeLab (Infrastructure and Research) and other Research schools, especially with WASP, WASP-HS, international training programs such as the EMBL Training Advanced Centre, ELIXIR, EOSC etc. 2) Networking and team building aspects within the Research School for the learners and possibly also the supervisors. 3) Engage the recruited DDLS Fellows and their group members to provide courses for the training program.

We envision the SciLifeLab Training Platform to be a complement to, as well as aligned with, the universities different life science curricula and that the training activities provided from SciLifeLab will help to foster next-generation data-driven life scientists.

6.6 Communications

The SciLifeLab brand was significantly upgraded and updated during 2020. In June, a new SciLifeLab website was launched, with simplified navigation, more flexible design, and with the addition of Community Pages, which are like an open intranet, where information is published about e.g., graphic profile, IT systems, internal events and processes. In September, the new SciLifeLab logotype was announced, with an added graphic element harboring broad symbolism, from cell division and sprouting plant seeds to human footprints (*Figure* 8).

SciLifeLab's digital newsletter is distributed weekly to some 2,000 subscribers. It reflects the news feed on the SciLifeLab website but also informs about upcoming events, training opportunities and vacancies. The news feed covers everything from press releases and publication summaries, to in-depth articles about employees, projects and initiatives.

News from SciLifeLab is also highlighted in our social media channels: LinkedIn, Twitter and Facebook (with about 13,000, 6,000 and 2,300 followers, respectively), and in the newly launched Instagram channel. The channels are continuously growing in terms of followers, dialogue, and visibility – for instance, in 2020, the SciLifeLab Twitter account rendered a 42% increase in followers and LinkedIn accounted for a 48% increase.

Activities and scientific publications from both the SciLifeLab research environment and infrastructure are continuously featured in editorial media. In 2020, Swedish media featured 798 articles (print and web) on SciLifeLab activities, and 496 articles (web) were published in international media.

The Communications team of the SciLifeLab Operations Office not only manages all the SciLifeLab channels and website, it also extensively supports central initiatives such as the DDLS program, COVID-19 efforts, the Science & SciLifeLab Prize for Young Scientists, as well as a large number of initiatives from infrastructure and the community. A challenge with SciLifeLab communications is that as the visibility of the organization grows and the scope widens, so does the communication needs. SciLifeLab continuously launches communications efforts aimed at academic researchers, industry, other sectors, and the general public; locally, across Sweden and globally, as well as to the SciLifeLab infrastructure staff, research community and the DDLS program. Furthermore, there are continuous efforts to help the community members further develop their own scientific communication e.g., through workshops on presentation technique, providing graphic templates, and guidelines for research groups setting up their own social media channels.

To meet these growing needs, the Communications team is working on an updated communications strategy, to enable synergies and extended visibility, and make sure information about SciLifeLab activities and what SciLifeLab can offer is communicated in an efficient way.

Figure 8. The old and new SciLifeLab logo.

▶ 6.7 Community Building Efforts

SciLifeLab organizes a wide range of events, as well as supports initiatives from the infrastructure and community, aiming to promote interaction and collaboration between researchers from different universities, scientific areas, and backgrounds. The activities are focused around SciLifeLab core research areas and/or technologies, and towards the different levels of the community, e.g., at and between the Campus Solna and Navet Uppsala sites, the wider national and international research community also in the context of DDLS, as well as different target groups (e.g. junior researchers, group leaders, Fellows, infrastructure staff). Major events 2019–2021 are outlined in *Appendix D* with links to available recordings, and some are described below.

The SciLifeLab Seminar Series (The Svedberg seminars hosted by Uppsala, and Science for Life seminars hosted by Campus Solna) are broad-themed seminar series with international and national speakers. Previously these were organized as physical events, but due to the pandemic, SciLifeLab has focused on maintaining one of the series in a digital format (The Svedberg), with the advantage that the seminars have become freely accessible also to the wider community and participation has therefore been high during the pandemic.

In 2019, major events were the annual scientific conference, SciLifeLab Science Summit, on the topic "Artificial Intelligence for Life Sciences" with nearly 400 participants, and Facility Forum, which gathered SciLifeLab's infrastructure personnel to promote cross-platform discussions and collaborations.

In 2020, SciLifeLab celebrated its 10th anniversary and the planned physical event to highlight this occasion was rearranged into an innovative virtual Talk show with four themed episodes: "The future of SciLifeLab", "Combating COVID-19", "Data-Driven Life Science" and "Community Collaborations". This studio broadcast event was a new format used by SciLifeLab and it was very well received, as well as brought many new insights and ideas for upcoming events and outreach activities.

Together with Science and KAW, SciLifeLab annually hands out the global Science & SciLifeLab Prize for Young Scientists. This is a major event where SciLifeLab is promoted globally. The prize aims at rewarding scientists at an early stage of their careers in the areas of Cell and Molecular Biology, Genomics, Proteomics and Systems Biology Approaches, Ecology and Environment and Molecular Medicine.

While most planned community activities were initially cancelled due to the pandemic in 2020, SciLifeLab converted to digital events with many successful webinars on for example SciLifeLab's COVID-19 efforts and the announcement of the DDLS program and its future plans, which gathered several hundred participants. The digital format has made it easier to arrange and attend seminars, talks, and lectures, and it is likely that many SciLifeLab activities will be organized in this format also in the future to promote a wider national reach and inclusiveness, in combination with physical events.

In addition to the examples mentioned above of centrally organized community promoting activities, SciLifeLab is in strong support of initiatives brought forward by its community. Some such examples are: the seminar series Clinical talks hosted by Clinical Genomics, with a clinical perspective on topics concerning Rare Diseases, Cancer, Microbiology and Bioinformatics, the Campus Solna Science Talks symposium organized by Fellows, PhD council and management, the Campus Solna seminar series hosted by the PhD councils and targeted for the internal CS community (the successful format is planned to be introduced also at the Uppsala site in the autumn) and the recently formed Public Engagement committee and Diversity, Equity and Inclusion (DEI) committee. Their vision is to create a safe platform where all in SciLifeLab can discuss any topic related to DEI and their workplace. One aim of this platform is to recognize vital contributions of diversity to science, and through inclusion, create a synergistic atmosphere pleasant for everyone studying or working at SciLifeLab.

▶ 6.8 SciLifeLab in the COVID-19 Pandemic

The efforts made at SciLifeLab to fight the pandemic were initiated in March 2020, when the infrastructure units were asked to give priority to COVID-19 related projects. Also, major financial support from KAW, 60 MSEK for testing and biobanking and 50 MSEK for Phase 1 of a national research program (described below under *SciLifeLab-KAW National COVID-19 Research Program (Phase 1)*), and national funding of 12 MSEK, enabled SciLifeLab to launch several efforts aiming at fighting the pandemic. All efforts focused on promoting national collaborations between scientists and between infrastructure and scientists, a team science approach and sharing data openly. We focused on very rapid calls and decisions on funding. The fastest decisions were made in 2 weeks after the call closed. Therefore, for many scientists, SciLifeLab was the first route for them to get engaged early and quickly with COVID-19 research. Phase 2 of the KAW supported program (with 50 MSEK) started in 2021 and will continue until the end of 2022. In 2021, a government-supported program for Pandemic Laboratory Preparedness was also started as described below.

SciLifeLab-KAW Program for SARS-CoV-2 Testing

1) Virus testing: In collaboration between SciLifeLab, KI, the Public Health Agency of Sweden and the Swedish clinical microbiology laboratories, PCR-testing of SARS-CoV-2 was rapidly scaled up on a national level. Samples were processed at this "National Pandemic Center" at KI reaching a capacity of 7,000 samples per day and at the end of 2020, more than 620,000 samples had been analyzed and testing statistics were made available daily to the public domain at the COVID-19 portal (National Pandemic Centre SARS-CoV-2 (COVID-19) test statistics until end of 2020). This operation was stopped at the end of 2020, when health care and private laboratories had scaled up their testing capacity.

2) Antibody/serology testing: To detect antibodies against SARS-CoV-2, a reliable, fast and efficient serology test for large-scale investigations was developed and implemented at the Autoimmunity and serology profiling unit. The test has mainly been used to analyze samples from healthcare personnel, for population studies, and various research collaborations. By June 2021, over 150,000 samples have been analyzed as shown in the COVID-19 data portal which is updated weekly (COVID-19 serology statistics in the data portal).

3) Sample collections: SciLifeLab provided support early on to biobanks across the country for them to start collecting samples and data from asymptomatic individuals and from patients with mild, moderate, and severe COVID-19 symptoms, including longitudinal studies of the COVID-19 infection. These and other cohorts and unique biobank collections have been critical for the rapid launch of research projects as well as the development of diagnostic assays.

SciLifeLab-KAW National COVID-19 Research Program (Phase 1)

Through fast actions and coordination, and through an open call in mid-April 2020, a national COVID-19 research program was launched. The program has had a profound impact on research. It is still early days in terms of publications, but the projects funded through the program have, as of August 2021, resulted in 100 publications (with indicated KAW/SciLifeLab funding): 71 in scientific journals, of which 65 are published open access, and 29 as pre-prints (a few research highlights listed in *Table* 3) and major achievements from the program were presented at a public webinar, Combating COVID-19, in October 2020, which had close to 400 participants.

Phase 1 of the KAW-funded program included 67 funded projects within nine focus areas and aimed at understanding the etiology and how to inhibit the development of COVID-19 at the molecular, cellular, individual, population and environmental level. The program also supported the establishment of COVID-19 biobanks. National funding was used for program coordination, data management, and for supporting infrastructure upgrades as well as infrastructure for collecting and storing samples from both patients and the environment, as well as data analysis and logistics. In addition, the effort supported instrumentation upgrades and increased access to a BSL3 facility for handling live coronavirus, as well as capacity development in serology, chemoinformatics, and computational chemistry at SciLifeLab.

The program has contributed to creating new capabilities, new strong collaborations and data functions at SciLifeLab, which will have a lasting impact beyond COVID-19 and even beyond virus research. Interdisciplinary projects have been created, and diagnostic tests and research tools developed. In *Table* 3 are a few examples of the many achievements resulting from projects funded in the COVID-19 program (all publications from the program are collected in the COVID-19 portal, *Funder KAW/SciLifeLab).

6.

Table 3. Publication highlights from SciLifeLab National COVID-19 Research Program.

Highlight	References
Measurements of immunological markers in health care workers have increased our knowledge on how immunity against the COVID-19 disease develops, as well as the different stages of the disease, led by C. Thålin (Danderyds Hospital), P. Nilsson (KTH), S. Hober (KTH), and colleagues	*SARS-CoV-2 exposure, symptoms and seroprevalence in healthcare workers in Sweden*, Rudberg et al, Nature Commun (11) 5064, 2020; *Symptoms and Functional Impairment Assessed 8 Months After Mild COVID-19 Among Health Care Workers*, Havervall et al, JAMA 325 (19), 2021
Within the global COVID-Human Genetic Effort, this large group of investigators including P. Brodin (KI), found that neutralizing autoantibodies to IFN-I are present and responsible for some cases of life threatening COVID-19 in previously healthy individuals <50 years of age. These antibodies are believed to be present prior to the SARS-CoV-2 infection and can in some cases be removed by plasmapheresis with improved survival as a result	*Autoantibodies against type I IFNs in patients with life-threatening COVID-19*, Bastard, Rosen et al, Science 370 (423), 2020
Establishment of simple, fast, cheap or highly sensitive test methods for SARS-CoV-2 and COVID-19 immune response, studies led by N. Crosetto (KI), J. Schwenk (KTH) and SciLifeLab Fellow V. Pelechano labs	*COVseq is a cost-effective workflow for mass-scale SARS-CoV-2 genomic surveillance*, Simonetti et al, Nature Commun 12 (3903), 2021; *Multianalyte serology in home-sampled blood enables an unbiased assessment of the immune response against SARS-CoV-2*, Roxhed et al, Nat Commun 12; *Rapid Detection of COVID-19 Coronavirus Using a Reverse Transcriptional Loop-Mediated Isothermal Amplification (RT-LAMP) Diagnostic Platform*, Yu et al, Clinl Chem 66 (7), 2020
A first description of the immune system in children with hyperinflammatory and multiorgan syndrome, termed MIS-C occurring 1-2 months after a mild/moderate SARS-CoV-2 infection in children and young adults. The report contrasts the inflammatory response in MIS-C to the overlapping syndrome Kawasaki disease and P. Brodin (KI) and colleagues also report specific autoantibodies that could explain some of the inflammatory symptoms and the response to immunomodulatory therapy in children with MIS-C	*The Immunology of Multisystem Inflammatory Syndrome in Children with COVID-19*, Consiglio et al, Cell 183 (4), 2020
Program researchers in the area *Environmental virus profiling* focused on measuring and monitoring virus titers in wastewater and on public transport, which enabled detection of coronavirus very early in the spring of 2020, and could also predict the second COVID-19 wave during the autumn in Stockholm and Uppsala based on wastewater analysis. With assigned national funds, the research area began preparations for a biobank facility for environmental testing and environmental monitoring of viruses and other infectious pathogens, with all waste water data openly accessible	Székely, A. & Mohamed, N. *Dataset of SARS-CoV-2 wastewater data from Uppsala, and neighbouring towns Knivsta, Enköping, Östhammar and Älvkarleby, Sweden*, 2021

COVID-19 Data Portal

In the spring of 2020, the European Commission established a data sharing platform for the purpose of sharing COVID-19 data from across Europe and beyond (operated by the European Molecular Biology Laboratory-European Bioinformatics Institute, EMBL-EBI). SciLifeLab was assigned by the Swedish Research Council to develop and maintain the Swedish node of this platform, and in June 2020, the Swedish COVID-19 Data Portal was launched, operated by SciLifeLab Data Centre (DC). This was the very first national data portal launched and has so far had over 20,000 visitors and 100,000 page views. It provides tools, services, and guidance for data sharing, and multiple additional resources have been made available for the benefit of both the research community and the general public, see *Figure* 9 for an overview of important milestones. Some key services include the Sample Collection Database, developed in collaboration with Biobank Sweden), and the Publication Database. The Portal also promotes visibility of Swedish research in collaboration with the research community, for example by publishing highlights on papers that openly share data, enables rapid data sharing on the Portal (e.g., the regular upload of the results of wastewater testing by multiple research groups), and integration of externally developed resources. The DC is continually working for collaborating more broadly and developing new and existing services. COVID-19 portal also serves as a model for the type of data support that we are interested in developing as part of the DDLS program in the future.

SciLifeLab-KAW National COVID-19 Research Program (Phase 2)

KAW announced their second-phase support with continued donations to SciLifeLab in the autumn of 2020 whereby SciLifeLab launched the second phase of COVID-19 calls. This funding enabled Phase 2 of the COVID-19 research program with extension of current and inclusion of new projects in the program (50 MSEK), and establishment of a vaccine research program (53 MSEK).

In addition, projects focused on data-driven life science approaches were integrated to the COVID-19 research program. 34 new projects were selected for funding in the areas Biobanks, Serology and host response profiling, Genetic studies (virus and host), Drug discovery, development and repurposing, Host cell systems biology and functional studies, Environmental virus profiling and Vaccine effects (*Figure 10*). Taken together, there are 101 funded projects in the COVID-19 program, with a total of 165 MSEK of funding, the majority of these from the KAW.

When the Swedish governmental research bill was announced in December 2020, SciLifeLab's role in the set-up of national COVID-19 actions was well recognized. SciLifeLab was commissioned to further develop its capacity of laboratory preparedness for future pandemics, for which an additional national funding of 130 MSEK for 2021–2024 was allocated, see *Section 7.7* for details about the Pandemic Laboratory Preparedness (PLP) program.

SciLifeLab has collected and compiled an overview of the experiences from the COVID-19 pandemic in 2020 from the SciLifeLab perspective in the PM *SciLifeLab COVID-19 efforts: Reflections from 2020 and Lessons for the Future (Appendix E)*. The overall goal with this internal report was to summarize the actions and pinpoint the hurdles met so far, and to highlight and clarify both the potentials, as well as the challenges for SciLifeLab in the role as a national research infrastructure engaging in combating a pandemic. The report will be important when developing strategies for the future as part of Pandemic Laboratory Preparedness.

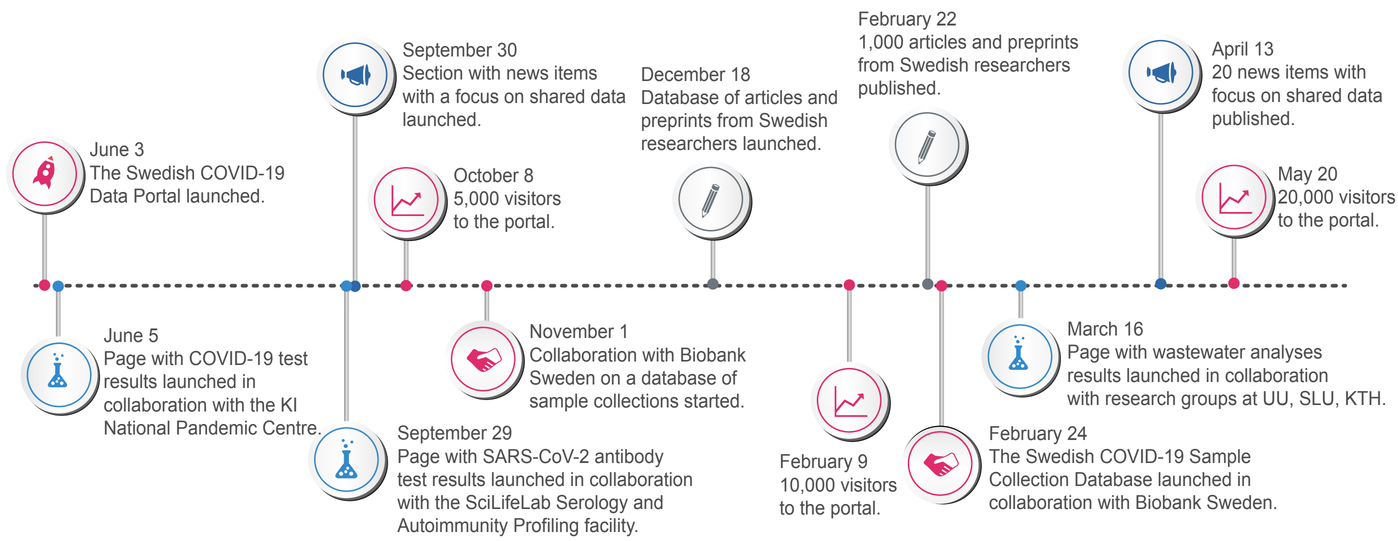


Figure 9. COVID-19 data portal timeline.

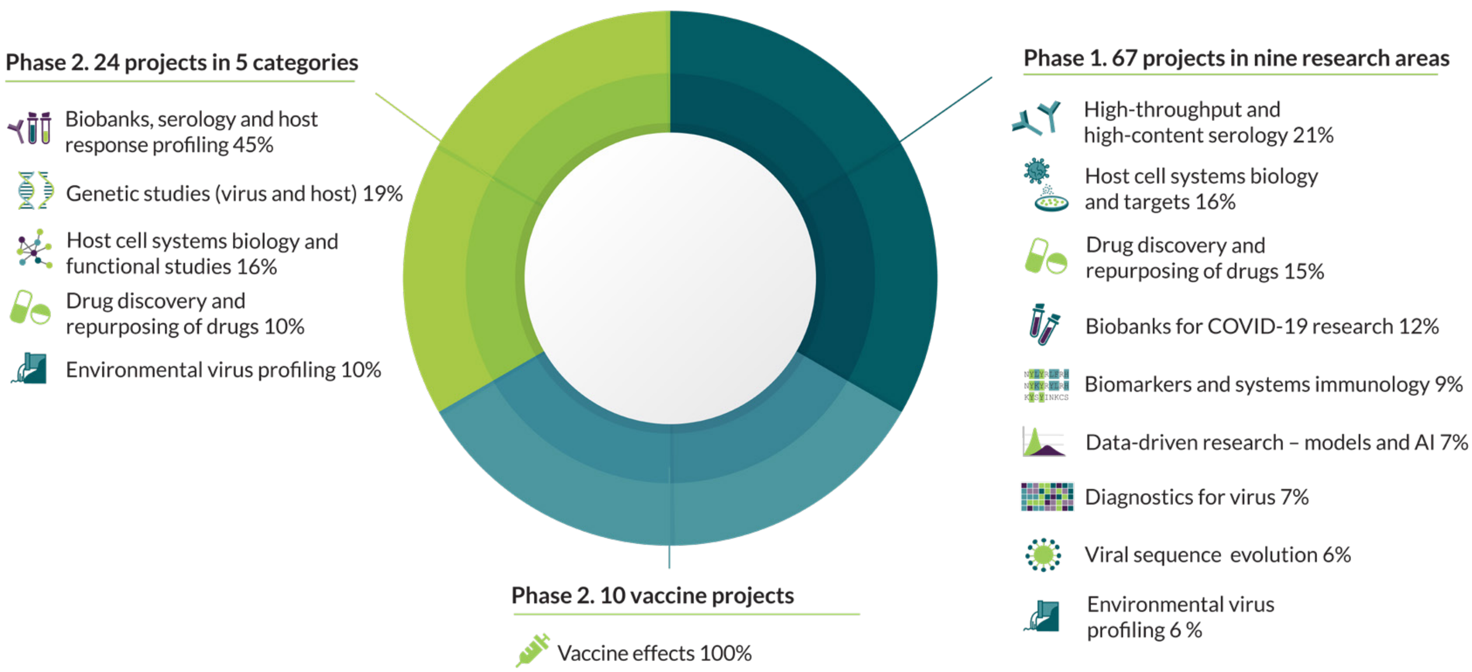


Figure 10. The SciLifeLab national COVID-19 research program.

7. Infrastructure

This section aims to give the IAB a summary of significant infrastructure developments made during 2019–2021 and describes future plans and strategies.

7.1 Background

Since appointed a national research infrastructure in 2013, SciLifeLab has had the mission to provide cutting-edge, unique, and enabling infrastructure to life science researchers across Sweden. Today, the infrastructure provides complementary technologies and services for assisting users in projects ranging from basic to translational research, and with the potential to support large-scale research initiatives and societal grand challenges. As part of its national mission, the SciLifeLab infrastructure services are offered to all Swedish researchers on equal terms, regardless of academic affiliation. If demand exceeds capacity, a formal prioritization process with an external steering/advisory board is recommended. The infrastructure should also be accessible to research in sectors outside of academia, including industry and healthcare, under a full-cost fee structure.

Since the last IAB visit to SciLifeLab, major focus has been on preparations for launch of the new SciLifeLab infrastructure organization and deciding its budget for 2021–2024. In this section we describe the evaluation process and present the new infrastructure organization as well as the budget allocations for 2021. All new platforms are presented separately, including their missions and future plans. We will also briefly present output and statistics for the infrastructure performance based on reporting from the infrastructure units for 2020. Finally, we describe the recent developments and plans for the Data Centre support function.

7.2 Infrastructure Evaluation 2020

We expect SciLifeLab platforms to continuously update and provide cutting-edge technologies and services and support this centrally by organizing annual calls for expensive instruments and calls for technology development projects. In addition, a major evaluation is performed every four years, the last being carried out in the spring of 2020. The evaluation is an essential component of the four-year life cycle and forms the basis for decisions on major changes to be made of the infrastructure and is in sync with the governmental four-year funding period of SciLifeLab. This renewal of the infrastructure includes decisions on phasing out technologies and infrastructure units no longer considered to fulfill the criteria set up by SciLifeLab, as well as to phase in new, emerging technologies and units. In addition, major re-organizations of platforms and units may also be done. The most recent evaluation process involved several steps during 2019 and 2020. In summary, the overall process included: 1) internal platform planning involving assessment of the current status and future needs from each individual platform's perspective, 2) a national survey on technology needs and suggestions on existing core facilities to be incorporated into the infrastructure, 3) an international evaluation, 4) input from all Swedish major universities and the National SciLifeLab Committee (NSC), and 5) a final review and budget allocation by the SciLifeLab Management Group and chair of NSC, illustrated in *Figure 11*. The Board approved the infrastructure and the new budget in its meetings in February and May 2021.

Figure 11. Illustration of process for the launch of the new SciLifeLab infrastructure 2021–2024.

The preparations for the new SciLifeLab infrastructure 2021–2024 began with an extensive and proactive planning process during 2019. This involved discussions with relevant external national stakeholders and international experts. Platforms were encouraged to suggest investments in new technologies and instrumentation and to propose appropriate changes to the platform organization.

In parallel with the internal process, SciLifeLab carried out two nation-wide surveys in June 2019 in an effort to engage the whole Swedish life science community in the development of the infrastructure:

- **Technology Needs Inventory.** Proposals on new cutting-edge life science technologies, matching nation-wide scientific needs and currently not provided as a service by infrastructures in Sweden. In total, 73 proposals were submitted.
- **Suggestions on New Units.** Suggestions on existing core facilities, currently not funded by SciLifeLab, for incorporation into the SciLifeLab infrastructure from 2021. The survey resulted in 32 unique suggestions.

Eventually, 10 out of the 32 proposed units were included in the platform strategy plans as candidates for the international evaluation that followed.

A comprehensive infrastructure report including the platform plans for 2021–2024, a description of current and future technologies, detailed statistics and metrics of users and publication output for each of the existing and candidate infrastructure units were distributed to the International Evaluation Committee (IEC) in February 2020. The full report that was submitted by SciLifeLab is found in *Appendix F*.

The IEC meeting originally planned as a physical meeting in Stockholm on April 20–22, 2020, was rearranged into a virtual event. During the meeting all platforms and units presented their technologies, operations, and future plans, and the presentations were followed by questions from the IEC panel. Based on both written material and meeting presentations the IEC were instructed to compile a report, in which each of the platforms and units were graded on a scale from 9 (outstanding) to 1 (poor) in terms

The key criteria for evaluation of the SciLifeLab infrastructure technologies and operations were defined during the last international evaluation in 2016. According to these, SciLifeLab platforms and facilities should ideally:

- Facilitate world-leading research in molecular life sciences.
- Enable research that otherwise would not be possible in Sweden.
- Provide high-quality services to academic researchers, industry, healthcare and other organizations in Sweden.
- Be utilized by multiple research groups for high-quality research projects across the nation.
- Be associated with a high-quality research environment.
- Provide internationally competitive services.
- Have a long-term plan for instrumentation renewal, technology development, data management and sharing, scientific domains and user communities being served, as well as for a sustainable and versatile funding base.
- Have complementary and synergistic capabilities within and across SciLifeLab platforms.
- Participate in national coordination of similar platforms and facilities at other universities in Sweden.
- Promote translational implementation of research findings into healthcare and industry.

In addition to the criteria above, we would like the evaluators to also consider the following aspects in the evaluation:

- Quality of current technologies and services provided by the unit (national uniqueness and international competitiveness)
- Plans and impact of new technologies described for 2021–2024
- Past performance and user statistics (if applicable).
- Fit within the SciLifeLab infrastructure, and importance of the technologies and services as complement to other platforms and facilities.
- Overall impact on Swedish life science research
- Overall impact on healthcare, industry, and society in Sweden (if applicable)

Figure 12. Grading criteria for IEC evaluation of the SciLifeLab infrastructure 2020.

of estimated **importance for and impact on Swedish life science in 2021–2024** according to the criteria given in *Figure 12*. The evaluation report from IEC was submitted to SciLifeLab on May 8, and is found in *Appendix G*.

Two representatives of the IAB were present and helped to guide the IEC from the international perspective and their understanding of SciLifeLab. Also, all major Swedish universities, as well as the NSC, were invited to participate in the evaluation by joining the presentations and discussions at the IEC meeting and they were also asked to grade all units from a single university angle or, for NSC with a national user base perspective. *Figure* 13 shows the grading from the IEC plotted against the mean score from universities, where some units that received a high grade from the IEC were less appreciated by universities. It was also noted that established, well-funded and larger units in general received higher grades when compared to the smaller and emerging ones.

With the combined evaluation material and input from the IEC, the universities and NSC, a working group composed of the SciLifeLab Director, Co-Director, Infrastructure Director and Head of the NSC conducted the final review of the infrastructure during the summer and fall of 2020. This included numerous discussions with the infrastructure platform and units, other stakeholders, and overall strategic considerations concerning the scope and mission of the future SciLifeLab infrastructure.

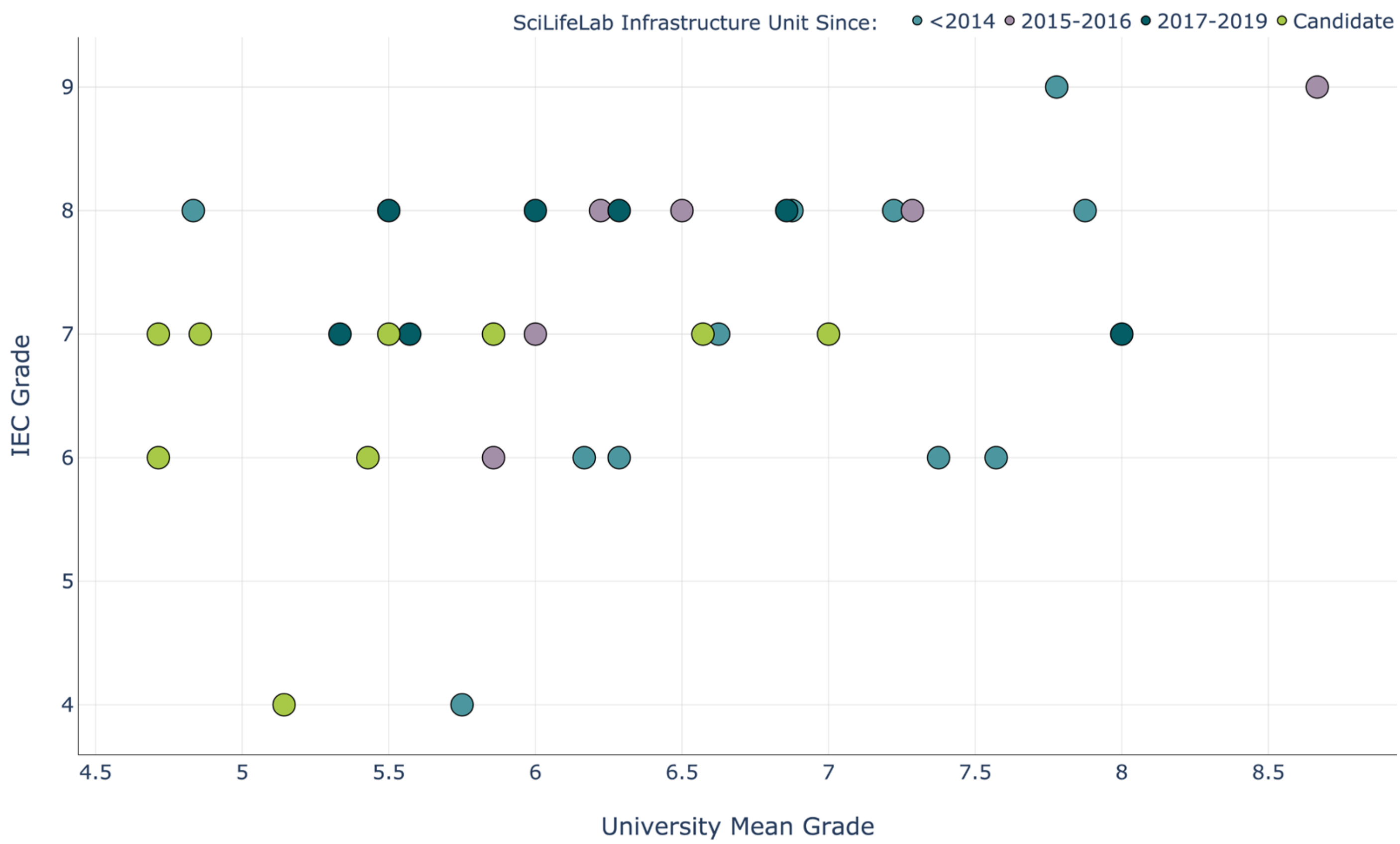


Figure 13. IEC consensus grades versus universities mean grades of the infrastructure units evaluated (9 = outstanding, 1 = poor).

7.3 Infrastructure Organization and Funding

The final suggestions on a new infrastructure organization, the overall scope and mission, as well as the funding for 2021, were approved stepwise by the SciLifeLab Board during November 2020–May 2021. The major points of the decisions are summarized below:

- Scope and boundaries for the infrastructure defined to broadly cover relevant, nationally unique and internationally competitive life science technologies for biomedical and translational research, however, not including services based on organism and animal models or biobanking
- The infrastructure is organized into ten platforms
- Each platform is composed of units (previously called facilities)
- Platform composition is primarily based on units sharing a common user base (capability type platforms)
- Phase-out of two units (Genome Engineering Zebrafish, Uppsala, and Mass Cytometry, Linköping), and considerable budget cuts and decisions on merging some of the old facilities
- Inclusion of eight new units
- Platform Management Groups given increased mandate to make decisions at the platform level
- Platform Directors (PD) and Platform Coordination Officers (PCO) appointed for all platforms
- Platform Specific Terms and Conditions for Funding agreements established to clarify the mission and expectations on the platform level
- Future focus on cross-platform operations and services (capabilities)
- Increased emphasis on data handling
- Promoting the role of senior staff scientists in the platform organization

The new infrastructure organization with the ten platforms and their service units is shown in *Figure 14*. *Figure 15* shows the geographical distribution of the platform operations across the universities.

Terms and Conditions for Funding (Appendix H) is the general steering document for infrastructure and was updated in 2021. It describes e.g., the new governance policy for the platforms and the responsibilities and roles for PD and PCO. In addition, the *Platform Specific Terms and Conditions for Funding documents (Appendix I)* contain specific missions and expectations given to the individual platforms.

As previously described in *Section 6.2*, the total National and DDD funds from the government for 2021 is 282 MSEK (about 28 MEUR). The distribution of this funding, including the support functions is illustrated in *Figure 16*. The funding that is direct operational support to the infrastructure amounts to 216.7 MSEK. The distribution of this funding across the platforms is shown in *Figure 17*, and the distribution based on the receiving universities (hosts of the infrastructure units) is shown in *Figure 18*.

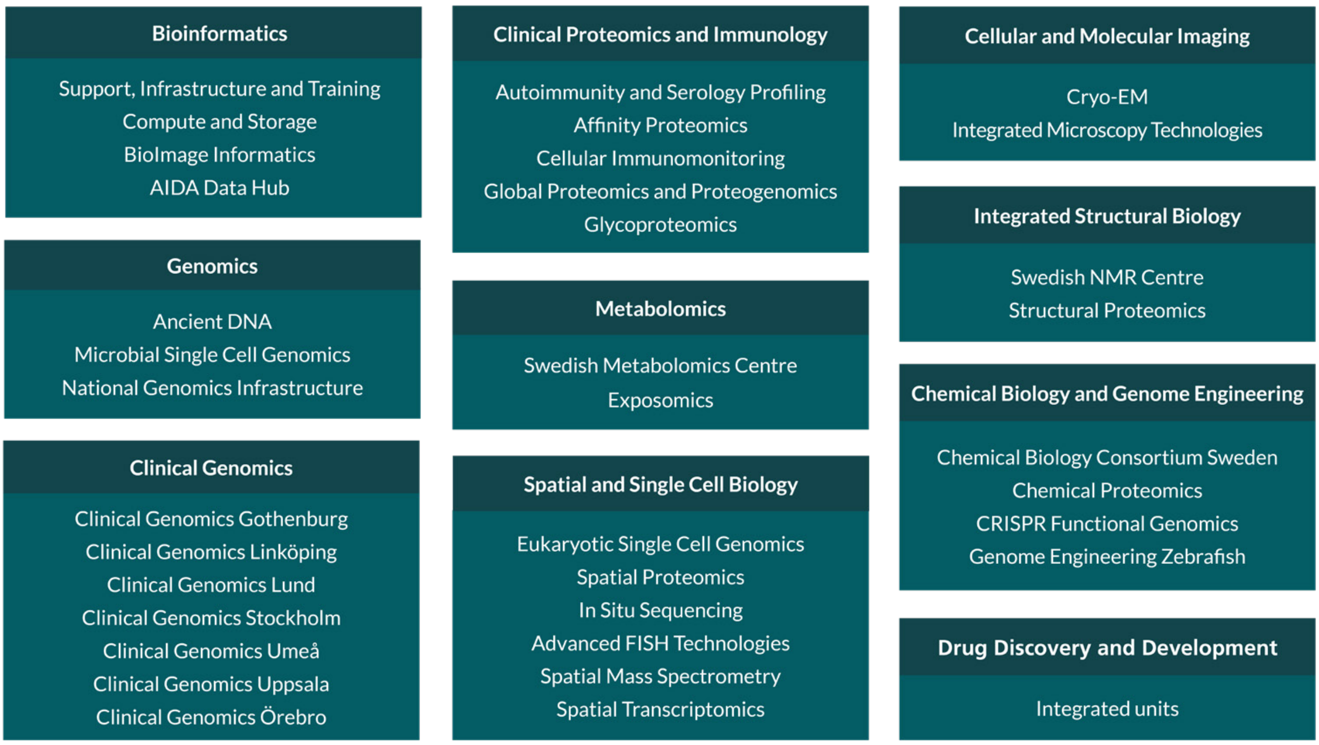


Figure 14. SciLifeLab infrastructure organization from 2021.

Platforms	Universities											
	Chalmers	GU	KI	KTH	LiU	LU	NRM	SLU	SU	UmU	UU	ÖRU
Bioinformatics	●	●	●	●	●	●	●	●	●	●	●	
Genomics		●	●	●				●	●	●	●	
Clinical Genomics			●	●	●	●				●	●	●
Clinical Proteomics and Immunology		●	●	●	●						●	
Metabolomics	●							●	●	●		
Spatial and Single Cell Biology			●	●					●		●	
Cellular and Molecular Imaging		●		●					●	●		
Integrated Structural Biology		●				●				●		
Chemical Biology and Genome Engineering			●							●	●	
Drug Discovery and Development			●	●		●			●		●	

Figure 15. Physical distribution of platform operations across Swedish universities. The dots indicate service units and personnel hired at the various universities that carry out the work.

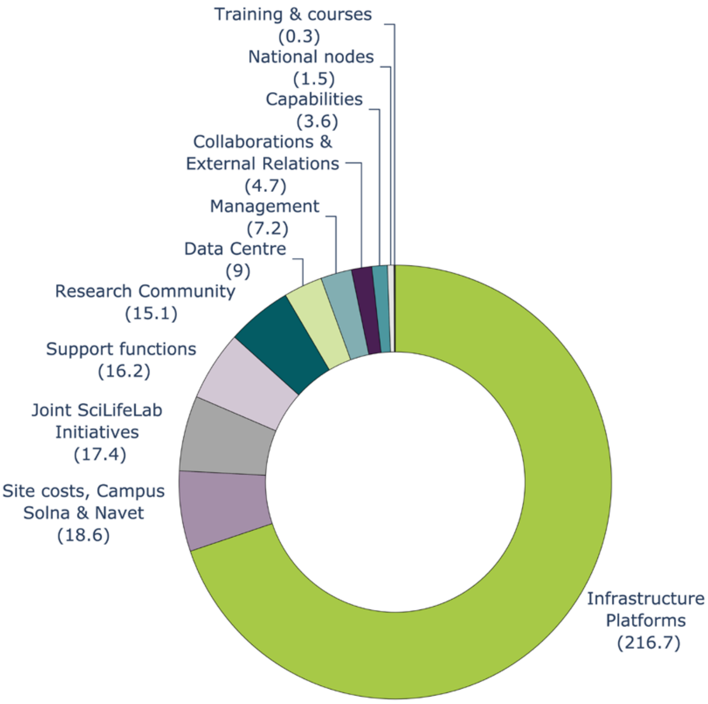


Figure 16. Overall distribution of SciLifeLab National and DDD funding 2021 (MSEK).

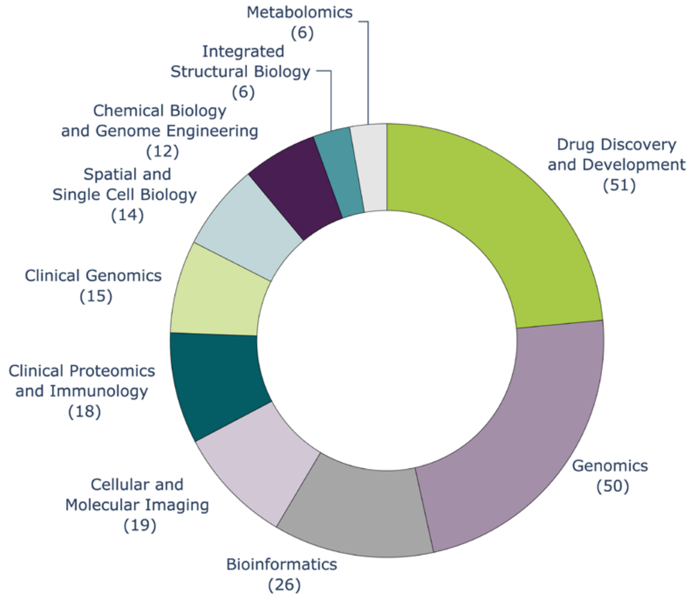


Figure 17. Distribution of SciLifeLab funding to the infrastructure platforms 2021 (MSEK).

In addition to direct SciLifeLab support and income via user fees (amounting 223 MSEK in 2020), the infrastructure units receive funding from their host universities, the Swedish Research Council (VR), and KAW, among others. The total funding 2021 (user fees not included) supporting the entire infrastructure is ca 530 MSEK, which funds staff corresponding to close to 400 FTEs. The distribution of the total funding sources for 2021 is given in *Figure 19.*

Many units receive only a minor share of their funding directly from SciLifeLab, whereas for other units SciLifeLab is the major source of financial support.

In the following section, each of the ten platforms is presented in more detail, including their overall mission, technologies, and services, as well as their plans for operations and development throughout 2021–2024.

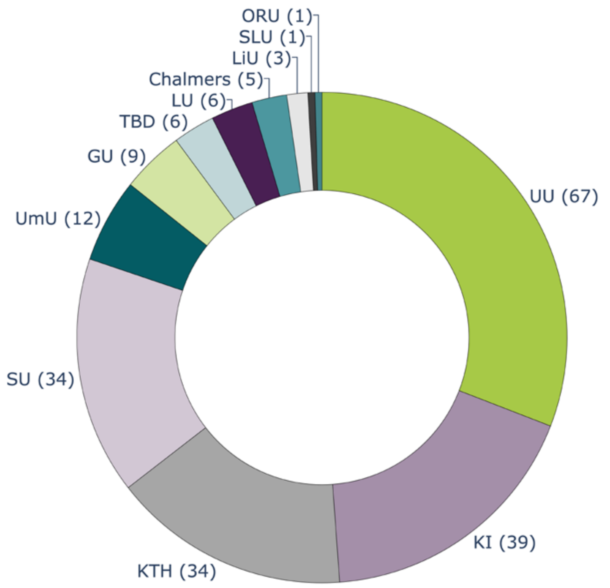


Figure 18. Distribution of infrastructure funding 2021 based on receiving universities hosting the infrastructure units (MSEK). TBD: platform strategic budget; allocation to be determined in October.

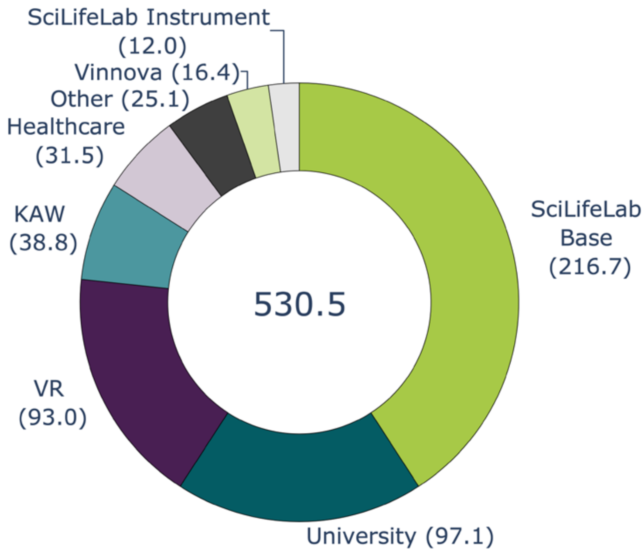


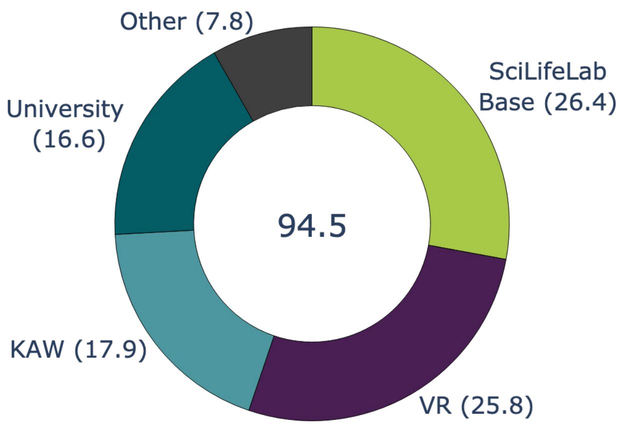
Figure 19. Distribution of all funding sources to the SciLifeLab infrastructure 2021 (MSEK).

Bioinformatics

Platform Director: Bengt Persson, UU
Co-Platform Director: Björn Nystedt, UU
Platform Coordination Officer: Björn Nystedt, UU
Platform and Units SciLifeLab Funding 2021:

Unit	(MSEK)
Support, Infrastructure and Training	17.0
Compute and Storage	3.4
BioImage Informatics	3.6
AIDA Data Hub	1.0
PD, PCO, Platform Strategic Budget	1.4
Sum:	**26.4**

Total Funding 2021:



Technologies and Services

The Bioinformatics platform, a.k.a. NBIS (National Bioinformatics Infrastructure), today provides technologies, services and expertise within:

- genomics (incl. single cell transcript-omics, comparative genomics metagenomics, and ancient DNA analyses), genome annotation & assembly,
- proteomics, metabolomics, systems biology, and multi-omics/integrative bioinformatics,
- biodiversity and biostatistics,
- bioimage informatics and spatial omics,
- data publication & FAIRification of data, data management & data stewardship,
- systems development & tools provision.

NBIS activities also include maintenance of important tools and web resources, maintenance of the ELIXIR core data resource Human Protein Atlas, provision of the Swedish node in the Federated EGA (European Genome-phenome Archive), user support to SNIC computational resources, and advanced training.

NBIS also forms the Swedish ELIXIR node. The technologies and services are provided through 9 units [Support (SMS, LTS, Systems biology, BioImage Informatics); Infrastructure (Data management, Systems development, Compute & Storage); Training & Outreach; Swedish ELIXIR node].

Future Plans

Future plans include to expand in provision of human data in the federated European landscape (EGA-SE and the European 1+ million genome project); increased data management, data publication and data stewardship; and systems development to support emerging AI techniques. During 2021–2027, NBIS will contribute to the construction of the European digital pathology infrastructure, funded by the EU IMI project BigPicture. We will also invest in development of the future ELIXIR core data resource Metabolic Atlas. We will expand our efforts in Biodiversity e.g., within the frameworks of the Earth Biogenome Project (EBP) and the European Reference Genome Atlas (ERGA).

Furthermore, we expect an increase in systems development support projects, in particular for web-interfaces to specific databases/tools, development of databases and development of analytical pipelines. Bioinformatics training and outreach, increasingly utilizing remote techniques and tools and material developed within ELIXIR and GOBLET, including engagement in the planned SciLifeLab Training Platform and future research schools in bioinformatics and AI.

We will increase our interactions with other platforms and enable staff to spend time at other SciLifeLab platforms and/or have specific NBIS contact persons for each platform/unit. An additional trend we see is the wish to use combined datasets to answer complex research questions. Our integrated bioinformatics team provides support for integrative studies, with several multi-omics projects already running, but the scientific challenges are large, especially considering collection of appropriate data and development of adequate analytical methods. We will therefore expand our efforts in this area to provide the necessary expertise for multi-omics data-driven science.

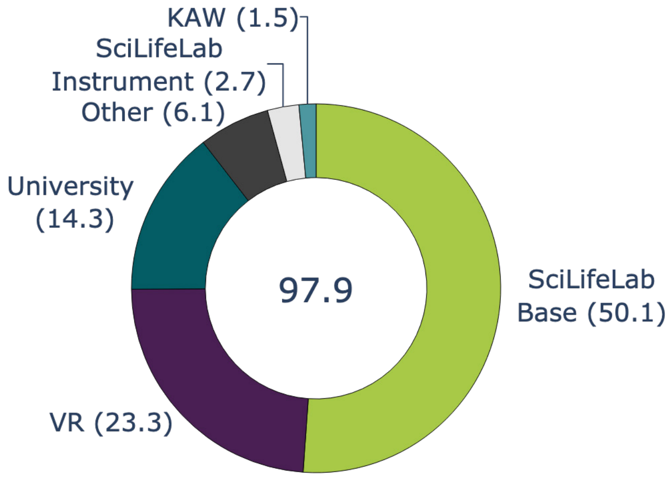
NBIS will interact with the DDLS effort in providing support, infrastructure, and training. Support via additional WABI support, incl. Cryo-EM, and via already existing channels. Of special interest is provision of data management support and to encourage FAIRification of data among current users, working closely with the SciLifeLab Data Centre, supporting the platforms. Infrastructure includes provision of databases of interest for DDLS, e.g., EGA-SE, Metabolic Atlas, HPA, and provision of tools of interest for DDLS, e.g., MrBayes, pcons, and provision of user support to compute and storage resources. Training includes providing advanced courses for PhD students and post-docs within DDLS and organizing advanced courses together with DDLS.

Genomics

Platform Director: Tuuli Lappalainen, KTH
Co-Platform Director: Lars Feuk, UU
Platform Coordination Officer: Magnus Lundgren, UU
Platform and Units SciLifeLab Funding 2021:

Unit	(MSEK)
Ancient DNA	2.0
Microbial Single Cell Genomics	2.0
National Genomics Infrastructure	44.5
PD, PCO, Platform Strategic Budget	1.6
Sum:	**50.1**

Total Funding 2021:



Technologies and Services

The Genomics platform consists of three units, the National Genomics Infrastructure (NGI), Ancient DNA, and Microbial Single Cell Genomics, who enable cutting-edge genomics research in Sweden by providing an extensive range of technologies and services:

Project planning and assistance with sample and library preparation:

- Project planning support and assistance with selection of appropriate technology
- High molecular weight DNA extraction
- Automated, high-throughput library preparation for whole genome sequencing re-sequencing, RNA-sequencing, exome sequencing, etc.
- Library preparation for specialized applications such as degraded samples (FFPE), ATAC-seq, amplicons, metagenomes and HiC sequencing libraries from cells and tissues
- DNA extraction and library preparation of ancient material in clean-room laboratories
- Handling of live cells in BSL2 and BSL3-classified laboratories

Sequencing and microarray analyses:

- Generation of short-read sequencing data using Illumina and Ion Torrent
- Generation of long-read sequencing data using PacBio and Oxford NanoPore
- High-throughput SNP genotyping using Illumina arrays

Single-cell and spatial transcriptomics:

- Library preparation of eukaryotic and prokaryotic single cells using plate-based and droplet-based single-cell technologies for transcriptome and genome sequencing
- Spatial transcriptomics analysis using 10X Genomics Visium

Epigenetic analysis:

- Analysis of genome-wide DNA methylation patterns using sequencing and genotyping
- Analysis of methylation using native DNA with PacBio and NanoPore sequencing

Protein analysis:

- High-throughput protein quantification with NGS output using Olink Explore

Bioinformatics services:

- Quality control, mapping to reference genomes, variant calling, de novo assembly, gene expression counts, methylation analysis, protein expression, analysis of ancient DNA, etc.

The Genomics platform supports other SciLifeLab platforms (Spatial and Single Cell Biology, Bioinformatics, Clinical Genomics, Clinical Proteomics and Immunology, Drug Discovery and Development) by providing technologies and expertise for joint projects.

Future Plans

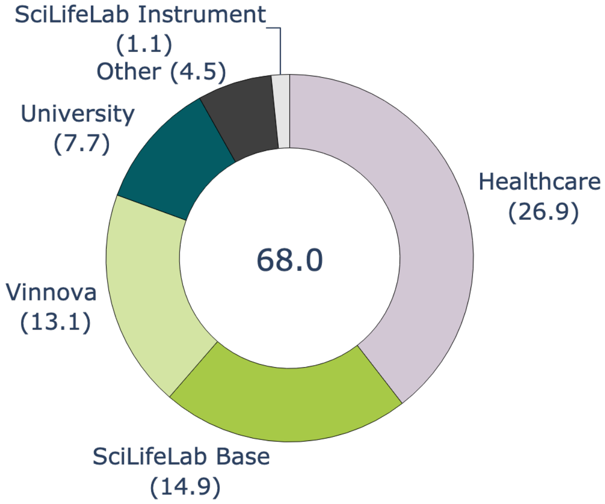
The Genomics Platform will continue to develop and adopt new technologies, e.g., in long-read sequencing, analysis of challenging biospecimens (incl. sediment and ancient plant samples), integrative DNA, RNA and protein multi-omics analysis, and biodiversity (via Earth BioGenome Project), while continuing to provide competitive service with well-established applications. Services will also be developed to include handling and preparation of insect material, including disease-transmitting vectors, for single cell transcriptome sequencing.

Clinical Genomics

Platform Director: Thoas Fioretos, LU
Co-Platform Director: Lucia Cavelier, UU
Platform Coordination Officer: Eva Berglund, UU
Platform and Units SciLifeLab Funding 2021:

Unit	(MSEK)
Clinical Genomics Gothenburg	2.1
Clinical Genomics Linköping	0.8
Clinical Genomics Lund	2.1
Clinical Genomics Stockholm	5.0
Clinical Genomics Umeå	0.8
Clinical Genomics Uppsala	2.5
Clinical Genomics Örebro	0.8
PD, PCO, Platform Strategic Budget	0.8
Sum:	**14.9**

Total Funding 2021:



Technologies and Services

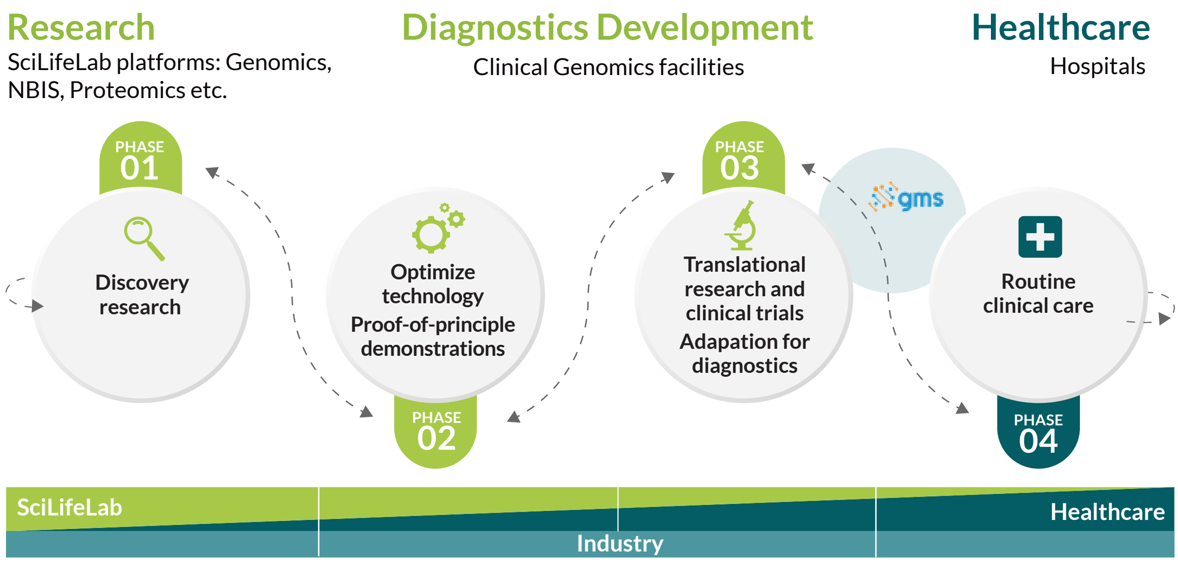
The Clinical Genomics platform is the national research infrastructure for the development, validation, and implementation of new high-throughput technologies for clinical and translational research projects, clinical trials, and diagnostics within healthcare. Through our close connection to healthcare, we provide access to a unique research and development environment as well as end-to-end service (i.e., from sample preparation and analysis to clinical interpretation).

Our current key technologies include short- and long-read sequencing, transcriptome analysis, single-cell sequencing, and ultrasensitive variant detection. These basic technologies are complemented with unique diagnostic and medical expertise, bioinformatics and IT expertise, and access to clinical validation cohorts, to enable end-to-end service for the users. The platform has a strong national outreach and consists of seven nodes that provide service at all seven medical faculties and university hospitals in Sweden (Gothenburg, Linköping, Lund, Stockholm, Umeå, Uppsala, and Örebro).

Future Plans

An important mission for the coming years is to continue developing and adapting new genomic technologies for improved services for translational and clinical research projects and to facilitate the implementation of tomorrow's diagnostics within healthcare. Future plans include the development of new clinical-grade molecular assays including long-read sequencing, clinical transcriptomics, ultra-sensitive variant detection, and clinical single-cell diagnostics. By our close connection to Genomic Medicine Sweden and healthcare, new assays and protocols developed by our platform can be transferred to a clinical diagnostic setting and harmonized at the national level for immediate patient benefit.

Given our expertise in developing assays and offering service for precision diagnostics, our platform will also contribute significantly to the SciLifeLab capability initiatives 2021. As part of this, we will continue to strengthen our collaborations with other SciLifeLab platforms and the SciLifeLab Data Centre.



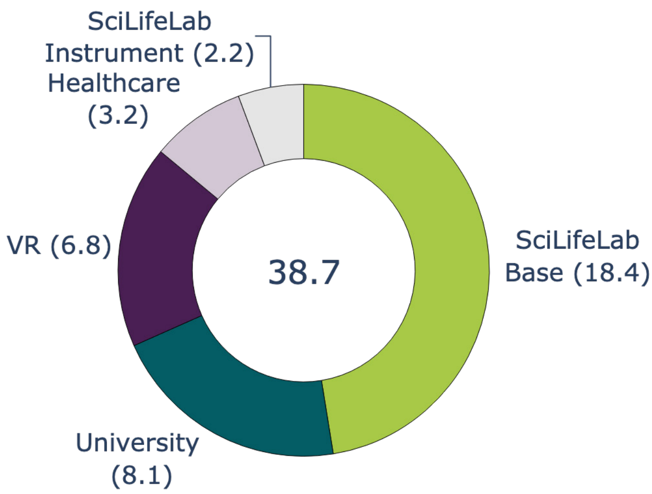
The Clinical Genomics platform operates in phase 2 and 3 as a 'bridge' between research and healthcare. The scale at the bottom indicates the engagement of SciLifeLab, healthcare and industry throughout the process.

Clinical Proteomics and Immunology

Platform Director: Masood Kamali-Moghaddam, UU
Co-Platform Director: Elisabet Carlsohn, GU
Platform Coordination Officer: Claudia Fredolini, KTH
Platform and Units SciLifeLab Funding 2021:

Unit	(MSEK)
Autoimmunity and Serology Profiling	2.4
Affinity Proteomics	5.1
Cellular Immunomonitoring	5.6
Global Proteomics and Proteogenomics	3.0
Glycoproteomics	1.5
PD, PCO, Platform Strategic Budget	0.8
Sum:	**18.4**

Total Funding 2021:



Technologies and Services

The Clinical Proteomics and Immunology (CPI) platform provides technologies, services, and expertise within the field of state-of-the-art mass spectrometry (MS), affinity proteomics and single cell analyzing tools for advanced protein analyses in body fluids, cells and tissues. The services allow studies of proteins in clinical and basic research projects, includes assays to profile immune-responses, quantification of autoantibodies and circulating blood proteins, as well as cellular protein expression, modifications and interactions. Furthermore, the CPI units develops new advanced technologies and assays for tailored applications, such as ultra-sensitive immunoassays for novel candidate biomarkers, unique proximity assays, antibody validation workflows, custom designed protein, peptide arrays and MS-assays, genome annotation, independent proteogenomics analysis, characterization of glycans and glycopeptides, as well as single cell immunophenotyping of intracellular and secreted proteins.

The technologies and services are provided through five units: Autoimmunity and Serology Profiling (KTH); Affinity Proteomics (nodes at KTH and UU); Cellular Immunomonitoring (KI); Glycoproteomics (GU) and Global Proteomics and Proteogenomics (KI).

Future Plans

- Update/renewal of the technologies to broaden the analytical portfolio and capabilities.
- Harmonization of services and activities across units with common project pipelines.
- Recruiting and retaining the staff with high domain expertise remains as an important item.
- Further strengthen and contribute to the SciLifeLab's Precision Medicine capability.
- Contribution to capabilities within the Pandemic Laboratory Preparedness capability through developing combined multimodal analysis workflows and prospective analysis capabilities to serve clinical trials and cohort analysis,
- Developing data flows and clinical data reporting tools together with Data Centre and DDLS program.
- To implement proteomics technologies in hospital to speed up precision medicine development.
- Continuing development of combined project support with the NBIS for seamless integration of analysis and bioinformatics support.
- A new affinity analytical capability that requires the use of sequencing as a readout of protein assays is developed together with the National Genomics Infrastructure (NGI).
- The capacity for different types of serological analyses will be adapted to emerging SARS-CoV-2 variants and other viruses, as well as those initiated by the Swedish national vaccination programs.
- New sample types, such as dried blood spots (DBS) or material collected from micro-sampling techniques will be included into the analysis portfolio.
- New MS techniques are being installed to enable a more rapid analysis of defined proteins for molecular phenotyping.
- In studies of systems immunology, we will work towards a deeper integration and expansion of cellular and circulating protein analyses to monitor the changes more precisely on a molecular level.

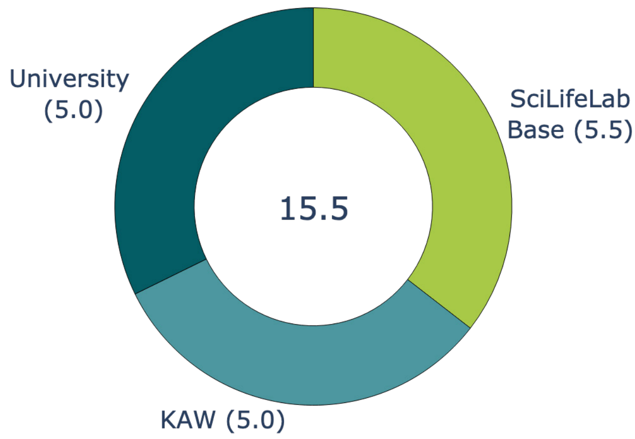
Metabolomics

Platform Director: Anders Nordström, UmU
Co-Platform Director: Thomas Moritz, SLU
Platform Coordination Officer: Annika Johansson, UmU
Platform and Units SciLifeLab Funding 2021:

Unit	(MSEK)
Swedish Metabolomics Centre	3.0
Exposomics	1.9
PD, PCO, Platform Strategic Budget	0.6
Sum:	**5.5**

7.

Total Funding 2021:



Technologies and Services

The Metabolomics platform today provides technologies, services, and expertise within targeted and untargeted small molecule analysis by mass spectrometry. A new pilot infrastructure unit (Exposomics) hosted by Stockholm University will soon begin to offer services for water and human biofluid analysis by sensitive wide-scope target and nontarget methods. Overall, the technologies and services are provided through two units being Swedish Metabolomics Centre (SMC) with nodes in Umeå and at Chalmers Mass Spectrometry Infrastructure in Gothenburg and Exposomics unit in Stockholm. The services include quantitative analysis of one to a few target metabolites to untargeted analysis of hundreds of annotated and unknown metabolites. Sample size capacities vary from 10´s to 1000´s of samples.

Future Plans

Future plans include to further increase the capability to analyze very large sample sets to meet the increased demand to provide analytics for high throughput screening experiments, large biobank studies, nutritional intervention studies and from GWAS with metabolic traits.

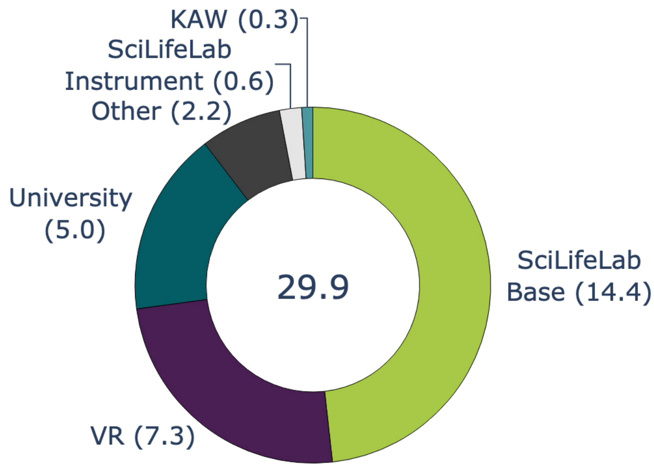
Mass spectrometry lab at Swedish Metabolomics Centre.

Spatial and Single Cell Biology

Platform Director: Mats Nilsson, SU
Platform Coordination Officer: Charlotte Stadler, KTH
Platform and Units SciLifeLab Funding 2021:

Unit	(MSEK)
Eukaryotic Single Cell Genomics	5.0
Spatial Proteomics	3.5
In Situ Sequencing	2.4
Advanced FISH Technologies	1.3
Spatial Mass Spectrometry	1.5
PD, PCO, Platform Strategic Budget	0.8
Sum:	**14.4**

Total Funding 2021:



Technologies and Services

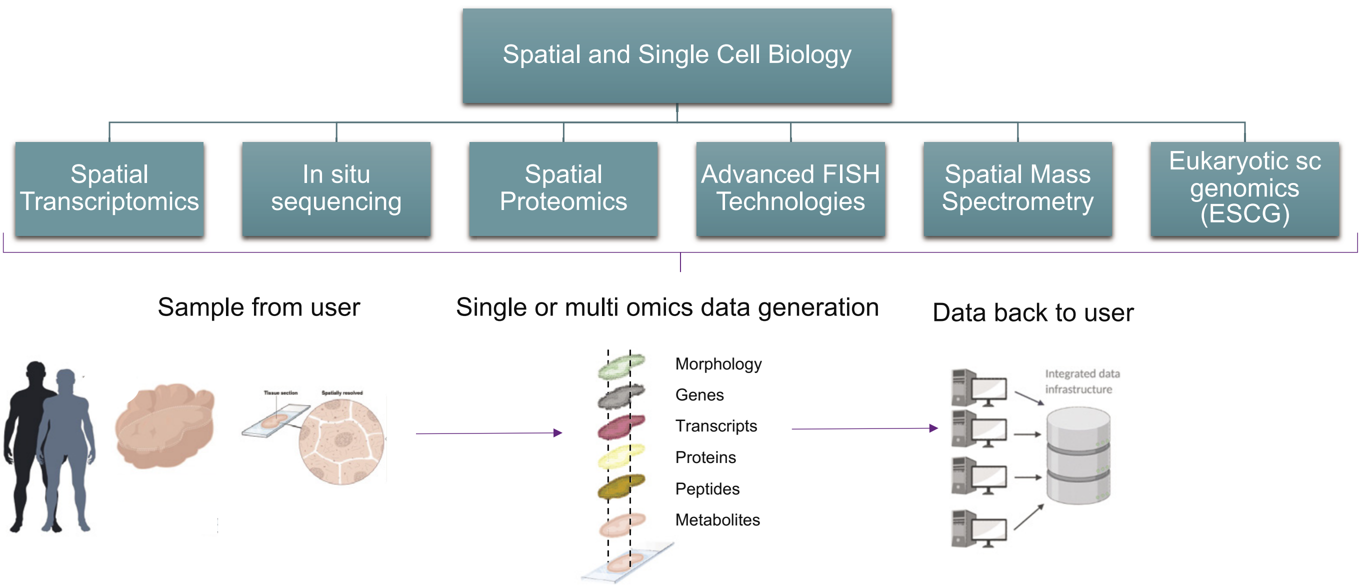
The Spatial and Single Cell Biology platform (SSCB) is a new platform since 2021 and provide technologies, services and expertise within advanced spatial analysis of biomolecules as well as complementary single cell sequencing.

The technologies and services are provided through six units: Spatial Transcriptomics, In Situ Sequencing (ISS), Spatial Proteomics, Advanced FISH Technologies (AFT), Spatial Mass Spectrometry and Eukaryotic Single Cell Sequencing. The platform also works closely together with the SNP&SEQ unit from the Genomics Platform, the BioImage Informatics unit of the Bioinformatics Platform as well as with Data Centre to facilitate data analysis, handling and management of the large quantities of data generated.

Future Plans

While the units currently mostly offer "stand alone" service with separate technologies, the platform goal and ambition are to develop protocols and operations that allows for integrated services and data generation from more than one unit within the same project. This will enable a multi-omics approach with more in-depth understanding and scientific knowledge. Current integrative analysis includes joint analysis of spatial transcriptomics, ISS and scRNAseq data. Ongoing internal platform development work to add on modalities are: 1) integrated analysis of spatial mass spectrometry and in situ sequencing on the same tissue section, 2) protocol optimization for integrated analysis of in situ sequencing and spatial proteomics, 3) protocols for integrated multiplexed DNA FISH and spatial proteomics in cells and tissue sections, 4) implementing spatial transcriptomics service on FFPE sections, and 5) development of a data portal for visualization and browsing of data (with BioImage Informatics and Data Centre).

Other future plans not yet initiated include 1) joint operations for tissue sample handling including sectioning, and 2) a platform centric data management and order portal for project management in collaboration with Data Centre.

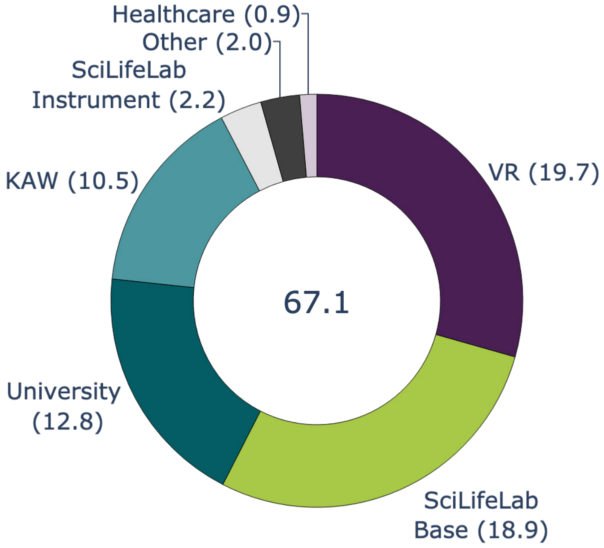


Cellular and Molecular Imaging

Platform Director: Marta Carroni, SU
Platform Coordination Officer: Ana Agostinho, KTH
Platform and Units SciLifeLab Funding 2021:

Unit	(MSEK)
Cryo-EM	11.5
Integrated Microscopy Technologies GU	1.5
Integrated Microscopy Technologies KTH	3.5
Integrated Microscopy Technologies UU	1.5
PD, PCO, Platform Strategic Budget	0.9
Sum:	**18.9**

Total Funding 2021:



Technologies and Services

The Cellular and Molecular Imaging (CMI) Platform today provides technologies, services and expertise within super-resolution microscopy, cryo-electron microscopy, and tomography.

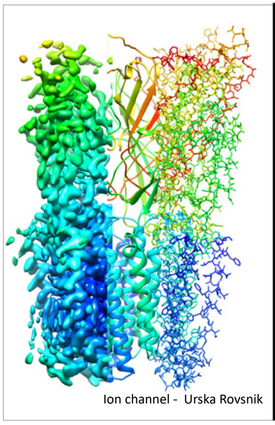
The techniques available at the CMI Platform in the realm of super-resolution fluorescence microscopy for nanoscale biological visualization are SIM, STED and STORM/PALM. Support with single molecule measurement and analysis with fluorescence correlation spectroscopy (FCS), combined with super-resolution for nanoscale dynamical studies (STED-FCS), is also given. For the analysis of large specimens such as organs or tissues, light-sheet fluorescence microscopy (LSFM) can be used. This allows live imaging of optically cleared samples at unprecedented volumetric speed with low phototoxicity. Single-cell fast volumetric imaging of biological processes at high-resolution is provided by lattice light-sheet microscopy (LLSM).

The techniques available at the CMI Platform on the molecular and near-atomic range of analysis are Single Particle Cryo-EM (SPA), electron diffraction of protein/compound nano crystals (micro-ED) and electron tomography (Cryo-ET) for pleomorphic samples such as viruses or thin cells. The Platform offers also consulting for processing of Cryo-EM images to generate 3D molecular structures as well as training on the various techniques on a one-to-one basis.

The technologies and services are provided through 2 Units: the Integrated Microscopy Technologies Unit and the Cryo-EM Unit. Future plans include the development and extension to users of two new techniques: Correlative Array Tomography (CAT) and Focused Ion Beam Scanning Electron Microscopy (FIB-SEM). CAT and FIB-SEM will allow the generation and analysis of large 3D volumes of tissues with electron microscopy ultrastructural level of resolution. The CMI Platform is also undergoing an extension of the national Cryo-EM network for preparation and screening of sample all over the country, but more importantly for transferring skills to new researchers. This project, called CryoScreeNET, is carried out by having part time FTEs at the Cryo-EM Unit stationed at four different host universities: UU, GU, LU and KI. These researchers are trained at the SciLifeLab Unit, participate actively at the Unit's life and help with the design and optimization of projects coming from the host universities.

Future Plans

The Platform aims to strengthen this way the imaging community in Sweden for a large variety of biological specimens, over a large range of dimensions.


Ion channel - Urska Rovsnik

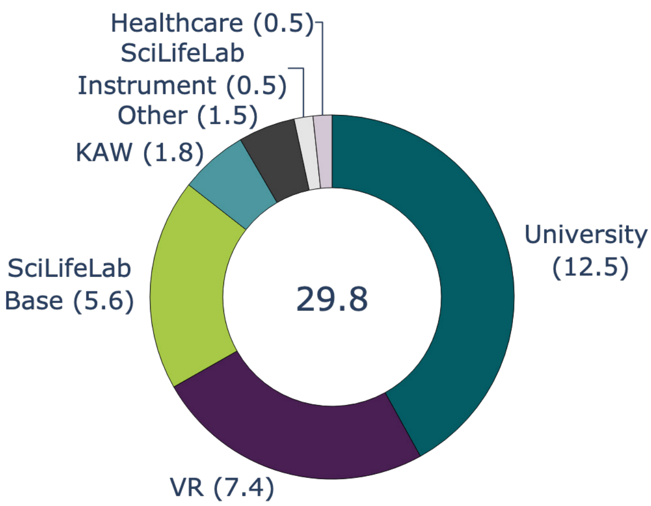

Zebrafish head Steven Edwards

Integrated Structural Biology

Platform Director: Göran Karlsson, GU
Platform Coordination Officer: Cecilia Persson, GU
Platform and Units SciLifeLab Funding 2021:

Unit	(MSEK)
Swedish NMR Centre	3.5
Structural Proteomics	1.5
PD, PCO, Platform Strategic Budget	0.6
Sum:	**5.6**

Total Funding 2021:



Technologies and Services

Several national research infrastructures in structural biology play an important role in supporting the Swedish research community. To further improve the output of existing infrastructures and enable an integrative approach in structural biology the SciLifeLab ISB platform was launched in 2021. The ISB platform confers new capabilities in structural biology, coordinating existing SciLifeLab structural biology technologies with that of MAX IV and ESS and other stakeholders, e.g., protein production research infrastructures and the InfraLife program.

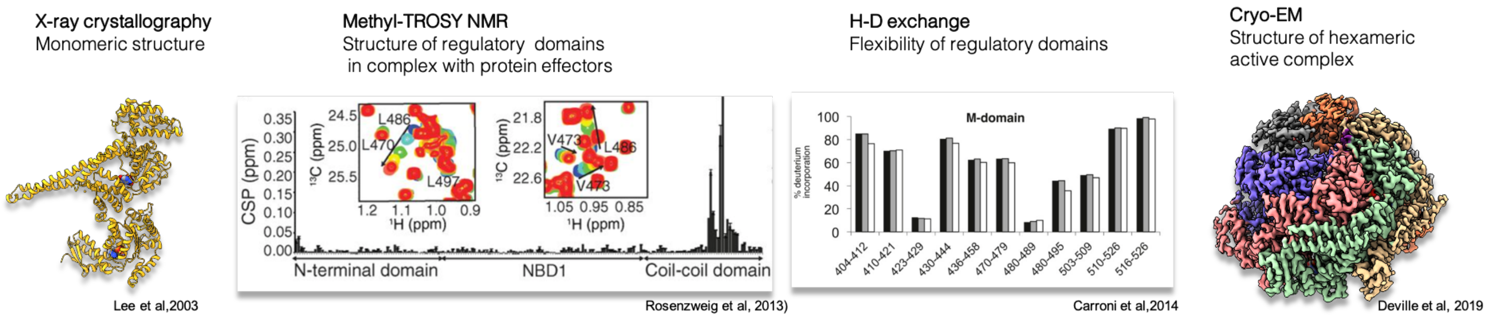
The ISB platform comprises the Structural Proteomics unit and the Swedish NMR Centre. The Cryo-EM unit is virtually linked and represented in the platform management group. External operations and activities are coordinated by the extended management group (EMG) with representatives from all stakeholders including MAX IV and ESS. Short term goals include the establishment of a common web portal for access and information, an interactive communication channel and a webinar series. The EMG will also focus on integrative aspects of structural biology within its group of expert staff scientists, and the development of data handling in close collaboration with the SciLifeLab Data Centre and the Bioinformatics platform.

SciLifeLab structural biology technologies and services are provided by the Structural Proteomics unit (Lund) and the Swedish NMR Centre (Gothenburg and Umeå), in close collaboration with the Cryo-EM unit (Stockholm and Umeå) on the CMI platform. The Structural Proteomics unit offers access and advanced support for time resolved H/D exchange and crosslinking mass spectrometry approaches for structure and dynamics analysis of proteins and protein complexes. The Swedish NMR Centre provides access and advanced support for high resolution solution NMR for protein structure and dynamics, advanced DNP-NMR technology for e.g., in-cell NMR application (Gothenburg) and high-field ultra-fast MAS applications for e.g., membrane protein structure and dynamics analysis (Umeå). In addition, the Swedish NMR Centre provides access to iso-certified NMR-based metabolomics and fragment-based screen technologies.

Future Plans

The instrument park at the ISB platform is continuously upgraded and developed. A new tribrid OrbiTrap MS instrumentation was recently installed in Lund. In Gothenburg, the first 3mm 900 MHz cryo-probe and the first DNP-NMR system in Scandinavia recently became available to users. In Umeå, the first ultrafast (110 kHz) MAS probe in Sweden was taken into use in 2021, and the first 3.2 MAS cryoprobe will be installed in 2022.

Example of integrated structural biology techniques – understanding the ClpB disaggregase

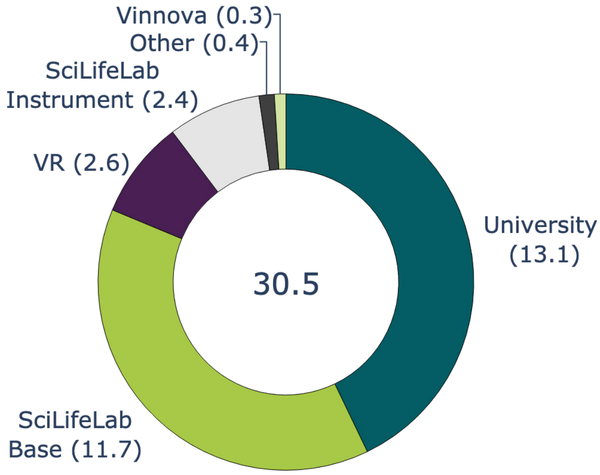


Chemical Biology and Genome Engineering

Platform Director: Anna-Lena Gustavsson, KI
Co-Platform Director: Berhard Schmierer, KI
Platform Coordination Officer: Berhard Schmierer, KI
Platform and Units SciLifeLab Funding 2021:

Unit	(MSEK)
Chemical Biology Consortium Sweden	6.0
Chemical Proteomics	1.7
CRISPR Functional Genomics	3.2
Genome Engineering Zebrafish	-
PD, PCO, Platform Strategic Budget	0.8
Sum:	**11.7**

Total Funding 2021:



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Technologies and Services

The Chemical Biology and Genome Engineering (CBGE) platform provides a range of services in chemical biology, chemical proteomics, and CRISPR-based functional genomics through three units.

The three CBGE units offer a wide range of chemical, proteomic and genetic methods for biological discovery, enabling cutting-edge research across a wide range of disciplines. As a platform, CBGE aims at combining these orthogonal methods into comprehensive pipelines for the identification and validation of novel small molecule/target pairs. By building confidence in such pairs, CBGE builds the foundations for successful further development of small molecules into research tools or drugs.

Services provided by CBCS: CBCS supports users in the identification, validation, and application of small molecules. CBCS provides expertise, experimental resources, and instrumentation for assay development and small molecule (SM) screening, as well as computational and medicinal chemistry support. The Compound Center provides access to more than 350,000 SMs. Various sets are available as assay-ready plates at nano-liter scale through acoustic liquid dispensing. Screening formats range from isolated targets via phenotypic, cell-based assays to whole organisms. Functional profiling of SMs for precision medicine, as well as biosafety level 2 and 3 screening capabilities are in development.

Services provided by ChemProt: ChemProt's deciphers SM-induced proteome signatures for mode-of-action elucidation and has developed a range of high-throughput proteomic methods. ChemProt provides expertise in target deconvolution of SMs and in mapping of the off-target landscape. Methods include thermal proteome profiling, expression profiling, and affinity-based approaches. ChemProt also provides RedOx proteomics, enzyme substrate identification, and structural interaction analysis with HDX-MS. Miniaturization efforts to enable work with primary cells and limiting patient material are underway.

Services provided by CFG: CFG specializes in pooled genetic loss- and gain-of-function screening using CRISPR-Cas technology. CFG carries out both small-scale and genome-wide screens with custom-made lentiviral guide-libraries offering CRISPR-knockout, CRISPR-inhibition, and CRISPR-activation screening. Recent developments include CRISPR-based mutagenesis screens to study molecular interactions, small pooled screens with single-cell transcriptomic readout, and imaging-based pooled screens with downstream deconvolution by in situ guide RNA sequencing.

Future Plans

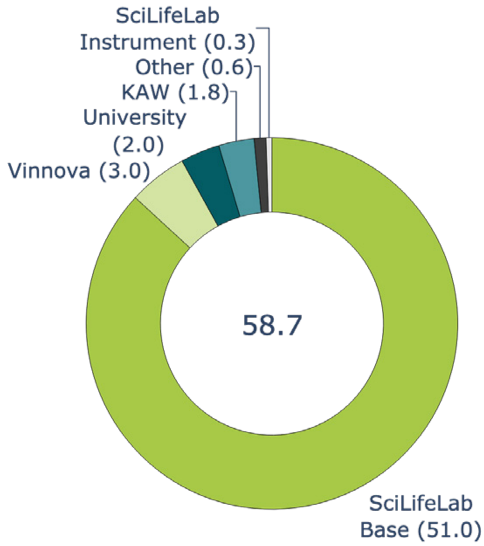
Future platform plans include establishing adaptable pipelines to turn phenotypic observation into mechanistic insight; feeding validated SM-target pairs into DDD for further development; actively contributing to precision medicine, integral structural biology, and pandemic preparedness; as well as improving data management and data integration across all units.

Drug Discovery and Development

Platform Director: Per Arvidsson, KI
Co-Platform Director: Kristian Sandberg, UU
Platform Coordination Officer: Rebecka Klintenberg, UU
Platform and Units SciLifeLab Funding 2021:

Unit	(MSEK)
Drug Discovery and Development	51.0
Sum:	**51.0**

Total Funding 2021:



Technologies and Services

The mission of the SciLifeLab Drug Discovery & Development platform (DDD) is translational research for early drug development programs, and to build an environment for scientific collaborations of highest international standard, competence, and advanced infrastructure in the area of drug discovery. Two major specific objectives are: i. To increase the reproducibility rate in academic life science by providing an industry standard infrastructure tailor-made for drug discovery research and; ii. To provide expertise knowledge and training in drug discovery.

The technologies and services are provided through ten units located at five universities:

- A Target Product Profiling and Drug Safety Assessment unit
- Two units for medicinal and computational chemistry
- Human Antibody Therapeutics unit with two nodes
- From 2022, a unit for therapeutic oligonucleotides
- A unit for Protein Expression and Characterization
- A unit for Biochemical and Cellular Assays
- A unit for Drug metabolism and pharmacokinetics
- A unit for Biophysical Screening and Characterization
- A unit for In Vitro and Systems Pharmacology, phased out 2022

The platform has a proved track record of delivering high quality drug discovery programs (for example, see Figure) based on small molecules, protein therapeutics (mostly antibodies), and cell therapies with on average two spin-outs per year. Starting in 2022, the platform will expand to offer drug discovery capabilities for oligonucleotide therapeutics by incorporating the KAW and SciLifeLab funded Oligonova HUB at Gothenburg University.

Actions to restructure current units and to rebalance the portfolio have been initiated to adjust costs to run the platform for antibody and small molecule therapeutics; e.g., decisions to phase out the IVSP unit, to substantially decrease the small molecule portfolio, and to reduce support to regional Swedish innovation system (TTOs). An urgent issue now concerns how to handle the new commission for therapeutic oligonucleotides.

Future Plans

Improved collaboration between DDD and TTOs was proposed in the SciLifeLab roadmap 2020–2030. To act on this third mission, funding is required if the platform is to retain as a state-of-the-art experimental infrastructure for academic drug discovery. Work is ongoing to find solutions for systems transformation with the aim to build public-public/public-private support functions for academic science and academic scientists to translate their findings into innovations. In addition to oligonucleotides, DDD is rewriting the strategy for small molecules therapeutics. In the future, discovery of small molecule therapeutics will be solely target based and supported by a mixture of established and new methods like X-ray structures, cryo-EM, DNA-encoded libraries, data simulations and machine learning. We need to adapt our selection criteria for new projects to run according to our version of structure-based lead generation. Of importance is to develop cross-SciLifeLab platform and academic collaborations.

Former DDD program from UmU being listed at Nasdaq in April 2021. Another DDD program from UU was listed on June 11, 2021.

▶ 7.4 Infrastructure Output and Metrics

A full report with output and metrics for the infrastructure units are given in *Appendix J*. All analyses are based on data reported 2020 and previously, therefore please note that the infrastructure platforms and unit names may differ from the current ones as described above (that started in 2021 and hence we have no statistics yet).

User Base

The quantity and geographical distribution of infrastructure users are key parameters that SciLifeLab monitors for each infrastructure unit as well as for the whole SciLifeLab infrastructure. In 2020, there were over 1,300 individual academic users of the SciLifeLab infrastructure, totaling over 3,000 projects. The distribution of users based on the affiliation of the PI is shown in *Figure 20*. Notably, in 2020, 50% of users were from universities or institutions outside of the SciLifeLab founding universities, including 8% international universities. In addition to the users included in *Figure 20*, the bioinformatics unit Compute and Storage in Uppsala reported 883 active user accounts spread across Sweden that have utilized the data storage and computing capacities that the unit provides.

Distribution of user affiliation across infrastructure units, illustrated in *Figure 21*, further demonstrates the utility on a national level. SciLifeLab infrastructure is also accessible for non-academic researchers, and our aim is that up to 15% of the infrastructure services should be devoted to non-academic users from healthcare, industry and other sectors. For some of the Clinical Genomics units, that typically serve many heathcare users on a full-cost model, the fraction of non-academic users can be higher. Based on the total infrastructure FTE resources during 2020, 12% were spent on projects from healthcare users, 2% on industry projects and 2% on projects from other governmental organizations.

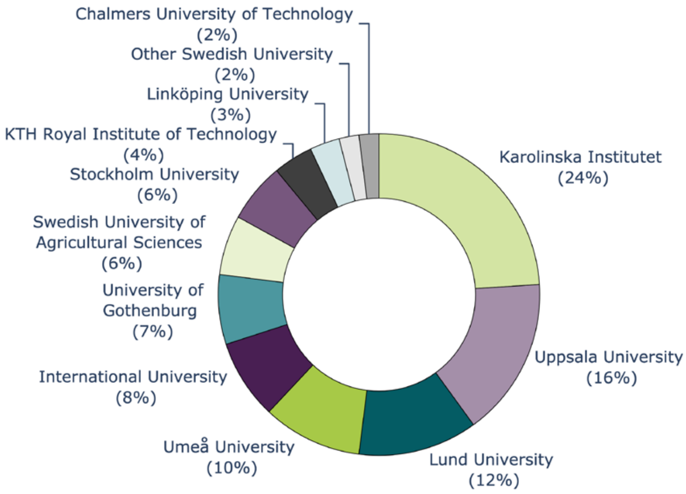


Figure 20. Academic user distribution 2020 based on affiliation of individual PIs.

Figure 21. Distribution of users 2020 from universities, healthcare and industry across all SciLifeLab infrastructure units. The size of the circles corresponds to the number of users.

Publications by the Infrastructure Units and Their Users

Infrastructure units report publications resulting from their service projects to external users and from their internal technology development. In the SciLifeLab Publication Database, publications are labelled either as **service** (infrastructure unit mentioned in acknowledgement), **collaborative** (collaborative project with unit staff as co-authors) or **technology development** (unit staff as corresponding author). Publications may be labelled by more than one infrastructure unit, for example if one unit is collaborating with a research group and the project receives regular support services from a second infrastructure unit. For impact calculations, publications are only counted once.

For years 2019–2020, the infrastructure units reported in total 1,218 publications resulting from their work, which is at the same level as the average of about 600 publications per year since 2016 (*Figure* 22).

Out of the 1,218 publications for 2019–2020, 966 (80%) were labelled as service, 288 (24%) as collaborative, and 74 (6%) as technology development by at least one unit, respectively. This indicates that the vast majority of infrastructure reported publications are indeed resulting from regular services or other interactions with external parties. As comparison, for years 2015–2018, 1,403 out of 2,268 (62%) of reported publications were labelled as service projects. Hence, the fraction of service publications had significantly increased for 2019–2020. This could be a true shift, although we cannot exclude that this reflects improved reporting of service publications as the systematic publication database tracking was started in 2017.

SciLifeLab infrastructure publications are receiving an increased number of citations each year, even while the number of publications remains steady (*Figure* 23). Thus, the citations of older publications decline at a slower rate than the increase in citations of more recent publications.

Impact scores are used to measure the impact based on citations in comparison with other publications in the same field and period. We have used PP(top 10%), the fraction of published papers found among the top 10% most cited in the same field and time period. The impact of infrastructure reported publications is high, with PP(top 10%) = 24% for the years 2015–2018. In the reported subcategories – service, collaborative, and technology development publications – PP(top 10%) were 25%, 19%, and 24%, respectively. As comparison, the Swedish university reporting the highest impact in the Biomedical and Health Sciences category, Karolinska Institutet, reported an organization-wide PP(top 10%) of 17.4%. See *Section* 9 for further analyses of infrastructure output and impact in relation to SciLifeLab affiliated researchers and impact and output for specific scientific fields.

An important objective of the SciLifeLab infrastructure is to promote and increase multidisciplinary research using several platforms, units, and technologies for addressing scientific questions. In this respect SciLifeLab is unique, even in global terms, in being able to provide complementary world-class capabilities covering a broad range of technologies. SciLifeLab monitors cross-unit usage based on papers published by infrastructure users. Here, we have analyzed 1,218 publications of infrastructure users from years 2019–2020. Of these, 518 involved more than one infrastructure unit. However, a large fraction of these involved the Compute and Storage unit in the Bioinformatics platform that facilitates access to external

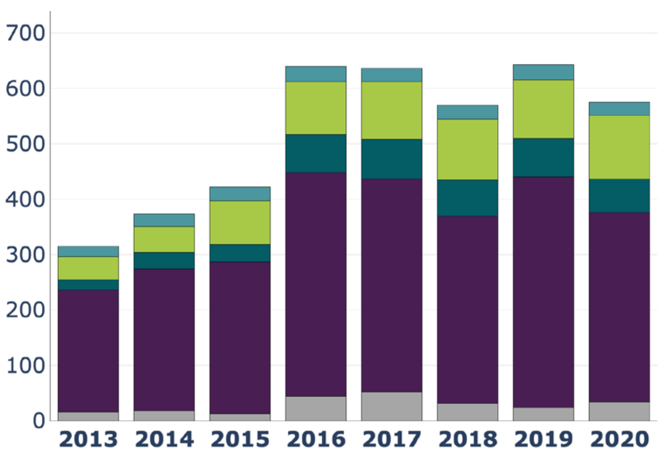


Figure 22. Infrastructure user publications 2013–2020 with Journal Impact Factor (JIF) distribution: JIF > 25 (blue), JIF 9–25 (light green), JIF 6–9 (dark green), JIF < 6 (purple), JIF unknown (grey).

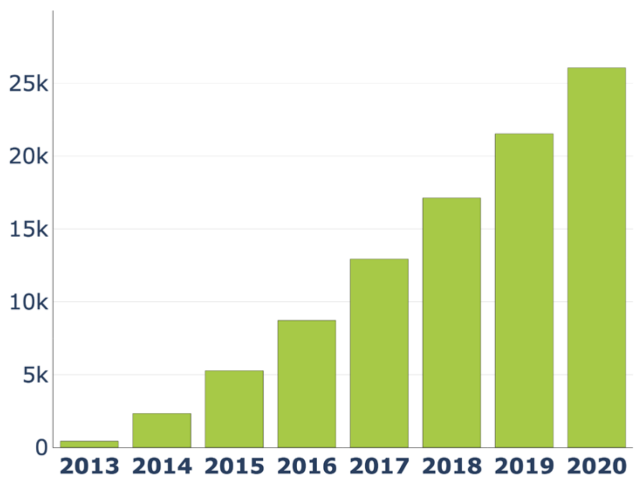


Figure 23. Number of citations received in each year for publications by infrastructure users

e-infrastructure resources. We omitted this unit from further analyses of cross-unit interactions, and after removing 390 Compute and Storage publications that only involved one additional unit from the analysis, 128 (11%) cross-unit publications remained. The interactions between units in this group of publications is illustrated in *Figure 24*.

In conclusion, the scientific output from activities involving SciLifeLab infrastructure remains at a steady level since 2016, including both service, collaborative, and technology development publications. All these publication types are very highly cited, as measured by the normalized fraction of top 10% cited papers, i.e., the PP(top 10%) metric when compared to the average metrics from any Swedish university. While no causal relationships can be drawn, SciLifeLab can be satisfied with either of these alternative explanations: 1) that the use of SciLifeLab services improves the likelihood of creating high-quality publications or, 2) that users who are interested in SciLifeLab services publish on average more highly cited papers. We hope and anticipate that that the fraction of infrastructure cross-unit publications will grow over the coming years as a result of increased focus on cross-unit and cross-platform service offerings and by the launch of new research capabilities in 2021–2022.

Additional bibliometric analyses are reported in *Section 9*.

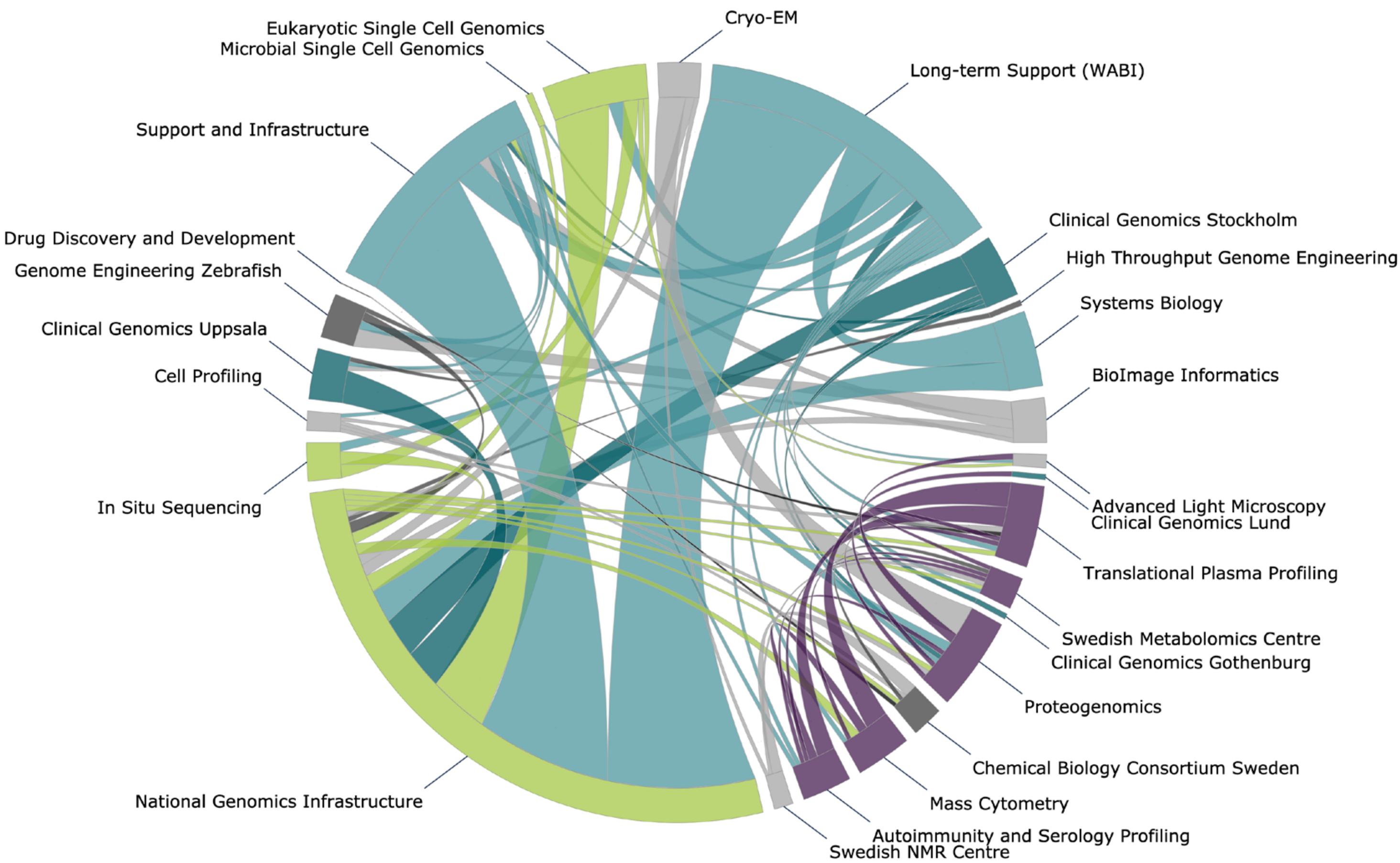


Figure 24. Circos plot illustrating cross-unit use based on user publications from 2019–2020 (n = 128). The length of the circle segments corresponds to number of cross-unit publications for each unit, and the ribbons connects the units that contributed to the publication with service, data, or analysis. Publications from a single unit only are not shown in this picture, and publications involving the Compute and Storage unit (with only one additional unit) are also excluded.

7.5 SciLifeLab Capabilities

Capabilities aim to exploit the full potential of the infrastructure by creating comprehensive, impactful services that can address grand challenges, as opposed to single units operating independently and giving service to individual users. Capabilities are designed to connect a broad range of infrastructure techniques, expertise, researchers, sample handling resources, data analysis pipelines and coordinate these to answer complex and demanding questions.

Some of the established infrastructure platforms can already be described as capability rather than technology platforms, one example being the Drug Discovery and Development platform, composed of several service units that collectively cover all aspects needed for early drug discovery. In the new infrastructure organization launched in 2021, some of the new platforms are also composed in a similar way and have been given the mission to promote and coordinate capability services in a broader sense (e.g., Spatial and Single Cell Biology platform and the Clinical Genomics platform).

In 2020–2021, SciLifeLab has launched three capabilities: 1) Precision Medicine, 2) Planetary Biology and 3) Pandemic Laboratory Preparedness (*Figure* 25). These will be supported with dedicated funding during 2021–2022 and onwards. These areas are typical examples where multiple platform technologies and coordination are needed. The Precision Medicine initiative is further described in *Section* 7.6, and a call for a scientific leader and coordinator for the start-up phase of the Planetary Biology capability is planned for in the fall of 2021. Precision Medicine, and to some extent the Planetary Biology, also match with the research areas in the DDLS program.

In the 2020 governmental research bill, SciLifeLab was allocated an additional 130 MSEK for 2021–24 to set up a program for Pandemic Laboratory Preparedness. The commission will also be a major capability offered by the SciLifeLab infrastructure and research community in the future and is described in more detail in *Section* 7.7.

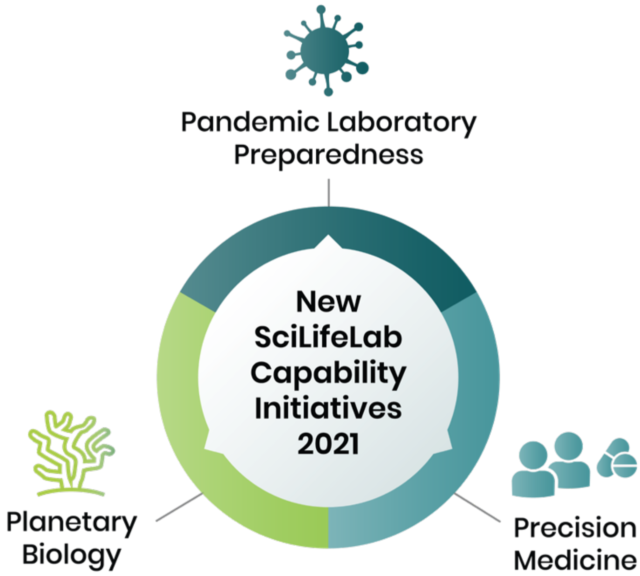


Figure 25. New SciLifeLab capabilities 2021, based on collaboration between the SciLifeLab infrastructure, the DDLS program, and technology development research.

7.6 Precision Medicine

SciLifeLab infrastructure can facilitate research and clinical diagnostics according to the Precision Medicine (PM) concept. Today PM is usually focusing on genetic analyses. In the SciLifeLab PM program, we will promote the use of additional molecular profiling layers to help PM projects, such as spatial and image-based analyses, single-cell analysis and functional drug testing.

Our vision is that SciLifeLab should play an important national role in the development and implementation of multimodal PM by providing cutting edge technologies to researchers and clinicians. We need collaboration between technology platforms, researchers, and the clinics to enable knowledge transition, as well as systematic clinical sample and data handling processes.

Important pioneering work has been done by the Clinical Genomics Platform and Genomic Medicine Sweden (GMS) by providing genomic analyses to patients in Sweden, aiming to improve diagnostics and individualized treatment. GMS has established seven regional genomic medicine centers at the Swedish university hospitals. We envision continued knowledge exchange from SciLifeLab to university hospitals and establishment of real-world testbeds on complex sample preparations and data handling to push PM also beyond genomics. Data is central to PM and will require novel data storage and analysis frameworks that connect molecular and clinical data flows (*Section* 7.9). Here, the DDLS program will provide novel solutions and concepts that can be co-developed and where the future PM data experts are trained.

The initial task of our newly set up PM taskforce is to create a PM Roadmap and formulate long-term visions for the SciLifeLab PM capability. This plan will need to be realized in close collaboration with all universities and with the health care organizations.

7.7 Pandemic Laboratory Preparedness

The Pandemic Laboratory Preparedness (PLP) program at SciLifeLab is newly launched and represents a 4-year national 130 MSEK program (for 2021–2024). The basis of the program was presented by the Swedish government as part of the budget proposition for 2021. The main aim is to give SciLifeLab, in consultation with The Public Health Agency of Sweden, resources to build better capacities for laboratory support during future pandemics to support health care, clinical laboratories, as well as public and commercial sectors but without replicating or creating competing clinical testing capacities. This will be achieved through both strengthening technical facilities for molecular analyses at SciLifeLab such as sequencing, genetic analyses and immunological methods and increasing the capacity and capability to process patient samples for molecular profiling and to analyze large amounts of data (*Figure 26*).

Being a national research infrastructure, the most important and primary role for SciLifeLab in the PLP program is to support research, and researchers working with issues related to disease-causing agents that can cause pandemics, not to act as a clinical laboratory during a pandemic. Relevant research fields include diagnosis, analysis of infection, development of disease, immunity, resistance related to viruses, bacteria, and other disease-causing agents. The main role of SciLifeLab during pandemics will be to provide technological support, diagnostic method development, and evaluation, as well as data handling and integration to help discovery of predictive models in collaboration with representatives from the health care system and governmental agencies, the National Public Health Authority in particular.

Phase 1 of the PLP program has a focus on the ongoing and future waves of the current pandemic. This was initiated in early 2021 with a call for letters of intent, LOI, to seek ideas for how SciLifeLab can develop nationally significant services and capabilities that are important during the current COVID-19 pandemic, and later during the post-pandemic phase. These PLP capabilities were suggested to be developed by current units within the SciLifeLab infrastructure, by researchers in collaboration with the SciLifeLab infrastructure, or as proposals for new SciLifeLab infrastructure services. A total of 17 LOI were received of which eight were selected for further discussion. After a review process and interactive discussions, proposals based on the eight LOI with a final plan were submitted. The capabilities suggested by these eight proposals will form the basis of the PLP research network (*Figure 27*). A total funding of 39 MSEK has been decided for 2021–2022 via the PLP program.

Phase 2 of the PLP program will focus on the post-pandemic area and will have an additional LOI call in 2022 for support of the post-pandemic phase (years 2023–2024). This will enable an increase in the number of PLP capabilities and expand and strengthen the effort (*Figure 27*). An advantage when planning Phase 2 of the PLP program is to use the experiences gained during Phase 1, the overall SciLifeLab pandemic efforts (*Appendix E*) as well as similar global efforts elsewhere.

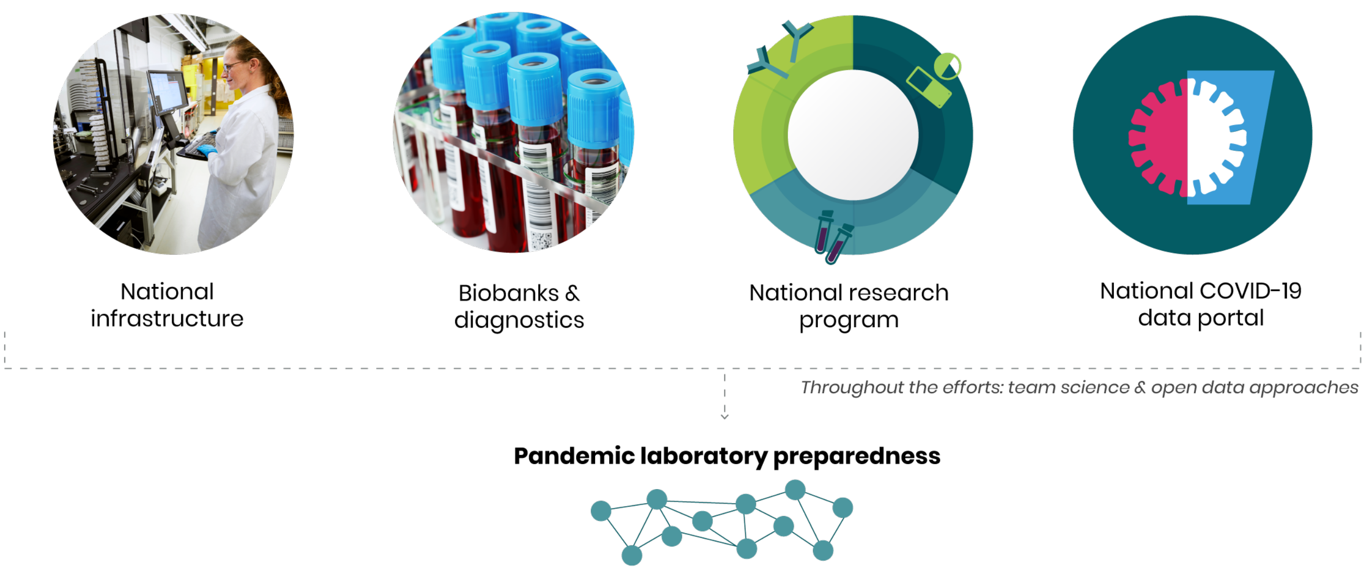


Figure 26. SciLifeLab Pandemic Laboratory Preparedness program (PLP).

The following eight priorities describe the current focus areas of the PLP program:

1. Focus on research support (research is always critical during pandemics)
2. Support and coordinate team-science efforts
3. Support techniques and technology development important for the study of pandemic pathogens and their effects
4. Operate nationally and in collaboration with other research infrastructures
5. Work to facilitate the flow of patient samples to infrastructure platforms
6. Support data management, data sharing and open publication during pandemics
7. Support training in pandemic laboratory preparedness
8. Make a permanent investment in pandemic laboratory preparedness within SciLifeLab

SciLifeLab has the ability to strengthen both basic and clinical research, as well as technology development at universities, hospitals, public authorities and companies during and between pandemics through its established and well-known life science infrastructure and research network. The PLP program will establish capabilities for use in future pandemics, meaning they are long-term investments that can also be used in other SciLifeLab activities such as precision medicine. The goal is to make the PLP resources permanent within SciLifeLab from 2025 to maintain and develop the capabilities needed during future pandemics.

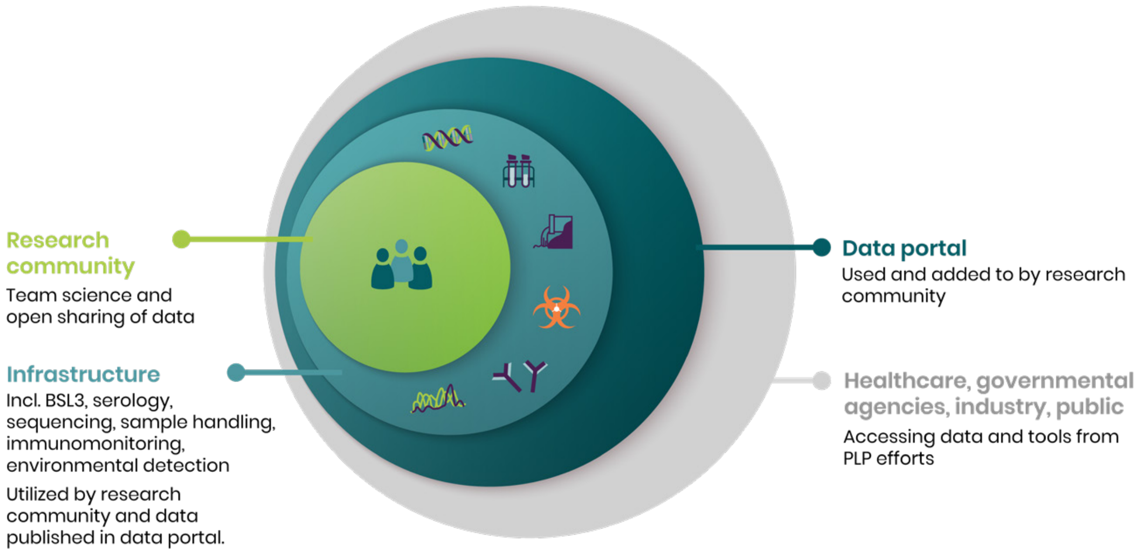


Figure 27. The first phase of the dynamic Pandemic Laboratory Preparedness and its essential components: a research community that generates data closely associated with SciLifeLab's infrastructure, exchange of open data and support of big data handling through the portal, and interaction with healthcare, governmental agencies, industry and the public.

7.8 Technology Development and Renewal of Instrumentation

Continuous updating of the technologies and services is important for maintaining the SciLifeLab infrastructure at the forefront. This is challenging due to the wide spectrum of services, the complexity of operations across universities and the country, and the frequency of required upgrades of expensive instrumentation. To facilitate a continuous renewal, SciLifeLab has developed four cornerstones for enabling infrastructure technology development and equipment upgrades.

1. Infrastructure units are allowed and even encouraged to use up to 20% of their allocated national funding for technology development, thus identifying and implementing opportunities for new relevant technologies, upgrades, and new protocols, to complement existing capabilities.
2. In 2018, SciLifeLab launched the first national call for Technology Development Projects (TDPs), open to all researchers in Sweden. The purpose was to develop, or implement, novel technologies for incorporation as services within existing infrastructure units. In 2021, we are launching a second TDP call, this time directed towards the infrastructure platforms and units. Grants can be used to develop technologies also in collaboration with external PIs and research groups.
3. Since 2018 SciLifeLab has also arranged annual calls for funding of expensive instruments (in the range of 2 MSEK and above) for the national infrastructure. We consider this as important and plan to reserve about 20 MSEK annually from the national budget for this purpose (i.e., contributions to instrument depreciations).
4. Technology development is also done by the research community closely associated with the SciLifeLab infrastructure. Research in these groups is often conducted in collaboration with infrastructure units, and in many cases give rise to new technologies that can be implemented as service at the units, as well as provides a scientific edge to the services offered.

Technology Development Highlights 2019–2020

The SciLifeLab community was excited and proud about the nomination of Spatially Resolved Transcriptomics as the Method of the Year 2020 by the Nature Methods journal. The technology was developed at SciLifeLab by the KTH researcher Joakim Lundeberg, whose group published the seminal early papers and filed IP on Spatial Transcriptomics.

Also, Mats Nilsson at SU has developed single-cell resolution In Situ Sequencing technologies and together these and other technologies constitute the newly created Spatial and Single Cell Biology platform at SciLifeLab, with associated image informatics capabilities. The platform was started in 2021 around the globally unique special expertise and technologies available at SciLifeLab.

SciLifeLab has supported the technology development in these fields with several TDP grants, and spin-off companies generated around both above-described technologies have recently been acquired by 10x Genomics, a major US company and technlogy leader in this field.

7.9 SciLifeLab Data Centre

The Data Centre (DC) is a central support function at SciLifeLab with responsibility for services, resources and support for IT and data related issues. It serves the infrastructure platforms, but also operations and management, research programs and strategic initiatives, and represents SciLifeLab in national and international collaborations for issues regarding data and IT. As data driven research has become central to SciLifeLab's future, including the launch of the DDLS research program, DC is now established as an important part in the SciLifeLab organization.

The goal of DC is to maximize the scientific impact of the technology platforms of the infrastructure and the research supported by SciLifeLab by providing strong common services and enabling open science and FAIR data. Openness and transparency are paramount to Data Centre operations and the software developed by the team is always available as open source.

DC supports the **infrastructure** by closely interacting with the service platforms, providing IT solutions and software services, advice regarding the design of data flows and for the preparation of operational plans or grant proposals. New services developed or procured by DC often originates in platform requirements, followed by collaboration projects piloting and evaluating prospective services. A particularly close collaboration is between the Data Centre and the Bioinformatics platform, NBIS, regarding data management and FAIR. DC and NBIS are now together establishing a service brokering function at SciLifeLab, with the focus on facilitating submissions of data produced by SciLifeLab platforms to the appropriate repositories at EMBL-EBI, through interactions with the platform, researchers in the project, and EMBL-EBI curators.

A particularly important service to platforms is a new system for data delivery, that will be deployed in production this autumn at a number of platforms. This is built around a cloud-based storage system and on-the-fly encryption enabling transfer and storage of sensitive data. The philosophy of DC is to make data sharing an integral part of the research process, linking data producing platforms and research projects, rather than being used passively for data publishing at the end of the research project.

Although the Data Centre is a part of the central SciLifeLab organization and not a platform, the unit also supports external **research projects** in a number of cases. This includes the projects in the KAW funded COVID-19 research program, where DC has an active role in engaging with individual projects from the start in order to support good data practices and open science. The Data Centre also engages directly with external research projects for the purpose of strengthening strategic development central to SciLifeLab, such as clinical research handling, collaborations with biobanks and sample collections, and image data applications.

The Data Centre also has an integral part in SciLifeLab **operations**, closely interacting with Management Group and the Operations Office and the newly appointed ELSI advisor. DC operates self-developed systems for data collection from the infrastructure, a publications database, systems for reporting and surveying and Anubis, a system for handling proposal submissions and the reviewing process, for example used in the 2020 infrastructure evaluation and the calls for proposals under the COVID-19 research program.

Since the start of the COVID-19 pandemic, DC has broadly provided collaborative tools aimed at facilitating work from home or distributed across the country. This includes commonly used software platforms, such as Confluence and Slack. This has proven to be very important for community building and as an example, at the time of writing (August 2021), the SciLifeLab Slack workspace has over 1,200 members and transfers approximately 4,500 messages every day.

Data Centre has also operated the national COVID-19 data portal on assignment from the Swedish Research Council, participating in the European COVID-19 data platform coordinated by EMBL-EBI. The Swedish portal was the first national portal to be established in Europe, less than two months after the launch of the EU data platform itself. The software and design of the national Swedish COVID-19 data portal has been used by several of the national data portals that have followed.

Presently, the Data Centre is expanding and adapting to the new task to lead the operational work for the DDLS program data services and resources, as the hub of a national network for life science data across the participating universities. This includes a strengthening of the compute- and storage capacity that is required to operate the data platform, often through coordination with other e-infrastructure centres across Sweden. For example, a close collaboration has been established with the KAW funded Berzelius resource for AI research located at the National Supercomputer Centre (NSC) at Linköping University. DC's effort for increased e-infrastructure capacity is managed through a closer collaboration with KTH IT, and will also include a stronger coordination between Campus Solna IT activities and the national infrastructure.

The Data Centre today employs 13 FTEs: system developers, data engineers, data stewards and project managers. The unit is funded with 9 MSEK/year from the SciLifeLab national infrastructure budget, and will receive further funding from the DDLS program to operate its data platform, described in more detail in the DDLS part of this report (*Section 11*). The unit has also received 6 MSEK in funding from the Swedish Research Council in 2020 and 2021 to operate the national COVID-19 data portal. From 2022 and forward, it is expected that the COVID-19 data portal will be fully operated and funded as a part of SciLifeLab's program for Pandemic Laboratory Preparedness, and the DDLS program. The Data Centre has also received additional funding in 2020 through the EIT Digital program and the SciLifeLab/KAW COVID-19 research program. The services provided by Data Centre are summarized in *Table 4*.

Table 4. Services from the SciLifeLab Data Centre. Services are provided to the infrastructure and operations/management, and to SciLifeLab affiliated research programs, except a few broad services to all Swedish life science researchers. DC also operates a data and IT helpdesk at datacentre@scilifelab.se.

SERVICE	DESCRIPTION
SciLifeLab Data Repository	General data repository, powered by Figshare. Provides a service to publish data and other information with a persistent Digital Object Identifier (DOI). Available to all SciLifeLab affiliated platforms and research projects.
COVID-19 Data Portal	National COVID-19 data portal, aggregating data, services, information and guidelines regarding COVID-19 research. Available to everyone.
Order Portal	Web-based management system that, amongst other things, enables infrastructure units to communicate with their users. It is currently in use at multiple units and can be configured in platform-specific instances.
Infrastructure Management System (iLAB)	Commercial software system to assist with managing the multiple aspects of infrastructure unit administration including scheduling, invoicing and operational management. Provided at KI and UU facilities.
Data Delivery System	Cloud-based system facilitating data delivery and storage for units. It can also provide some other services, including feedback forms. This system has been developed in close collaboration with the infrastructure units and is now undergoing testing.
Anubis	System for call proposal submissions and handling the reviewing process
Confluence	Web-based system for wiki-style collaborative workspaces.
NextCloud	Dropbox-style file management system with DC-managed storage, enabling file sharing and editing for platforms and operations.
Slack	Cloud based communication system for rapid work communication.
Publication databases	Self-developed system used to store publication data, providing a search and browse interface, and an Application Programming Interface: publications produced by researchers affiliated with SciLifeLab (including Fellows) and publications produced based on infrastructure services. The system is also a reporting tool for the platforms.
Data Stewardship Wizard	Web-based tool for storing and maintaining structured data management plans (DMPs), aimed at enabling their use by SciLifeLab researchers and infrastructure users. The system supports DMP formats as required by the SciLifeLab research programs and the Swedish Research Council. SciLifeLab participates in the national coordination on DMPs.
Hosting services	DC provides hosting for some data and services for the units, and for research groups in some specific cases. This is provided on DC managed compute- and storage and a Kubernetes-based container management system.
ProjectPlace	Project management system

8. Research

This section aims to give the IAB a brief summary of significant research developments made during 2019–2021, and describe future plans and strategies.

▶ 8.1 Research Community

The SciLifeLab infrastructure serves researchers, and the infrastructure is also developed in collaboration with the research community. Maintaining a strong reciprocal connection between the two domains is essential to ensure long-term success of SciLifeLab. Hence, the continued scientific productivity of the research community is critically important (see *Section* 9). Key events in 2019–21 have been:

- Directed efforts through which SciLifeLab extends into, and promotes, the **wider research community** including: 1) Research Community Programs, 2) the KAW-supported National Molecular Medicine program, 3) the National COVID-19 Research Program and the iv) the DDLS program (see *Section* 11).
- **SciLifeLab Group Leader definition** launched and implemented.
- More **SciLifeLab Fellows** have been recruited and the program further developed and harmonized (see below).
- A survey of the SciLifeLab Fellows program was executed in 2021.
- In 2021, SciLifeLab signed an **MoU to collaborate with EMBL** (see *Section* 6.4).

SciLifeLab Group Leaders defined

The first uniform criteria for the SciLifeLab group leader (*Appendix K*) were approved by the SciLifeLab Board. This program started just before the pandemic hit, and we were able to appoint the first research and infrastructure group leaders from the SciLifeLab founding universities, with a documented strong affiliation to SciLifeLab. The program supports interactions among group leaders and with the infrastructure. The group leader definition is also helpful to get systematic bibliometric data from SciLifeLab in the future as well as to engage people in training. Currently, there are 189 SciLifeLab group leaders, including the 37 SciLifeLab Fellows (active in the program or alumni). New nominations are welcome throughout the year and we have the ambition that the program is open to all those, who want to have an engagement with SciLifeLab that is beyond that of a regular infrastructure user. Today, 106 and 83 group leaders are located to the CS and Uppsala sites, respectively, and we estimate that via these group leaders, about 1,500 researchers are affiliated to SciLifeLab. In the next phase of the program, we are planning to expand the community of research beyond these sites, such as to include more infrastructure scientists, the associated research communities, the PLP and COVID-19 research program, the WCMM and DDLS Fellows and their groups.

Research Community Programs

To facilitate internationally competitive and groundbreaking research throughout Sweden, SciLifeLab supports seven Research Community Programs (RCPs) which connects top researchers with each other, and with the SciLifeLab infrastructure in large dynamic networks: Biology of Molecular Interactions, The Human Protein Atlas, Large-scale clinical genomics and complex diseases, The Human Developmental Cell Atlas, Aquatic Microbiome Research Initiative, Phenotypic Drug Discovery in Human Disease and Swedish Tumor Microenvironment.

Since these dynamic programs were launched in 2019, several new group leaders have joined. The new PIs now make up about 20–50% out of the 20–70 PIs that belong to each RCP. Each RCP is linked to at least three SciLifeLab infrastructure units, and over 30 SciLifeLab infrastructure units are linked to at least one RCP. RCP members connects through a variety of activities, such as seminars, network meetings, workshops, doctoral student exchanges between group leaders, and some also produce training and information materials and newsletters.

NMMP (National Molecular Medicine Partnership) Network

Together with the Wallenberg Centers for Molecular Medicine (WCMM) in Umeå, Linköping, Gothenburg and Lund, SciLifeLab has formed the KAW-supported National Molecular Medicine Program (NMMP), to strengthen the connections between these partners, and for promoting collaborations between their researchers and the SciLifeLab infrastructure. This network now consists of a total of 121 Fellows (young group leaders). 84 of them at the WCMM centers, and they interact through annual meetings. In addition, research collaborations across the different sites are supported with funding allocated through the program for this purpose.

8.2 SciLifeLab Fellows Program

The SciLifeLab Fellows program is funded by SFO-funds allocated by the government to the four founding universities. The program is a recruitment and career development initiative designed to attract excellent young scientists at the beginning of their academic careers as group leaders, with the aim to strengthen Swedish research by recruiting and keeping international top talent in Sweden.

As of June 2021, a total of 38 Fellows have been recruited to the program. Since the previous visit by IAB, 15 new SciLifeLab Fellows have started the program and six SciLifeLab Fellows have completed the program and will continue as Fellow alumni SciLifeLab group leaders (*Figure* 28 and *Table* 5). Thus, there are currently 31 Fellows active in the program. One of the recently recruited UU Fellows will start the program in the spring of 2022. One KI SciLifeLab Fellow position is being announced during 2021 (in addition to the recruitment of DDLS Fellows, *Section* 11).

At the end of 2020 there were 234 active researchers, of which 35% postdocs and 37% doctoral students, in the SciLifeLab Fellows' research groups. During 2019–2020, 15 of the PhD students in the SciLifeLab Fellow's groups successfully graduated. To date, 16 of the SciLifeLab Fellows have qualified for a Docent title, and 14 (an additional seven since the previous IAB visit) have either received a permanent position or have been promoted to a formal tenured position at their host university, indicating the outstanding career progressions of the SciLifeLab Fellows.

There are differences across universities and faculties in how the SciLifeLab Fellows are recruited, the length and conditions of the appointments, and in the tenure evaluation. This is due to the fact that each university runs their SciLifeLab Fellow appointments according to their usual procedures for recruitments.

Overall, the SciLifeLab Fellows publish in high impact journals, see *Section* 9 for further details.

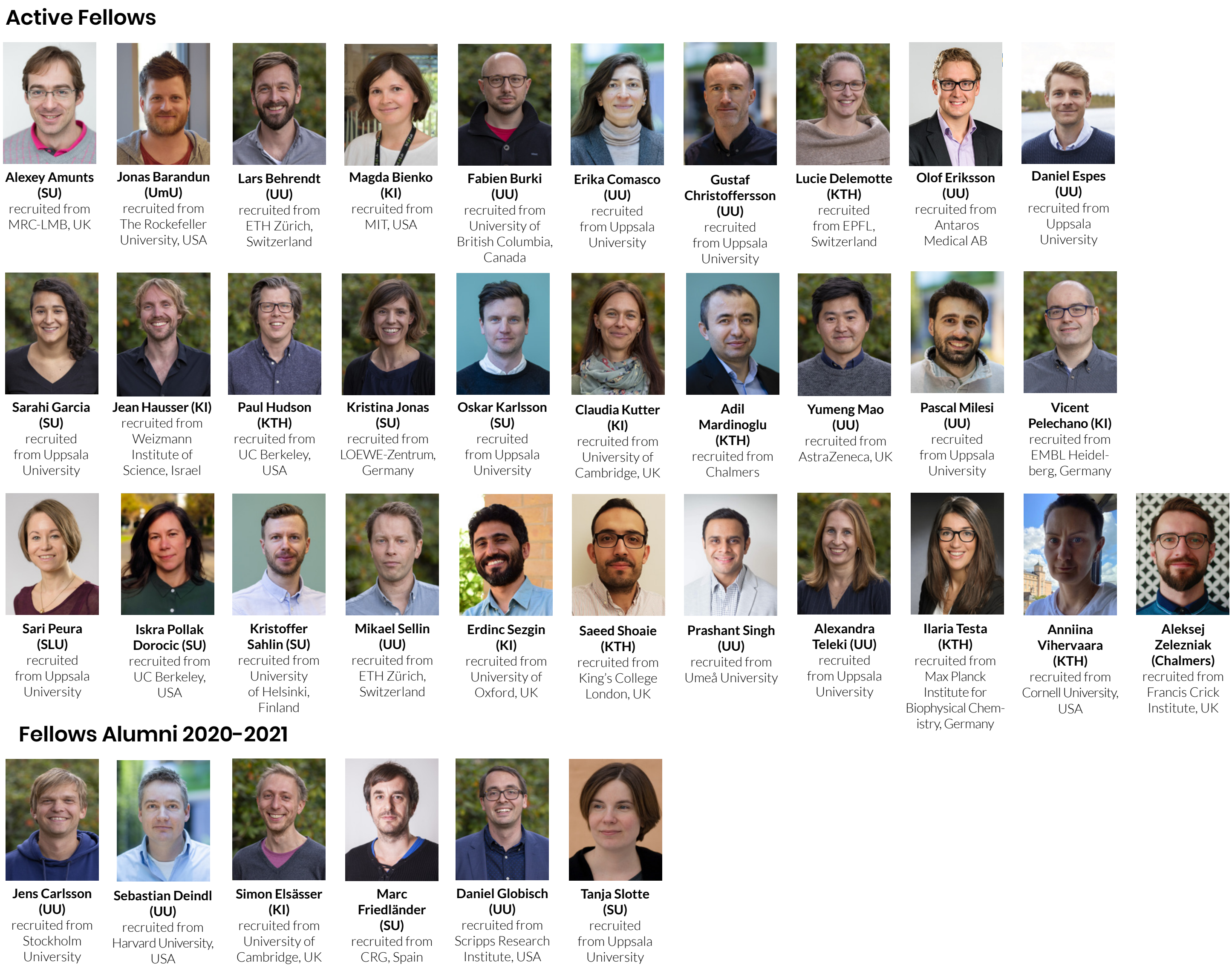


Figure 28. The 37 Fellows who are in the active fellowship phase or who have completed the SciLifeLab Fellows program.

Table 5. New Fellow Recruitments 2019–2021.

Fellows recruited 2019–2021	Scientific field	Affiliation
Lars Behrendt	Environmental toxicology	UU
Gustaf Christoffersson	Mechanisms of autoimmune diseases	UU
Sarahi Garcia	Microbial interactions in aquatic environments	SU
Jean Hausser	Quantitative rules in tumor biology	KI
Yumeng Mao	Cancer immunology	UU
Pascal Milesi	Evolutionary biology with focus on genetic determinism of adaptation	UU
Kristoffer Sahlin	Computational biology with focus on high-throughput genomics and transcriptomics data	SU
Erdinc Sezgin	Physicochemical principles underlying cellular processes	KI
Saeed Shoaie	Systems biology	KTH
Alexandra Teleki	Drug development and pharmaceutical nanotechnology	UU
Anniina Vihervaara	Molecular genomics	KTH
Iskra Pollak Dorocic	Neurochemistry with focus on molecular visualization and manipulation methods	SU
Jonas Barandun	Macromolecular complexes of specialized pathogenic organisms	UmU
Daniel Fürth	High-resolution spatial methods	UU
Daniel Espes	Functional imaging specializing in targeted therapy	UU
Prashanth Singh	Scientific computing in data-driven life science	UU
TBD	Data-driven biomedical research	KI

Development and Continuation of the SciLifeLab Fellows Program

The SciLifeLab Fellows program is essential for the SciLifeLab profile, and we want to promote and advance this program further together with the four founding universities. The two-year action plan for SciLifeLab Campus Solna (*Section* 6.3, and *Appendix* C), are addressing several of the previously raised concerns by the IAB. Additionally, the founding universities have agreed on an Introduction and integration document, that will help to align and quality assure the whole process of the SciLifeLab Fellows program, from recruitment to the end of program, where all key steps and responsible stakeholders are highlighted.

In 2020–2021, SciLifeLab did a survey of the SciLifeLab Fellows program, to gather information to measure how successful the program has been, as well as finding out how it can be further developed (*Appendix L*). This survey was important for several reasons: 1) motivating the host universities to continue to fund the program; 2) formulating recommendations for the future of the SciLifeLab Fellows program and for the SciLifeLab & Wallenberg National Program for Data-Driven Life Science (DDLS); 3) documenting information of value for other career programs; and IV) to support communication with funding agencies. The survey collected input from SciLifeLab Fellows, host university representatives, and the SciLifeLab infrastructure, and was focused on the program as a whole, i.e., not a person- or organization-specific evaluation. The survey has pinpointed the major advantages of the program, but also provided many points that we will need to consider and potentially act on to improve and develop the program. The main findings are summarized below, while the full report is in *Appendix L*.

SciLifeLab Fellow Recruitment and Funding

The SciLifeLab Fellows program is, as previously mentioned, funded by SFO-funds at the four founding universities. SFO funding is therefore critical to the future of this program.

SciLifeLab Fellows consider the current funding level (3 MSEK/year for the first 5 years of the program) sufficient to start an independent group. The funding available was a main reason why the Fellows chose to join this program. Other factors involved in the recruitment are given in *Figure* 29.

The host universities consider the SciLifeLab Fellows to be a good investment and emphasize that it would have been difficult to recruit the SciLifeLab Fellows without the program (*Figure* 30).

In addition to the SFO funding package, the SciLifeLab Fellows have been exceptionally successful in attracting external research funding to further support their research and groups. Throughout the period 2014–2020 they were granted over 1.1 BSEK in external grants (*Figure* 31). Noteworthy, 11 out of 35 SciLifeLab Fellows (currently in the program or alumni) have been awarded a prestigious grant from European Research Council (ERC). These include 10 starting grants, two consolidator grants and one proof of concept grant. Recently, several SciLifeLab Fellows have actively engaged in the SciLifeLab National COVID-19 Research Program and were granted funding from KAW for projects to combat the pandemic.

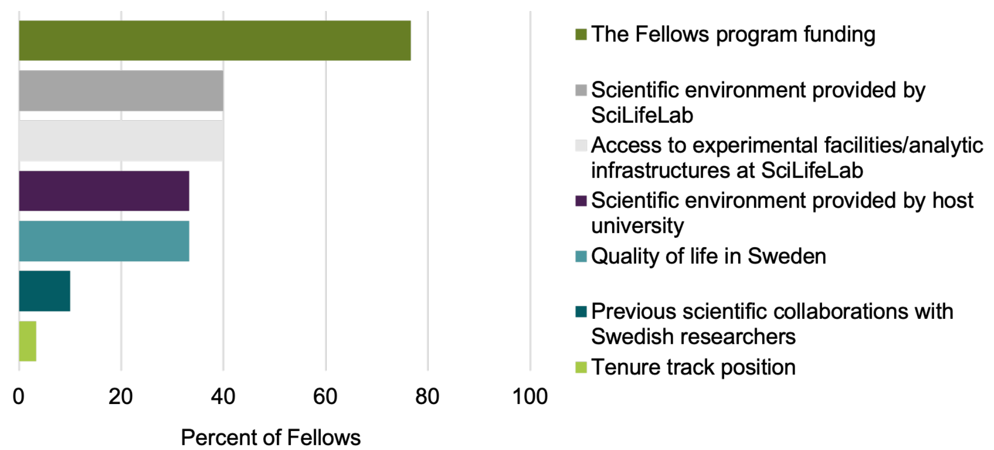


Figure 29. The major reasons why the SciLifeLab Fellows decided to accept the offer to join the program.

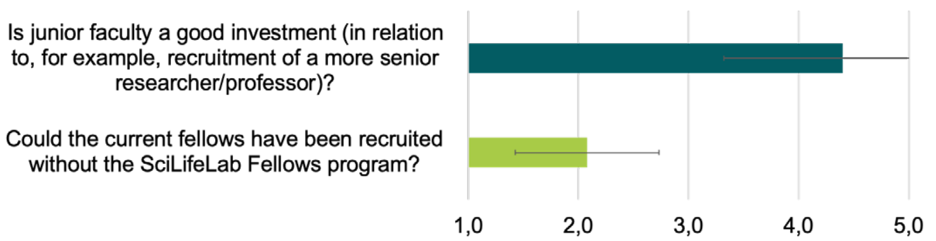


Figure 30. Importance of the SciLifeLab Fellow program for the host universities (scale 1–5, Strongly disagree - strongly agree).

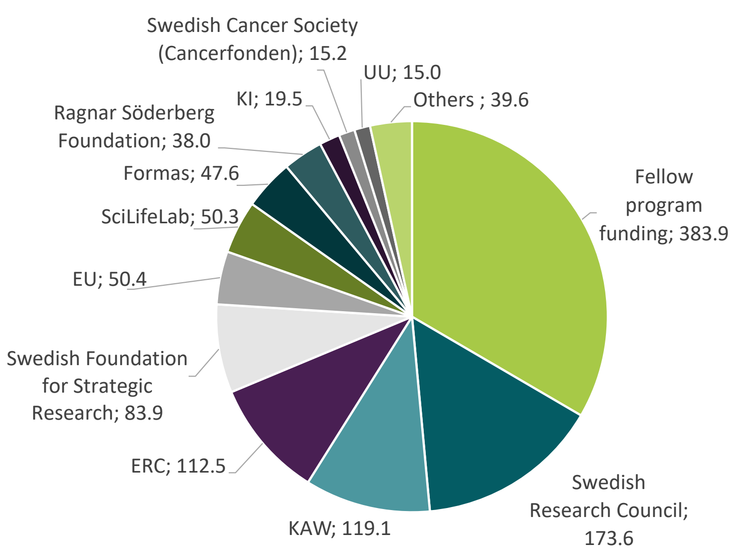


Figure 31. Grants received by 29 Fellows during 2014–2020 (MSEK), total 1.1 BSEK. Grants below 10 MSEK were summed into "Others". The complete list of grant-givers is shown in *Appendix L*, *Table 1*. SciLifeLab funding includes funding for pilot facility, shared post-docs, RCP, TPD, and Fellows' instruments.

Interaction with SciLifeLab and the Wider Research Community

Being part of the stimulating research environment at SciLifeLab and having access to its state-of-the art research infrastructure have been other main drivers for the SciLifeLab Fellows for wanting to join the program (*Figure* 29). They find that they have a good compatibility with the SciLifeLab infrastructure (*Figure 32a*), 80% of the SciLifeLab Fellows use the services provided, and more than 40% of them have engaged with an infrastructure facility in technology development, research collaborations projects (e.g., joint grant applications), and as participants in creating a facility service (*Figure 32b*).

The SciLifeLab Fellows are also actively collaborating with other parts of SciLifeLab and the wider research community. 80% of SciLifeLab Fellows have established bi-lateral extensive research collaborations, or consortia that are significant for their own work since becoming a SciLifeLab Fellow (*Figure* 33). In addition to scientific collaborations, the Fellows have also actively engaged in their own host university community, foremost by developing and sharing new techniques, but also by increasing the quality of teaching (*Figure* 34).

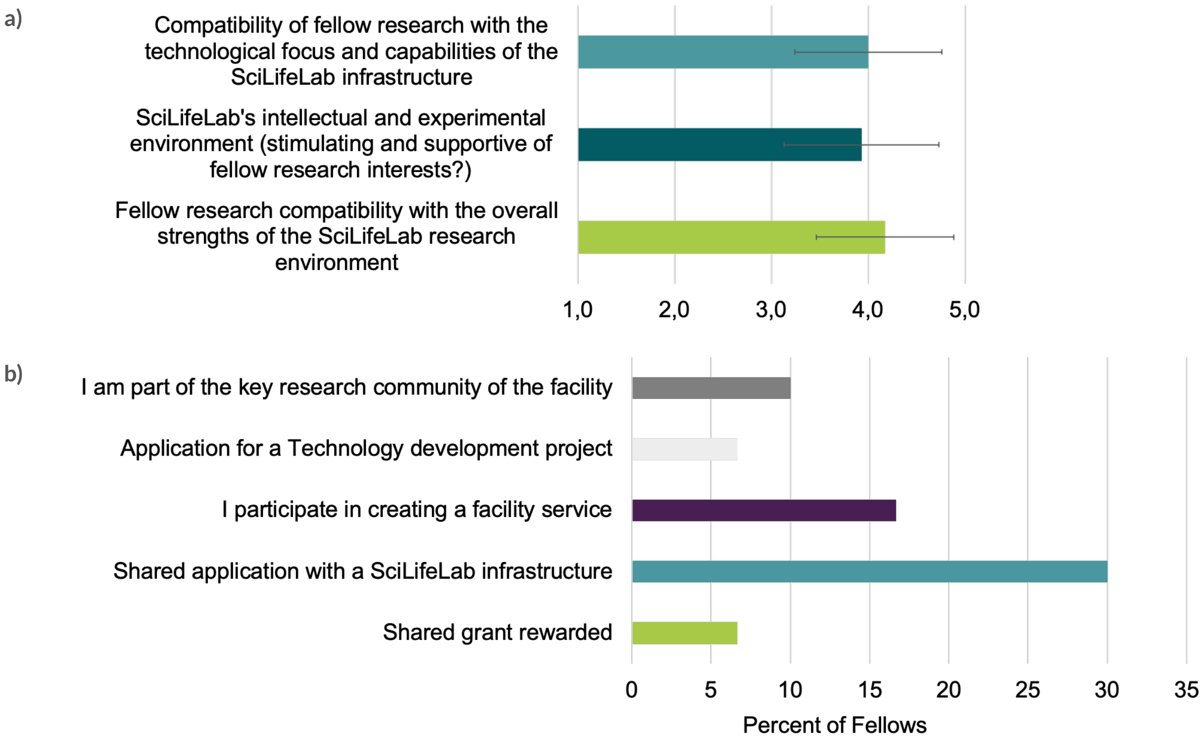


Figure 32. Fellows' interaction with SciLifeLab's infrastructure and research community. a) How Fellows rate their compatibility with SciLifeLab (scale 1–5: Compatibility poor – excellent fit; Intellectual and experimental environment insufficient – highly stimulating; Fellow research compatibility poor fit – excellent fit). b) Activities Fellows have engaged with in collaboration with SciLifeLab's infrastructure.

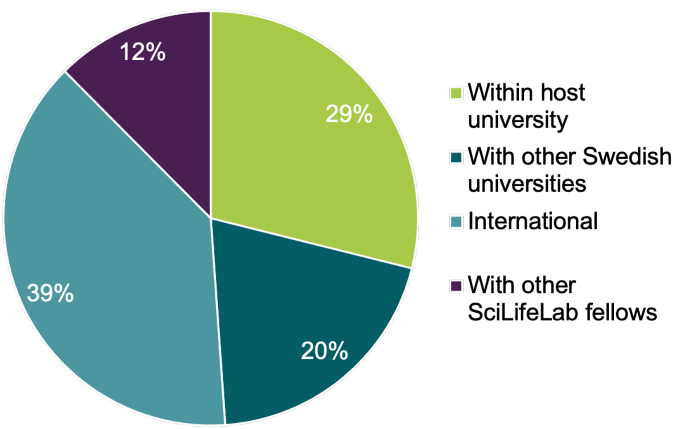


Figure 33. Nature of Fellows' collaborations with high significance for their own work (n = 225). Fellows are actively collaborating with partners at SciLifeLab, host university and the wider research community.

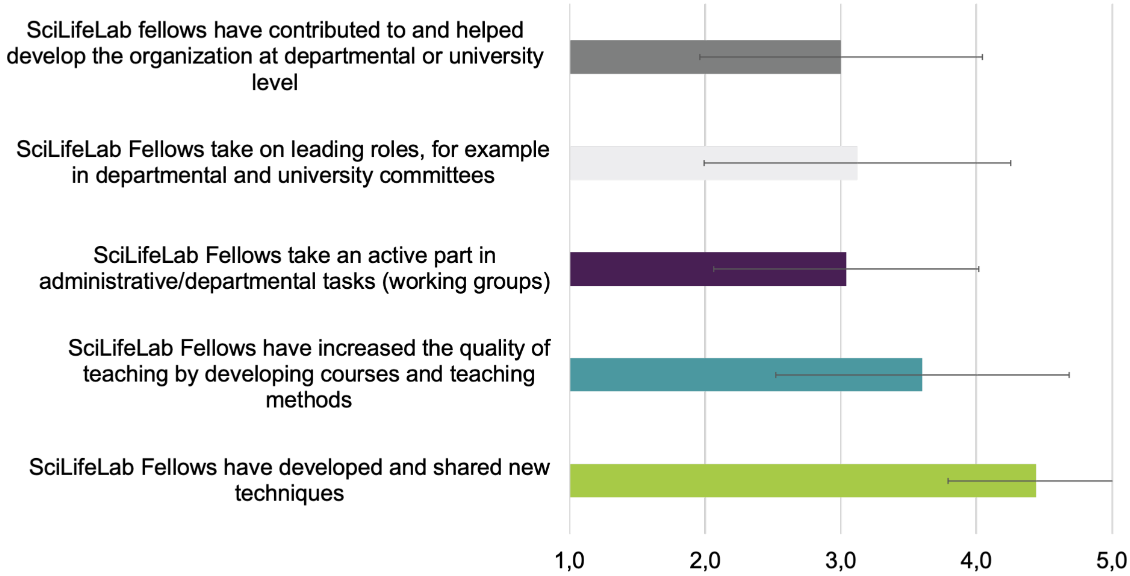


Figure 34. Contributions of the SciLifeLab Fellows to the intellectual environment at the hosting university (scale 1–5, Strongly disagree – strongly agree), as reported by the host university representatives.

Impact and Output of Fellows Research

SciLifeLab Fellows' scientific output and impact were analyzed with bibliometric methods and the results indicate that the program maintains the high scientific quality and impact that it aims for, with a high proportion of Fellow publications published in journals with high impact factor (JIF) scores (*Figure* 35).

The high impact of the publications from the Fellows is further verified by the increasing number of citations with 7,615 citations in 2020 for publications co-authored by SciLifeLab Fellows (*Figure* 36).

In 2018, 22.5% of the publications from SciLifeLab Fellows were among the 10% top cited across all fields (*Figure* 23 in *Appendix* L). Bibliometric analysis based on co-authorship analysis of Fellows' publications indicate a broad international network from this community, and in particular highlights strong interactions between the Swedish universities that are hosts for SciLifeLab Fellows (*Figure* 24 in *Appendix* L).

From the **infrastructure perspective**, the most advantageous aspects of working in a research environment with a SciLifeLab Fellows program are (based on free text):

- Inflow of **scientifically interesting projects** brought to the facility, which encourages staff to be at the forefront of what is happening in the field
- Development of **new capacities and technologies** within the facility, and the **inspiration** and motivation this brings
- The driving force of young PIs, ability to co-develop methods and apply for shared grants, and provide service with higher chances of publishing the results
- That SciLifeLab Fellows and their PhD students and postdocs provide a **bridge between SciLifeLab and the surrounding academic environment**

From the **host university perspective**, the major advantages associated with the SciLifeLab Fellows program are (based on free text):

- Recruitment of **excellent researchers**
- Build, renewal, and expansion of a s**trong research community**
- **Strong links** to SciLifeLab, within and between universities, both nationally and abroad

Through the survey we also received input on how the program can be further developed. Some of the main points:

- Communication between SciLifeLab, the host universities and the SciLifeLab Fellows needs improving. This request has at least partly been addressed through the implementation of the "Introduction and integration document", which clearly outlines the responsibility of each part, and by having follow-up meetings with the SciLifeLab Fellow, SD, CS Director and the Head of department
- Better aligned recruitments between the host universities with same rules for all positions and announcements in broad research areas
- A better introduction to the SciLifeLab infrastructure is needed, with structured contact and more opportunities for interactions
- 28% of the SciLifeLab Fellows state that they have not been offered sufficient amount of teaching at their host university to qualify for promotion

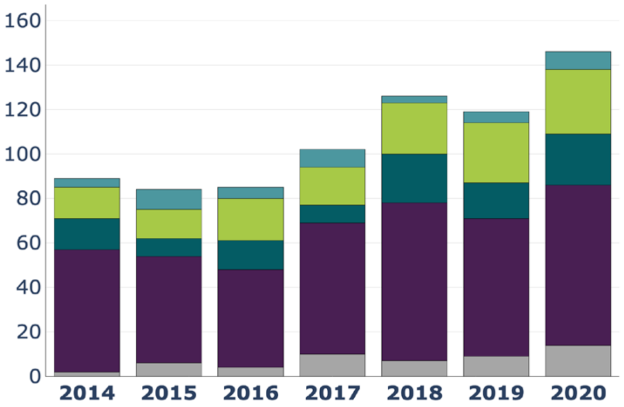


Figure 35. Number of scientific publications produced by Fellows annually, with Journal Impact Factor (JIF) distribution: JIF > 25 (blue), JIF 9–25 (light green), JIF 6–9 (dark green), JIF < 6 (purple), JIF unknown (grey).

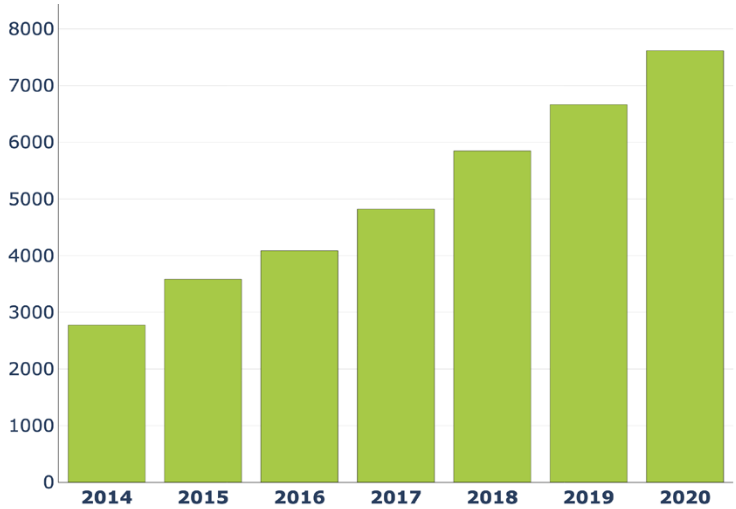


Figure 36. Number of citations received in each year for publications by Fellows.

- The program should include better mentorship, more networking activities, and more information regarding funding in Sweden
- It is important to continuously consider technology focus when recruiting

Future Plans for the SciLifeLab Fellow Program

- **New Fellow recruitments.** The continuation of the SciLifeLab Fellows program is dependent on SFO funding or a similar funding model from the Swedish government to the founding universities. Uppsala University has recently recruited three new SciLifeLab Fellows, and Karolinska Institutet is also underway to recruit a new Fellow (*Table* 5). Stockholm university and KTH are likely to announce new positions in 2022, and Uppsala University is intending to also announce two further positions in 2022. Thus, the program seems to continue at each of the four universities.
- **Follow-up on recommendations from the survey.** SciLifeLab will use this feedback to develop the program, such as launch additional networking activities within the program, but also with the infrastructure and the wider SciLifeLab community. SciLifeLab will also work to further develop and formalize mentorship in addition to mentoring and support by the founding university SDs, as also previously suggested by the IAB.
- **Establish a SciLifeLab postdoc training program.** Initiated by SciLifeLab Fellows, plans are underway to submit an application for funding of a postdoc training program through the Marie Skłodowska-Curie Actions (MSCA) COFUND call.
- **Connect the SciLifeLab Fellows program with the SciLifeLab & Wallenberg National Program for Data-Driven Life Science (DDLS).** Discussions are underway on how to in the best way connect the SciLifeLab and DDLS Fellow programs, as well as the NMMP network to the benefit from each and to create maximum synergies.

9. Scientific Output and Impact 2019-2021

This section describes SciLifeLab's scientific output and impact based on qualitative and quantitative bibliometric analysis. Additional data and analyses can be found in Appendix M.

▶ 9.1 Publication Tracking at SciLifeLab

SciLifeLab tracks publications from the following categories:

i. **Infrastructure** units report publications resulting from their service projects to external users and internal technology development. Publications can be labelled as **service projects** (infrastructure services mentioned in acknowledgement), **collaborative** (infrastructure staff as co-author), and **technology development** (resulting from the development of the unit's own services or technologies). Publications may be labelled by more than one infrastructure unit, and with more than one subcategory, but are counted only once when calculating impact. These publications can be found in the SciLifeLab Infrastructure Publication Data Base.

ii. **Affiliated researchers**, who are identified through reporting SciLifeLab as their address or affiliation in the publication record in Web of Science.

iii. **SciLifeLab Fellows**, which is a subset of the affiliated researchers. Publications co-authored by Fellows are automatically added to the database, then curated and labelled by the Fellows themselves, who can also add or remove records. The information is stored in the same database instance as affiliated researchers, but can be identified by the labels curated by the Fellows.

SciLifeLab also maintains other publication databases for specific purposes. For example, the COVID-19 research program collects reports about publications from the participating researchers in the program. Publications can appear in more than one database, such as publications resulting from affiliated researchers using infrastructure services. The Data Centre maintains and develops the publication databases and supports the reporting process. The dependence of self-reported data results in a fraction of papers that are incompletely reported or misclassified. For example, some users of infrastructure services may not report back publications to the infrastructure unit serving them, or otherwise not credit them. Also, affiliated researchers may publish only under their university affiliation, and leave SciLifeLab affiliation out, either by mistake or on purpose. Such errors cannot entirely be eliminated, but we continue to improve our systems, guidelines and support for reporting publications in order to minimize the errors.

Only publications identified or reported with a publication date prior to December 31, 2020, were included in this report. Impact calculations based on citations are in general reported for the period 2015–2018 which enables institution level impact comparisons with public data available at Leiden Ranking. In this report, we use PP(top 10%), the fraction of publications found among the top 10% most cited papers in the same field and for the same time period. Commonly, at least two years are required before citation data is considered stable and comparable for the purpose of citation-based impact scores.

Since the previous IAB report, work has progressed to improve the granularity by which publications can be tracked and analyzed. This will be enabled by the recent definition of SciLifeLab group leaders (and ORCIDs), which were not yet applied in these analyses. It has been a long process to establish this definition and process by the management and the universities, and this will enable future analyses on co-author level. We will require that affiliated researchers use ORCID in publications to facilitate publication tracking, and the Data Centre has developed the database system to handle author level identification and association to publications through ORCID. The Data Centre has also established a collaboration with the KTH library that includes access to raw bibliometric data, curated records, and support from staff bibliometricians. Therefore, the analyses in this report have been produced entirely within SciLifeLab, and we now have a stronger capability to assess bibliometric output dynamically. We are also evaluating new systems for altmetrics, which collects attention type impact (such as news, social media, etc.) for recent publications for which no robust citation data yet exists.

9.2 Scientific Output from Infrastructure Units and their Users

In 2019–2020, infrastructure units reported 1,218 publications resulting from their work, in level with the approximately 600 publications reported every year since 2016. 24% of these publications were among the top 10% most cited papers in the same field and time period (2015–2018).

The analysis and figures for publications from infrastructure units and their users is reported in *Section 7.4*, and in following sections, infrastructure publications are only analyzed when compared to other types of SciLifeLab publications.

9.3 Scientific Output from Affiliated Researchers

SciLifeLab affiliated researchers are identified by their reported affiliation or address, and publications are harvested from Web of Science. SciLifeLab Fellows curate their own records in this database, providing an identifiable subset with more accurate information. Below, when reporting data from affiliated researchers, data from SciLifeLab Fellows is included as part of it. More information about the output and impact of Fellows' publications can be found in *Section 8.2* and *Appendix L*.

We note that the group of affiliated researchers to a large extent is based in Uppsala and at Campus Solna. With the recently introduced group leader definition and the ability to trace individual co-authors (and thereby all their affiliations) we expect future analysis to provide even more detailed insights to the output and impact of publications from the research community. We require that SciLifeLab group leaders list their affiliation as both SciLifeLab and that of the host university, but we have seen that SciLifeLab affiliation is sometimes not used.

In 2019–2020, affiliated researchers published 1,629 papers, many in journals with high impact journals (*Figure 37*). Similar to the infrastructure publications reported in *Section 7.4*, the number of publications has remained relatively consistent since 2016, at around 800 papers each year. The number of citations received in recent years has increased sharply (*Figure 38*) with 39,630 citations obtained in the year 2020.

The impact of the publications from affiliated researchers is also high, with 22% of the 3,107 papers published in 2015–2018 belonging to the top 10% most cited.

In 2019–2020, SciLifeLab Fellows published 265 papers of which 69 were in journals with impact factor (JIF) over 9. PP(top 10%) impact score for Fellows in 2015–2018 was 22%, at the same high level as the overall group of affiliated researchers.

To study the impact of publications across the main fields where SciLifeLab operates, we categorized publications in scientific fields, and assessed field-normalized impact scores for these. Six categories dominate the publication landscape of both infrastructure and affiliated researchers: biochemistry and molecular biology, cell biology, genetics and heredity, biochemical research methods, biotechnology and applied microbiology, and oncology. We estimate impact scores of these subcategories only, as the larger number of publications makes these data more reliable (*Figure 39*).

SciLifeLab affiliated researchers obviously produced a relatively small fraction of the papers published by all Swedish researchers in 2015–2018, even in the six fields

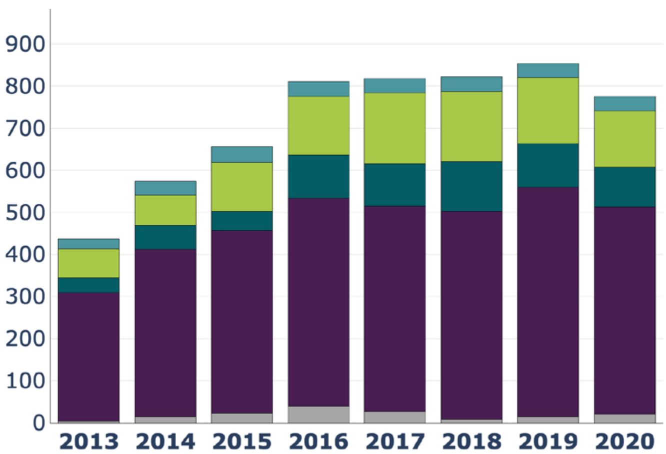


Figure 37. Number of publications produced by affiliated researchers annually, with Journal Impact Factor (JIF) distribution: JIF > 25 (blue), JIF 9–25 (light green), JIF 6–9 (dark green), JIF < 6 (purple), JIF unknown (grey).

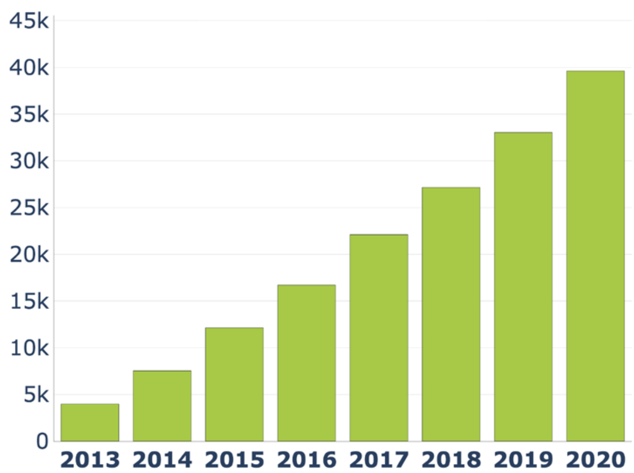


Figure 38. Number of citations received in each year for publications by affiliated researchers.

where SciLifeLab publishes most frequently. For example, affiliated researchers produced 10.4% of the biochemistry and molecular biology publications of all Swedish organizations. However, papers from SciLifeLab affiliated scientists outperform the impact of Swedish universities, as measured by the percentage of papers in the top 10% most cited (PP(top 10%)) (*Figure* 39). For example, in the biochemical research methods, the PP(top 10%) for all papers from Swedish organizations is 12.8%, but it is 20.8% for SciLifeLab affiliated researchers. In field-specific analysis, SciLifeLab associated papers score particularly strongly. For example, in genetics and heredity, affiliated researchers produced papers where approximately 30% of the published papers are in the top 10% most cited, whereas for all Swedish publications, this figure is nearly 20%, in itself a strong indicator of the Swedish scientists in this field.

We used word clouds based on publication titles to visualize the diversity in publication topics from the affiliated researchers, and compared these between infrastructure and the Fellows (*Figures* 40*a–c*). This visually demonstrates the similarity between publication topics in the three groups.

COVID-19 papers were not yet prominent at the end of 2020 when the data was collected. As the Data Centre also collects and curates COVID-19 related publications with Swedish co-authors as part of their work with the national COVID-19 data portal, we do see a very strong output because of the pandemic. These publications can be found in a dedicated database, which holds 1,760 papers as of August 30, 2021. This database collects all papers on COVID-19, not just those arising from SciLifeLab affiliated scientists or users of SciLifeLab infrastructure.

In conclusion, the bibliometric analysis indicates that the SciLifeLab research environment (mostly at the four founding universities) gives rise to a consistent number of publications each year, attracting increasing number of citations, and with long-term citation-based impact scores that are considerably stronger than average values for Swedish universities in the same fields.

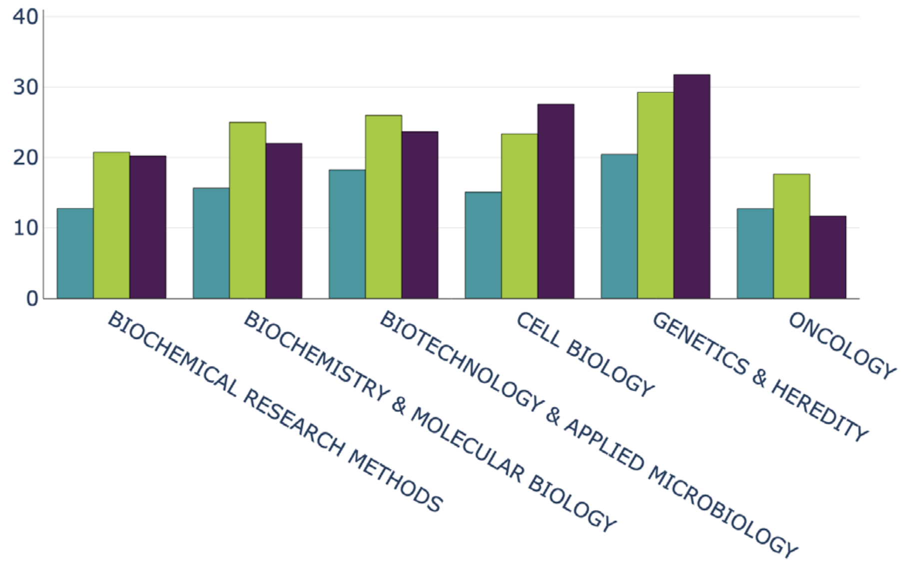


Figure 39. Percentage of papers in the top 10% of most highly cited publications (PP(top 10%) score) for all Swedish research institutes (blue), affiliated researchers (green) and infrastructure users (purple), and in the six subject categories in which SciLifeLab publishes most frequently. All scores are for papers published in 2015–2018.

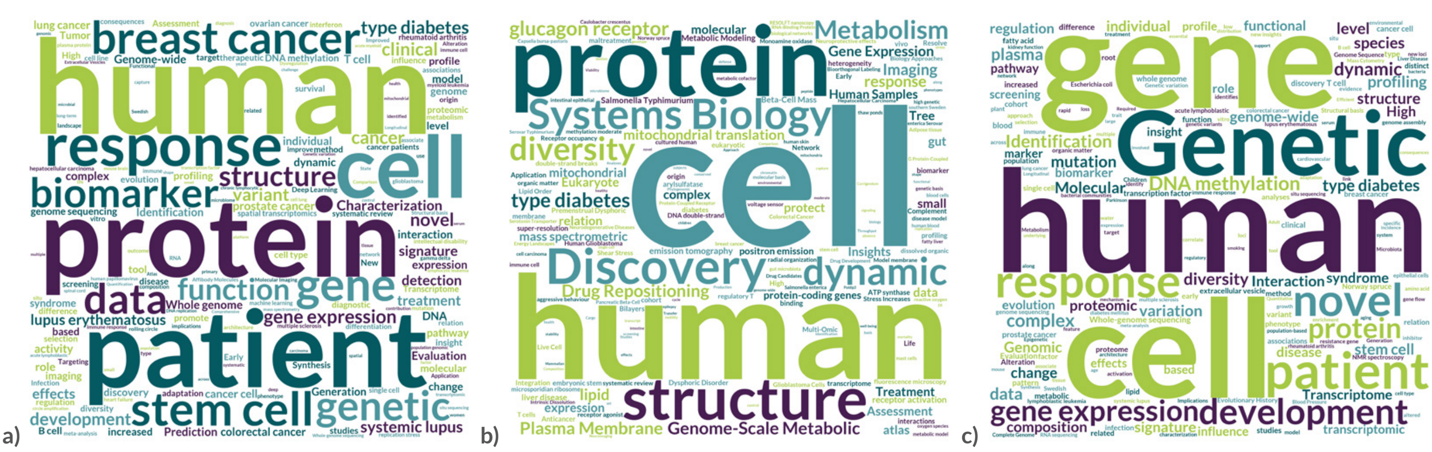


Figure 40. Word clouds generated using the titles of papers published in 2019–2020. a) Affiliated researchers, b) Fellows, and c) Infrastructure supported projects. Note how the "protein" keyword is very prominent for affiliated researchers and for Fellows, while infrastructure users publish more on "gene" and "genetic".

▶ 9.4 National and International Collaborations of Affiliated Researchers

Affiliations of co-authors of publications with SciLifeLab affiliated researchers indicates a wide network of national and international collaborations (*Figure 41a*). Strong interactions with SciLifeLab founding universities are particularly evident, as are high impact links with other national (e.g., Lund University and Umeå University) (*Figure 41b*) and international (e.g., Harvard, Stanford and MIT) parties.

Deeper network analyses will be possible with the new group leader assignments, allowing tracking in a better way that is also now supported in the SciLifeLab Publication Database, and will be part of future reports.

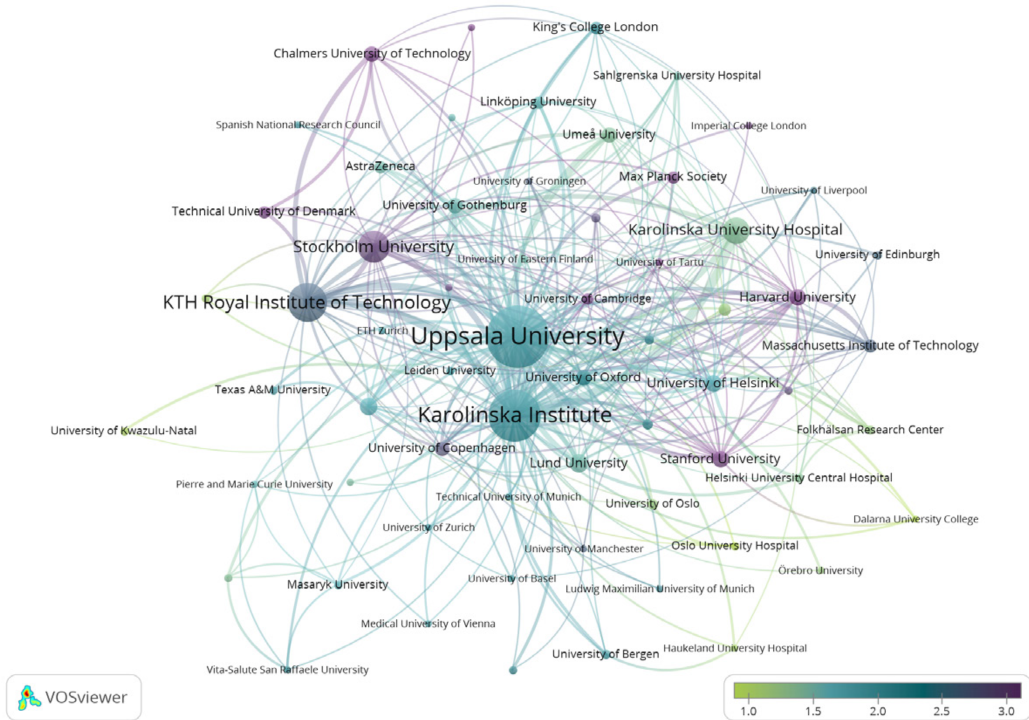


Figure 41a. Co-publication plot of publications 2015–2018 by SciLifeLab affiliated researchers involving both international and national collaborators. The size of the 'bubble' for an institute indicates the number of co-publications, with larger bubbles indicating more co-publications. Institutes are colored by mean normalized citation (MNCS) score, as defined in legend.

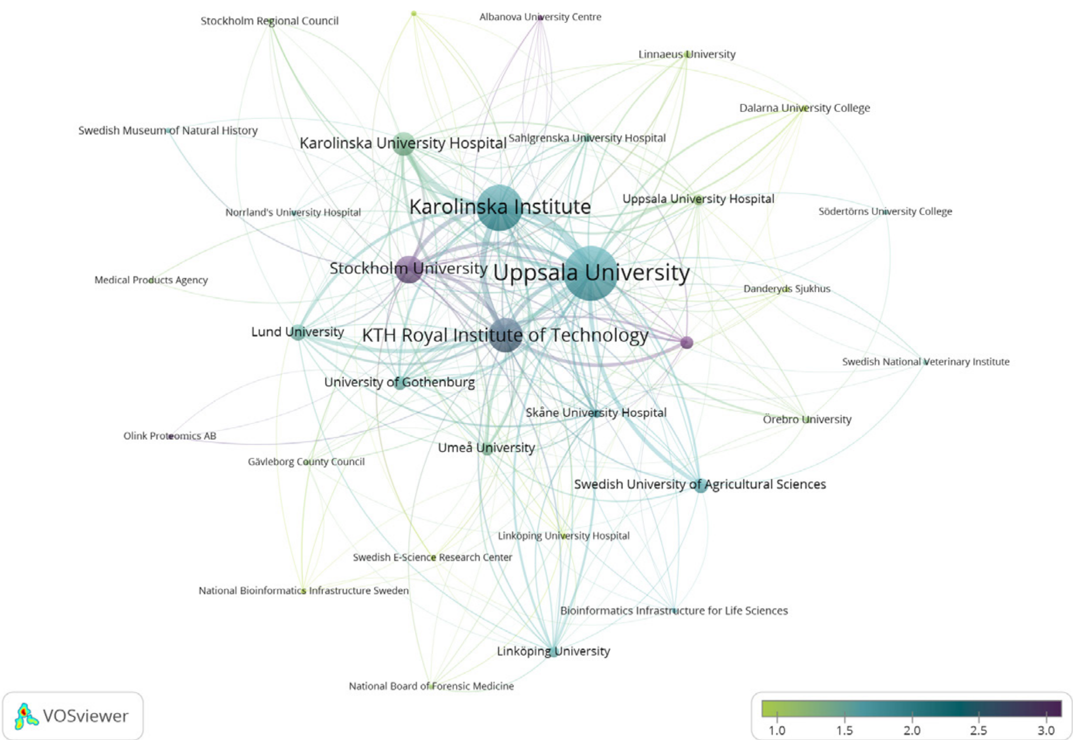


Figure 41b. Co-publication plot of publications 2015–2018 by SciLifeLab affiliated researchers involving only national collaborators. The size of the 'bubble' for an institute indicates the number of co-publications, with larger bubbles indicating more co-publications. Institutes are colored by mean normalized citation (MNCS) score, as defined in legend.

9.5 Interaction Between Infrastructure and Research

In 2019–2020, infrastructure projects resulted in 1,218 publications, and affiliated researchers (including Fellows) published 1,629 papers. From all these, an intersection of 463 publications were reported by the infrastructure and had SciLifeLab affiliated co-authors, representing 38% and 28% of each group, respectively. 755 papers utilized SciLifeLab infrastructure and had no SciLifeLab affiliated co-authors; 1,166 papers (72%) of the publications from affiliated researchers did not involve infrastructure units (*Figure* 42).

It is important to note that the group of affiliated researchers includes infrastructure PIs and staff at host universities, but publications that involve these in their infrastructure capacity are also expected to be reported as infrastructure papers and thus belonging *only* to the intersection of the two sets, except for cases of misreporting. The three groups of the Venn diagram in *Figure* 42 present different observations and conclusions.

Firstly, the 755 papers from infrastructure not involving co-authors affiliated to SciLifeLab are mainly service projects with users elsewhere in Sweden. This group represents 62% of all infrastructure reported papers, a sizeable fraction of infrastructure work towards the bigger life science community even when taking into account that a small number of SciLifeLab based researchers may sometimes publish without listing their SciLifeLab affiliation. This distribution is in line with the reported distribution of the home organizations of infrastructure users, approximately half representing the four founding universities and half other universities. In 2015–2018, the impact of this group was PP(top 10%) = 22%, and corresponding numbers for the three subcategories were for service projects 23%, collaborative projects 16% and technology development 27%.

The 1,166 papers from SciLifeLab affiliated researchers not served by the infrastructure is also quite sizeable, which prompts the question why only 28% of SciLifeLab research publications are supported by SciLifeLab infrastructure. However, this still represents a five-fold enrichment compared to the overlap expected based on all Swedish publications during 2015–2018 (data not shown). Thus, the interaction between the SciLifeLab research environment and its infrastructure units is much stronger than could be expected by random, but it also suggests that the entire group of affiliated researchers are not intense infrastructure users, at least not in all their research efforts. For this group, PP(top 10%) for 2015–2018 was 20%.

The third group, the 463 papers in the intersection, reported by infrastructure units and also with SciLifeLab affiliated co-authors, are also labelled as service projects, collaborative or technology development (see *Section* 7.4). Nearly a quarter of these publications involve more than one infrastructure unit in different roles, and half of them are service projects. 35 publications are labelled only as technology development (7.6%), and 21 more technology development projects have also other infrastructure units involved in other roles (*Figure* 43). This intersection therefore also includes service projects to "local scientists", i.e., SciLifeLab affiliated researchers at host universities. In contrast, service projects towards the broader life science community are found in the "infrastructure only" group (n = 755) of the Venn diagram.

In 2015–2018, the impact of this group was PP(top 10%) = 26%, and corresponding numbers for the three subcategories were for service projects 28%, collaborative

Figure 42. Venn diagram of publications by infrastructure users and affiliated researchers published 2019–2020. Papers from infrastructure users only (green), affiliated researchers only (blue), and papers reported by infrastructure units with SciLifeLab affiliated co-authors in the intersection (purple). The PP(top 10%) in 2015–2018 of these three groups were: Infrastructure users only (22%), affiliated users only (20%) and intersection (26%).

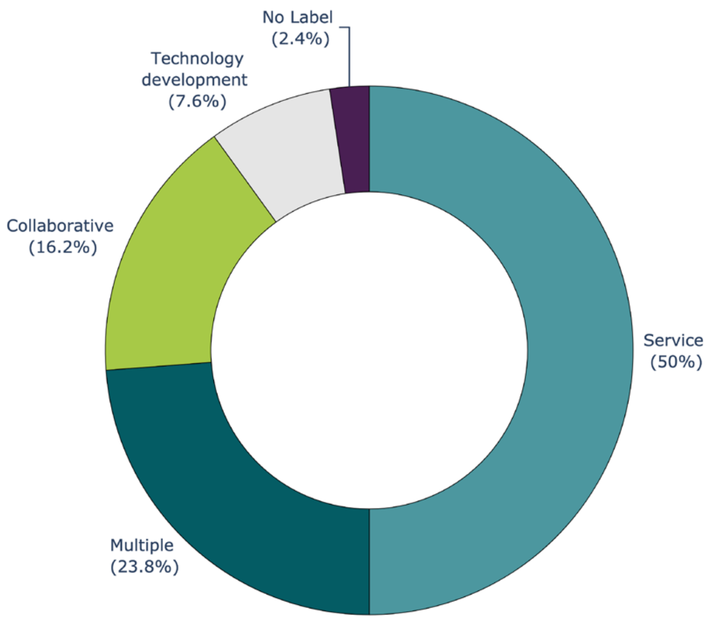


Figure 43. Out of the 463 publications reported by infrastructure units and also with SciLifeLab affiliated co-authors, half have been labelled as service projects only by infrastructure units, and nearly a quarter have been reported by multiple infrastructure units in different roles.

projects 20% and technology development 24%. We observe an increase in impact for service projects and collaborative projects involving SciLifeLab community when we compare with support for the first group (infrastructure only, see above). 18 publications from technology development project have no SciLifeLab co-authors, so these are primarily technology development projects from non-host university infrastructure units.

9.6 Highlights and Summary

In *Table* 6, we present a few selected highlights of publications produced by affiliated researchers (including Fellows), or resulting from projects funded by SciLifeLab and infrastructure users 2019–2021. These papers cover a range of topics and are published in a wide variety of high impact journals. Of especially high significance was the nomination of Spatially Resolved Transcriptomics as the method of the year in 2020 by Nature Methods, developed at SciLifeLab (see *Section* 7.8). A few examples of the important contribution that SciLifeLab has made to efforts related to combating the COVID-19 pandemic are highlighted in *Section* 6.8.

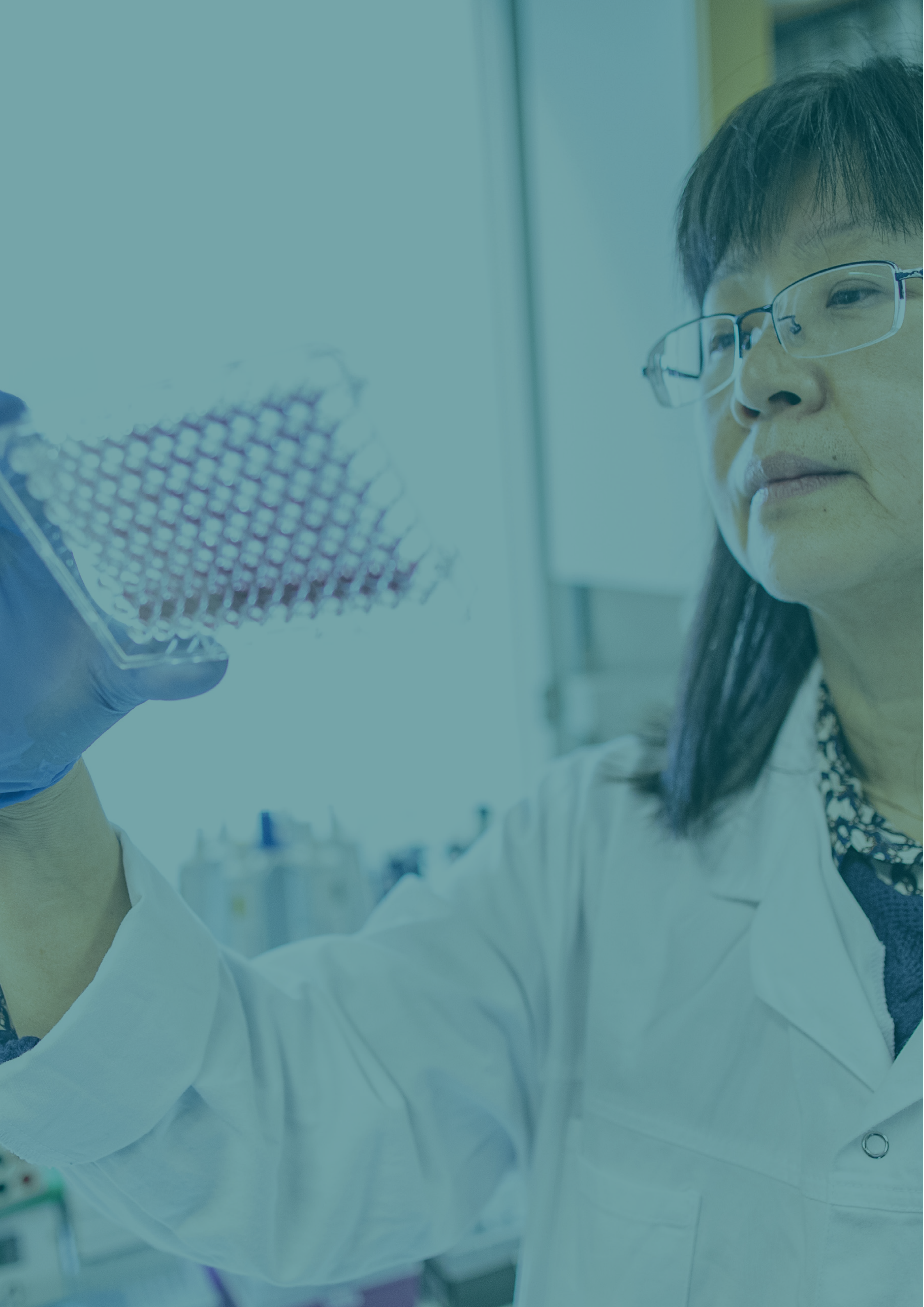
In summary, our analysis indicates that SciLifeLab continues to produce very high impact publications both from the infrastructure and the affiliated researchers, and we observe that the trend of citations received each year is steeply increasing. The scientific areas covered are diverse but with particular strength in the fields of biochemistry, genetics, proteomics and biomedical life sciences, where the impact is considerably stronger both for the affiliated researchers and infrastructure users. The volume of publications represents approximately 10–15% of all Swedish publications in these fields. Therefore, our conclusion is that SciLifeLab contributes to a relatively small, but impactful, fraction of Swedish research outcome each year. The intersection between affiliated researchers supported by infrastructure platforms shows a slightly increased impact for service projects and collaborative projects. It should also be noted that citation statistics lag behind the raw output statistics, and that they are highly sensitive to annotation such as the group leader affiliation and the proper annotation of infrastructure users' publications.

Since the last visit by the IAB, much effort has gone into securing the data sources, collaborations and dedicated staff to enable Data Centre to work dynamically with bibliometric data and with a wider range of analyses. One of the main improvements is the recent decision to define and assign group leaders, and strengthening requirements on reporting and acknowledgements. This will help SciLifeLab to become a more data-driven organization.

Table 6. Selected high-level SciLifeLab publications 2019–2021. R: Publication from SciLifeLab-affiliated researcher, F: Publication from SciLifeLab Fellow, I: Publication where SciLifeLab infrastructure services have been used.

I, R	The repertoire of maternal anti-viral antibodies in human newborns **Pou C, Nkulikiyimfura D,** Henckel E, **Olin A, Lakshmikanth T, Mikes J, Wang J, Chen Y, Bernhardsson AK,** Gustafsson A, Bohlin K, **Brodin P.** *In this study, the high-capacity phage-display method VirScan was used to globally profile all maternal antiviral IgG in term and preterm newborns. The results show that differences between these groups were much smaller than previously believed and that a lack of maternal antibodies cannot explain the increased susceptibility to viral infections in preterm infants.* Nat Med. 2019 March; 25: 591–596
I, F, R	A spatiotemporal organ-wide gene expression and cell atlas of the developing human heart **Asp M, Giacomello S, Larsson L, Wu C,** Fürth D, **Qian X,** Wärdell E, **Custodio J, Reimegård J,** Salmén F, Österholm C, **Ståhl PL,** Sundström E, Åkesson E, Bergmann O, **Bienko M,** Månsson-Broberg A, **Nilsson M,** Sylvén C, **Lundeberg J.** *This study revealed the transcriptional landscape of the human embryonic heart at three developmental stages, and mapped cell type-specific gene expression to specific anatomical domains.* Cell. 2019 Dec; 179: 1647–1660
I, R	Discovery of novel sequences in 1,000 swedish genomes **Eisfeldt J, Martensson G, Ameur A, Nilsson D,** Lindstrand A. *Novel sequences (NS) are DNA sequences not present in the reference genome. In this study the researchers identifed 46 million base-pairs of NS in 1000 Swedish individuals. The majority of NS were present in Chimpanzee and a Pan-African genome, indicating that a wealth of ancient DNA is missing from the human reference genome.* Mol Biol and Evol. 2020 Jan; 37: 18–30
F	The molecular basis for sugar import in malaria parasites Qureshi AA, Suades A, Matsuoka R, Brock J, **McComas SE,** Nji E, Orellana L, Claesson M, **Delemotte L,** Drew D. *The sugar transporter of the malaria parasite has the evolutionary advantageous ability to transport various simple sugars. Probing its structure and dynamics has revealed that, counterintuitively, this promiscuity comes not from the sugar binding site itself, but from a distal region that is involved in structural changes necessary for sugar import. This opens new avenues for the design of drugs to treat malaria.* Nature. 2020 Jan; 578: 321–325

I, R	[Artificial intelligence for diagnosis and grading of prostate cancer in biopsies: a population-based, diagnostic study] Ström P , Kartasalo K, Olsson H, Solorzano L, Delahunt B, Berney DM, Bostwick DG, Evans AJ, Grignon DJ, Humphrey PA, Iczkowski KA, Kench JG, Kristiansen G, van der Kwast TH, Leite KRM, McKenney JK, Oxley J, Pan CC, Samaratunga H, Srigley JR, Takahashi H, Tsuzuki T, Varma M, Zhou M, Lindberg J, **Lindskog C,** Rusuvuori P, **Wählby C,** Grönberg H, Rantalainen M, Egevad L, Eklund M. *Cancer diagnosis based on microscopy images of biopsies is critical for the clinical management of men with prostate cancer. Visual assessment is difficult and tedious, and grading variability can lead to under- and over treatment. The researchers trained an AI system to assist cancer grading, resulting in detection and grading comparable to that of international experts in prostate pathology.* Lancet Oncology. 2020 Feb; 21: 222-232
F, R	[DNA surface exploration and operator bypassing during target search] **Marklund E, van Oosten B, Mao G, Amselem E, Kipper K, Sabantsev A, Emmerich A, Globisch D, Zheng X, Lehmann LC, Berg OG, Johansson M, Elf J, Deindl S.** *Life depends on an intricate game of hide-and-seek taking place inside the cell. This study sheds light on the mechanisms with which DNA-binding proteins search the genome for their specific binding sites.* Nature. 2020 Jul; 583(7818): 858-861
I, R	[Distinct oligodendrocyte populations have spatial preference and different responses to spinal cord injury] Floriddia EM, Lourenço T, Zhang S, van Bruggen D, **Hilscher MM,** Kukanja P, Gonçalves dos Santos JP, Altınkök M, **Yokota C,** Llorens-Bobadilla E, Mulinyawe SB, Grãos M, Sun LO, Frisén J, **Nilsson M,** Castelo-Branco G. *Mature oligodendrocytes show transcriptional heterogeneity, the functional consequences of which are unclear. Here, distinct oligodendrocytes populations were shown to have spatial preference in the mammalian central nervous system, by using technologies as In Situ Sequencing. These populations also presented different susceptibility to spinal cord injury, demonstrating different responses to disease.* Nat Commun. 2020 Nov; 11(5860)
F	[Error correction enables use of Oxford Nanopore technology for reference-free transcriptome analysis] **Sahlin K,** Medvedev P. *Oxford nanopore technologies is a company that produces DNA and RNA sequencing data, which is used to study the genomes and transcriptomes of organisms. The new approach published reduces the median error rate in ONT transcript sequencing data from 7 percent down to 1 percent.* Nat Commun. 2021 Jan; 12(2)
F, I, R	[Spatiotemporal dissection of the cell cycle with single-cell proteogenomics] **Mahdessian D, Cesnik AJ, Gnann C, Danielsson F, Stenström , Arif M, Zhang C, Le T, Johansson F, Shutten R, Bäckström A, Axelsson A, Thul P,** Cho NH, Carja O, **Uhlén M, Mardinoglu A, Stadler C,** Lindskog C, **Ayoglu B,** Leonetti MD, Pontén F, **Sullivan DP, Lundberg E.** *In this study, trajectories of RNA and proteins in single cells as they progress through the cell cycle are described and the reserachers could identify over 300 new cell cycle proteins. These can be important for controlling cell growth, and have implications in a variety of diseases.* Nature. 2021 Feb; 590: 649–654
F	[Mechanism of membrane-tethered mitochondrial protein synthesis] **Itoh Y, Andréll J,** Choi A, Richter U, Maiti P, Best RB, Barrientos A, Battersby BJ, **Amunts A.** *The bioenergetic role of mitochondria is facilitated by synthesis of membrane proteins by mitoribosomes. This study determined structures of human mitoribosome during nascent chain synthesis, while bound to its membrane insertase. It revealed a mechanism of conformational changes within the exit tunnel, which offers a molecular insight into mitochondrial translation.* Science. 2021 Feb; 371(6531): 846-849
I, R	[Million-year-old DNA sheds light on the genomic history of mammoths] **van der Valk T,** Pečnerová P, Díez-del-Molino D, Bergström A, Oppenheimer J, Hartmann S, Xenikoudakis G, Thomas JA, Dehasque M, Sağlıcan E, Rabia Fidan F, Barnes I, Liu S, Somel M, Heintzman PD, Nikolskiy P, Shapiro B, Skoglund P, Hofreiter M, Lister AM, **Götherström A,** Dalén L. *In this study, genomes from mammoths that lived 1.2–0.7 million years ago were sequenced. This is the oldest DNA ever recovered. The analyses allowed the researchers to identify a previously unknown mammoth lineage, discover past hybridization events, and to estimate the rate of adaptive evolution through time.* Nature. 2021 Feb; 591: 265–269
I, R	[Bifidobacteria-mediated immune system imprinting early in life] Henrick BM, **Rodriguez L, Lakshmikanth T, Pou C, Henckel E, Arzoomand A, Olin A, Wang J, Mikes J, Tan Z, Chen Y,** Ehrlich AM, **Bernhardsson AK, Mugabo CH,** Ambrosiani Y, Gustafsson A, Chew S, Brown HK, Prambs J, Bohlin K, Mitchell RD, Underwood MA, Smilowitz JT, German, JB, Frese SA, **Brodin P.** *The study shows the dynamic changes that occur in the newborn immune system after birth in response to novel microbial encounters and in response to variable bacterial colonization, and is the first to report a successful modulation of the gut microbiome leading to a modulation of the immune system in vivo in human subjects.* Cell. 2021 July; 184(15): 3884-3898



10. Impact and Importance of SFO Funding for SciLifeLab

In this section we aim to highlight activities enabled through SciLifeLab's strategic research funding to the founding universities.

The strategic research area funding, SFO, allocated by the government to each of the four SciLifeLab founding universities, has been used to build the local SciLifeLab research environment. In 2021, SciLifeLab's SFO funding (165 MSEK) was allocated as following: 115 MSEK split in thirds between KTH, SU and KI, and 49 MSEK to UU. The funding has been used for independent initiatives at each university, but has also prompted joint events across faculty and university borders as well as links to the wider research community and the national infrastructure.

In Stockholm, the Campus Solna community is a notable example of the collaborative impact of the SFO funding across Stockholm universities, and this collaboration is described in more detailed in *Section* 6.3. One of the major investments for each of the four universities is the highly successful SciLifeLab Fellows program, which as a whole is described more in *Section* 8.2. Several other activities have also been supported by SFO funds, such as technology development projects (TDPs), the research community programs (RCPs), postdoc programs, and research community activities. All these efforts contribute to the strengthening of the SciLifeLab community, which today engages almost 200 SciLifeLab group leaders (106 groups at Campus Solna (32 KI; 47 KTH; 27 SU), and 83 groups in Uppsala) and beyond (the group leader definition is being expanded to universities outside of Stockholm and Uppsala). KTH, KI and SU jointly run the master program linked to SciLifeLab, Molecular Techniques in Life Sciences, with support from the SFO.

Overall, the continuation of the SFO funding, in one format or another, is crucial towards the future profile of SciLifeLab research. We are optimistic on the future, both short-term and long-term, and the founding universities have expressed their strong support to this program.

In the sections below, some of these activities at KTH, KI, SU and UU, funded specifically by the SFO support during 2019–2021 are highlighted. Note that the major contributions of these universities to the national infrastructure, beyond the use of their own SFO funding, are not described here. The sections are written by the SDs, IDs and the SciLifeLab committees at each university and hence reflect also on how the universities view SciLifeLab.

KTH Royal Institute of Technology

The development of SciLifeLab and Campus Solna as a site for research and development in the broader context of biomolecular sciences is of strategic importance to KTH. Research performed at SciLifeLab, enabled by the national infrastructure, stimulates development of new life science technology at KTH. The SFO funding is of highest importance for future KTH activities at SciLifeLab. This funding makes it possible to support a development of new technology and to form a strong research community that is prepared to address unknown and unexpected future challenges. An important concept for all KTH researchers at SciLifeLab, is that their research shall support and strengthen the infrastructure. All KTH research groups at SciLifeLab are, directly or indirectly, involved in development of technology and competence. This is essential for the infrastructure's capacity to deliver highest quality service to the research community.

Major Initiatives Enabled by SciLifeLab SFO funding 2019–2021

- Recruitment of Tuuli Lappalainen from the New York Genome Center as Director for NGI and professor at KTH. This recruitment was made possible by startup funding from KTH SFO funds.
- SciLifeLab Fellows program recruitment of two new Fellows, whom both started in 2020. Anniina Vihervaara in molecular genomics, recruited from the Åbo Akademi/Cornell University, and Saeed Shoaie in systems biology, recruited from Kings College London.
- KTH SFO funds have in addition to faculty support, been used for postdoc calls and for equipment grants. These grants have focused on research of relevance for future development of the infrastructure, not necessarily existing technologies but rather focusing on exploratory research and proof-of-concept ideas.

Future Plans and Strategies

The future direction for use of KTH SFO funds is to focus the resources on research and development of next generation technologies within life sciences. SciLifeLab infrastructures need to continuously develop and evolve to stay at the scientific forefront. KTH SFO funding that contribute to this development is thus of high strategic importance.

Karolinska Institutet

In summary, SFO funding has enabled the KI contribution to technology and data-driven life science at SciLifeLab mainly through the SciLifeLab Fellows program, but also by engaging the research faculty in training, technology and application development, especially in the area of precision medicine.

Major Initiatives Enabled by SciLifeLab SFO funding 2019–2021

- Recruitment of two new SciLifeLab Fellows: Erdinc Sezgin, recruited from University of Oxford, UK, focusing on physicochemical principles of cellular processes using advanced imaging and developing biomimetic systems, and Jean Hausser, recruited from Weizmann Institute of Science, Israel, focusing on data and experimental cancer evolution and quantitative tumor biology.
- Infrastructure/technology development: Several technology development projects (TDPs) co-funded with SFO have been connecting KI research teams with SciLifeLab infrastructure, catalyzing development of future cutting edge services on topics. In addition, multiple collaborations between research faculty and platforms have led to technology and application development in several areas such as: Advanced Light Microscopy, methods in translational control, chemical proteomics, and Proteogenomics.
- During the past year, KI and the Karolinska University Hospital (KS) have formed a precision medicine taskforce and have invited SciLifeLab as an integrated part of the working groups. The successful collaboration between SciLifeLab and KS within clinical genomics on rare diseases has broadened to other disease areas, and techniques such as proteomics, single cell analysis and functional drug testing of patient-derived cells. Also, a joint technology testbed between SciLifeLab and KS has been financed by Vinnova.
- Training: KI researchers have been engaged in multiple training initiatives, for example in super resolution microscopy, Cancer Research Summer School on precision medicine, Chemical Proteomics workshop series, MS proteomics and omics data analysis courses, and a Genomics for Biomedical Scientists course.

Future Plans and Strategies

The KI involvement at SciLifeLab aims to continue the close connection within pandemic research and the Pandemic Laboratory Preparedness program (see *Section* 7.7), as well as co-developing the Precision Medicine capability (see *Section* 7.6). In line with this, KI has announced SFO funded postdoc call for translational postdocs projects within both technology and clinical research. In the future, KI also aims to strengthen the DDLS connections with local initiatives.

Stockholm University

SFO funds were predominantly used to support and extend the ongoing SciLifeLab Fellows program and the infrastructure units.

Major Initiatives Enabled by SciLifeLab SFO funding 2019–2021

- Recruitment of three SciLifeLab Fellows: Iskra Pollak Dorocic, recruited from U. C. Berkeley focusing on serotonin and dopamine neuronal circuits and their impact on animal behavior. Sarahi Garcia, recruited from University of Wisconsin-Madison, a molecular ecologist focusing on microbial interactions in aquatic environments. Kristoffer Sahlin, recruited from Pennsylvania State University, focusing on the development of new algorithms for analysis of high-throughput genomics and transcriptomics data.
- Infrastructure/technology development: SU has focused on being a major force in computing science and bioinformatics linked both to infrastructure services and research projects. SU has supported its imaging infrastructure incorporated into the National Microscopy Infrastructure (NMI) as well as access for SU research groups to NGI, NBIS and Cryo-EM infrastructure units. In Structural Biology, SU has expanded the successful Cryo-EM unit with funding from KAW and SFO, and support has been given for developing new infrastructure services; e.g., an in situ-sequencing service within the Eukaryotic Single Cell Genomics unit, the candidate unit Exposomics within the Metabolomics platform, and the expansion of the DDD platform towards targeted protein degradation as a pharmacological principle. Moreover, the Cryo-EM unit and SU researchers have developed RELION and Scipion, new software for high-throughput image analysis and structure determination
- Funded research: SU researchers and SU-funded infrastructure units participated in the Human Cell Atlas and the Human Developmental Cell Atlas initiatives, co-funded with SFO. SU researchers at SciLifeLab with colleagues at UT Austin revealed how anesthetics and benzodiazepines act on human GABAA receptors. The SU computational biology groups at SciLifeLab developed a novel deep learning method for predicting protein-protein interactions, new

network inference algorithms and a comprehensive network database that allows network analysis of SARS-CoV-2. Research in archaeogenetics research described prehistorical migrations and elucidated evolutionary mechanisms and biodiversity based on ancient DNA sequencing.

- Training: SU established a two-year postdoctoral program facilitating collaborations between SU research groups and the SciLifeLab Infrastructure units.

Future Plans and Strategies

SU will maintain its strategic commitment to further develop new and existing SciLifeLab infrastructure, and plans to recruit new SciLifeLab Fellows. SU strongly supports the DDLS program with recruitments in the areas of Cell & molecular biology, Precision medicine as well as Biodiversity & evolution.

Uppsala University

Overall Impact of SciLifeLab at UU

At UU, SciLifeLab forms a platform for interdisciplinary collaboration, which in addition to delivering cutting-edge technology, forms an incubator for the development of advanced techniques. The SciLifeLab Fellows program enables UU to recruit top performing young PIs and can offer them outstanding starting conditions, as well as an excellent national network.

Major Initiatives Enabled by SciLifeLab SFO funding 2019–2021

- Recruitment of SciLifeLab Fellows: The majority of the SFO funds to SciLifeLab in Uppsala have been used to recruit SciLifeLab Fellows. Since the previous IAB visit eight new SciLifeLab Fellows have been recruited: Lars Behrendt, Gustaf Christoffersson, Pascal Milesi, Alexandra Teleki, Yumeng Mao, Daniel Espes, Prashant Singh, and Daniel Fürth (*Table* 5).
- Funded research: An interdisciplinary postdoc program focusing on technology development has funded 20 postdocs with shared supervisors from the MedPharm and TechNat disciplinary domains at UU. In association with the national COVID-19 call for research projects during the spring of 2020, the SciLifeLab committee at UU decided to fund four initiatives investigating SARS-CoV-2 diagnostics and drug development, viral pathogenesis, and clinical effects on the central nervous in severely sick patients.
- Infrastructure/technology development: The local UU parts of the national SciLifeLab infrastructures Drug Discovery and Development platform, NGI and Clinical Biomarkers Facility (now Affinity Proteomics Uppsala) have all received SFO support. The SciLifeLab UU committee have also funded local facilities of special interests for researchers at UU, and with a potential to become national service units: 1) Customized Microfluidics, 2) Preclinical PET-MR platform, 3) Preclinical Cancer Treatment, 4) Spatial Mass Spectrometry and 5) the 3D printing core facility U-print. Of these, Spatial Mass Spectrometry obtained national status in the new infrastructure organization 2021–2024. The development of local technologies has also been supported including Distributed Cryo-EM screening network, Genome Engineering Zebrafish, Amplicon sequencing of microbes in environmental samples, Reference genome production of threatened species (ERGA), Ancient DNA, BioImage Informatics and BioNano Genomics.
- Training initiatives: A PhD school focused on big data handling is organized at UU with support from SFO funds together with eSSENCE, another SFO initiative whose main focus is computational. SciLifeLab UU supports PhD students with supervisors from both the life science and computational science fields with the aim to later adapt this PhD school to also include the DDLS PhD students.
- The Bioinformatics and Genomics platforms at UU have given many courses and workshops in genomics, bioimaging, bioimage informatics and proteomics technologies. Over 1,000 scientists from all over Sweden have taken courses in analysis of next-generation DNA sequencing data. UU also offers a MSc program and a highly acclaimed seminar series.

Future Plans and Strategies

The SciLifeLab committee at UU continuously identifies and supports synergistic efforts to improve the local research environment by both strengthening the cutting-edge techniques developed by UU researchers, as well as by supporting excellent research efforts. Furthermore, following the launch of the national DDLS program, a strong UU focus has been and will be to facilitate implementation of the DDLS approach in both basic and advanced education and in research in a cross-disciplinary manner.

11. SciLifeLab and Wallenberg National Program for Data-Driven Life Science (DDLS)

This section describes in detail the KAW-funded SciLifeLab DDLS program. The program is central for SciLifeLab's data-driven life science framework, the third pillar of the organization.

In this section, all details about the major new Data-Driven Life Science (DDLS) program are outlined, as well as the framework provided from the funder for the generous funding by KAW (3.1 Billion SEK over 12 years). The early steps taken during the first six months of the program are also mentioned. Moreover, we elaborate on the synergies that can be achieve when adding this third pillar to SciLifeLab. A first version of a DDLS strategy text is embedded here in the IAB report and will serve as a more in-depth description of the program. What directions are to be taken, and what DDLS wants to achieve in the coming years. The strategy also briefly describes the program organization and its connection to the already existing structures at SciLifeLab.

We wish to highlight the importance of the DDLS program for SciLifeLab and therefore ask the IAB members for their international insights, visions and feedback on the directions of the DDLS program, specific aims, and the overall strategy for the full 12-year program period. Particularly important, how do we best integrate DDLS with other SciLifeLab functions to optimize synergistic and mutual benefits.

11.1 Background

In October 2020, KAW announced a 12-year funding initiative of 3.1 BSEK, to support data-driven life science in Sweden. SciLifeLab was named host and coordinator of the initiative, but should closely collaborate with ten Swedish research universities and the Swedish Museum of Natural History (*Figure 44*). This funding has enabled SciLifeLab to fulfill several of the strategic objectives in the SciLifeLab Roadmap 2020–2030, wherein SciLifeLab has emphasized data-driven life science as a key strategic initiative critical for Sweden's ability to be a forefront life science nation.

11.2 DDLS strategy development

This first version of a long-term DDLS program strategy was prepared by the newly formed DDLS steering group with input from the 11 partner organizations. It was published on the SciLifeLab website in June 2021 to be openly available for input and comments from collaborators, the Swedish life science research community, industry, healthcare, as well as other stakeholders in society at large. Based on the contributions and feedback we receive, a revised and final long-term strategy for the DDLS program will be developed and published in early 2022.

Figure 44. Sites and DDLS 11 partner organizations: Lund (Lund University), Gothenburg (Chalmers University of Technology, University of Gothenburg), Linköping (Linköping University), Stockholm (Karolinska Institutet, KTH Royal Institute of Technology, Stockholm University, Swedish Museum of Natural History), Uppsala (Uppsala University), Umeå (Swedish University of Agricultural Sciences (SLU), Umeå University).

The future of life science is data-driven

Strategy for the SciLifeLab & Wallenberg National Program for Data-Driven Life Science

Knut and Alice Wallenberg Foundation

SciLifeLab

DDLS strategy – The Future of Life Science is Data-Driven

Executive summary

SciLifeLab & Wallenberg National Program for Data-Driven Life Science (DDLS) is a national 12-year research program funded by the Knut and Alice Wallenberg Foundation (KAW) with SEK 3.1 billion. SciLifeLab (Science for Life Laboratory), as a national infrastructure for life science, coordinates this program in collaboration with ten universities and the Swedish Museum of Natural History. Over the years, the DDLS program will recruit 39 new academic leaders, train over 400 PhD students and postdocs, and work with all stakeholders to profoundly change how life science is practiced today. This document describes the DDLS program's motivation, specific aims, an overall strategy, and the priorities of the four research areas (Cellular and Molecular Biology, Evolution and Biodiversity, Epidemiology and Infection Biology, as well as Precision Medicine and Diagnostics). We believe that the future of life science is data-driven and that an active national collaboration in the DDLS program will promote the government's aim to make Sweden a leading nation in life sciences.

Vision and mission

Vision: the future of life science is data-driven

Mission: DDLS is a national research and training program accelerating the data-driven life science paradigm in Sweden, promoting Swedish universities acting at the global frontline with eventual impact on every life scientist and the entire society.

The national DDLS mission is accomplished by joint recruitment of talent, a national program of training and research excellence, launch of a national data platform and set up of an international collaboration hub for engaging academia, health care and industry. Besides top scientific excellence, DDLS also promotes a broad impact for every life scientist as well as for society.

Why is the DDLS program important right now?

Life science is increasingly data-centric. The European Bioinformatics Institute currently manages about 300 PB of public life science data, and this, along with other data resources are growing rapidly in terms of content, depth and interconnection of data. At the same time, advances in computational capabilities, AI, machine learning and other technologies, provide enormous new opportunities for new objective, unbiased ways to analyze data and to promote biological discovery, insights on life as well as innovation and society benefits. The DDLS program is essential right now because:

1. **Most life science data are still not FAIR:** Despite recommendations, most data are still not readily available and FAIR (Findable, Accessible, Interoperable, and Reusable). Often data are not annotated or organized in a standardized, interoperable way to be machine-readable. There is a need for coordinated national efforts facilitating such goals to integrate and make life science data better available.
2. **Data analysis capabilities need to be further developed and made available:** Data-driven analysis has developed rapidly as a result of advances in artificial intelligence (AI) and machine learning (ML). As a result, biology can be studied, hypotheses generated, and comprehensive and systematic insights generated in an unbiased manner. However, most scientists are not yet making optimal use of the available data or the latest tools and technologies in their research.
3. **Life scientists need much more data science expertise and competence:** Most researchers in life science do not currently have the multi- and cross-disciplinary skills and competences that data-driven science demands. Therefore, training and education is essential to ensure the availability of cutting-edge experts, but also the utilization of data science in the broader life science community.
4. **Data science and society needs:** Industry, health care, decision-makers and the public all need unbiased, data-driven insights of biological processes, human health, and ecosystems. However, there is often a lack of access to data, tools, and technologies as well as expertise. In order for data-driven life science to prosper in the future, a number of policy issues, such as privacy, legislation, and ethical considerations, access to health data, need to be addressed. For example, the COVID-19 pandemic uncovered huge

gaps in the flow of data across health care, authorities, academia, the public and decision makers. This contributed to challenges faced by health care and the society at large.

Creation of an entirely new data-driven and hypothesis-generating scientific process would boost discovery opportunities within life science and efforts to examine and understand life processes. A powerful iterative cycle is emerging; from data science to laboratory experiments and back.

We are at the start of a new digitalization era of life sciences which offers exceptional opportunities but also many challenges. We envisage that the DDLS program is essential for Sweden to lead this transformation, not just react to it. Given the importance of data-driven life science, we believe that these actions will substantially promote the government's aim to make Sweden a leading nation in life sciences.

Strategic objectives

The DDLS program will have the following long-term objectives, figure 1:

1. Create a National Framework for Data-Driven Life Science
2. Attract Scientific Excellence
3. Train the next generation of data-driven life scientists
4. Develop national research programs across universities
5. Bridge the gap between the life science and data science communities
6. Create partnerships and impact on society at large – industry, health care, and other national and international links
7. Promote policy actions at the national level to provide opportunities for data-driven research

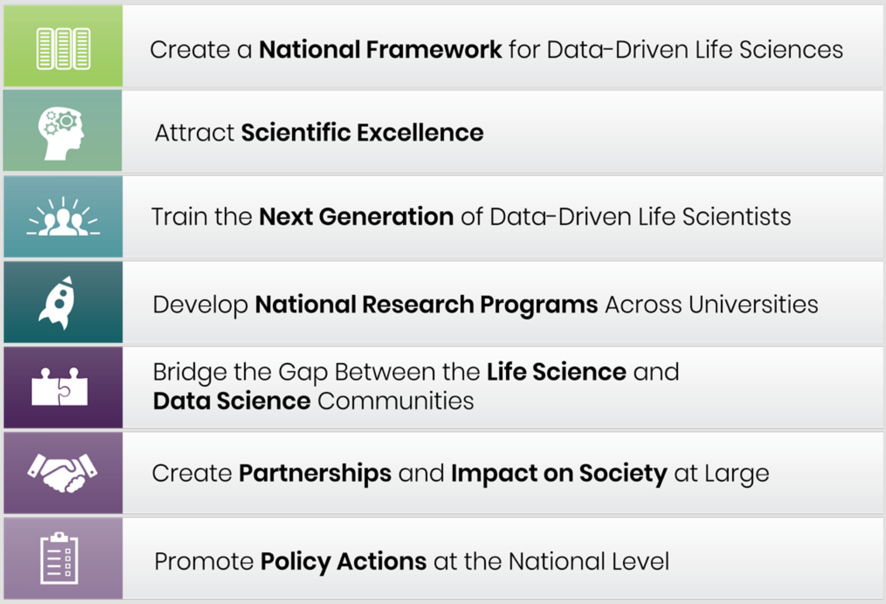


Figure 1. DDLS program 7 strategic objectives.

Implementations

To realize the strategic objectives of DDLS, we will launch the following specific actions:

1. **Create a National Framework for Data-Driven Life Science:** We will establish a national data platform for data services and life science databases, providing data availability, FAIR data management and advanced data analytics support services. The platform will utilise the top computational resources for the national life science research community in collaboration with all universities. We will coordinate efforts across the country to make FAIR (Findable, Accessible, Interoperable and Reusable) data a norm in academia and to create services and resources to support this. We will facilitate the creation of data resources and services, and organize scientific information, including data, code, methods, and meta-data. The platform will support the needs of the main scientific areas of the DDLS program, and establish domain-specific portals, following the example of the national COVID-19 portal with links to international data resources. We will link up with powerful computational capabilities, advanced data analysis technologies, and AI capabilities and develop new computational methods to facilitate life science research. DDLS will publish a data road map to describe these actions in more detail.

2. **Attract Scientific Excellence.** DDLS will launch the recruitment of 39 junior group leaders (DDLS Fellows) in four research areas to the participating universities. After a 5-year Fellowship, the DDLS Fellows may have a possibility to be promoted as tenured faculty and continue as key members of the national DDLS program. We expect that the caliber of the DDLS Fellows to be recruited will be truly world-leading. In addition, the DDLS Fellows should be located in progressive, multi-disciplinary local research environments that form powerful links and synergies with the national DDLS program. Thus, for DDLS to succeed in building a truly globally leading program, it is necessary to attract talented early carrier scientists, but also to link up each university's best research environments and unique capabilities together into a synergistic national DDLS network.

3. **Train the next-generation data-driven life scientists:** Besides the PhD students and postdocs to be recruited to the DDLS Fellows' groups, there will be additional positions that will be made available in open calls. Altogether more than 400 PhD students and postdocs are expected to be trained as part of this program. We will launch a national DDLS research school / training programme. The purpose of the training is to educate the future workforce for data-driven life science in Sweden, within academia, industry, health care, and other fields. Courses will be organized together with all universities, SciLifeLab's Data Centre and Bioinformatics Platform, Wallenberg Centre for Molecular Medicine (WCMM), the Wallenberg AI, Autonomous Systems and Software Program (WASP) and many other parties. The training will also aim at making the broad life science community better prepared for the data opportunities and challenges in the next decade.

4. **Develop national research programs across universities:** DDLS will focus on four research areas where all the Fellows will be assigned. We will build on this core DDLS community to create a broad national DDLS community, which will participate in research collaborations and training. As DDLS will be anchored at 11 different sites across the country, creation of active national collaborative communities will be key. We expect interactions within each research area, but also cross-disciplinary collaborations across the four research areas.

5. **Bridge the gap between the life science and data science communities:** DDLS program has a unique opportunity to form multi-disciplinary collaborations with the Wallenberg Autonomous Systems and Software (WASP and WASP-HS) Programs and other KAW funded programs. This will enable the life science community to collaborate with the large community of world-leading data science, software, and automation experts. Conversely, this will also provide life science grand challenges to be explored by the WASP community. DDLS will also link up with e.g., the Wallenberg Centre for Quantum Technology and the recently inaugurated Berzelius HPC cluster, Wallenberg Advanced Bioinformatics Infrastructure (WABI) as well as the Wallenberg Centers for Molecular Medicine (WCMM).

6. **Create partnerships and impact on society:** DDLS will boost data-driven life science through partnerships and spread the benefits to the society at large: **A) Industry:** Industry will be a beneficiary of the training programs and junior experts, and it will be important that DDLS is engaged with industry at many levels; including R&D collaborations. Collaboration with the Wallenberg Launch Pad (WALP) program may allow innovative ideas originating from the DDLS research to be developed further into products and services. **B) Health care:** DDLS will promote training of the next-generation of data experts for health care. In the research areas of Precision Medicine and Diagnostics as well as for Epidemiology and Infection biology, we will focus on the links and secure integration of

molecular and clinical data in a research setting. DDLS will also work together with the health care regions, biobanks, Genome Medicine Sweden, and the WCMM network on the challenges and policy issues with **health care data (see below). C) Other collaborations nationally and internationally:** DDLS will also engage with other national communities within areas such as biodiversity, environment, agriculture, and forestry. International networking is key to DDLS, and we will build collaborative programs with leading international institutions in data-driven research. DDLS scientists will participate in international (e.g. EU) programs in health care, precision medicine, biodiversity, etc. and will work with its partners to create and promote international standards and practices in data handling.

7. **Promote policy actions at the national level to provide opportunities for data-driven research:** Progress in many areas of life science is highly dependent on regulation and ethical, legal, and social implications (ELSI) and guidelines. These include data security, privacy, ownership, fragmentation and access to health care data that are already being actively debated at the national level. There are also policy questions on biodiversity and sustainability in environmental research. Hence, the DDLS program will work with the community of stakeholders and connect leading experts on ELSI, and related matters, to the program. We will set up a policy action group to address some of the issues that would easily become roadblocks to the transformation to a digital, data-driven future in life science research.

11.

Milestones and deliverables

At the end of the 12 years, we anticipate that the DDLS program has achieved the following outcomes:

- Accelerated adoption of data-driven life science throughout Sweden and the quality of life science (publication output)
- Sweden and Swedish universities are considered world leading in data-driven life science.
- Outstanding international PI recruitments have taken place.
- A community of 400 PhD students and postdocs has been trained.
- A unique national research program and a networked community established across the 11 partners.
- Major collaborations in place with industry, health care, and other national stakeholders.
- Innovations have taken place and translated via private sector to the society
- Major grants have been acquired by researchers within the DDLS program, such as ERC grants and industry collaboration grants.
- Collaborative interactions with leading international institutions have taken place.
- Established a data platform, broadly enabling and facilitating FAIR data sharing
- Developed high-end computational and ML/AI technologies to transform life science
- Set up advanced computational services for the whole life science sector
- Key policy discussions and actions have helped to take the field forward.
- Taken together, the diverse steps to promote data-driven life science have enabled improved understanding of life and health.

◆ Four strategic research areas

The program will focus on four broad research areas, where the 39 DDLS Fellow positions will be recruited (see figure 2) and where national communities are formed. The aims of these four research areas will be explained below.

Cell and molecular biology

The DDLS program will support research that fundamentally transforms our knowledge about how cells function by peering into their molecular components in time and space, from single molecules to native tissue environments. This research area aims to lead the development or application of novel data-driven methods relying on machine learning, artificial intelligence, or other computational techniques to analyze, integrate and make sense of cellular and molecular data. Our vision for the DDLS program is to support data-driven research that takes advantage of these opportunities, and builds on the state-of-the-art infrastructure and computing capabilities.

Figure 2. Main research areas within the DDLS program.

11.

Evolution and biodiversity

The DDLS program will support research that takes advantage of the massive data streams offered by techniques such as high-throughput sequencing of genomes and biomes, continuous recording of video and audio in the wild, high-throughput imaging of biological specimens, and large-scale remote monitoring of organisms or habitats. This research area aims to lead the development or application of novel methods relying on machine learning, artificial intelligence, or other computational techniques to analyze these data and to address major scientific questions in evolution and biodiversity. The DDLS and SciLifeLab will also provide state-of-the-art infrastructure, computing facilities and training for data-driven research in evolution and biodiversity.

Precision medicine and diagnostics

The DDLS program will support data-driven research for next generation precision medicine making use of and connecting multiple data layers from genotype to molecular phenotype to clinical data. Molecular precision medicine is about tailoring preventive and therapeutic approaches to the particular characteristics of each person and their disease. Data integration and analysis in DDLS aims to lead to development of molecular patient stratification and discovery of biomarkers for disease risk assesement, prognosis, treatment or prevention. This can include development of data interpretation, visualization and clinical decision support tools. The research is expected to use assets such as high-quality electronic health care data, molecular (e.g. imaging and omics) data, as well as longitudinal patient and population registries, biobanks and digital monitoring data.

Epidemiology and infection biology

Infectious diseases pose significant global threats, including emerging, neglected and chronic infectious diseases, growing antimicrobial resistance, and a lack of antivirals and vaccines. For many host-pathogen systems, multidimensional, genome-scale experimental data can now be processed through computational methods and models to generate testable hypotheses regarding pathogen biology and transmission, as well as to identify antimicrobial or antiviral targets. Population-scale genetic, clinical, or public health data from pathogen surveillance efforts and biobanks, on the other hand, offer opportunities for data-driven prediction of the emergence, spread, and evolution of infectious agents, improved diagnostics, and to understand pathogenicity. DDLS work in this research area will use big experimental, clinical, or pathogen surveillance data in innovative ways to transform our understanding of human, animal or plant pathogens, their interactions with hosts and the environment, and how they are transmitted through populations.

DDLS organization and steering structure

The DDLS program is funded by the Knut and Alice Wallenberg Foundation (KAW) with a total of SEK 3.1 billion over twelve years and the use of the funding is stipulated in the KAW donation letter. Funding will be provided in 3-year allocations, based on a progress report and a detailed strategic plan. The SciLifeLab Board is the decision-making body for the DDLS program, while the Program Director manages the operations toghether with the DDLS steering group members. A national reference group with representatives from all 11 parties will support and advise on strategic issues and to ensure close links to the operations and leadership at the collaborating organizations, figure 3.

The program's main operations currently include Recruitments, Research school and Data infrastructure. The steering group coordinates these operations to create synergies throughout the program. As the program develops, working groups for other activities will be launched as needed.

As a SciLifeLab coordinated program, DDLS gains substantial synergies in the interactions between infrastructure, research and data at the national level. For example, the SciLifeLab Data Centre is responsible for coordinating data infrastructure and support. In addition, we can make use of the SciLifeLab organization in the coordination and administration of the DDLS program, such as communication, external relations, training, meetings, events, financing and reporting.

Working groups set up for DDLS as of April 2021:

1. **Data strategy working group:** This group works on establishing a national data-sharing platform, providing access to services including compute and storage e-infrastructure, computational tools, bioinformatic web services, databases, and topic-specific, along with web-based data portals for the four research areas of the DDLS program. The platform will provide a common structure for data-centric services and projects, community-created content, and a single point of contact user support portal. The DDLS program will work together with major Swedish e-infrastructure providers to increase the capability to analyze and share data.
2. **Recruitments working group:** This group works on defining the principles of the national recruitment for the DDLS program, and will organize the coordination of recruitments at the national level as well as the adherence to the aims of the program.
3. **WASP collaborations - working group:** This group will plan and coordinate the interactions with the WASP community and together with a joint WASP – DDLS working group organize and launch joint calls and networking activities.
4. **Program coordination, networking and research school – working group:** This group will plan and coordinate program overarching activities, such as annual conferences and other networking activities, plan for training and research school development and ELSI support, as well as act as support to the other three working groups mentioned above.

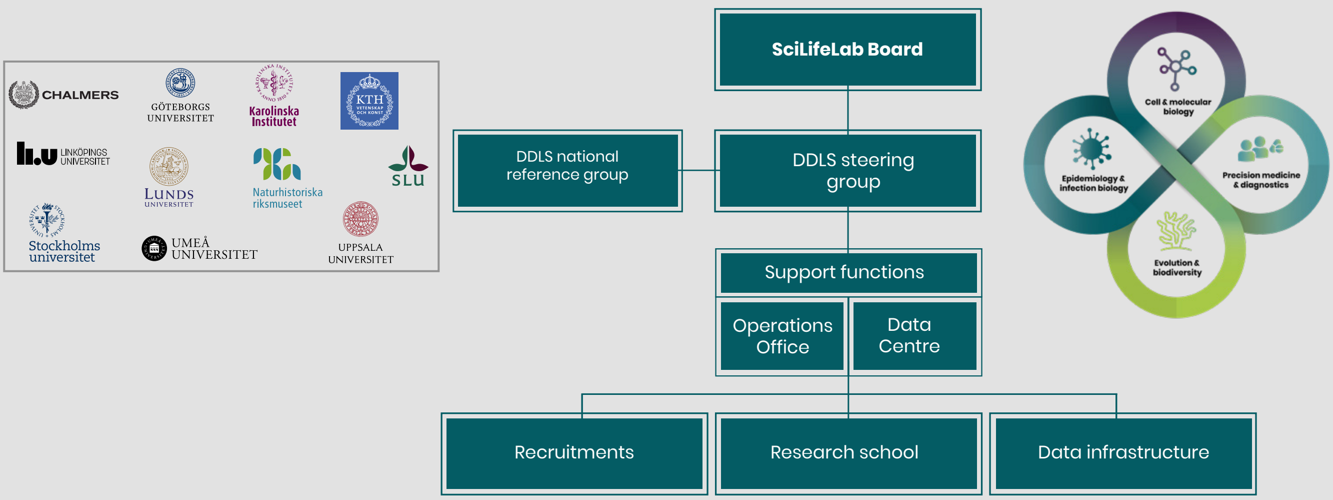


Figure 3. The DDLS governance, operations, and support functions

Acknowledgements

This first version of the DDLS strategy has been developed by the DDLS steering group with input from the KAW, DDLS national reference group (representatives from the 11 participating organizations Chalmers, GU, KI, KTH, LiU, LU, NRM, SLU, SU, UmU and UU), SciLifeLab Board, Management group, Operations office and the Data Centre.

11.3 Program Funding and Progress

In the donation letter from KAW, the support to the DDLS program is stated at 3.1 BSEK for the time period 2021-2032, and the donation is distributed over five phases of two or three years (*Table* 7). For each new phase an application has to be provided to the KAW, meaning the program can be stopped or the funding revised after any of the phases. However, an overall plan which specifies the funding frame for the full 12-year period was provided already in the donation letter (*Figure* 45). The program is expected to recruit 39 DDLS Fellows, who in their funding package (17 MSEK) can fund two PhDs and two postdocs summing up to 78 PhDs and 78 postdocs at the end of the program. In addition, 140 PhDs in academia and 45 industry PhDs, 90 postdocs and 45 industry postdocs will be recruited via open calls. In addition, 210 MSEK and 35 MSEK should be allocated for collaborations with WASP and WASP- HS, respectively, 235 MSEK should be set aside for financing WABI (including Cryo-EM) and 670 MSEK to provide data support and databases.

When estimating costs for each year for the different operative areas of the program it is clear that all program components are not activated until 2026 when the program is fully operating. It also shows how cost accumulation rolls over to forthcoming phases, partly due to the length for different operative areas, such as DDLS Fellows (5 years) and PhD project positions (4 years), *Figure* 46.

Table 7. KAW donation allocation over 5 phases of the program.

Phase	Funding period	Grant (MSEK)
Phase 1	2021 Jan–2024 Mar	580
Phase 2	2024 Apr–2026 Mar	740
Phase 3	2026 Apr–2028 Mar	670
Phase 4	2028 Apr–2030 Mar	560
Phase 5	2030 Apr–2032 Dec	550
Total	2021 Jan–2032 Dec	3,100

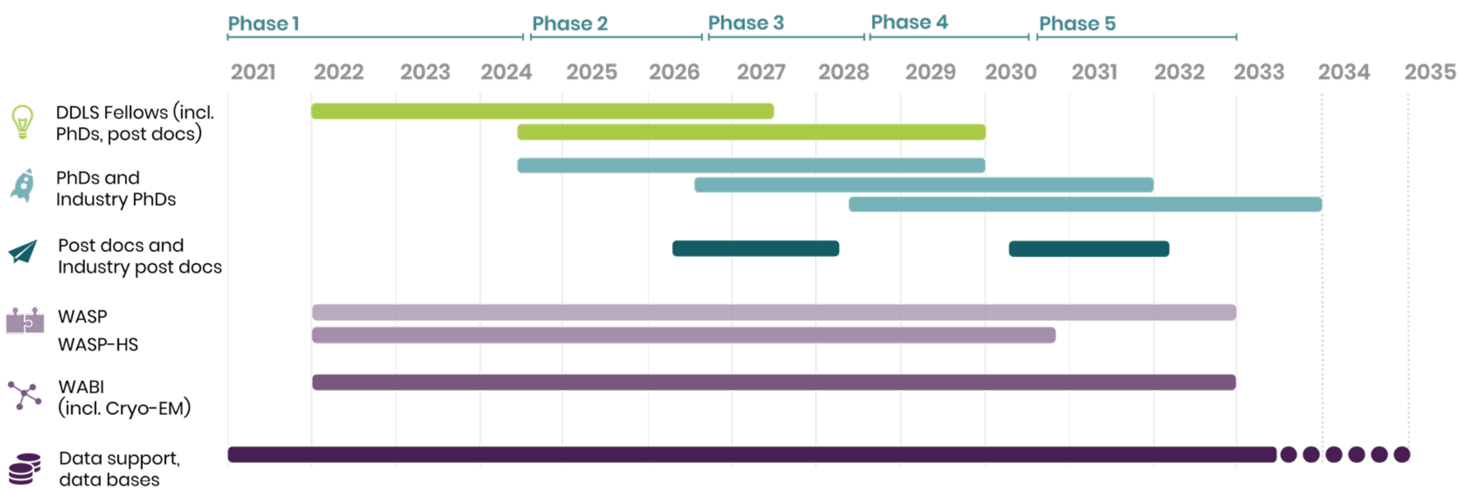


Figure 45. The overall 12-year plan for the DDLS program. Specifies active time period per operative area based on the overall plan provided in the KAW donation letter, and adjusted according to detailed plans set by the program management for the first funding phase (2021–2023). Dotted line indicates depreciation time of assets.

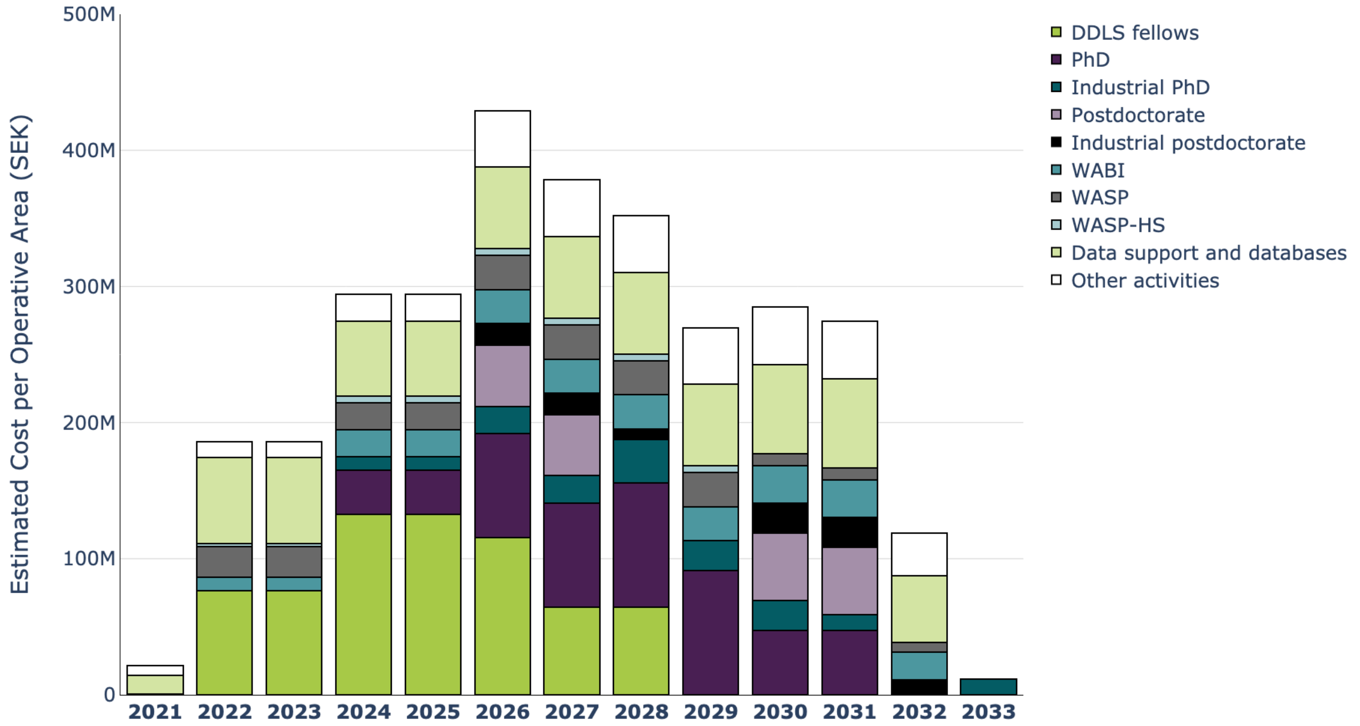


Figure 46. Distribution of estimated costs per operative area per year (SEK). The phase-wise funding for each operative area, as provided in the donation letter and adjusted to detailed plans set by the program management for the first funding phase (2021–2023), was estimated to costs per year per operative area. Note: *1) DDLS Fellows also includes costs for two PhDs and two postdocs per Fellow and running costs, 2) other activities consist of management, networking activities, research school and free resources.*

11.4 Program Start in 2021 (First Six Months)

The main focus for the first few months of the program have been on organizational matters such as; appointing a program director and steering group members, getting a support team in place, connecting all 11 partner organizations to the program (via establishment of a DDLS national reference group and a network of coordinators, administrators and data contacts), and setting detailed plans and budget for the first phase. Specific milestones and achievements are listed in *Figure* 47, while status of main ongoing activities is described in further detail below.

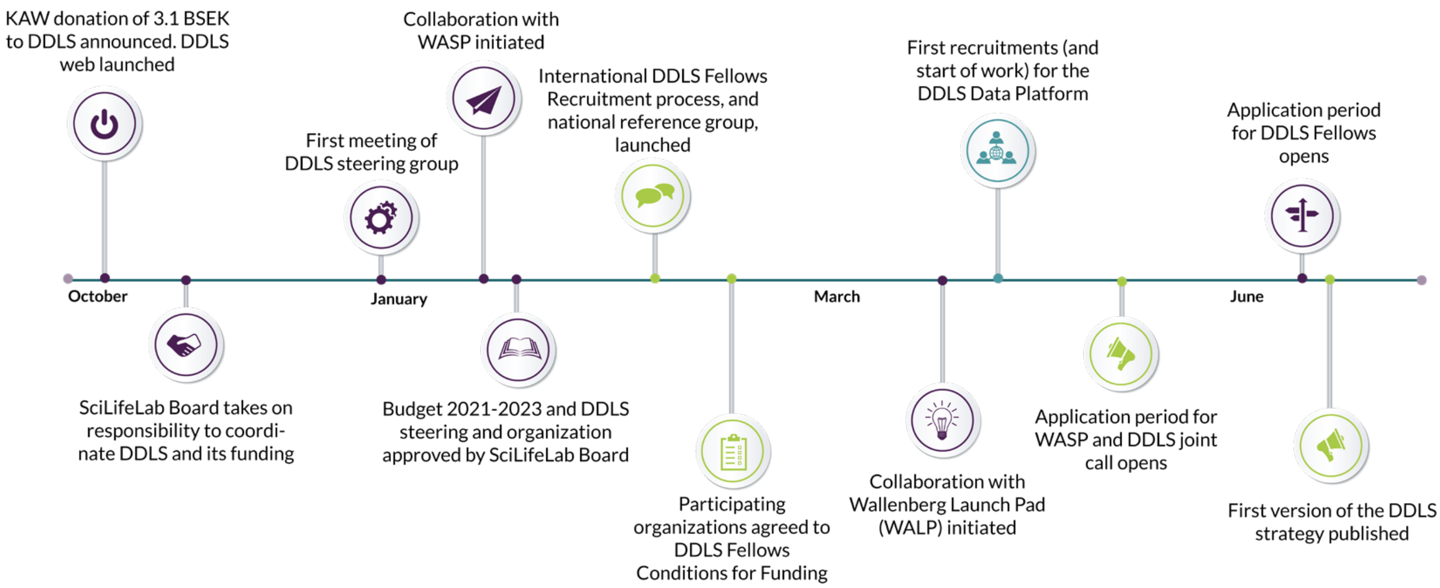


Figure 47. Achievements, timeline with important milestones Oct 2020 –June 2021.

Recruitments of DDLS Fellows

The 39 DDLS Fellows are being recruited in two rounds to four strategic research areas of the program and directly to the 11 partner organizations. Similar to the SciLifeLab Fellows, each DDLS Fellow will be recruited to one of the participating organizations, enabling them to utilize the strong local research environments. However, the SciLifeLab Board (and the DDLS steering group) has a strong coordinating and supervisory function on the overall recruitment process and the research areas announced. This will also ensure that the DDLS Fellows will be closely connected to the national DDLS program, fostering a strong, interdisciplinary community of researchers.

The process to coordinately recruit the first set of 20 DDLS Fellows to the DDLS program in four research areas was started in February 2021, see *Figure* 48. In June 2021, all 20 positions were simultaneously announced at the SciLifeLab webpage and in Science and during autumn the selection process will start. The next recruitment round is planned for 2024.

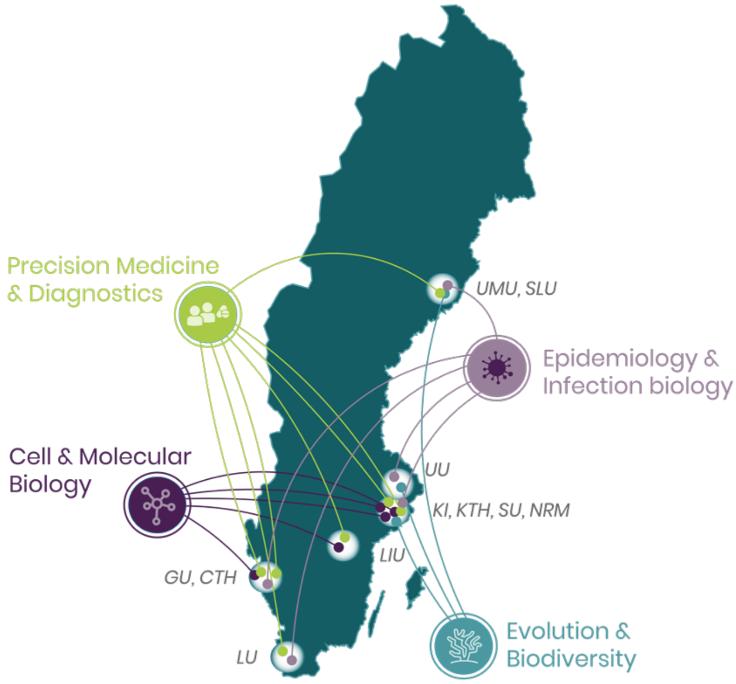


Figure 48. Distribution of DDLS Fellow positions to the participating organizations and the four DDLS research areas was pre-defined in the donation letter from KAW. Each line represents a DDLS Fellow recruitment package in the first 2021 round of recruitments. Each package has a budget of 17 MSEK to cover salary for 5 years as DDLS Fellow, two PhD positions and two postdoc positions, as well as running costs. The DDLS Fellow positions are tenure-track, and the respective hosting organizations take long-term responsibility of tenured group leaders.

First DDLS Call in Collaboration with WASP

DDLS funds have also been earmarked for collaborative efforts between DDLS and another major KAW funded initiative, WASP, the Wallenberg Autonomous Systems and AI Program, to link up with the pre-eminent data scientists in the country, and to access e.g., AI-optimized high-performance computing capabilities provide major attractive dimension for DDLS. The aim with this partnership is to form multidisciplinary collaborations and bridging the gap between the life science and data science communities by facilitating flow of ideas, solutions and competence in both directions between the programs.

To kick-start this collaboration a joint call between WASP-DDLS was launched in May 2021, and a zoom community meeting with more than 200 participants was held in connection to the call opening both for bringing awareness, as well as to connect life and data science researchers. The DDLS-WASP collaboration call closes in September 2021 with the evaluation process during the fall.

Data Platform to Support DDLS and Swedish Life Science

"Data Support and Databases" is an important DDLS operative area. This national scope aligns well with the strategic goal in the SciLifeLab Roadmap, **Creating a national framework for life science data**. 140 MSEK has been allocated from DDLS funds for "Data Support and Databases" during the first phase of the program, and an additional 530 MSEK until the end of the program.

The SciLifeLab Board has appointed the SciLifeLab Data Centre to create a national data platform with components for supporting the entire data life cycle, from study design and data management planning to data publishing and re-use. The data platform will have strong support for FAIR data management and will link SciLifeLab to major e-infrastructures both in Sweden and internationally. Acting as a central hub, a network of technical life science will be supported across Sweden through the platform, and linking local services and resources to SciLifeLab and the DDLS program.

Moreover, the data platform will organize domain-specific data offices placed at the partner organizations, which will coordinate services, resources and software tools for the four major scientific areas in the DDLS program. This enables the data platform to interact with local research environments and boost local life science data efforts, as well as providing a national platform where locally developed services, such as bioinformatic tools and databases built by individual research groups, can be given a strong technical environment for development, maintenance, and visibility on a national level. The data platform will be fronted by a DDLS web portal, and include research area specific data portals, similar to the national

COVID-19 data portal as described in *Section* 6.8. The data platform has kick-started operations by deciding on; 20 MSEK worth of investments in hardware, 13 new persons to be hired in 2021, and a collaboration with the KAW-supported Berzelius HPC system at Linköping university, Sweden's largest GPU based compute resource and particularly built to strengthen computational capabilities for AI.

11.5 Future Plans and Links to Other SciLifeLab Functions

During the DDLS planning and strategy, synergies between data-driven life science and the other two pillars at SciLifeLab, infrastructure and research, were identified. Overall, data-driven life science is a third pillar of SciLifeLab, and was already featured in SciLifeLab Roadmap 2020–2030 and thus integrated with most functions of SciLifeLab. However certain specific synergies are of high importance and relevant for both DDLS and SciLifeLab to emphasize:

Data. SciLifeLab's overall aim as well as the strategic objectives of SciLifeLab aim at creating a national framework for life science data. SciLifeLab DC connects the infrastructure, research and data-driven life science pillars, and supports users, facilities, and the national research community throughout the data management life cycle. Currently, a SciLifeLab data policy covering both the DDLS program and the SciLifeLab infrastructure is being developed. The data area is also strengthened by SciLifeLab hosting the Swedish ELIXIR node, and also by the recently establish collaboration between SciLifeLab and EMBL.

Synergistic national research network. Building and strengthening networks between the new DDLS Fellows and current SciLifeLab Fellows, as well as with other national fellow programs (e.g., WCMM and WASP), will form multidisciplinary opportunities for advancing careers of young scientists, establishing multi-disciplinary research collaborations, leveraging unique capabilities and synergies between researchers, infrastructure and data science. Joint events, conferences, workshops and seminar series will be organized, as well as joint calls for research, such as the DDLS-WASP interaction.

Courses and training. Training of the next generation data scientist for the life science area is vital, and helps to make the broad life science community better prepared for the challenges in the next decade. An inventory and evaluation of the current courses and training at SciLifeLab, as well as identification gaps in the advanced life science training in Sweden, is now being carried out (see *Section* 6.5). In the next 4-year period, we will launch a DDLS research school, as well as planning for an advanced training center to support training activities.

ELSI. Many ethical, legal, and social implications (ELSI) are important both in DDLS and in many of the other SciLifeLab operations, such as biodiversity, precision medicine, application of artificial intelligence, or access to and sharing of personal and health data. There is a need to strengthen the ELSI work within all these aspects. DDLS and SciLifeLab will work together and have assigned funding to an ELSI advisor to conduct a survey to identify areas, lead activities, outline a DDLS/SciLifeLab ELSI plan, and establish collaborations with external parties nationally and internationally.

12. Key Challenges and Opportunities to be Discussed with the IAB

SciLifeLab has undergone major positive changes and rapid developments since the last IAB site visit. As before, we warmly welcome feedback from the IAB, including both positive and critical (even provocative) comments on any aspects of current and past achievements or the future plans. In addition, we specifically would like to hear IAB comments on the following 5 topics and questions:

1) Infrastructure. a) We would appreciate comments from the IAB on whether the current infrastructure spectrum and breath of activities seems optimal for the funds available and whether there are new areas that would need to be actively developed. SciLifeLab does not need to do everything in life science, as there are important infrastructure units also outside of SciLifeLab, funded by e.g., VR and universities. We have developed the current SciLifeLab infrastructure largely based on comments from the community and used a bottom-up process to select new core facilities from universities that could be upgraded to a SciLifeLab unit. In some cases, we have actively promoted the launch of entirely new infrastructure units, such as Eucaryotic and Microbial Single Cell Biology and Cryo-EM in the past as well as Exposomics in 2021. Thus, we would like to hear, if you have compelling examples of technology areas that we may have so-far neglected or underestimated? In addition, we have defined boundaries of technologies that we will not support, such as services involving biobanks, animals and other model organisms as well as clinical/diagnostic imaging. This resulted in a lot of discussion during the last infrastructure evaluation and is good to explore also with the IAB.

In addition, we would like to get your view on how SciLifeLab can contribute to the promotion and recognition of infrastructure staff scientists within the traditional university system. We have noticed and fear we will lose skilled people unless this is addressed appropriately.

b) We would also be curious to get your feedback regarding the plan to make infrastructure platforms address capabilities together with the research community, Data Centre, and DDLS. Some platforms are by themselves already organized as capabilities, such as the Drug Discovery and Development, Integrated Structural Biology and the Spatial and Single Cell Biology platforms. In addition, we have now defined three broad research areas where we will develop capabilities: 1) Pandemic Laboratory Preparedness, 2) Precision Medicine and 3) Planetary Biology. Of the three areas chosen, the plan for the Pandemic Laboratory Preparedness capability is currently most advanced and serves as a leading example.

2) Research Profiling, New SciLifeLab Sites and Young Scientist Programs. We would like to continue to hear IAB views on the progress towards the integrated research mission of SciLifeLab and the more harmonized young scientist programs (SciLifeLab and DDLS Fellows), including the role and the new plans at Campus Solna. The IAB suggested ambitious research center plans for SciLifeLab after the last visit. However, our ability to direct and promote a coherent research center mission is limited as the primary role of SciLifeLab is that of a national infrastructure.

Also, SciLifeLab funding has increased for a variety of national, not local missions. We would therefore appreciate a discussion on the role of the four founding universities vs. the national dimension of SciLifeLab. With the launch of the prominently national DDLS program, the SciLifeLab community has grown and will continue to grow across the country. We think that the four founding universities should still retain a central role and interest to SciLifeLab in the future. We would appreciate any thoughts on synergizing between the two current distinct profiles of SciLifeLab: the national/infrastructural/DDLS mission vs. the founding-university centric, more research and technology development mission. This is highly relevant also in the light of the recent Krantz investigation and subsequent discussion of the role and steering of national infrastructures.

3) DDLS and Data. The DDLS program is perhaps the most remarkable new development at SciLifeLab. These are still early days in the 12-year program, but we would like to hear how the IAB views the strategies for DDLS, as well as how the data support and Data Centre actions should develop? We realize that this is a major opportunity to change the profile of life science across the nation, but also a major challenge for SciLifeLab, given that we have now eleven (equal) partners involved, four research areas and major expectations from the funder, the research community and the society.

4) SciLifeLab Training. We would particularly like your input on our plans for a national SciLifeLab Training Platform, aiming at increased coordination of educational activities across the three SciLifeLab pillars.

5) Managing SciLifeLab Integration, Synergy and Growth. Given the three strong pillars we have at SciLifeLab, i.e., infrastructure, research and data (DDLS), how should we best focus our actions so that these distinct programs and funding commitments produce the biggest synergy? In some ways SciLifeLab always needs to cater to the big life science community on one hand (for infrastructure users), but research and data actions should ideally be more focused and leveraging the synergies and best options available. We would like to ensure that we are optimally operating and managing the various roles, stakeholders and distinct funding programs involved, which together almost double the SciLifeLab size in a short period of four years. Thus, we will need to seek synergy and focus at the same time as our commitments and responsibilities across Sweden and across the society have substantially expanded.

13. Concluding Remarks

This will be the first fully virtual IAB meeting, which will present a number of challenges, not the least regarding the time zones. We hope that you will have a chance to read the written document before the sessions start, as we had to cut many of the session shorter than originally planned.

Many of the IAB members have been with us for a very long time, and we would have liked to thank you and celebrate the first ten years of SciLifeLab with you in person! We are indeed highly thankful for your efforts over the years. There continues to be natural rotation in the SciLifeLab Board composition (e.g., Carl-Henrik Heldin's term as Chair of the Board is ending), and there have been continuous changes in the Management Group and SciLifeLab committees and stakeholder representatives (e.g., rectors). Thus, we all look forward to seeing you via Zoom and discussing exciting developments at SciLifeLab.

Appendix A.

SciLifeLab Leadership, Stakeholders and Committees 2021

SciLifeLab International Advisory Board

Name	Affiliation	Role
Jan Ellenberg	EMBL Heidelberg, Germany	Chair
Søren Brunak	Technical University of Denmark and University of Copenhagen, Denmark	Board member
Yoshihide Hayashizaki	RIKEN Omics Science Center, Japan	Board member
Sirpa Jalkanen	University of Turku, Finland	Board member
Janet Jansson	Pacific Northwest National Laboratory, USA	Board member
Jonathan Knowles	FIMM, University of Helsinki, Finland	Board member
Svante Pääbo	MPI for Evolutionary Anthropology, Germany, Okinawa Institute of Science and Technology Graduate University, Japan	Board member
Aviv Regev	Genentech, USA	Board member
Sarah Teichmann	Wellcome Sanger Institute, UK	Board member
Jo Bury	VIB, Belgium	Board member
Stephanie Alexander	EMBL Heidelberg, Germany	Secretary

SciLifeLab Board

Name	Affiliation	Role
Carl-Henrik Heldin	Uppsala University	Chair, until September 30, 2021
Lotta Ljungqvist	Cytiva	Industry representative
Annika Stensson Trigell	KTH Royal Institute of Technology	KTH representative
Anders Gustafsson	Karolinska Institutet	KI representative
Anders Karlhede	Stockholm University	SU representative
Stellan Sandler	Uppsala University	UU representative
Göran Landberg	University of Gothenburg	Other university representative
Fredrik Elinder	Linköping University	Other university representative
Katrine Riklund	Umeå University	Other university representative
Gunilla Westergren-Thorsson	Lund University	Co-opted, Chair NSC

SciLifeLab Management Group (MG)

Name	Affiliation	Role
Olli Kallioniemi	Karolinska Institutet	Director
Mia Phillipson	Uppsala University	Co-Director
Annika Jenmalm Jensen	Karolinska Institutet	Infrastructure Director
Hjalmar Brismar	KTH Royal Institute of Technology	Scientific Director (SD)
Janne Lehtiö	Karolinska Institutet	Scientific Director (SD)
Christos Samakovlis	Stockholm University	Scientific Director (SD)
Staffan Svärd	Uppsala University	Scientific Director (SD)
Jenny Alfredsson	Uppsala University	Co-opted, acting Head of Operations
Sandra Falck	KTH Royal Institute of Technology	Co-opted, acting Vice Head of Operations
Per Ljungdahl	Stockholm University	Co-opted, Campus Solna Director
Johan Rung	Uppsala University	Co-opted, Head of Data Center

SciLifeLab Integration Directors (IDs)

Name	Affiliation
Amelie Eriksson Karlström	KTH Royal Institute of Technology
Stefan Eriksson	Karolinska Institutet
Lena Mäler	Stockholm University
Eva Tiensuu Janson	Uppsala University

A.

Founding University Rectors' Council

Name	Affiliation
Sigbritt Karlsson	KTH Royal Institute of Technology
Ole Petter Ottersen	Karolinska Institutet
Astrid Söderbergh Widding	Stockholm University
Anders Hagfeldt	Uppsala University

DDLS Steering Group (DDLS-SG)

Name	Affiliation	Role
Olli Kallioniemi	Karolinska Institutet	Program Director
Siv Andersson	Uppsala University, Knut and Alice Wallenberg Foundation	KAW representative
Oliver Billker	Umeå University	Steering group member
Niklas Blomberg	ELIXIR	Steering group member
Matts Karlsson	Linköping University	Steering group member
Erik Kristiansson	Chalmers/University of Gothenburg	Steering group member
Janne Lehtiö	Karolinska Institutet	Steering group member
Erik Lindahl	Stockholm University	Steering group member
Emma Lundberg	KTH Royal Institute of Technology	Steering group member
Fredrik Ronquist	Museum of Natural History	Steering group member
Gunilla Westergren-Thorsson	Lund University/WCMM	Steering group member
Carolina Wählby	Uppsala University	Steering group member

DDLS Reference Group (DDLS-RG)

A.

Name	Affiliation	Role
Ann-Sofie Cans	Chalmers University of Technology	Group member
Anna Martling	Karolinska Institutet	Group member
Sebastiaan Meijer	KTH	Group member
Per Dannetun	Linköping University	Group member
Jonas Larsson	Lund University	Group member
Per Andersson	Museum of Natural History	Group member
Ylva Engström	Stockholm University	Group member
Sara Hallin	Swedish University of Agricultural Sciences	Group member
Lars Nyberg	Umeå University	Group member
Christina Jern	University of Gothenburg	Group member
Mats Larhed	Uppsala University	Group member

National SciLifeLab Committee (NSC)

Name	Affiliation	Role
Gunilla Westergren-Thorsson	Lund University	Chair and member of SciLifeLab Board
Maria Fällman	Umeå University	Committee member
Maria Jenmalm	Linköping University	Committee member
Carina Mallard	University of Gothenburg	Committee member
Martin L Olsson	Lund University	Committee member
Tommy Olsson	Wallenberg Centers for Molecular Medicine	Committee member
Jan Stenlid	Swedish University of Agricultural Sciences	Committee member
Mikael Elofsson	Umeå University	Deputy
Thoas Fioretos	Lund University	Deputy
Anders Fridberger	Linköping University	Deputy
Sara Hallin	Swedish University of Agricultural Sciences	Deputy
Christina Jern	University of Gothenburg	Deputy

KTH SciLifeLab Committee

Name	Affiliation	Role
Amelie Eriksson Karlström	KTH Royal Institute of Technology	Committee Chair and Integration Director (ID)
Afshin Ahmadian	KTH Royal Institute of Technology	Committee member
Hjalmar Brismar	KTH Royal Institute of Technology	Committee member and Scientific Director (SD)
Lucie Delemotte	KTH Royal Institute of Technology	Committee member and Fellow representative
Emma Lundberg	KTH Royal Institute of Technology	Committee member
Peter Nilsson	KTH Royal Institute of Technology	Committee member
Kevin Smith	KTH Royal Institute of Technology	Committee member
Mathias Uhlén	KTH Royal Institute of Technology	Committee member

A.

KI SciLifeLab Committee

Name	Affiliation	Role
Stefan Eriksson	Karolinska Institutet	Committee Chair and Integration Director (ID)
Lars Engstrand	Karolinska Institutet	Committee member
Carsten Daub	Karolinska Institutet	Committee member
Claudia Kutter	Karolinska Institutet	Committee member and Fellows representative
Janne Lehtiö	Karolinska Institutet	Committee member and Scientific Director (SD)
Katja Petzold	Karolinska Institutet	Committee member

SU SciLifeLab Committee

Name	Affiliation	Role
Henrik Cederquist	Stockholm University	Committee chair
Nora Bergfelt	Stockholm University	Committee member and student representative
Tom Britton	Stockholm University	Committee member
Joakim Edsjö	Stockholm University	Committee member
Martin Jakobsson	Stockholm University	Committee member
Lena Mäler	Stockholm University	Committee member and Integration Director (ID)
Berit Olofsson	Stockholm University	Committee member
Catarina Rydin	Stockholm University	Committee member
Christos Samakovlis	Stockholm University	Committee member and Scientific Director (SD)

UU SciLifeLab Committee

Name	Affiliation	Role
Eva Tiensuu Janson	Uppsala University	Committee Chair and Integration Director (ID)
Karin Forsberg Nilsson	Uppsala University	Committee member
Mathias Hallberg	Uppsala University	Committee member
Peter Lindblad	Uppsala University	Committee member
Karl Michaelson	Uppsala University	Committee member
Carolina Wählby	Uppsala University	Committee member
Anna Qvarnström	Uppsala University	Committee member
Anna Dimberg	Uppsala University	Deputy
Aristidis Moustakas	Uppsala University	Deputy
Anna Rosling	Uppsala University	Deputy
Mikael Widersten	Uppsala University	Deputy
Staffan Svärd	Uppsala University	Scientific Director (SD)
Kristina Edström	Uppsala University	Co-opted
Ann-Sophie Fröjmark	Uppsala University	Co-opted
Bengt Persson	Uppsala University	Co-opted
Ola Spjuth	Uppsala University	Co-opted
Jenny Alfredsson	Uppsala University	Co-opted, acting Head of operations

Campus Solna Committee (CSC)

Name	Affiliation	Role
Amelie Eriksson Karlström	KTH Royal Institute of Technology	Chair, Integration Director (ID)
Hjalmar Brismar	KTH Royal Institute of Technology	Scientific Director (SD)
Stefan Eriksson	Karolinska Institutet	Integration Director (ID)
Annika Jenmalm Jensen	Karolinska Institutet	Infrastructure Director
Janne Lehtiö	Karolinska Institutet	Scientific Director (SD)
Lena Mäler	Stockholm University	Integration Director (ID)
Christos Samakovlis	Stockholm University	Scientific Director (SD)
Per Ljungdahl	Stockholm University	Co-opted, Campus Solna Director (CSD)
Olli Kallioniemi	Karolinska Institutet	Co-opted, SciLifeLab Director
Eva Tiensuu Janson	Uppsala University	Co-opted, Integration Director (ID)
Staffan Svärd	Uppsala University	Co-opted, Scientific Director (SD)
Jenny Alfredsson	Uppsala University	Co-opted, acting Head of operations

SciLifeLab Data Centre Management

Name	Affiliation	Role
Johan Rung	Uppsala University	Head of Data Centre
Hanna Kultima	Uppsala University	Deputy Head of Data Centre

SciLifeLab Operations Office

Name	Affiliation	Role
Jenny Alfredsson	Uppsala University	Head of Operations (acting) and Director Office for SciLifeLab Uppsala
Sandra Falck	KTH Royal Institute of Technology	Vice Head of Operations (acting)/External relations officer, Responsible for Operation support area *External relations*
Erika Erkstam	Uppsala University	Deputy Director Office for SciLifeLab Uppsala, Manager meetingplace Navet, Project leader. Responsible for Operation support area *Events and Training.*
Maria Bäckström	Uppsala University	Coordinator
Titti Ekegren	Uppsala University	Project coordinator, DDLS
Anna Frejd	KTH Royal Institute of Technology	Communications manager, Responsible for Operation support area *Communication*
David Gotthold	KTH Royal Institute of Technology	Project leader, Communications officer
Disa Hammarlöf	KTH Royal Institute of Technology	Research coordinator, Responsible for Operation support area *Research environment*
Elvan Helander	KTH Royal Institute of Technology	Controller, DDLS
Anna Höglund Rehn	KTH Royal Institute of Technology	Administrative Coordinator, Management support
Johan Inganni	KTH Royal Institute of Technology	Communications officer
Lars Johansson	KTH Royal Institute of Technology	Infrastructure coordinator, Responsible for Operation support area *Infrastructure*
Anna Lidin	Uppsala University	Controller, Responsible for Operation support area *Finance*
Josefin Lundgren Gawell	KTH Royal Institute of Technology	External relations officer
Karin Nedler	KTH Royal Institute of Technology	Communications officer
Niklas Norberg Wirtén	KTH Royal Institute of Technology	Communications officer
Alexandra Patriksson	Uppsala University	External relations officer
Heidi Persson Törmänen	Uppsala University	Project leader, Program coordinator DDLS, Responsible for Operation support area DDLS, Responsible for Operation support area *Management support*
Alice Sollazzo	Uppsala University	Project coordinator
Jeannette Söderberg	KTH Royal Institute of Technology	External relations officer
Isabel Tengkrans	KTH Royal Institute of Technology	Controller
Ulrika Wallenquist	Uppsala University	Project coordinator, DDLS
Susanne Wikblad	Karolinska Institutet	Executive assistant/ PA to Director
Tove Alm	KTH Royal Institute of Technology	Campus Solna Facility Manager, Responsible for Operation support area *Campus Solna*
Magnus Bjurström	KTH Royal Institute of Technology	Lab coordinator, site support CS
Sara Diaz Moreno	KTH Royal Institute of Technology	Lab safety coordinator, site support CS
Malin Kardell	KTH Royal Institute of Technology	Lab coordinator, site support CS
David Meyer	KTH Royal Institute of Technology	Lab coordinator, site support CS
Pär Schött	KTH Royal Institute of Technology	Lab coordinator, site support CS
Nutcha Söderdahl Romjun	KTH Royal Institute of Technology	Lab coordinator, site support CS

A.

SciLifeLab Infrastructure

Name	Affiliation	Role
Bengt Persson	Uppsala University	Bioinformatics, Director
Björn Nystedt	Uppsala University	Bioinformatics, Co-Director and Platform Coordination Officer
Tuuli Lappalainen	KTH Royal Institute of Technology	Genomics, Director
Lars Feuk	Uppsala University	Genomics, Co-Director
Magnus Lundgren	Uppsala University	Genomics, Platform Coordination Officer
Thoas Fieretos	Lund University	Clinical Genomics, Director
Lucia Cavalier	Uppsala University	Clinical Genomics, Co-Director
Eva Berglund	Uppsala University	Clinical Genomics, Platform Coordination Officer
Masood Kamali-Moghaddam	Uppsala University	Clinical Proteomics and Immunology, Director
Elisabet Carlsohn	University of Gothenburg	Clinical Proteomics and Immunology, Co-Director
Claudia Fredolini	KTH Royal Institute of Technology	Clinical Proteomics and Immunology, Platform Coordination Officer
Anders Nordström	Umeå University	Metabolomics, Director
Thomas Moritz	Swedish University of Agricultural Sciences	Metabolomics, Co-Director
Annika Johansson	Umeå University	Metabolomics, Platform Coordination Officer
Mats Nilsson	Stockholm University	Spatial and Single Cell Biology, Director
Charlotte Stadler	KTH Royal Institute of Technology	Spatial and Single Cell Biology, Platform Coordination Officer
Marta Carroni	Stockholm University	Cellular and Molecular Imaging, Director
Ana Agostinho	KTH Royal Institute of Technology	Cellular and Molecular Imaging, Platform Coordination Officer
Göran Karlsson	University of Gothenburg	Integrated Strucural Biology, Director
Cecilia Persson	University of Gothenburg	Integrated Strucural Biology, Platform Coordination Officer
Anna-Lena Gustavsson	Karolinska Institutet	Chemical Biology and Genome Engineering, Director
Bernhard Schmierer	Karolinska Institutet	Chemical Biology and Genome Engineering, Co-Director and Platform Coordination Officer
Per Arvidsson	Karolinska Institutet	Drug Discovery and Development, Director
Kristian Sandberg	Uppsala University	Drug Discovery and Development, Co-Director
Rebecka Klintenberg	Uppsala University	Drug Discovery and Development, Platform Coordination Officer

Representative for new SciLifeLab sites

Name	Affiliation	Role
Elisabet Carlsohn	University of Gothenburg	Representative for SciLifeLab site Gothenburg
Thoas Fieretos	Lund University	Representative for SciLifeLab site Lund
Linda Sandblad	Umeå University	Representative for SciLifeLab site Umeå

SciLifeLab Fellows

Name	Affiliation
Alexey Amunts	Stockholm University
Jonas Barandun	Umeå University
Lars Behrendt	Uppsala University
Magda Bienko	Karolinska Institutet
Fabien Burki	Uppsala University
Jens Carlsson	Uppsala University
Erika Comasco	Uppsala University
Gustaf Christoffersson	Uppsala University
Sebastian Deindl	Uppsala University
Lucie Delemotte	KTH Royal Institute of Technology
Simon Elsässer	Karolinska Institutet
Olof Eriksson	Uppsala University
Daniel Espes	Uppsala University
Daniel Fürth	Uppsala University
Marc Friedländer	Stockholm University
Sarahi Garcia	Stockholm University
Daniel Globisch	Uppsala University
Jean Hausser	Karolinska Institutet
Paul Hudson	KTH Royal Institute of Technology
Kristina Jonas	Stockholm University
Oskar Karlsson	Stockholm University
Claudia Kutter	Karolinska Institutet
Yumeng Mao	Uppsala University
Adil Mardinoglu	KTH Royal Institute of Technology
Pascal Milesi	Uppsala University
Vicente Pelechano	Karolinska Institutet
Sari Peura	Swedish University of Agricultural Sciences
Iskra Pollak Dorocic	Stockholm University
Kristoffer Sahlin	Stockholm University
Mikael Sellin	Uppsala University
Erdinc Sezgin	Karolinska Institutet
Saeed Shoaie	KTH Royal Institute of Technology
Prashant Singh	Uppsala University
Tanja Slotte	Stockholm University
Alexandra Teleki	Uppsala University
Ilaria Testa	KTH Royal Institute of Technology
Anniina Vihervaara	KTH Royal Institute of Technology
Aleksej Zelezniak	Chalmers University of Technology

A.

SciLifeLab Training and Education

Name	Affiliation	Role
Jessica M Lindvall	Stockholm University	SciLifeLab training coordinator

Pandemic Laboratory Preparedness

Name	Affiliation	Role
Staffan Svärd	Uppsala University	Pandemic laboratory preparedness lead
Monica Ekberg	Karolinska University Hospital	Pandemic laboratory preparedness coordinator

Precision Medicine Panel

Name	Affiliation	Role
Päivi Östling	Karolinska Institutet	Chair
Janne Lehtiö	Karolinska Institutet	Precision medicine panel member
Petter Brodin	Karolinska Institutet	Precision medicine panel member
Åsa Johansson	Uppsala University	Precision medicine panel member

Knut and Alice Wallenberg Foundation (KAW)

Name	Affiliation	Role
Siv Andersson	Uppsala University	Head of Basic Research, KAW
Göran Sandberg	KAW	Executive Director

A.

Appendix B.

SciLifeLab Roadmap 2020-2030

B.

SciLifeLab

Towards technology- and data-driven life science

Roadmap 2020–2030

Karolinska Institutet

KTH Vetenskap och Konst

Stockholms universitet

Uppsala Universitet

B.

Roadmap approved by the SciLifeLab Board on 2020.02.06

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B.

Executive summary

SciLifeLab (Science for Life Laboratory) is a national center for molecular life science research and provides an attractive collaborative platform for cross-disciplinary research across academia in Sweden, engaging also medical, environmental, industrial and other societal sectors. In this roadmap document, we describe how SciLifeLab will leverage its national infrastructure for the benefit of Swedish research, recruitment, training, translation, innovation and utilization of life science data. This strategy focuses on what SciLifeLab can achieve together with all of its stakeholders, maximizing the capacity of the life science ecosystem as a whole.

The future role of SciLifeLab is interlinked with the increasing importance of life science in general. Life science encompasses basic research on all living species and their interactions, but is also central in medical research, healthcare, drug discovery, diagnostics, biotechnology, agriculture, forestry, biodiversity, evolution, environment, climate change and many other fields. Recent decades have witnessed a technology-driven revolution in life sciences where modern technologies (e.g. sequencing, mass spectrometry and imaging) can be broadly applied across the entire spectrum of life science. Therefore, single infrastructure technologies can benefit several organizations and disciplines and hence coordination of cost-effective and dynamic deployment of national infrastructure with high accessibility becomes critically important. At the same time, the amount of data produced from this infrastructure has exponentially increased, providing unprecedented opportunity for a deep comprehensive understanding of life, a data-driven approach to basic research, and for addressing major societal challenges. Given the trends in both technology- and data-driven science, SciLifeLab plays an increasingly important role in Sweden's ambition to be a globally leading life science nation.

As a national infrastructure, the primary mission of SciLifeLab has been to offer access to cutting-edge life science infrastructure, in support of ground-breaking life science research across Sweden. During 2020-2030, in collaboration with universities, industry, healthcare and national funding agencies, SciLifeLab will leverage its strong technology base through six strategic objectives, which synergize with each other:

Strategic objectives

1. **Provide Unique and Impactful Life Science Infrastructure.** Promote continuous development and early application of cutting-edge technologies and services to deconvolute fundamental biology, address human health and biodiversity, and thereby enable research that otherwise would not be possible in Sweden.

2. **Develop World Class Research Capabilities and Research Communities.** SciLifeLab will bring together national communities to enable new technology- and data-driven life science research. We will engage in multidisciplinary research programs on: i) data-driven cell biology, ii) data-driven research on individualized health, as well as iii) data-driven research on biodiversity and evolution.

3. **Create a National Framework for Data-Driven Life Science.** Coordinate a national framework for life science data management, meeting the requirements of tomorrow's open, real-time data sharing and data cycles.

4. **Attract Scientific Excellence and Provide Advanced Training.** Provide an attractive environment for recruitment of top international competence, and focus on advanced educational and training initiatives for a new generation of young scientists in technology- and data-driven life science.

5. **Promote Collaborations Across Sectors and Borders.** Promote collaboration and knowledge exchange between different sectors of society and individual organizations, many of whom would not otherwise interact, with the intent of increasing interdisciplinary research, mobility and international visibility.

6. **Build Translational and Innovation Capabilities.** Develop translational capabilities in diagnostics and drug development in collaboration with biobanks, healthcare and industry, promoting medical breakthroughs and enabling innovation in healthcare.

About SciLifeLab

Ten years ago, through strategic research funding (SFO) to its host universities (KTH, KI, SU, UU), the foundation of SciLifeLab was laid as a strategic research collaboration in life science. In 2014, SciLifeLab was appointed as a national life science research infrastructure by the government (*Förordning* 2013:118), with funding dedicated to make the infrastructure accessible nation-wide. SciLifeLab is governed by a national board, which represents the host universities, other universities, as well as industry. SciLifeLab host universities manage their research contributions via local SciLifeLab committees. A National SciLifeLab Committee representing other Swedish universities and stakeholders contributes with a national perspective to the operations. SciLifeLab's International Advisory Board ensures that SciLifeLab evolves in accordance with international trends and developments.

SciLifeLab today is a national resource with established operations across Sweden (Figure 1). The infrastructure and expertise at SciLifeLab provides unique capabilities within a multitude of molecular technologies such as genomics, proteomics, metabolomics, imaging, microscopy, structural biology, bioinformatics, single cell biology, chemical biology and gene editing. There are dedicated infrastructure platforms for diagnostics development and academic drug discovery, promoting translation and innovation. Both the technologies and the dedicated expertise available within SciLifeLab are available to all researchers throughout Sweden, including researchers active in the private sector, healthcare and other research entities. Today, there are over 400 staff active at SciLifeLab's infrastructure facilities, supporting over 1300 unique users and 3000 projects annually. Over half of these users are located outside the host universities, a testament to SciLifeLab's national accessibility and its successful implementation as a national research infrastructure. Importantly, the technologies provided are broadly applicable across the entire life science spectrum, supporting users from sectors outside of academia such as healthcare, industry, museums and other research institutes. In Stockholm, SciLifeLab-associated researchers and facilities are concentrated at Campus Solna, where some 600 scientists from the three Stockholm universities are co-located. In Uppsala and elsewhere, SciLifeLab activities are integrated within various established university departments.

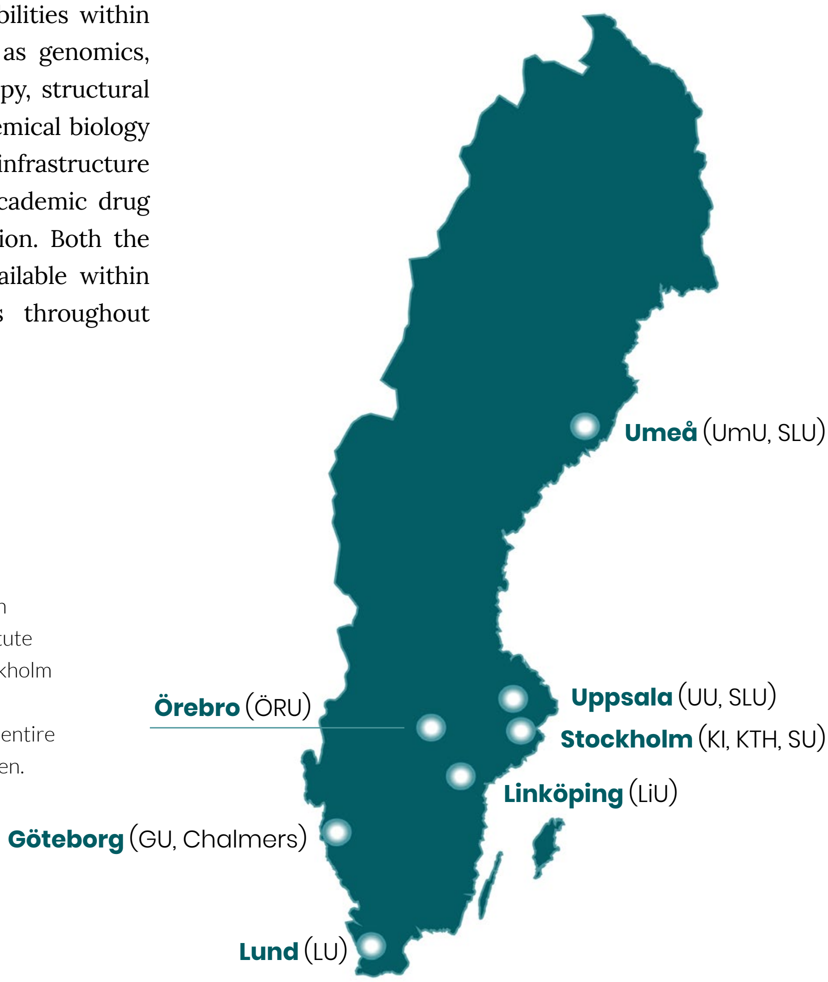


Figure 1. SciLifeLab is a national research infrastructure hosted by KTH Royal Institute of Technology, Karolinska Institutet, Stockholm University and Uppsala University, and developed in close collaboration with the entire academic life science community in Sweden.

B.

Life Science 2020-2030

The future role of SciLifeLab needs to adapt to the global changes that are currently underway as well as those anticipated in life science as a whole. Life science is in the midst of a technological and digital revolution that will have a major impact on basic research, biotechnology, medicine and health, environmental science and many other fields. Concepts that until recently were considered science fiction – rapid and affordable whole genome sequencing, proteome profiling, gene editing, single cell biology, super-resolution imaging, systems biology, "big data" and artificial intelligence – are providing unprecedented opportunities for understanding the molecular complexity of life. The development of new technologies and the complexity and amount of data are only likely to increase in the future. On top of major opportunities in fundamental science, we face major societal challenges, as outlined in the UN Global Sustainable Development Goals [1] – a rapidly aging population, rising healthcare costs, environmental degradation, climate change, and lack of access to sustainable energy, food, clean air and water. How these challenges are tackled will have a broad and deep impact on our society in the future.

SciLifeLab's future strategy will consider developments in national research policy and Sweden's competitiveness internationally. In 2019, the Swedish government outlined a national life science strategy, defining eight priority areas for the development of Swedish life science in the future, with the ambition of making Sweden a leading life science nation[2]. Many of the priority areas indicated concern healthcare only, but they do overlap significantly with SciLifeLab's ambitions for the future (Figure 2). SciLifeLab can play a particularly important role in achieving the national strategy as outlined in priority area 6 – *Research and infrastructure*.

In order to perform cutting-edge research across the entire spectrum of life science, access to the latest advanced molecular technologies and expertise is necessary, along with the computational methods and e-infrastructure required to process the huge amounts of data produced. SciLifeLab technologies have already had a major impact on Sweden's ability to deliver life science research of the highest international quality. This roadmap proposes an ambitious new vision for SciLifeLab towards the next decade (2020–2030), with the intention of further strengthening Sweden's position within advanced research infrastructure, interdisciplinary research, collaboration, translation and innovation, and recruitment of the best talent. Our ambition is to increase quality and international competitiveness of Swedish research through continued efforts on technology-driven infrastructure, as well as a new focus on data-driven life science.

1	Structures for collaboration
2	Utility of healthcare data for research and innovation
3	Responsible, safe and ethical policy development
4	Integration of research and innovation in healthcare
5	Welfare technology for increased independence, inclusion and health
6	Research and infrastructure
7	Recruitment, talent attraction and life-long learning
8	International attractivity and competitiveness

Figure 2. Priority areas in the Swedish governmental life science strategy (translated from Swedish).

[1] https://sustainabledevelopment.un.org/

[2] En nationell strategi för life science, Regeringskansliet, artikel nummer N2019.06

SciLifeLab Roadmap 2020-2030

Our mission and vision

The overall *mission* for SciLifeLab is to enable life science research in Sweden that is beyond what is possible for an individual researcher, an individual university or an individual research discipline. By providing access to the latest key technologies, SciLifeLab's infrastructure creates prerequisites for research and conceptually new forms of collaboration between individuals, groups and organizations.

Our vision is for ***Sweden to be a world-leading nation in life science.***

Our strategic objectives

Maintaining and developing the national research infrastructure and associated services is SciLifeLab's most important task and the foundation upon which other objectives are developed. The infrastructure enables and supports strong research capabilities and research communities, while new research discoveries and methodological innovations develop the national infrastructure in a reciprocal manner. This synergistic environment of infrastructure and research, when supported by a national framework for efficient data management, enables recruitment of international expertise, creates new opportunities for collaboration, and catalyzes translation and innovation (Figure 3).

Our values

The following statements encapsulate SciLifeLab's core values and define the manner in which we will achieve our mission to the Swedish life science community.

- *Our national infrastructure aims to strengthen and empower life science research across Sweden and across all sectors of life science.*
- *We are dedicated to advancing and disseminating knowledge in technology- and data-driven topics in life science.*
- *We strive for excellence, reproducibility and integrity of our research as well as open accessibility and dissemination of data, methods and results.*
- *We prioritize recruitment, training and career development of the best scientific talent, particularly young scientists.*
- *We facilitate collaboration across universities, disciplines, organizations and society sectors.*
- *We welcome diversity of individuals, opinions and experiences in a community of scientific excellence.*

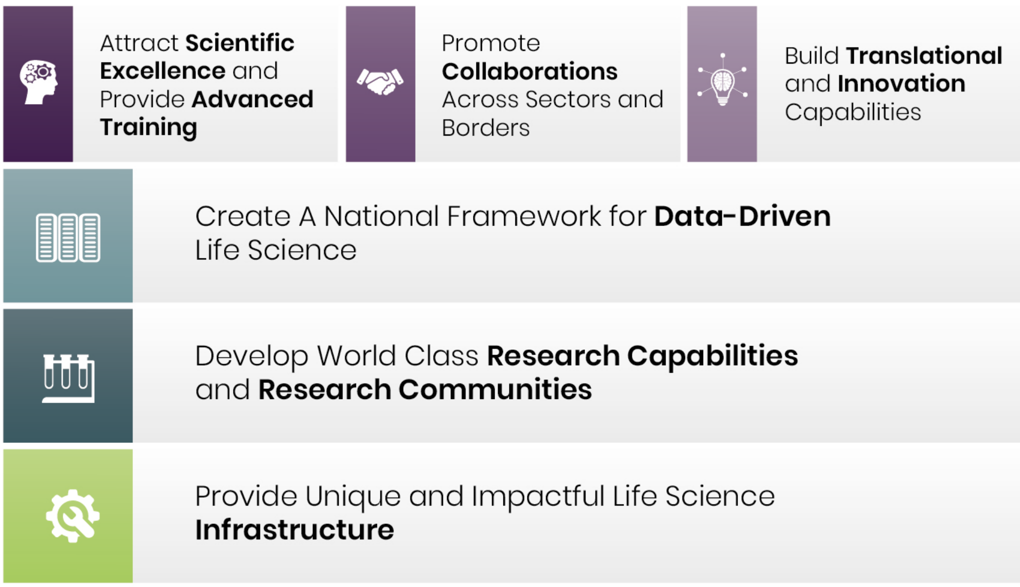


Figure 3. SciLifeLab's strategic objectives 2020–2030.

Strategic objective 1

Provide Unique and Impactful Life Science Infrastructure

We intend to continue development and coordination of the most relevant and advanced life sciences infrastructure and its availability for researchers throughout Sweden (Figure 4). The infrastructure should be i) unique and cutting-edge, ii) accessible and relevant to a large number of national users, iii) synergistic with other strategic research and infrastructure initiatives, iv) embedded in an excellent research environment, and v) utilize the best expertise available in the country. We will promote application of multiple SciLifeLab technologies and platforms and integration of associated data both within individual projects and in key strategic and/or translational initiatives. There is an increasing need to achieve a holistic understanding of life through the use of many new and established technologies as well as integration of the data acquired.

Evolving and continuously optimizing the role of national life-science infrastructure

Building on the current infrastructure platforms, we will initiate new platforms and facilities as technology evolves and needs arise. Recurrent international evaluation every four years will ensure consideration and prioritization of cutting-edge technologies and capabilities of broad national interest. Technologies will take advantage of regional strengths and be supported where the best expertise in Sweden is available. This can take place as: a) a single dedicated national site, b) a hub/node model with a primary national hub and other sites providing collaborative expertise, or c) as an integrated network of nationally distributed facilities (Figure 5a). While we will ensure that the infrastructure evolves, we also need to secure sufficient focus and sustainability to create an internationally competitive mass of expertise in each field, given available funding. We will link to, but not duplicate, compete, or overlap with, local university infrastructure, international research infrastructures, and infrastructure provided through commercial sources (Figure 5b).

Improving life cycle management of the infrastructure

The process of how facilities and platforms are managed, launched and operated is already established around the 4-year international review-cycle. Given the rapid developments in life science, we will continue to develop the SciLifeLab infrastructure life-cycle, from early-stage technology development, scaling-up services from local to national scale, equipment renewals and upgrades, good infrastructure practice, training, strategic collaborations as well as translation and national dissemination (Figure 6).

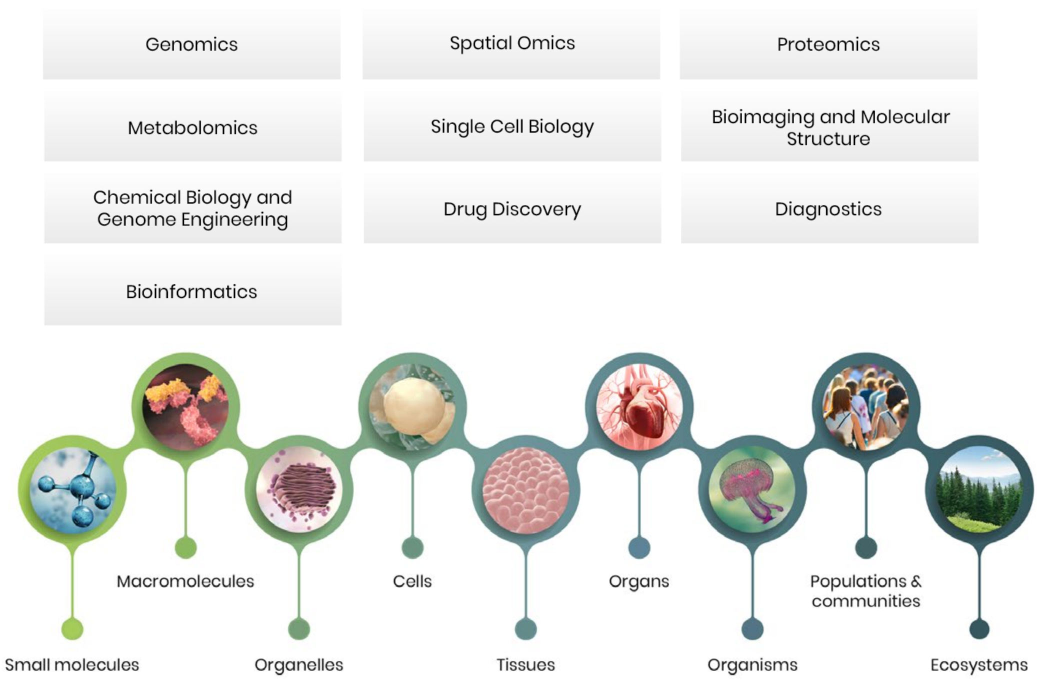


Figure 4. The SciLifeLab infrastructure service areas are provided as illustrated above (status of the infrastructure in 2019). SciLifeLab's technologies can be used for studying the molecular aspects of life ranging from the atomic scale up to entire ecosystems, and are available to all researchers in Sweden on equal terms and are applicable across a large spectrum of disciplines and research fields in life science.

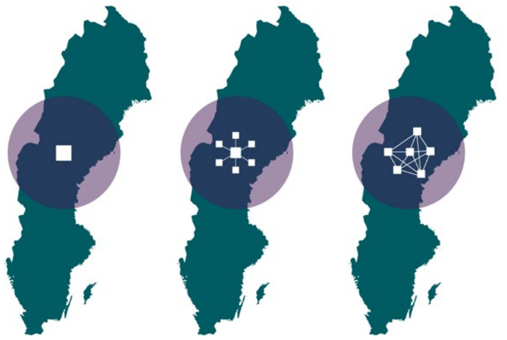


Figure 5a. SciLifeLab's infrastructure is operated in the most suitable format, depending on each platform, either as a single site (left), hub-and-node (center) or distributed network (right). The most appropriate and efficient model chosen may change over time depending on technology maturation, expense and expertise required, sample handling and other factors.

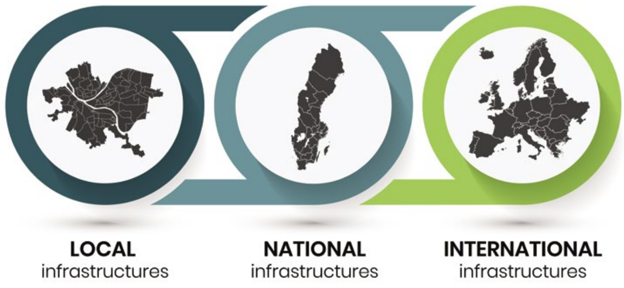


Figure 5b. SciLifeLab´s infrastructure is linked to local, national and international research infrastructures (academic and industrial).

Technology Development Projects (TDPs) will be funded to support infrastructure evolution within existing facilities and platforms as well as new openings. This continuous cycle is critical for agile responsiveness to new developments and will be coordinated through international evaluation, dialog and interaction with the National SciLifeLab Committee, International Advisory Board, host universities, our user community from all sectors and other key national stakeholders (e.g. URFI, KAW and VR-RFI).

Transitioning from facility-centric to platform-centric infrastructure

SciLifeLab has funded and managed about 40 independent facilities at any point in time. While this has worked well, similar services may arise and be offered by multiple facilities, resulting in redundancy. It has also been challenging for some users to find the most relevant technology for their research or to combine data from multiple facilities. We will gradually evolve this facility-based management model towards a platform-centric model, where individual facilities belong to a national platform, covering multiple related and often synergistic technologies. A part of national funding is directed through the platforms and through transparent processes based on expertise, objective demands and opportunities. Facilities and technologies within a platform can then evolve more rapidly as part of a larger context. Our aim is that platforms can guide users more efficiently towards the most relevant technologies and also increase the synergy between technologies.

Promoting Good Infrastructure Practice

We have established clear guidelines and expectations for what is required to be funded as a national SciLifeLab facility. Maintaining standards for Good Infrastructure Practice

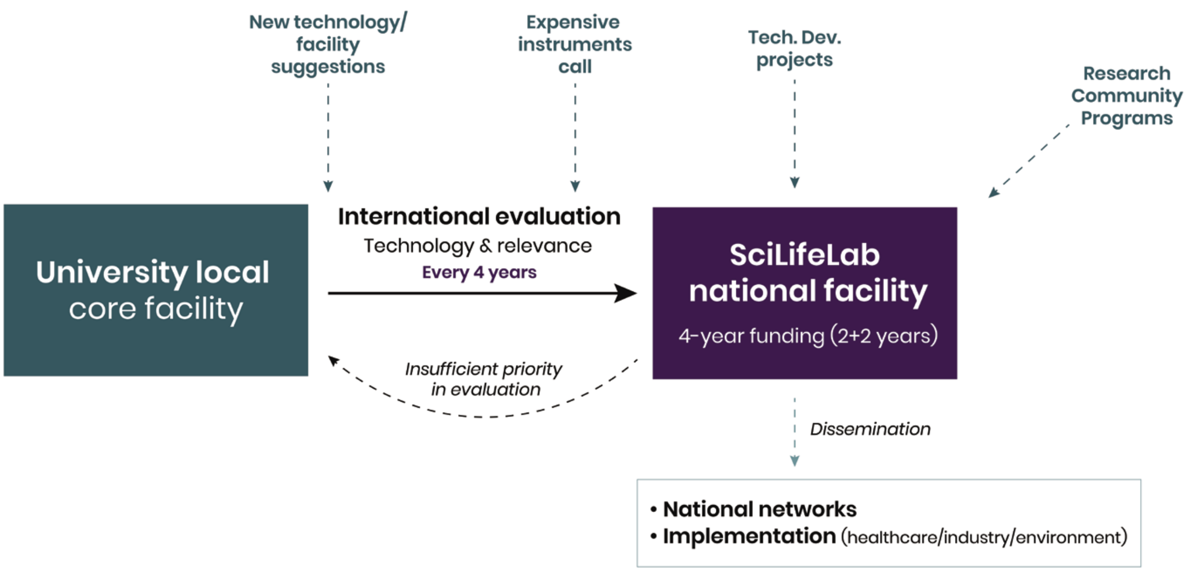


Figure 6. Processes for continuous development of the SciLifeLab infrastructure.

guarantees the highest level of quality, reproducibility, transparency and delivery in our operations and the data produced. These criteria will be enforced for all national SciLifeLab facilities, ensuring broad accessibility, quality and integrity of data. We will develop best practices on infrastructure management across our diverse infrastructure and share assets, such as software tools, data pipelines, and management of user needs in between the facilities, platforms and host universities.

Increasing national awareness of SciLifeLab infrastructure

We will increase national awareness of the capabilities that SciLifeLab infrastructure can provide to diverse research disciplines within academia, industry, healthcare, museums, environmental agencies and other applicable research organizations. Communication of SciLifeLab as a national resource will be achieved through dedicated events, visits, workshops, personal interactions and improvements of the SciLifeLab web page as a gateway to the facilities. We intend to set up local SciLifeLab "nodes" that may include an office, a contact point, advice and other functions at all Swedish major universities for guiding new users and promoting research collaborations. The current well-functioning bioinformatics help desk will be used as a base and as a model.

Promoting career development of infrastructure scientists

Key to SciLifeLab's success as a research infrastructure is the dedication and expertise of our outstanding staff scientists, who guide users towards application, disseminate knowledge to the community and develop technological advances. The increasing importance of these individuals in competitive research environments cannot be understated. However, their career development opportunities are often not aligned with traditional career paths within academic environments. In close dialogue with the universities where all staff are employed, we intend to design more predictable and attractive career paths for these infrastructure scientists, such as specialists and technical experts, who require more transparent professional development opportunities and continuous education and training. In addition, staff scientists ensure that we promote rapid adaptation of new technologies from international laboratories across the world, hence there is increased need for short-term visits, education, training and sabbaticals for staff.

Strategic objective 2

Develop World Class Research Capabilities and Research Communities

Infrastructure is an integral part of an excellent research environment, and conversely, an active research community is vital for the long-term development of world-class infrastructure (Figure 7). Research infrastructure that is not deeply embedded within an outstanding research community runs a significant risk of becoming rapidly outdated. National infrastructure should therefore be connected with excellent research environments in a multi-disciplinary setting. For example, the research environment at SciLifeLab has been key to aspects of new technology development, supported by the TDPs, which has ensured a flow of new capabilities for the national infrastructure.

Closer interaction of research and infrastructure, with distinct funding

While we want to continue to promote close links and interactions between research and infrastructure, it is important to distinguish that research performed in the SciLifeLab community is supported by a variety of dedicated university or external funds to specific research areas, while the national SciLifeLab infrastructure funding is dedicated to infrastructure services accessible widely throughout Sweden and across all research areas. We will further enhance our established research sites at SciLifeLab Campus Solna (KTH, SU and KI) and in Uppsala to create

Figure 7. The synergistic interplay of world-class research and cutting-edge infrastructure guarantees the best prerequisites to perform top level science and for continuous development of new technologies within SciLifeLab platforms.

collaborative research environments of excellence linked to the national infrastructure. Another initiative where strategic research is linked to SciLifeLab is the Wallenberg Centers for Molecular Medicine (WCMM) at Linköping, Umeå, Gothenburg and Lund Universities which together with SciLifeLab infrastructure and research form the National Molecular Medicine Program (NMMP). SciLifeLab will be keen to engage in other national collaborative initiatives and networks and will launch national research programs in three data-driven life science areas (see below).

Implementing the SciLifeLab Group Leader concept

We have defined criteria and expectations of a SciLifeLab Group Leader, a term that has so far been defined differently by different universities. The new definition will be implemented nationally across all universities and will be applicable for principal investigators (PIs), senior researchers and team-leaders in technology and data infrastructures. This concept defines the national SciLifeLab research and technology community and will help to build the research environment where new PIs and SciLifeLab fellows are recruited and where postdoc and PhD recruitments and training will take place (see strategic objective no. 4).

Building strong national research environments linking infrastructure with excellent research communities

We will continue and expand the recently-initiated SciLifeLab Research Community Programs (RCPs) and other efforts to promote interactions among selected research communities that share interest in common technologies or research areas. These efforts will extend SciLifeLab's impact by not just serving individual scientists one-at-a-time, but by providing a network of scientists with similar interests who can share best practices, expertise, ideas, seminars and events and who will collaborate both among themselves as well as with the infrastructure. This provides SciLifeLab also formal access to the vast research expertise available in the greater Swedish scientific community.

Launching new research programs on data-driven life science (DDLS)

SciLifeLab will continue to bring technology-driven opportunities to all scientists in Sweden, and facilitate formation of strong collaborative communities in selected research fields. Going forward, we see that there are major opportunities for SciLifeLab to engage in strategic collaborative research programs in data-driven life science. DDLS implies how data will assume an ever-increasing and central place in life science.

The practice of life science is more and more data-dependent, the amount of data grows exponentially, but also becomes more complex, continuous, and needs to be openly available accessible and reusable in real-time to all. In the planning of any aspect of life science, be it research projects, infrastructure investments, education, career development, translation, societal impact or other, we will need to put data in the forefront. DDLS implies a comprehensive approach to data generation with clear strategies for what data sets to collect, how the data should be curated, analyzed and made available to the community, and how we derive life science knowledge from both newly-generated and existing data sets.

DDLS is not an alternative to hypothesis-driven science, but will help scientists to define research hypotheses better based on the previous data available locally or globally. Hence, every biologist needs to be able to better analyze and interpret data patterns, and integrate their own data seamlessly with the global life science data streams. DDLS is a paradigm shift already today, but over the next 10 years, the concept will substantially evolve and penetrate as a central theme in advanced training and education, reshaping research traditions, and practices on publication. Progress in science will evolve around the production, availability and analysis of openly available science across the entire life

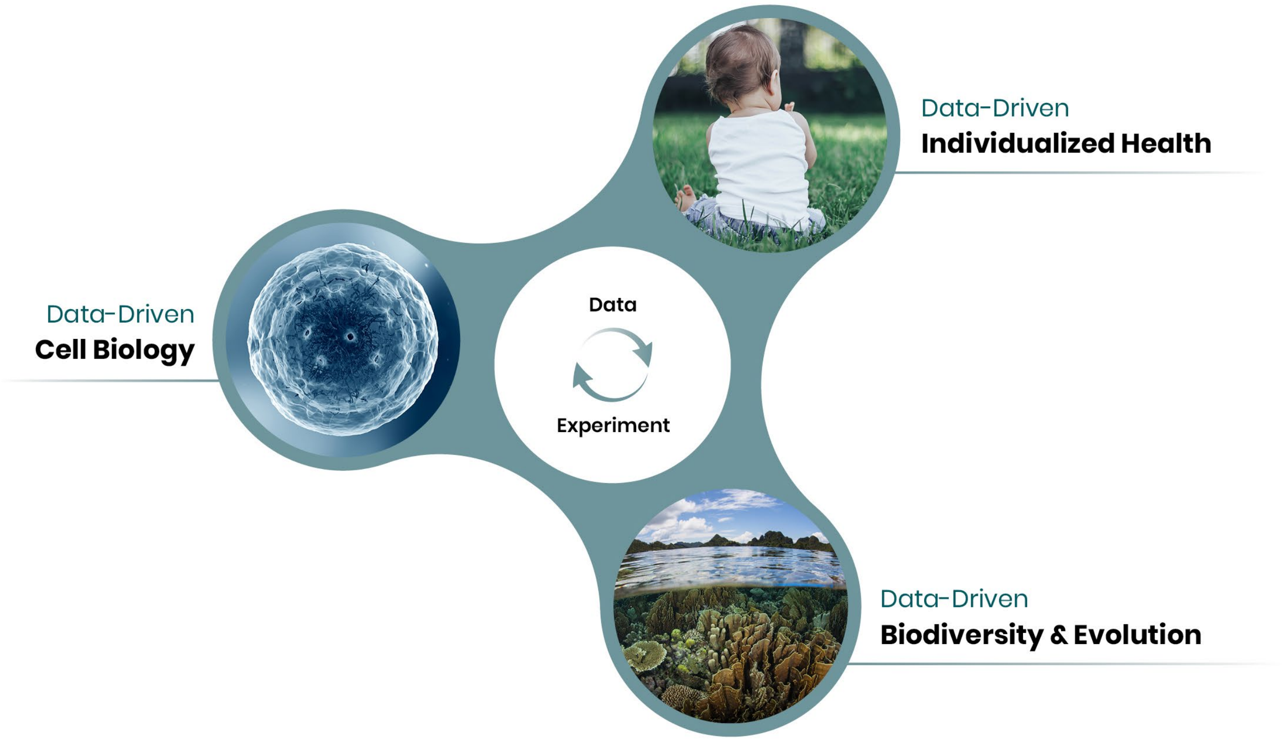


Figure 8. Focus areas for SciLifeLab data-driven life science Data-driven cell biology (DDCB), Data-driven individualized health (DDIH) and Data-driven biodiversity and evolution (DDBE)

B.

science domain, with the latest tools in data science, such as modeling biological networks, machine learning and AI.

The DDLS program will promote all these developments. It will be national in scope and strongly aligned and making use of national initiatives in computational science, such as the Wallenberg Artificial Intelligence, Autonomous Systems and Software Program (WASP), AI centre in Lindholmen Science Park, high-performance computing facilities, the potential for quantum computing and other major technology advances, as well as with SciLifeLab data science and national and international bioinformatics expertise (e.g. SciLifeLab Data Centre, the bioinformatics platform, European Bioinformatics Institute (EBI), the European Life Science Infrastructure Initiative ELIXIR and other communities). We will also partner with major international data science initiatives.

We hope to create an extremely strong computational and data science base for the DDLS initiative. In terms of application areas, we are planning the following three broad data-driven application areas for DDLS (Figure 8), including collaborations across these three topics.

Finally, it will be necessary to set up a program to explore the ethical, legal and social implications (ELSI) of DDLS, both from the angle of human health, but also biodiversity, environment and other sectors of society.

Data-driven cell biology (DDCB)

The cornerstone of life science research is deep understanding of the molecular mechanisms and components of the prokaryotic and eukaryotic cell. Breakthrough technologies, such as single cell sequencing and proteomics technologies or microscopic and imaging technologies in terms of multiplexing, increasing resolution and live imaging, are helping to launch a new era of cell biology. Individual cells can be systematically characterized, visualized with unprecedented detail, and their interactions explored continuously and in real-time. Data from e.g. the Human Protein Atlas and the international Human Cell Atlas initiative, have already contributed to major international resources. Going forward, we will see real-time, increasingly automated, exploration of cell responses to a variety of stimuli and perturbations, such as genes, proteins, biologicals, chemicals, drugs, environmental substances etc. This will lead to comprehensive datasets and resources as well as better understanding on how cells function and react to their environment, eventually leading towards mathematical models predictive of cellular functions. Therefore, DDCB program will promote initiatives to create strong research environments, advanced multidisciplinary training and research efforts that place Sweden at the global forefront in next-generation data-driven cell biology research.

Data-driven individualized health (DDIH)

Genomics, transcriptomics, proteomics, metabolomics, microbiomics, single-cell profiling and many other new technologies will continue to enable massive amounts of informative data on human molecular health to be collected. This can be applied to explore human development and aging, life style changes, environmental exposures (exposome), transitions from health to disease as well as follow up of medical treatments. Understanding variability across individuals and finding individualized aging and disease trajectories will create new opportunities for sustaining health, preventing and diagnosing disease as well as for precision treatments. DDIH will enable a strong base for drug development in rare diseases and in disease subgroups defined by pathogenetic mechanisms. We will anchor DDIH initiatives with other Swedish, Nordic, EU and global efforts (e.g. Genomic Medicine Sweden (GMS), ELIXIR, 1 Million genomes initiative, Global Alliance for Genomics as well as phenotypic profiling efforts). DDIH initiative will also promote comprehensive collection and sharing of open, but privacy-protected data over time from research subjects and patients for use in machine learning and AI-based diagnostics. We wish to advance data-driven health interventions and clinical trials. New collaborative team-science studies on the same cohorts are needed to apply a range of methods systematically and over time, sharing the data, even in real-time. This would create major synergy as compared to the current extremely scattered medical research initiatives where data is often impossible to integrate. We will provide training and education on individualized health to students, scientists, medical professionals, decision makers and the public. The DDIH program will promote prevention and prediction of disease, such that people could in the future make real-time data-driven decisions of their own health. These types of proactive changes would be needed to increase the cost-efficacy and long-term sustainability of healthcare.

Data-driven biodiversity and evolution (DDBE)

We will intensify SciLifeLab's engagement in research on biodiversity, evolution as well as research on the impact of the environmental and climate change on global and local ecosystems. Using the latest technologies, we will promote systematic studies of ecosystems at multiple levels and over time. We will engage in partnerships with universities, infrastructures, environmental agencies, natural museums and others to take DDBE towards practical applications in evolution, biodiversity, molecular ecosystem monitoring and impact of climate change. We will anchor the DDBE initiative with major national and international research programs and biodiversity initiatives, such as the Earth BioGenome project. DDBE will go beyond existing initiatives to engage in data-driven analysis and modelling of the functional diversity of life on earth, analysis of evolutionary processes and time-trends. DDBE will match the data from functional studies of experimental ecosystem models in the laboratory with data streams from natural ecosystems over time to create data-driven predictions and deeper understanding of ecosystem changes. DDBE will undertake advanced training of a new generation of scientists in these emerging fields.

Strategic objective 3

Create A National Framework for Data-Driven Life Science

We envisage that future life science research is increasingly not only technology-driven, but also data-driven, as illustrated by SciLifeLab's three major data-driven research strategies. Throughout the life cycle of data, from project planning, data production, data analysis, data sharing, to publishing and reuse of data, researchers are dependent on advanced data analysis and e-infrastructures (Figure 9). SciLifeLab will take a lead in coordinating and supporting such activities, focussing on data arising from the use of SciLifeLab infrastructure platforms, both to promote research on adding value to data, research deriving biological knowledge from data, and infrastructure making data findable and available.

Data represents the most valuable and long-lasting products of SciLifeLab and we must ensure that it is handled according to FAIR criteria, open science standards and that its long-term value to the scientific community is maximized. We hope to collaborate with users of the infrastructure so that SciLifeLab can provide metadata and eventually full access to

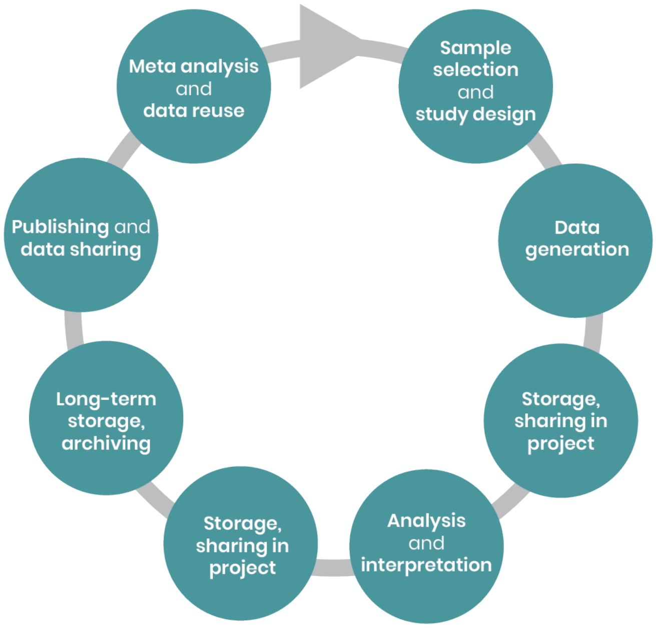


Figure 9. The flow of data in a cycle from production to analysis, sharing in projects, publication and re-use to initiate new studies characterizes data-driven life science.

all data generated through a dedicated access system, with curated systematic annotations. We want to promote not just open, but rapidly available, sometimes real-time access to data, but also access to analysis pipelines, algorithms, and software for data analysis. SciLifeLab's Data Centre and bioinformatics platform NBIS will increase coordination with other national stakeholders, such as universities and e-infrastructures, to build a national framework for data-driven life science. Transition towards data-driven life science is a major paradigm shift, and we envision substantial need for educational, training and collaborative programs with universities, research funders and the government. We will also support education and training on the ethical, legal and social implications (ELSI) of this work.

Strengthening IT for SciLifeLab's data production platforms

Swedish universities and e-infrastructures already provide IT services, including compute and storage solutions for individual researchers. In order to provide IT solutions that SciLifeLab's data-producing platforms require, we will efficiently utilize existing resources and push for new IT development that is aligned with the requirements that we expect will develop within the SciLifeLab infrastructure (Figure 10). This will be done together with Swedish universities and national e-infrastructures and in alignment with Nordic and international standards.

Providing services and infrastructure for data-driven life science

Data produced at SciLifeLab is governed by the university or the organization that hosts a research project. SciLifeLab will provide additional data stewardship, services and infrastructures that enable large-scale, complex and high impact data-driven projects that would otherwise not be possible. This will include hosting of data repositories, added-value databases, visualization and analytics, meta-data services through interaction with SciLifeLab data stewards, and facilitation of data publishing in international repositories using automated pipelines. Researchers will also need support and services to comply with international standards for data sharing, such as the FAIR principles and GDPR, and to improve the reproducibility of published results.

The ability to access and re-use data is central to data-driven science. In particular, this is of high importance for cross-disciplinary research such as the development and application of new AI-based methods. This will require high quality reference datasets and establishment of collaborative opportunities and relationships with national AI initiatives such as AIDA, WASP and AI Innovation of Sweden.

Developing processes for safe, secure and ethical way of handling sensitive data

SciLifeLab will build on our already strong international network of services, standards and infrastructure providers such as EMBL-EBI, ELIXIR, Global Alliance for Genomics and Health, and many others to develop services and resources for sensitive or confidential data. Such data, for example whole genome sequencing data from humans, have special demands on access control and data protection. Increased effort for sensitive data will support applications in healthcare and industrial collaborations in a safe, secure, ethical and responsible way. In particular, this will be required for data-driven precision medicine and to support large scale initiatives like the 1+ Million Genomes Project, where Sweden is one of 20 European nations committing to large scale human genome sequencing to improve health.

SciLifeLab will also engage in the development of national health data repositories as being developed within Genomic Medicine Sweden and act as a federated source for international initiatives such as the Nordic Commons digital infrastructure development and the European Open Science Cloud (EOSC). We will follow ongoing international research efforts on de-identifying data while still retaining sufficient information to perform research; this is critical for deep-learning applications in healthcare.

Simplifying access to services through data-centric integration

Researchers should be able to access SciLifeLab services and infrastructure in simple ways that best serve their research projects, without needing to know the details of the SciLifeLab infrastructure organization. Using a data-centric approach for infrastructure operations and a common project portal, we will improve how researchers can access services as well as track, edit, annotate and store information from all their SciLifeLab projects across all platforms.

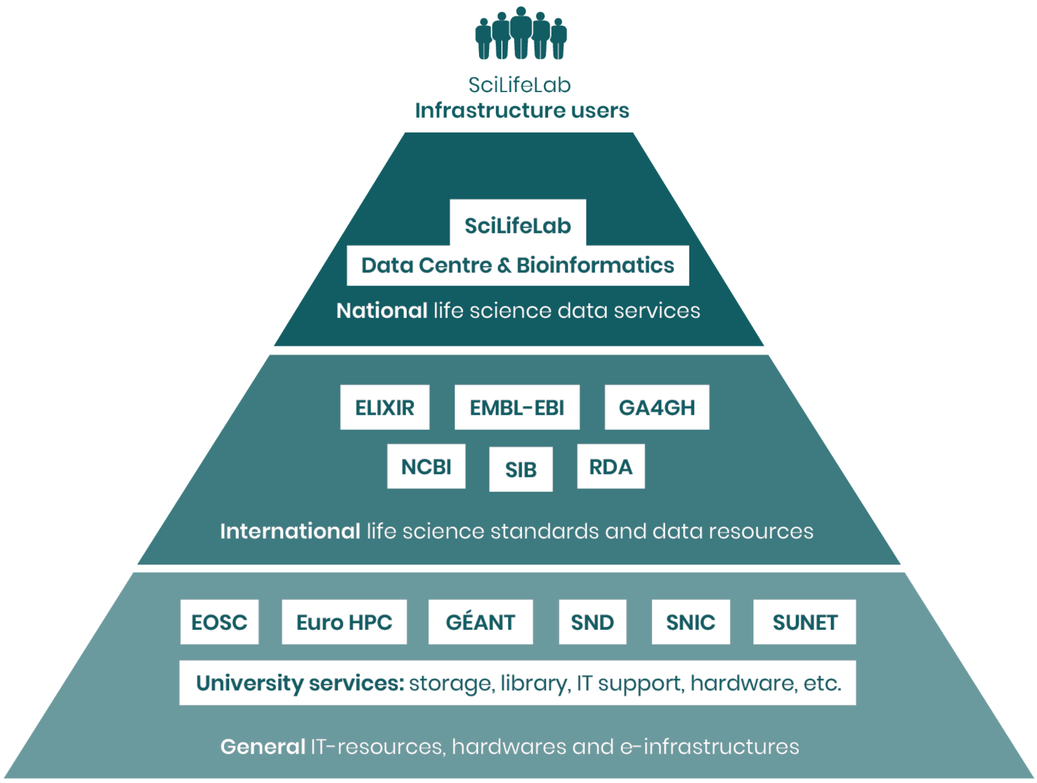


Figure 10. SciLifeLab provides life science specific services to its infrastructure users primarily by utilizing national and international general IT services and e-infrastructures (bottom level) and international life science data resources and standards (second level). All abbreviations explained on page 21.

Strategic objective 4

Attract Scientific Excellence and Provide Advanced Training

The quality of research performed in Sweden is highly dependent on the talent that we can attract and retain in our country and on the ability of individual researchers to keep up to date with the latest technologies, major research transitions and new capabilities in data-driven science. We will support a number of initiatives to help create excellent international life science research environments that attract talent to Sweden, and will help to retain, renew and expand critical expertise.

International recruitment of young PIs: Next-phase of the SciLifeLab fellows' program

SciLifeLab's host universities have recruited around 30 internationally renowned young researchers to start their academic careers in Sweden (mostly in Stockholm and Uppsala via SFO funding) as part of the SciLifeLab Fellows program. The success of the program (six years support for a position, including generous start-up funding) has already become apparent through the large number of grants and awards that these young talented group leaders have received, including many ERC starting grants. This program will continue, depending on host universities ability to support it through strategic research funding, and will collaborate with similar efforts at other universities, such as the national WCMM program. The new research program on data-driven life science is expected to also involve recruitment of young PIs across Sweden. Finally, we also plan to attract senior, internationally accomplished scientists either as permanent or part-time/visiting faculty in the SciLifeLab community within technology- or data-driven themes.

Building attractive research and training environments

Considerable effort will be placed on developing attractive research and training environments at the main SciLifeLab sites in Solna and Uppsala as well as nationally. This will involve building an engaging research community, seminar series, mentoring programs and other activities, as well as ensuring access to equipment and infrastructure to young PIs and fellows. This has already started in the Campus Solna site, where a dedicated Campus Solna Director position will be established in 2020. The Campus Solna Director will focus on improving the research environment and interactions within the SciLifeLab site in Stockholm.

Launching a program on advanced training and education in technology- and data-driven life science

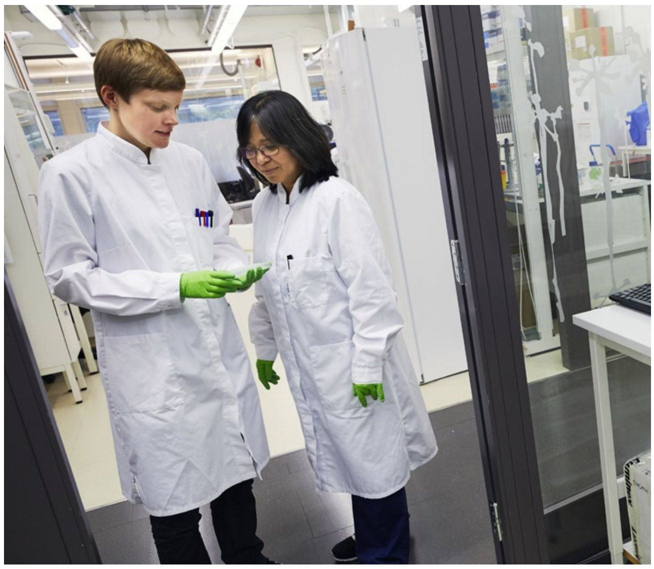
SciLifeLab platforms have been very active in organizing national courses in technology and data-centered topics for the user community. Over the past decade, 100s of events have been organized and 1000s of researchers have gained insights on recent technology developments in life science, promoting continued and life-long learning for scientists in Sweden. These activities will continue, linking up and highlighting the latest technologies. We will also build a new training program in data-driven life science.

Launching postdoc & PhD student programs

SciLifeLab host universities have operated their own SFO-funded postdoctoral programs aiming to e.g. unite researchers within their university with technology facilities. As part of the plan for the data-driven life science focus, we plan to launch a postdoctoral program as well as a graduate student programs and educational initiatives. Here, in order to focus on training of next-generation scientists, we will consider a national program with extensive course work and multi-disciplinary training initiatives involving both life science and computational topics. The postdoc and PhD programs may also involve systematic international recruitment, rotations and exchange as well as joint supervision across universities and disciplines.

Spreading knowledge beyond academia

Increasing the knowledge of SciLifeLab's capabilities is important to industry, healthcare and other sectors of society, which are not as connected with the latest developments within the global academic community. We will increase the dissemination of new technology applications and scientific areas to the broader community and the public in order to increase national awareness of life science and promote STEM research to a new generation of students in Sweden.



Strategic objective 5

Promote Collaborations Across Sectors and Borders

Addressing the grand challenges of life science demands the collective effort of the entire life science community, including increased collaboration between disciplines and different sectors in society. SciLifeLab's role is to promote new paradigms for collaboration and interdisciplinary research that would not otherwise happen, such as across universities and across disciplines. For example, utilizing multi-omics research and data and continuous monitoring of health transition in medicine, utilization of machine learning and artificial intelligence in data-driven research on biodiversity and environment, or linking genetic markers of tree populations to advances in materials science and forestry. National research infrastructures present an ideal environment for serving as a hub for interdisciplinary collaboration, as well as partnerships between academia, industry, healthcare and the global research community.

Increase coordination with other national infrastructures and associated initiatives

SciLifeLab technologies are complementary to university core facilities, other national research infrastructures and strategic research initiatives in life science. Examples include structural biology and imaging facilities (e.g. MAX-IV, ESS), healthcare infrastructures (e.g. Genome Medicine Sweden, biobanks, quality registries), environmental infrastructure initiatives (Swedish Biodiversity Infrastructure and Swedish Infrastructure for Ecosystems Science), protein production and purification centers (e.g. GE Testa Center) and initiatives within artificial intelligence (e.g. WASP, AIDA and AI Innovation of Sweden). SciLifeLab will complement and collaborate with these strategic research initiatives, launch joint research efforts, promoting interdisciplinary science and thereby leverage Sweden's combined national infrastructure.

Promoting access of SciLifeLab infrastructure to industry, healthcare and environmental research

We will increase awareness of SciLifeLab's infrastructure and associated research community to sectors outside of academia. SciLifeLab will, together with our host universities, engage with the government and other public entities to improve industrial collaborations with academia, interactions with healthcare and environmental research, as well as increased focus on open data and its utilization. SciLifeLab will focus on creating the best possible prerequisites for cross-sector collaboration, particularly in areas that are currently underrepresented in the SciLifeLab community.

Creating an ideal multi-university environment for collaborative technology development and testing

As a technology-centric organization connected to several universities, SciLifeLab provides an attractive collaborative environment for technology development and early testing and adaptation, both within academia and between academia and industry. Many of our facilities embark on long-term collaborations in technology development with companies, including development of test-bed environments and designation as reference laboratories for industry partners. These opportunities will be further exploited, thereby attracting international visibility, investment, innovation, knowledge, and competitive edge to our infrastructure.

Promoting international collaboration

As a national organization, SciLifeLab can act as a collaborative platform between the Swedish life science sector and international organizations and collaborative networks in life science. This will allow for Swedish researchers to pool resources for maximum impact on the international arena and for attracting international funding. The access of SciLifeLab infrastructure for international users and reciprocal links with Nordic and European infrastructure networks will be explored to place SciLifeLab infrastructure and could build the ideal combination and synergistic interaction between national and international infrastructures. SciLifeLab today also acts as a site for other countries, research communities and funders to explore and compare how Sweden has set up its research infrastructure and how it engages in national initiatives. SciLifeLab often exists as a window to the Swedish life science ecosystem for such visitors.

Expressing a unified voice for the life science community

We will support and promote the entire life science community in Sweden. Together with other stakeholders in the public and private sector organizations such as the Swedish Research Council (VR), SwedenBio, Vinnova, the Läkemedelsindustriföreningen (LIF), Business Sweden, international partners and collaborators, embassies and chambers of commerce, we will support the communication and branding of Sweden as a strong life science nation internationally.

Strategic objective 6

Build Translational and Innovation Capabilities

SciLifeLab is a major sustainable source of innovation, exemplified by the considerable number of spin-off companies that have their origin from the SciLifeLab research environment, translational initiatives that have reached clinical application (e.g. Genomic Medicine Sweden), many lead drug molecules that have been licensed for commercial development, as well as numerous public-private initiatives that have been started (e.g. the Human Secretome Initiative and Center for Translational Microbiome Research). The Diagnostics Development (DD) and Drug Discovery & Development (DDD) platforms have played a major role in such interactions, and while we expect similar activities in other fields of research in the future, the description below focusses on DD and DDD.

Translating advanced diagnostics from research to healthcare and precision medicine

SciLifeLab will continue to provide service and expertise in the development, validation and implementation of genomic sequencing in translational and clinical research, clinical trials and new diagnostics through DD platform and the Genomic Medicine Sweden. The DD platform is established through dedicated technology and clinical genomics expertise at universities and university hospitals in Stockholm, Uppsala, Gothenburg and starting 2019, also in Umeå, Linköping and Örebro, reaching full national coverage. Together with DD and GMS, healthcare regions and biobanks, we will continue to transition genomics and other cutting-edge molecular technologies towards clinical application. The data-driven individual health research program will provide entirely new opportunities for translational research as well as for healthcare innovations.

Translating academic drug discovery projects to industry

The DDD platform makes use of fundamental academic research discoveries across the country and validates these as drug discovery targets and creates lead molecules that would provide attractive future investment and development opportunities within the private sector. In recent years, many pharmaceutical companies have scaled down their internal R&D initiatives in and are increasingly dependent on research collaboration with academic research. Over the past 4 years, DDD has successfully developed therapeutic discoveries with numerous academic groups across the country. Several projects have been out-licensing to industry or established as new spin-off companies. DDD will continue to promote academic discoveries towards industrial drug discovery, and will engage in joint drug discovery programs with SMEs and large pharma companies. Increasingly, new drugs being developed are biological therapies (proteins, peptides, antibodies) or new modalities (gene therapies, cell therapies, therapeutic vaccines etc.) and it is essential that DDD as a national platform has access to these technologies and expertise, ideally from within the national research community in Sweden.

Moving towards a national innovation system in drug discovery

The "valley of death" between early academic drug discovery and successful commercial drug development remains broad and deep. DDD will work with the national innovation system to promote effective licensing and transfer of early drug leads to the private sector. This requires close collaboration between the DDD research infrastructure, academic scientists, innovation funders (Vinnova, The Swedish Foundation for Strategic Research (SSF), Novo Seeds), innovation actors (innovation offices, Testa Center and RISE AB etc.), healthcare and industry. We see major opportunities for creating a joint plan for a new innovation ecosystem for Swedish drug discovery. ■

Final remarks

The SciLifeLab 10-year strategy described above is centered on leveraging the investments made into national life science infrastructure to enable collaborative research, recruitment, training, translation, innovation and data-driven strategies that provide synergistic benefits for the entire life science ecosystem. We hope to develop SciLifeLab from a technology-driven infrastructure organization towards an integrated and collaborating community in both technology- and data-driven life-science research. We believe this will benefit Sweden as a whole with the aim to position the country as a leading life science nation within fundamental research, but also in addressing challenges from the industry, healthcare and society at large. This is a collaborative research strategy where we work together with all the stakeholders in the broad life science sector towards these goals.

Acknowledgements

SciLifeLab 10-year strategy was developed by the SciLifeLab Management group with input from the International Advisory Board, members of the SciLifeLab Board, Data Centre, Operations Office, host university leadership and SciLifeLab Committees, the National SciLifeLab Committee, and in dialogue with SciLifeLab infrastructure platforms and the overall SciLifeLab community.

We are also grateful for valuable contribution and input from the following organizations in preparation of this roadmap: Apotekarsocieteten, AstraZeneca, Bayer, Beactica AB, Chalmers tekniska högskola, European Spallation Source (ESS), Genomic Medicine Sweden, Göteborgs universitet, Janssen, Karolinska Institutet, Karolinska Institutet Innovations AB, Kungliga Tekniska Högskolan (KTH), Linköpings universitet, Läkemedelsindustriföreningen (LIF), Lunds Universitet, MAX-IV, Naturhistoriska Riksmuseet, Naturvårdsverket, NBIS, Pfizer, Region Skåne, Region Stockholm, Region Uppsala, Region Västerbotten, Region Örebro län, Region Östergötland, RISE, Sveriges Lantbruksuniversitet (SLU), Stockholms universitet, STUNS/Uppsala Bio, SwedenBio, SWElife, Umeå universitet, Uppsala universitet, Uppsala Universitet Innovation, Vinnova, Vetenskapsrådet, Västra Götalandsregionen.

Abbreviations

AI	Artificial intelligence
AIDA	Analytic Imaging Diagnostic Arena
Chalmers	Chalmers University of Technology
DD	Diagnostics Development (Platform at SciLifeLab)
DDD	Drug Discovery and Development (Platform at SciLifeLab)
DDBE	Data-driven biodiversity and evolution
DDCB	Data-driven cell biology
DDIH	Data-driven individualized health
DDLS	Data-driven life science
EBI	European Bioinformatics Institute
ELIXIR	European Life Science Infrastructure Initiative
ELSI	Ethical, Legal and Social Implications
EMBL-EBI	The European Bioinformatics institute
EOSC	European Open Science Cloud
ERC	European Research Council
ESS	European Spallation Source
Euro HPC	High-Performance Computing in Europe
FAIR	Findable, Accessible, Interoperable and Reusable
GA4GH	Global Alliance for Genomics and Health
GDPR	General data protection regulation
GMS	Genomics Medicine Sweden
GU	University of Gothenburg
KAW	Knut and Alice Wallenberg Foundation
KI	Karolinska Institutet
KTH	KTH Royal Institute of Technology (Kungliga Tekniska Högskolan)
LIF	Läkemedelsindustriföreningen
LiU	Linköping University
LU	Lund University
NBIS	National Bioinformatics Infrastructure (SciLifeLab Bioinformatics, VR funded network name)
NCBI	National Center for Biotechnology Information
NMMP	National Molecular Medicine Fellows Program (with the WCMM, see below)
PI	Principal investigator
RCP	Research Community Program at SciLifeLab
RDA	Research Data Alliance
SFO	Strategic research area funding (support from the government) to Universities for their SciLifeLab collaboration
SIB	Swiss institute of Bioinformatics
SLU	Swedish University of Agricultural Sciences
SMEs	Small and medium sized enterprises
SND	Swedish National Data Service
SNIC	Swedish National Infrastructure for Computing
SSF	The Swedish Foundation for Strategic Research
STEM research	Research within Science, Technology, Engineering, Mathematics
SU	Stockholm University
SUNET	Swedish University Computer Network
TDP	Technology Development Project
UmU	Umeå University
URFI	The Universities' Reference Group for Research Infrastructures
UU	Uppsala University
VR	Vetenskapsrådet (Swedish Research Council)
VR-RFI	The Swedish Research Council's Council for Research infrastructure
WASP	the Wallenberg Artificial Intelligence, Autonomous Systems and Software Program
WCMM	Wallenberg Centers for Molecular Medicine (at the GU, LU, LiU and UmU)
ÖRU	Örebro University

B.

Appendix C.

Two-year action plan for SciLifeLab Campus Solna (VC-2021-0013)

Two-year action plan for SciLifeLab Campus Solna

Background

Despite the enormous success of SciLifeLab as a whole, the International Advisory Board (IAB) raised several concerns specifically related to the joint Stockholm research center, SciLifeLab Campus Solna. The IAB characterized Campus Solna as being an under-developed research environment lacking a supportive research infrastructure, and a well-defined leadership structure. The IAB report also highlighted several long-standing issues regarding the Fellows' situation, primarily at Campus Solna but to some extent at both nodes, which were "still not solved."

The IAB recommended immediate action was needed to address the following three points:

1. Renew the strong commitment to the synergistic dual mission of the SciLifeLab Campus Solna as an international center of research excellence and a national research infrastructure.
2. To provide the mandate and delegated authority to the SciLifeLab Campus Solna research director to run an internationally competitive center and support especially its excellent junior fellows adequately.
3. To truly integrate the complementary research strengths of the four host universities in a joint center and renew the commitment of the hosts to support SciLifeLab research with their Strategic Research Funds (SFO) funds.

C.

Moving Forward

To address these concerns, the SciLifeLab board appointed a "Campus Solna Action Group," consisting of the Dir, co-Dir, and 4 IDs. The CS Action Group worked actively between June 2019-June 2020. As a first major step, the Campus Solna Director position was created and through an open call, Prof. Per Ljungdahl, SU, was appointed as the first CS Dir, with a starting date of May 1, 2020.

The CS Action Group has drafted this two-year action plan for the continued development of SciLifeLab Campus Solna. This Action Plan is a Campus Solna-focused practical plan, in parallel with the more strategic Road-Map 2020-2030 that outlines future initiatives for the whole SciLifeLab. The Action Plan is an internal process document and is intended to keep the work focused and maintain forward momentum. The overall goal of the Action Plan is to enhance and further develop Campus Solna as a vital component of the SciLifeLab. This needs to be done with respect to the evolving aims and growing national impact of SciLifeLab and well-coordinated with the SciLifeLab-Uppsala node. Furthermore, actions should be taken to integrate and synergize with the KAW-funded Data Driven Life Science (DDLS) program.

The 2-year action plan (2021-2022) lists many goals and actions. It will be important to complement the document by setting priorities and time-frames for planning, decisions and implementation. The Campus Solna Committee is responsible for facilitating actions that specifically relate to CS. Importantly, there are several issues that require formal approval by the Vice Chancellors (Rectors) of the host universities. The Action Plan may need to be modified as time goes on, and full implementation may take longer than the 2-year time frame.

The Action Plan has 5 major goals with associated aims. Those should be decided upon by the CS Committee and then acknowledged by the SciLifeLab board, with a suggestion of presenting a progress report to the SciLifeLab board at the end of 2021, and a full report at the end of 2022. The CS Committee and the Management Group should coordinate the preparation of the report.

The Action Plan addresses the following goals:

1. Clarify the role of Campus Solna as a vital component of SciLifeLab
2. Improve governance of Campus Solna and its resources
3. Improve and enhance the academic environment
4. Establish processes to ensure proper level of support services, space allocations and rebuilding.
5. Optimize SciLifeLab Fellows program and support career development

C.

GOALS

1. Clarify the role of Campus Solna as a vital component of SciLifeLab

The CS action group is cognizant of the importance to of an integrated Stockholm-Uppsala center for the “big” research mission, and also the emerging activities at the national level. However, Campus Solna is an important physical center for integrated experimental research that should be further developed, and with expectations to deliver accordingly.

Aim 1.1: Strengthen and improve interactions with host university leadership, faculties/schools and departments to enhance coordination and level of engagement

Action:
Propose activities and meetings for host university representatives and other relevant groups (with different purposes for the activities/meetings)

Aim 1.2: Develop consensus view that Campus Solna is a *bona fide* Stockholm Trio campus, vital to the interest of each university

Actions:
a. *Provide fact-based description of Campus Solna to define its impact at Regional and National levels*
b. *Discuss with the Vice Chancellors how to best accomplish a truly integrated campus*
c. *Find solutions to overcome barriers caused by the university-based “ownership” of certain areas. Examples include: leadership affiliations, all aspects of IT (e.g. e-mail domain, data storage, library access), personnel administration, safety issues, etc.*

Aim 1.3: Obtain confirmation of continued support by Stockholm Trio

Action:
Discuss with the Vice Chancellors how this should be achieved and to ensure the long-term future of Campus Solna

Aim 1.4: Engage proactively and work to ensure that Campus Solna maintains a leading role in the DDLS-era

Actions:
a. *Space is currently limiting at Campus Solna, which negatively impacts the ability to recruit. Work to incorporate the Beta Building, or other alternatives, as part of Campus Solna*
b. *Maintain and improve data management capabilities at Campus Solna*

2. Improve governance of Campus Solna and its resources

This requires active and coordinated decisions involving the Stockholm Trio host universities.

Aim 2.1: Update the 3-party agreement(s)

Action:
Initiate the update by cooperative work between KTH admin and host university representatives. Important that the responsibility and mandate of CS Dir and of decision-making committees are spelled out.

Aim 2.2: Define a clear leadership structure at Campus Solna that dovetails with national interests

Actions:

a. *Consider to use the SciLifeLab Strategic Council (SC) as the most representative forum for an improved leadership structure, and to coordinate the Campus Solna-specific processes and decisions with the Uppsala node and with the national SciLifeLab initiatives, aiming to enhance synergy throughout the SciLifeLab organization.*

b. *Increase the representation of research groups/PIs, Fellows and Infrastructure facilities in the decision bodies or as adjunct members.*

c. *Define the level of administrative and site support that is needed for efficient running of Campus Solna, and to which degree this can be provided with existing staffing. Clarify how the costs should be shared and divided in a transparent way, and include them in coming budgets.*

d. *Improve communication between Campus Solna and national leadership to facilitate synchronizing research initiatives/interests of the host universities, research groups working at CS and the SciLifeLab infrastructure facilities.*

Aim 2.3: Improve and optimize the economic governance of Campus Solna to facilitate planning and decision making.

A comprehensive multi-year CS budget is necessary to facilitate an effective and transparent decision-making process in the long-term. This should also accurately reflect the intertwined local and national activities.

Actions:

a. *Develop a budget structure that comprehensively reflects the entirety of CS activities*

b. *Develop a long-term multi-year budget to enhance planning capabilities for CS and for host universities*

c. *Develop routines and processes, propose criteria/rules to decide on renovation and rebuilding project.*

3. Improve and enhance the academic environment

Aim 3.1: Create a center of research excellence

Actions:

Consider launching research programs (more specific than DDLS-areas but sufficiently broad to encourage collaborations between Campus Solna groups). Facilitate the development of strong research environments.

C.

Aim 3.2: Create a transparent and sustainable system for turnover of faculty (PIs and their groups) at Campus Solna

Action:
Develop exit strategies with defined criteria/rules for termination of PI contracts, and develop mechanisms/processes for its implementation together with the host universities.

Aim 3.3: Improve the intellectual and scientific research environment at Campus Solna.

Actions:

a. Mapping on-going research areas within CS.
b. *Creation of Research Clusters at CS, to strengthen research interactions and research/tech development.*
c. *Investigate how seminars, work-shop programs and yearly events can be strengthened, financing models for those, and how these should be coordinated and announced.*
d. *Create scientific meeting spots and initiate events, meetings and interactions among staff members (scientists, fellows, students, technicians, infra experts, IT, admin etc.)*

Aim 3.4: Create a research environment that is synchronized and well-integrated with the national infrastructures.

Actions:

a. *Improve the interface between research projects and infrastructure facilities to increase the possibilities of technology development.*
b. *Promote closer interactions between CS researchers and facilities by different activities.*
c. *Reduce the thresholds for collaborations and promote a collegial give-and-take attitude.*

C.

Aim 3.5: Develop a system for local Campus Solna research infrastructure

Actions:

a. *Survey of needs for local research infrastructures (e.g. sequencing, flow cytometry, sample handling, dish washing, etc.) of importance to investigators at CS. The aim should be to better support the full spectrum of research at CS.*
b. *Create a plan and a budget for launching CS local infrastructures (core facilities). These can be either funded jointly by the host universities, joint scientist input and/or linked with national infrastructure support*
c. *Improve the sharing of equipment within CS*

d. *Establish routines for recurrent revisions*

4. Establish processes to ensure proper support services, space allocations and rebuilding

Problems with space allocation, prioritization, re-building projects…

Aim 4.1: Improve processes and criteria/rules for prioritization and allocation of space within Campus Solna.

Action:
Improve routines and processes according to already agreed upon criteria/rules for prioritization, or propose new ones if necessary.

Aim 4.2: Create a common research infrastructures, e.g. Supply Centre, Dish washing and sterilization service, etc. at Campus Solna

Actions:
a. *Investigate the needs of a Supply Center and propose what type of "material" it should provide, how it should be operated, and financing models.*
b. *Investigate the needs of Core Facilities and propose what type of services a core facility support should provide, how it should be operated, and financing models.*
c. *Establish routines for recurrent revisions*

5. Optimize SciLifeLab Fellows program and support career development

C.

Referring to the IAB report, point 4.3f: The SciLifeLab Fellow's program has been a fantastic success. However, Fellows have repeatedly brought up problems and issues regarding the suboptimal academic environment and local infrastructure at Campus Solna. Many of their concerns are related to aims addressed in Goals 3-4. The aims of Goal 5 are focused on issues specifically relating to the Fellows' program.

Aim 5.1: Improve coordination of recruitment processes

Stockholm Trio universities have well-established rules and procedures for recruiting academic personnel and that govern career development and promotions. Better coordination and transparency to minimize differences in the career possibilities and trajectories of SciLifeLab Fellows at Campus Solna would be favorable. Early agreements exist but their implementation needs to reaffirmed and put in practice.

Actions:

a. *Improve coordination of Fellow recruitment at Stockholm Trio and Uppsala Universities*

b. *Prepare for recruiting KAW DDLS Fellows in 2021 and onwards. Conform to the KAW DDLS fellowship agreement and synchronize agreements to match those governing SciLifeLab fellows*

Aim 5.2: Improve the introduction and integration of new Fellows

Action:

Develop a "Fellows' introduction and integration" document, and confirm that is agreed upon and implemented by all four host universities.

Aim 5.3: Mentoring programs and contact persons for Fellows.

Action:

Ensure that each university has a mentorship program for their Fellows. All Fellows located at Campus Solna should also have a senior CS colleague as mentor.

Aim 5.4: Clarify tenure track rules at each university and establish criteria for prolongation of contracts for continued localization at Campus Solna

Actions:

a. *Ensure sure that each new Fellow receives clear written documentation of expectations and outline of rules governing career development that is specific for their university. The system for tenure, or lack there-of, at his/her university should be clearly described.*

C.

b. *The rules/criteria for prolongation of contract at Campus Solna vs the need to move-on, should be discussed and decided upon, and as part of the bigger process on criteria/rules for prioritization and allocation of space.*

Appendix D.

Major Community-building Events and Activities performed 2019-2021

SciLifeLab events 2019-2021

Present events at scilifelab.se/events.

Recorded events at SciLifeLab YouTube channel.

Seminar series

SciLifeLab The Svedberg seminar series

Speaker	Month	Year
Ludovic Orlando	February	2019
Rickard Sandberg	March	2019
Erin Baker	March	2019
Alexandra Teleki	March	2019
Gerhard Schuetz	April	2019
Mirko Trajkovski	May	2019
Gene Robinson	May	2019
Danny Ducat	August	2019
Kim D. Janda	September	2019
Geeta Narlikar	September	2019
Adam Abate	September	2019
Rudolf Jaenisch	October	2019
Juleen Zierath	October	2019
Magnus Nordborg	October	2019
Joseph Ecker	November	2019
Rotem Sorek	November	2019
Claudia Langenberg	December	2019
Denis Duboule	February	2020
Pascal Milesi	February	2020
Gustaf Christoffersson	March	2020
Yumeng Mao	March	2020
Greger Larsons	August	2020
Lars Behrendt	October	2020
Mikael Sellin	November	2020
Sebastian Deindl	November	2020
Olof Eriksson	November	2020
Fellows Candidates	March	2021
Nadia Singh	March	2021
Anniina Vihervaara	April	2021
Fellows Candidates	April	2021

D.

Christina Cuomo	April	2021
Iskra Pollak Dorocic	May	2021
Thanh Binh Nguyen	May	2021
Leo Lahti	May	2021
Ehab Abouheif	May	2021
Fellows Candidates	June	2021

Science For Life seminar series - Campus Solna

Speaker	Month	Year
Erin Schuman	January	2019
Marcel Tijsterman	January	2019
Silke Wiesner	March	2019
Lars Steinmetz	March	2019
Gerhard Schuetz	April	2019
Sarah Teichmann	April	2019
Aaron Gitler	May	2019
Johannes Söding	June	2019
Jennifer Doudna	August	2019
Kim D. Janda	September	2019
Geeta Narlikar	September	2019
Stirling Churchman	September	2019
Sarahi Garcia	November	2019
Joseph Ecker	November	2019
Mayra Furlan-Magaril	November	2019
Jon Houseley	December	2019
Gail Robertson	December	2019
Ivan Dikic	January	2020
Stephen Friend	February	2020
Elias Arnér	February	2020
Kristoffer Sahlin	March	2020
Yang Zhang	September	2020
Claudio Hetz	October	2020
Saeed Shoaie	November	2020

D.

Bioimage Informatics Call4Help

Speaker	Month	Year
Bioimage Informatics Call4Help	Monthly event	2019-2021

Campus Solna Seminar Series:

Speaker	Month	Year
Alba Corman and Eva Brinkman	September	2020
Johannes Ristau and Lea Rems	September	2020
Anna Huguet Ninou and Kristen Schroeder	October	2020
Dörte Schlesinger and Yue Liu	October	2020
Lucie Rodriguez and Dimitri Guala	October	2020
Rajitha Indukuri and Quentin Verron	October	2020
Sailendra Pradhananga and Marcel Tarbier	October	2020
Kim Thrane and Ana Agostinho	November	2020
Muhammad Arif and Karen Schriever	November	2020
Sami Saarempää and Ionut Atanasoai	November	2020
Wei Ouyang and Victor Tobiasson	November	2020
Christian Oertlin and Susanne Huch	December	2020
Dandan Song	December	2020
Claudio Bassot and Linnea Nordahl	December	2020
Angelo Salazar and Yujie Zhang	January	2021
Emma Åkerlund and Yuzuru Itoh	January	2021
Xiangyu Li and Patrick Sandoz	January	2021
John Lamb and Olga Surova	February	2021
Marianna Tampere and Stefan Wennmalm	February	2021
Sanem Sariyar and Koushik Choudhury	February	2021
Zaneta Andrusivova and Emir Konuk	February	2021
Ana Mota and Matthias Fink	March	2021
Bartlomiej Porebski and Thomas Hillerton	March	2021
Camila Rosat Consiglio and Julia Nuy	March	2021
Jemina Lehto and Keyi Gang	March	2021
Christian Oertlin and Julia Nuy	April	2021
Madeleine Birgersson and Vaishnovi Sekar	April	2021
Martin Schappert and Xavier Casas Moreno	April	2021
Maximilian Senftleben and Artemy Zhigulev	April	2021
Tharagan Kumar and Taras Sych	April	2021
Alma Andersson and Rasmus Kock Flygaard	May	2021
Meike Latz and Daniel Gyllborg	May	2021
Rui Shao and Yerma Pareja Sanchez	May	2021
Saman Hosseini Ashtiani and Valentina Carannante	May	2021
Gabriele Girelli and Anna Karlhede	June	2021
Trang Le and Aswathy Kallazhi	June	2021
Woonghee Kim and Markus Hilscher	June	2021

SciLifeLab Mini-symposia series

Title	Month	Year
Medical and Population Genetics and Genomics	April	2019
Cancer - Imaging life: leveraging cancer images for a cure	May	2019
Computational Biology - The Synergy between Chemo and Bioinformatics	May	2019
Biologics - Bridging the gap	May	2019
Formulation - Friend or Foe	October	2019
Medical and Population Genetics and Genomics	November	2019
Autotrophy in extreme environments	November	2019
From coarse-grained to atomistic description of biophysical processes	December	2019
Immunotherapy of Cancer	December	2019

Teacher seminars online

Title	Month	Year
The humane Protein atlas, Stefan Ståhl, KTH	November	2020
High throuhput serological testing for COVID-19, Anna Månberg , KTH	November	2020
High troughput testing of COVID-19 virus, Fredrik Edfors, KTH	December	2020
Detection of COVID-19 in sewage, Madeleine Birgersson, KTH	December	2020

Clinical Talks; Clinical Genomics Stockholm Seminars

Title	Month	Year
Next generation diagnostics of inborn errors of metabolism (Anna Wedell)	January	2020
Alma & Baltazars diagnostic journey (Ebba Carbonnier)	January	2020
Bugs and Drugs (Nele Brussalears)	February	2020
Prenatal diagnosis-ethical considerations (Charlotta Ingvoldstad Malmgren)	March	2020
Pharmacogenomics of adverse drug reactions (Mia Wadelius)	March	2020
New cancer drugs on the horizon (Sara Mangsbo)	May	2020
Saving the power of antibiotics (Fanny Boije af Gennäs Erre)	June	2020
KRY Research and Development	September	2020
A KTH developed COVID-19 screening methodology	October	2020
Gene expression profiling	October	2020
Starting up a high-throughput COVID-19 lab in 4 weeks – what we learned?	November	2020
Every cell is unique	November	2020
The genomic complexity of lymphocytic leukemia	November	2020
New technologies on the horizon	December	2020
Population Genomics – Where next? Progress to date. Possible next steps	January	2021
Swedish public health response to the pandemic, Anders Tegnell	January	2021

Separate events

Title
Drug Discovery Seminars: Jarkko Rautio
Cryo-EM Course on Tomography
Swedish Microfluidics in Life Science 2019
3D optical clearing, staining and imaging (CUBIC)
Biostatistics Essentials: a blackboard approach
ELIXIR Innovation and SME Forum: Genomics and Associated Data in National Healthcare Initiatives
Carpentry Instructor Training supported by ELIXIR Sweden - Improve your teaching/pedagogical skills
Introduction to Genome Annotation
Quick and clean: advanced Python for data science in biology
Keystone Lunch Seminar - Proteomics and its Application to Translational and Precision Medicine
SciLifeLab National hearing; Road map 2020-2030
RaukR, Advanced R for Bioinformatics, Summer course
Tools for reproducible research
DNA origami and what it can help us learn about biology
Antimicrobial peptides as novel ribosome-targeting antibiotics
The crystal structure of the heptameric LAMTOR complex: Insights into roadblock domain scaffolding
Probing the evolution of mitochondrial ribosomes
The structure of a mitochondrial ATP synthase
Using light to dissect and direct intracellular transport in neurons
Cryo-EM structures of Abo1 AAA+ chromatin assembly complexes
Epigenomics data analysis
SciLifeLab and EATRIS (European Infrastructure for Translational Medicine) seminar
Introduction to Bioinformatics using NGS data, Uppsala
Array-Based Proteomics
RNA-seq data analysis
Chromosome silencing by Xist RNA
New drugs - Can SciLifeLab make a difference?
Outreach Event of the National Bioinformatics (NBIS) and Genome Sequencing (NGI) infrastructures
The regulatory power of structured RNAs
Beyond asymmetry: evolutionary advantages of an active damage retention mechanism
Towards a high resolution structure of the human mitoribosome
Probing the evolution of mitochondrial ribosomes
Cryo-EM of human and parasite proteasomes for structure-based drug design

Title
Cryo-EM @ EMBL and ESRF in Grenoble
Host metabolism in cellular defense against Toxoplasma
Single particle Cryo-EM image processing
Cross-Talk seminar: Genomics of Gene Expression
Hands on Immunofluorescence
Postrevolution Cryo-EM: Reaping the benefits while looking to the future
One-day practical course: Fluorescence Correlation Spectroscopy - FCS
Bioinformatics for Principal Investigators
Unlocking the past: Ancient DNA symposium
Omics Integration and Systems Biology
Harnessing Microbial Diversity for Gene Editing and Beyond
Innovation by Evolution: Bringing New Chemistry to Life
Seminar on HiC applications
Introduction to Bioinformatics using NGS data, Lund
Advanced Molecular Technology and Instrumentation for Proteome Analyses
SciLifeLab-symposium in Advanced Fluorescence Microscopy
Python programming with applications to bioinformatics, Uppsala (NBIS/ELIXIR-SE course)
Connecting structure and dynamics in the ribosome
Characterization of noncoding expression and splicing diversity in the human brain
Python programming with applications to bioinformatics, Umeå (NBIS/ELIXIR-SE course)
New perspectives on bioanalysis of biologics in complex matrices
The Dynamics of Life
Introduction to high throughput screening, 2 ECTS
BiG Talks! seminar on How to spot problems in your sequencing data
Evolution of seasonal timer: towards understanding winter depression
Reproducibility and Data Reuse in Life Science
Annual Lecture in Structural Biology by Jennifer Doudna
Jennifer Doudna career discussion with students and postdocs
Biophysical methods in drug discovery
Joint SIB / SciLifeLab Autumn School Single Cell Analysis
Microbial single cell genomics workshop - from environment to infection
2nd Symposium on Plasma Profiling
Why are people so excited about Cryo-EM?

Title
Molecular mechanisms in neuronal development
New insights into ribosome biogenesis of plants
New approaches to grid preparation in cryo-EM for time-resolved studies
Progress on the structural characterization of bacterial secretion systems
RNA sequencing by mass spectrometry
Deciphering molecular mechanisms of energy transduction in complex I
Activation of a plant NLR protein
Refueling the cell: How ADP and ATP cross the mitochondrial inner membrane
Snapshots of key cell cycle regulation events by cryo-EM
The cryo-EM structure of human transcription factor IIH
Basic Course in SEM and TEM
Big Talks! 'Unexpected' ethical challenges in genomics and bioinformatics
Teaching Workshop: Content- to Outcomes (using the Mastery Rubric for Bioinformatics as a tool for curriculum design)
Chemical Biology Seminar Series
Protein biomarker discovery and implementation - from broad screening to validated signatures and custom panel development
Release of Blood, Brain and Metabolic Human Protein Atlases
Tools for reproducible research
Introductory Linux Tutorial for Life Sciences
Single cell RNA sequencing analysis
Mapping metabolic regulation: from E. coli amino acid metabolism towards global regulation networks, Hannes Link
Insights to Cardiovascular Disease Risk through Population-based studies, Panos Deloukas
R Foundations for Life Scientists
Seminar: Transcriptomes in cells and tissues
RNA-Seq
Chemical Biology Seminar Series
Bring Your Own DMP Drop-in
Metabolomics in clinical research
WCMM-LiU Clinical Arena - Genomic Medicine: resources and clinical implications (LIVE-streaming)
NGI on the road
Introduction to Bioinformatics using NGS data, Uppsala
10th Symposium on Pharmaceutical Profiling in Drug Discovery and Development
Moving from Bulk NGS to Precision Sequencing with Single-Cell Genomics
PhenoTarget RCP seminar: Talking to the matrix

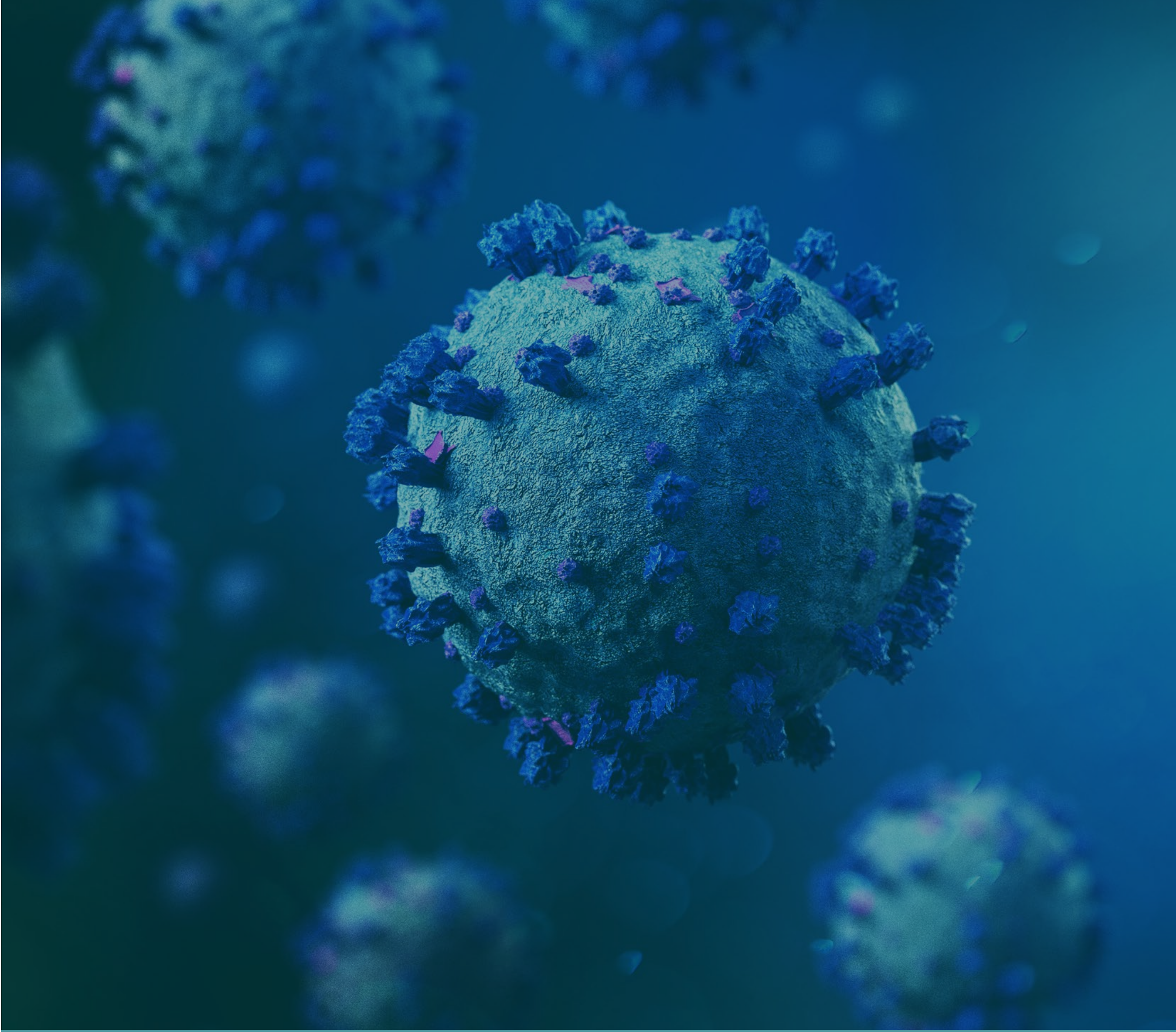
Title
Nf-core hackathon
Enabling Precision Cancer Medicine In Sweden - A Collaborative Effort
Building a cellular atlas of human development
National Users Meeting for the Cryo-EM Swedish Community
Developing innovative cancer immunotherapies
Half-time seminar: Towards understanding the evolution of the mitochondrial ribosome
Half-time seminar: High resolution structures of the translating human mitoribosome
Biologics - case study: From academic research results to industrialization of drug candidate
Basic Course in SEM and TEM
Drug Discovery seminars: Bile Salt-Stimulated Lipase: From Nutrition to Inflammation (Olle Hernell and Susanne Lindquist)
Publication release event
PacBio Sequel II launch party
Systems Biology of Human Metabolism and Gut Microbiome
SciLifeLab Advanced Microscopy Webinar
Statistical and machine learning techniques in microbiome research
ProtFunAI - An artificial intelligence for prediction of protein function from protein sequence alone
Science talks - Campus Solna SciLifeLab research symposium
NGI-NBIS Outreach Event: SLU
Mitochondria of Green and Red Algae | Claire Remacle, University of Liege
Illuminating the Structural Basis for Ligand Recognition and Selectivity of The Human Melatonin Receptors | Linda Johansson, Gothenburg University
Science Visualisation
Workshop in Advanced Fluorescence Microscopy, seminar online
Translating CLL genomics into clinical utility
Introduction to biostatistics and machine learning
Affinity Proteomics, High Density Protein Arrays (Arrayjet Webinar Series)
Brain Atlas release event
SciLifeLab 10 Year Anniversary Celebration
Omics Integration and Systems Biology
Introduction to high throughput screening
Whole-Body/Organ Imaging with Single-cell Resolution by CUBIC
SciLifeLab Advanced Microscopy Webinar
PromethION launch event
Imaging across scales with fluorescence microscopy (Bruker)
Introduction to bioinformatics using NGS data

Title
Python programming with applications to bioinformatics
Single particle Cryo-EM image processing
SciLifeLab National Genomics Infrastructure and Mission Bio Joint Webinar
Epigenomics Data Analysis: from Bulk to Single Cell
Snakemake BYOC (bring-your-own-code) workshop
Single cell analysis using flow and mass cytometry, 3 credits
Exploring the possibilities of super-resolution imaging with the Nanoimager
Tools for reproducible research
Workshop on Cancer Biology
How to become a MAXIV/ESS user
SciLifeLab AI Seminar Series: Sven Nelander
Introduction to Data Management Practices
COVID-19 Colloquium
R programming foundations for life scientists
How to become a synchrotron user
PhD&PostDoc Council - How to take part?
Combating Covid-19 - A Webinar
The 7th RIKEN-KI-SciLifeLab Symposium
RNA-seq data analysis
Aquatic Microbiome Research Initiative - All-Hands Meeting
Restriction-enzyme free Hi-C (Omni-C) in Assembly and comparative Genomics
Micro-C: Using MNase for chromatin conformation capture at the nucleosome level
Open Source Tools for Proximity-ligated datasets
BiG Talks! Petabase-scale sequence alignment catalyzes discovery of novel Coronaviruses
SciLifeLab Talk Show: Episode 1: the future of SciLifeLab
SciLifeLab Talk Show: Episode 2: Combating COVID-19
SciLifeLab Talk Show: Episode 3: Data-driven life science
SciLifeLab Talk Show: Episode 4: Community Collaborations
Single cell RNA sequencing analysis
Data-Driven Life Science (DDLS) - Live Update from SciLifeLab
NGI webinar series: Pelin Sahlen
SciLifeLab symposium in Superresolution Microscopy
State of the Art Covid-19
Accelerating the process from basic drug discovery to clinical trial for COVID-19
NGI webinar series: Zeynep Cetecioglu Gurol - Bacterial communities

Title
Omics Integration and Systems Biology
Raising Our Voices
MINSTED fluorescence localization and nanoscopy
Introduction to bioinformatics using NGS data
Tools for reproducible research
15th Nordic Photosynthesis Congress
International Women's Day panel discussion: Picture a Scientist
nf-core Hackathon - March 2021
Quick and clean: advanced Python for data science in biology
BioImage Informatics Facility: Examples of using image analysis in life science projects
Clinical Genomics Uppsala and Mission Bio joint webinar
SciLifeLab fellow position (BUL) on functional imaging
Introduction to high throughput screening, 2 ECTS
NGI and NBIS webinar on de novo sequencing and analysis
NGI webinar on Spatial Transcriptomics 10X Visium
Patenting of therapeutic antibodies
Campus Solna Science talks
BAM seminar: AI in Healthcare - accelerated by the Pandemic
RaukR, Advanced R for Bioinformatics, Summer course
Using the national infrastructures to solve antimicrobial resistance (InfraLife)
Nationella studier av värdet av breda genpaneler och helgenom-sekvensering för patienter med hematologiska maligniteter
SciLifeLab Data Repository Launch
Super-Resolution, Light-Sheet, STED-FCS and FRET-FCS
Data-driven approaches towards studying context-specific cell signalling
The evolution of human Genome Scale Metabolic models
Systems biology approaches for translational cancer research
The open source ecosystem for genome-scale metabolic models
SciLifeLab fellow position (BUL) on high-resolution spatial methods
Role of physiologically-based pharmacokinetics (PBPK) in regulatory submissions
DDLS and WASP join forces for research within a data-driven future
CryoEM in Drug Discovery
SciLifeLab AI Seminar Series: Arne Elofsson
SciLifeLab Workshop on Federated Machine Learning
Emerging Imaging Technologies to Study Cell Architecture, Dynamics, and Function
SciLifeLab-EMBL: Building new collaborative links

Appendix E.

SciLifeLab COVID-19 efforts – reflections from 2020 and lessons for the future



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SciLifeLab COVID-19 efforts:

REFLECTIONS FROM 2020 AND LESSONS FOR THE FUTURE

SciLifeLab

SciLifeLab COVID-19 efforts – reflections from 2020 and lessons for the future

During the COVID-19 pandemic, the role of SciLifeLab as a national hub for Life Science researchers and infrastructure was leveraged in the work to fight the pandemic. This document presents an overview of the actions taken and the difficulties that were exposed. We also address the lessons learned and how we take these into account in an effort to build better pandemic preparedness in the future, as part of the national task assigned to SciLifeLab for the years 2021-2024.

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SUMMARY

SciLifeLab's role in the pandemic in 2020:

SciLifeLab had the capacity to act quickly and with broad national outreach, due to its role as a national infrastructure organization with strong links to the national research community and by receiving dedicated funding from Knut and Alice Wallenberg Foundation (KAW).

COVID-19 actions taken in 2020

- Set up of clinical virus diagnostics, Engstrand facility (Karolinska Institutet (KI))
- Development of high sensitivity and specificity serology test, Hober/Nilsson (KTH Royal Institute of Technology)
- Set up of longitudinal sampling and biobanking of COVID-19 patient samples for analysis of disease pathogenesis, Hans Gustaf Ljunggren (KI)
- Set up of a BSL3 facility for research on COVID-19 (Biomedicum, KI)
- Set up of a national team-science research program on COVID-19 funded by KAW
- Creation of a national COVID-19 Data portal
- SciLifeLab infrastructure prioritized COVID-19 research projects

Challenges that limited the opportunities:

- Access to patient samples for research (in the beginning of the pandemic)
- Sharing of biobanked patient samples and data
- Regulatory and legal hurdles when engaged with healthcare

SciLifeLab plans going forward

We have defined 8 primary focus areas for SciLifeLab towards future work in pandemic laboratory preparedness (listed below and described shortly in the last section on "Reflections looking ahead: focus areas").

SciLifeLab shall:

1. Focus on research support – research is needed during pandemics
2. Support and coordinate team-science efforts during pandemics
3. Support techniques and technology development important for the study of pandemic pathogens and their effects
4. Operate nationally and in collaboration with other research infrastructures
5. Work to facilitate the flow of patient samples to its infrastructure platforms
6. Support data management, sharing and open publication during pandemics
7. Support training in pandemic laboratory preparedness
8. Make a permanent investment in pandemic laboratory preparedness within SciLifeLab

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SciLifeLab COVID-19 Research Infrastructure actions in 2020

To meet global crises, such as a new pandemic, time is of essence. SciLifeLab had a unique capacity, due to its organisation and role as a national infrastructure with links to a national research community, to act quickly and with broad national outreach upon receiving funding from KAW. SciLifeLab redirected all of its relevant technological expertise and infrastructure towards COVID-19 work and utilized its extensive national and international network for coordinated collective efforts. The work was led by SciLifeLab's management group (MG), with support from operations office, enabling an agile task-focused structure with quick decisions processes.

Key success factors for quick actions by SciLifeLab were:

- ❖ Funding from KAW – substantial resources were rapidly allocated together with a clear mandate
- ❖ SciLifeLab as national research infrastructure with competence, networks and organization in place could act quickly
- ❖ Authorization for universities, issued rapidly by the government, to assist in COVID-19 related actions such as clinical diagnostics.

SciLifeLab resources, technology and knowledge that were mobilized to meet the new challenge:

1. Equipment, facilities and expertise were available, these could flexibly be reorganized and refocussed towards COVID-19 efforts:
    - *SciLifeLab infrastructure was instructed to prioritize COVID-19 research (communicated by email March 20, 2020 to all Infrastructure Heads and Directors and followed up by emails, web page info and survey).*
    - *Lars Engstrand's lab at KI shifted focus to virus testing*
    - *Peter Nilsson's and Sophia Hober's labs, KTH, shifted focus to serology*
    - *SciLifeLab Data Centre launched the National COVID-19 Data Portal (on June 3, 2020, as the first national portal in Europe linked to the European COVID-19 data platform coordinated by EMBL-EBI), as well as provided collaborative data tools and support.*
    - *SciLifeLab admin/Operations Office (OO)/MG coordinates grant calls, launching of national research program, communication, funding etc.*

2. SciLifeLab as national research infrastructure had the unique possibility to rapidly launch a national research program addressing COVID-19. This was enabled by external funding from KAW and by allocating national

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SciLifeLab funding for the coordination of the program and its defined research areas, to facilitate novel collaborations and provide a link to the SciLifeLab infrastructure and management. If funding had been delivered to individual PIs without coordination, and without linking to biobanks and the data centre, the impact would have not been as great.

3. Relevant contacts to authorities, regions, internationally etc. provided means to coordinate activities (eg. for virus diagnostics the National Coordination Group was assembled, through Genomic Medicine Sweden (GMS) network and Per Sikora/Lars Engstrand, and had their first meeting just days after the KAW funding ("nationell projektkoordineringsgrupp med representanter från mikrobiologiska laboratorier vid universitetssjukhusen, Folkhälsomyndigheten, SciLifeLab och GMS") and equipment and reagents were secured rapidly (eg. Engstrand's China collaboration).

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REGULATORY CHALLENGES for academic research infrastructures to serve as diagnostic labs

The collaborative spirit and tireless work by a large number of individuals wanting to contribute as much they could to meet this crisis resulted in many great efforts. The chain of events in 2020 were special in the sense that the hospitals and clinical laboratories were not prepared to handle the COVID-19 diagnostics in the beginning. Hence, academic labs were requested to contribute. This may probably not be the case in the future, but the challenges met should be documented to make us better prepared for the future. Here, we aim to highlight challenges that were experienced and how they were solved, when possible.

1. Mandate for diagnostics

The technology/ equipment and competence are often available within academic labs and research infrastructures; however, they lack a mandate to perform healthcare diagnostics. SciLifeLab is a national *research* infrastructure that is organizationally a collaboration between universities, thus lacking mandate to perform diagnostics.

2020: *The issue was solved by a rapidly processed temporary government authorization for the universities to perform diagnostics, allowing large-scale virus testing/ diagnostics within KI/ SciLifeLab (National Pandemic Centre/ Engstrand) and KTH/ SciLifeLab (Large scale serology/ Nilsson & Hober) to meet the urgent need for increased testing capacity, as well as disease monitoring (prevalence), in particular in the early part of the pandemic.*

2. Regulatory requirements for diagnostics

For diagnostic lab activities to be pursued, regulatory requirements need to be met, such as:

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- The person responsible for the lab process needs to be a clinician taking the medical responsibility for the accuracy of the diagnostics
- The lab needs to be IVO registered
- The technology and test equipment needs to meet the regulatory requirements and be certified (CE marked)
- The data connection to the different LIMS systems in the healthcare regions was initially a big challenge

At the National Pandemic Centre the regulatory challenge was solved by Lars Engstrand becoming chief physician at Karolinska University Hospital to be medically responsible for the lab process. The IVO registration of the lab was *processed in record time. At the Nilsson/Hober lab this was solved by operating as a research effort with ethical permit and defined collaborators (FoHM, KS, Danderyd hospital and a few others) within the scope of the project. In other words, this laboratory did not enter the "clinical laboratory service space" to provide routine clinical diagnostics and thus did not need to prioritize which groups to test or set up logistics for testing and patient reporting etc.*

3. Stakeholder coordination and logistic challenges for academic research infrastructures to serve as diagnostic labs

During the pandemic, particularly in the beginning, the communication and division of tasks and mandates between stakeholders were not very clear (Government, FoHM, Regions, Universities, research infra etc.) and getting all the permissions, legal and practical clearance, and a go-ahead to start diagnostic work in the academia was slowed for weeks, even though all the requirements were met.

Intensive efforts and much time and resources were dedicated to solving questions around logistics of samples, orders, reporting results and particularly how an academic research laboratory could feed data into the hospital Laboratory Information Systems (LIMS).

For example, during the Spring 2020 there was capacity at the National Pandemic Centre to run large volumes of patient samples, but the facility was under-used as the samples were not reaching the lab from the different healthcare regions. This was partly due to unclear issues concerning cost refunding, biobank agreements and diversified regional decisions and guidelines. The National Pandemic Centre set up LIMS system in the lab to keep track of samples, but also the required links to hospital IT systems. In addition, direct sampling from patients as well as reporting the results back to the patients directly was started. This was initially not considered, since hospitals were entirely focussing on routine hospital laboratory operations and requested that all data from samples was reported via the hospital LIMS systems. Karlsson & Novak Medical AB and 1177 (direkttest.se) were used for (self)sampling and logistics. Thus, the pandemic situation showed the importance of direct reporting of virus testing results to patients.

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IDENTIFIED RESOURCE NEEDS to be addressed paving way for better pandemic laboratory preparedness

Large research efforts are needed during a pandemic with a “new” virus like SARS-CoV-2 in order to get deep knowledge of the virus and the disease in a short time, develop new diagnostic methods, treatments, vaccines and to learn how to best block transmission in the population. SciLifeLab has to be able to quickly change focus to pandemic research and studies of infectious diseases in the next pandemic period. ScilifeLab will also need to take the pandemic preparedness aspect into account when planning the selection of and assignments to its infrastructure facilities. In addition, SciLifeLab should be prepared to quickly start new facilities if need arises, something that is not usually possible in its 4-year facility cycle.

There is a need for better preparedness on how to quickly identify, scale up, organise and fund missing laboratory resources before the next pandemic. In 2020, required capabilities at SciLifeLab were set up (e.g. set up of environmental virus profiling or high-throughput technologies in BSL-3 lab facilities). Sweden has many BSL-3 laboratories, but they are poorly equipped for molecular biology or high-throughput work and often lacked trained staff, and could not handle the flood of requests when the pandemic started. To identify needs and get access to BSL-3 involved meetings between SciLifeLab/COVID-19 program management, the head of the department at KI, the head of BSL-3, KI Facility management and PIs of the program. SciLifeLab allocated funding covering needed equipment and a technician at Biomedicum’s BSL-3 lab, but practical challenges in managing a BSL-3 laboratory that was not a SciLifeLab facility remained. To not lose the knowhow gained from establishing assays and methods in the Biomedicum BSL3 lab, maintaining the BSL-3 environment during inter-pandemic times and having arrangements ready for the next pandemic is critical.

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Reagents and consumables from commercial vendors for virus research and testing ran out in the early phases of the pandemic, not just in Sweden, but globally. This raised the concern as to whether there should be more investments to ensure self-sufficiency with enzyme and reagent production in Sweden. Novel technologies (kits and reagents – both academic and commercial) need to be validated through a coordinated instance (test bed with access to a hospital data flows) to set up eg. a benchmarked sample set for validation of new technologies against gold standard methods. Questions have also been raised regarding the need for production of vaccines and antiviral drugs in Sweden. SciLifeLab can support these pandemic laboratory preparedness efforts in collaboration with other parties in society.

We do note, however, that the next pandemic may not follow the course of

COVID-19, and the problems faced in 2020 may not be repeated. For example, mRNA-based vaccines are now validated as a result of Covid-19 and these can be rapidly modified for new virus versions or strains and the scale up of their production is now well established. In contrast, the "old" protein- or adenovirus-based vaccines have faced major delays, production difficulties and may even have worse side effect/efficacy profiles.

2020: *Ex. for the* Nilsson/ Hober *large-scale serology initiative, protein deliveries from international companies were delayed and products of bad quality delivered (due to lack of time for the companies to quality check their products). Adequate in house/ national protein production capacity (from different species/ production systems) is an important resource to be secured.* A *plasma preparation facility (from whole blood patient samples) was not in place but needed to be set up, while the remaining step from plasma to analyses could be managed with available robots (requiring a bit of tweaking).*

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SUCCESFULL NATIONAL INITIATIVES paving way for better future pandemic laboratory preparedness

Large national initiatives where SciLifeLab played a central role during the acute phase of the pandemic in 2020 were that the national infrastructure prioritised Covid-19 projects and quickly engaged in setting up diagnostics and sample collections (biobanking) efforts. SciLifeLab also launched a novel national research program aiming to coordinate activities and resources across the country, and set up the national COVID-19 data portal as the first national portal in Europe linked to the European COVID-19 data platform (Fig 2 and below).

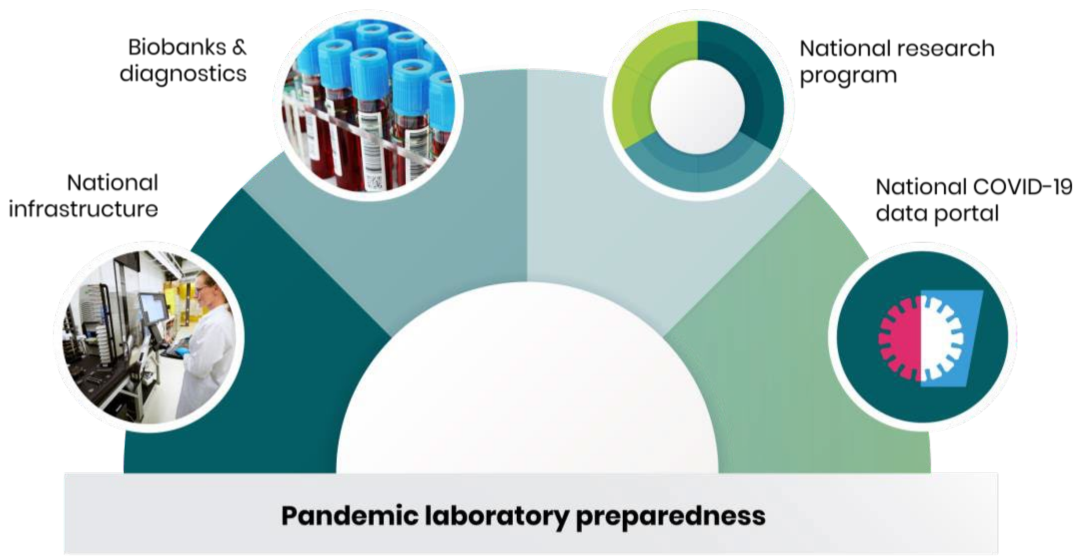

Figure 1. Central national initiatives paving way for better future pandemic laboratory preparedness.

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SCILIFELAB NATIONAL RESEARCH PROGRAM

Through funding from KAW, fast actions and coordination, SciLifeLab launched a national research program in mid-April 2020 following an open call. The program resulted in 67 funded projects within nine research areas together aiming at understanding and inhibiting development of COVID-19 at the molecular, cellular, individual, societal and environmental level, as well as supporting establishment of COVID-19 biobanks (Fig 1). This initiative established Team Science efforts of new constellation of researchers, and in January 2021 a second call was announced resulting in 34 additional COVID-19 research grants awarded to allow continuation of the projects, as well as inclusion of new projects and studies on the impact of the different COVID-19 vaccines.

SciLifeLab national funding has been used for program coordination, data management support, and support to specific needs identified by the research areas. This has resulted in creation of an infrastructure for collection and storage of samples from patients and from the environment, as well as data analysis and logistics. In addition, the effort resulted in expanded access to a BSL3 facility for handling of live coronavirus, and capacity development in serology, chemoinformatics, and computational chemistry at SciLifeLab. The achievements of the program have been plentiful. So far, the projects funded through the program has resulted in 76 publications (June, 2021), https://covid19dataportal.se/publications/, and major achievements from the program were also presented at the public symposia Combating COVID-19 in October, which had close to 400 participants.

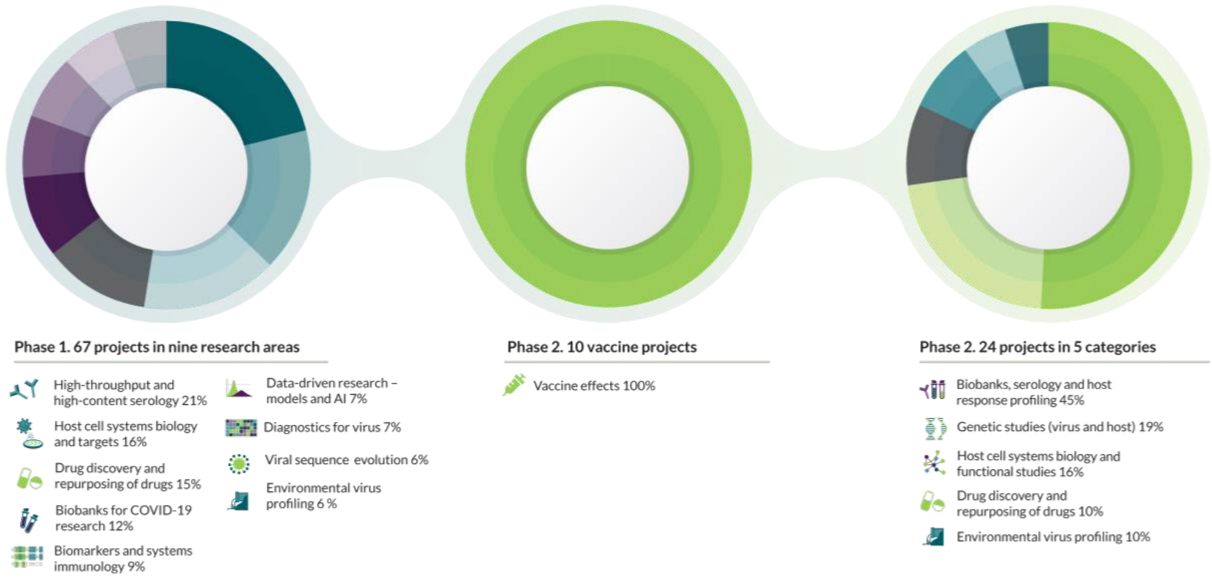

Figure 2. SciLifeLab COVID-19 national research program was launched in two phases. Phase 1 encompasses funding of 67 individual projects grouped in 9 thematic collaborative research areas in phase 1, followed by further funding and development of the program in phase 2 with funding for 10 vaccine projects and 24 projects in five categories.

DATA SHARING

Data sharing has been central for the international collaborative work on COVID-19, both in supporting a rapid pace of open research, but also to support data-driven approaches to public health policy.

SciLifeLab Data Centre launched the National COVID-19 Data Portal on June 3, 2020, as the first national portal in Europe linked to the European COVID-19 data platform coordinated by EMBL-EBI. VR assigned SciLifeLab Data Centre to develop and operate the Swedish portal. The design and code of the Data Portal website has been shared openly with other countries to establish other national portals.

The Data Portal supports all Swedish researchers and aggregates data, guidelines, tools, services and information. The principal functionality is the link to the data archives at the EMBL-EBI, which holds nearly 300 PB life science data and is the de facto standard data sharing platform in the field. The portal also provides a number of databases for Swedish researchers, including a publication database, databases for ongoing projects and open calls for funding, datasets published from Swedish research projects, and a database for sample collections and biobanks making both research sample collections and clinical biobanks findable for Swedish research. The sample collection database is operated in collaboration with Biobank Sweden.

By mid-March 2021, the portal has had over 100,000 page views from 22,000 visitors, of which half come from outside Sweden. The Swedish COVID-19 Data Portal has been a resounding success and lauded internationally for leading the way among national data portals in the EU coordinated network on data sharing.

We identify three success factors for the rapid implementation of the National COVID-19 Data Portal: i) The government acted rapidly to assign VR to coordinate the Swedish participation in the European data sharing platform, and VR rapidly assigned SciLifeLab Data Centre to develop and operate the portal with a national mandate; ii) SciLifeLab already had a national mandate for life science infrastructure and there was an operational and technical readiness, as well as in-house staff with the right skills, to quickly get a Data Portal up and running; and iii) The Data Portal could work closely with well-funded research programs, instructed to prioritize data sharing through the Data Portal, in addition to the many other research projects that started at Swedish institutions.

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General data sharing challenges in Sweden caused considerable difficulties also for COVID-19 efforts, in particular between health care and research domains. For almost one year since the start of the pandemic, the number of sequenced virus strains available in the EBI and other related databases was extremely small, as no party in Sweden had the mandate or ability (or data sharing permission) to share such data with international databases. Thus, freely available data from Sweden were missing or extremely limited while most other countries in the EU could arrange data sharing freely. Thus, from the angle of global tracing of the pandemic, Sweden was almost like a white spot.

The questions concerning data sharing hurdles are too many and too complex to dive into in this document, but concrete solutions in this area are needed from the perspective of better future pandemic preparedness: legal hurdles, organisational issues, fragmentation and confusion in assignments, lack of incentives for data producing organisations to share data for research, and a great lack of interoperability between data services and resources across the many regional operators. Sub-optimal prerequisites for data sharing as well as data ownership issues hamper real-time publication of sequences and tracking of virus strain evolution. Data release is important for monitoring the national spread in real time and comparison of the virus strains circulating in Sweden vs. those in neighbouring countries and globally.

Examples of questions to address to allow increased and streamlined secure data sharing:

- Clarity between actors and mandate for data sharing – fear of overstepping mandates and doing something new and perhaps inappropriate leads to situations where the "grey zones" never get addressed, in particular when they would need to be addressed through interactions between different organisations, sometimes across different public sectors.
- Permission for data sharing – Virus vs. human data. During a virus outbreak it is essential that virus sequences are widely shared, while in Sweden all such sequences were often considered personal human data, even though no person can ever be identified from a virus sequence. Therefore, clarity is needed for the future to ensure that personal protection is not unnecessarily blocking the public availability of virus sequences or the public response to the virus.
- Agreements for data sharing – In order to share data from research or biobanked samples, it is necessary to have the patient consent define the ability to share results with other researchers, national data portals or with international databases. However, most academic scientists have not requested consent for such purposes. With samples obtained from clinical diagnostics, this is more complicated, as patients do not sign any consents. Agreements for sharing of data obtained from diagnostic samples between government organizations need to be considered. Swedish universities also often do not have data processing agreements set up in a way that enables researchers from one university to work on human data generated by another university. The lack of infrastructure suitable for sensitive personal data processing in collaborative projects, including with international partners, is another import issue.
- Incentives for data sharing in healthcare – even simple and legally unencumbered, non-identifiable, data (such as virus sequences) remain as a default locked in the healthcare sector in systems that prohibits interactions with the research sector, largely due to legal limitations, but also lack of incentive or culture to share.
- Incentives for data sharing in research – researchers need strong support functions and data services within these systems, in order to facilitate

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sharing of data and ensuring law and IT-security are properly managed. Data publishing also needs to be merited in similar ways as publishing of scientific papers. We also need to move away from a protectiveness and sense of ownership of data, hampering sharing even when the research has been publicly funded and the data derives from samples donated by patients hoping to broadly support research.

- Collaborations with industry – increased engagement with commercial partners for technical platforms or technology development for data science would be desirable. The organisational structure of SciLifeLab makes these interactions difficult to set up and legal agreements arranged through individual universities are rarely able to fully take the national perspective SciLifeLab operates in into account.

SciLifeLab can build on the Data Portal model to provide integrated and rich data sharing platforms for Swedish researchers, that engages with the research community and provides a platform to share data and host user created databases and services, as well as leads the technical and the scientific development of data driven life science in Sweden.

SAMPLES & BIOBANKS

Collecting patient samples coupled to relevant medical data are key for studies providing deeper disease understanding and allowing better treatment.

There are several considerations to be made:

When confronted with a new disease, samples constitute an urgent requirement for research and tech development. Samples need to be well documented and correctly collected, and it is important to ensure processes to access samples for research (e.g. clinical vs. research samples, patient consents, ethical permits, prioritization of scarce material, acute crises versus long-term research etc.)

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Setting up pipelines for adequate collection and storage of relevant sample types with relevant patient consent in the middle of acute crises and chaos at the hospitals was very challenging in the early phases of the pandemic. It was necessary to avoid burdening routine care. Several lessons can be learned for better preparedness and smoother processes including:

- Digital tools needed – to avoid contagious consent papers
- Information in several languages needed – to reach a heterogeneous patient group
- How to access samples from deceased patients needs to be considered
- The challenge with a fast developing disease with patients moving between different wards needs to be considered

- Securing longitudinal samples coupled to clinical data, etc.

It is important that the sense of urgency is embraced by all parties and that central authorities have the flexibility to prioritize towards a pandemic and rapidly set up fast-tracks, for ex. EPN prioritizing COVID-19 applications was a central piece of the puzzle for rapid start of sample collection and research initiatives.

2020: National SciLifeLab Biobanking research track quickly funded at the start of the pandemic and biobanking efforts later developed jointly with Biobank Sweden, now a joint register is in place at the SciLifeLab COVID-19 portal.

Comprehensive EPN applications were formulated that should be made available for future usage.

PATHOGEN TRACING in the environment

In light of the many challenges with the access to health care samples and associated clinical data, as well as with sharing real-time virus data from clinical and health care samples, the ability to analyse the virus quantities and virus subtyping from the wastewater samples is a significant opportunity. This provides unbiased data from 100 000s people from each region, and once a system is properly set up it can be used to detect an upcoming epidemic wave much before clinical evidence of the disease. This can also be applied to study the load of several viruses if shed via the urinary or gastrointestinal tract, and it is unclear how many pandemic diseases outside of COVID-19 that can be detected in wastewater. SciLifeLab funded early studies to set up this technology and plans to support this approach as part of the pandemic laboratory preparedness work to set up a routine monitoring virus loads in wastewater on a weekly basis from several regions in Sweden. New methods will also be developed to get sequence information from viruses in wastewater and to identify pathogens on surfaces and in air samples.

2020: SciLifeLab funded early studies to set up this technology and plans to support this approach as part of the pandemic preparedness work to set up a routine monitoring virus loads on a weekly basis from several regions in Sweden.

REFLECTIONS LOOKING AHEAD: FOCUS AREAS

It is important to take advantage of the experience gained during the COVID-19 pandemic to be better equipped for the next pandemic. We have therefore made a comprehensive analysis of SciLifeLab's role during the pandemic so far, as presented in this document. Based on this analysis, important focus areas and

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developed measures that need to be implemented to strengthen SciLifeLab's role in future pandemics were identified. The work for pandemic laboratory preparedness will naturally be carried out in close collaboration with other parties (Fig. 3), and defining roles and mandates as well as keeping an active dialogue between stakeholders is a central part of being better prepared for future challenges. Below are our eight focus areas and proposed measures outlined.

1. Research is needed during pandemics – SciLifeLab will focus on research support

SciLifeLab should not function as a clinical laboratory during pandemics, as this should be done by clinical microbiology labs at hospitals, companies and authorities. SciLifeLab-associated capabilities can support clinical laboratories in the initial phase of a new pandemic crisis if regulatory issues are solved, but all diagnostics should as soon as possible rapidly shift to healthcare. Instead, the focus of SciLifeLab should be on supporting relevant research with the latest technologies. Research is central during pandemics because it generates the new knowledge needed, and the value of medical research and development has been very clear during the Covid-19 pandemic. Within the framework of Sweden's emergency preparedness work, the conditions for research and the opportunity to quickly utilize new knowledge must therefore be included. With its strong life science infrastructure and research network, SciLifeLab will strengthen basic, pre-clinical and clinical research, as well as technology development, at universities, hospitals, authorities (eg FoHM, SVA and FOI) and companies during and between pandemics.

2. SciLifeLab shall support team research efforts during pandemics

Coordinated joint efforts are central for adequate rapid response to new challenges and crises. This applies also for research projects, where Team Science efforts (rather than competing single PI projects) pave way for success, as resources and techniques are optimised (both with regards to scarce patient material, reagents, funding etc.). These multi expertise Team Science consortia can excel when supplied with support tools for integrated efforts (the latest infrastructure, communication tools, coordination supports, data sharing tools etc). The SciLifeLab organization is optimally set-up for these tasks, as shown in the COVID-19 pandemic, and should play an important role in the support of team research during coming pandemics.

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3. SciLifeLab shall support techniques important for the study of pandemic pathogens and their effects

A number of different life science techniques are important for generating knowledge about the pathogens that can create pandemics, and their effects in patients. All platforms within SciLifeLab can contribute to this type of knowledge and they should all be adapted to facilitate such use. Initially, during the investment in pandemic laboratory preparedness, the focus will be on Sequencing of DNA / RNA, Serological analyzes, Immune monitoring, BSL3 studies of pathogens and detection of pandemic pathogens in the environment. These activities build up an initial network that will be expanded with other technologies / platforms and actors at hospitals, authorities and universities. It is important that the technologies also have functions during inter-pandemic times such as in e.g. precision medicine and studies of antibiotic resistance.

4. SciLifeLab shall operate nationally and in collaboration with other infrastructures

Research infrastructures need to be better coordinated and made available nationally during pandemics. SciLifeLab is already a national infrastructure with nodes and users at all larger universities across the country. The work with pandemic laboratory preparedness within SciLifeLab must consider where to focus its activities and how they are to be coordinated with other research infrastructures at hospitals / regions, authorities, universities and companies, and thus contribute to the work with a national division of responsibilities within pandemic laboratory preparedness.

5. SciLifeLab shall work to facilitate the flow of patient samples to its facilities

In a crisis situation, it is of utmost importance that patient-centered studies on, for example, viruses, vaccines and treatment methods can get started quickly, so that new knowledge is passed on and really benefits healthcare and the general population. This presupposes that patient material can be collected and that these samples can be analyzed at infrastructures such as SciLifeLab. During this COVID-19 pandemic, it has become clear that there are a large number of rules and regulations that obstruct sample management and the flow to relevant facilities. Many regulatory adjustments were pushed through with record speed for the extraordinary challenge in 2020, but still several systematic challenges made it difficult for SciLifeLab and its partners to achieve a more significant impact. These issues have to be dealt with when preparing for the next pandemic to ensure a long-term and / or streamlined rapid contribution of academic labs and research infrastructures.

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6. SciLifeLab shall support data management and data sharing during pandemics

Open sharing and availability of data needs to be promoted during a pandemic when there is no concern of patient identity/privacy (e.g. virus sequences). During the COVID-19 pandemic, SciLifeLab has played an important role in making various types of research data related to COVID-19 available via the FAIR principle.

An important role for SciLifeLab during pandemics will be data management and data sharing nationally between healthcare, academia and authorities but also internationally. The investment in the DDLS program (SciLifeLab and Wallenberg National Program for Data-Driven Life Science) over the next 12 years will increase these opportunities and anchor it in the research community. This will lead to the development and use of new knowledge required for Sweden's citizens to quickly and efficiently receive the help they need during a pandemic.

7. SciLifeLab shall support training in pandemic laboratory preparedness

In addition to building knowledge, the pandemic has also emphasized the importance of researchers' competence as a central resource in crises. There must be research competence in health care that can carry out early studies during pandemics and thereby quickly increase knowledge in order to provide patients with the best possible care in the event of a health crisis. Researchers at all levels in the academic sphere need continuous further education in life science techniques and data management. SciLifeLab will provide training for both clinical and academic researchers in techniques useful in the study of pandemic pathogens and their effects.

8. A permanent investment in pandemic laboratory preparedness within SciLifeLab

A strong research infrastructure in life science, adapted for research on pandemic pathogens and its effects, is required to cope with future pandemics. SciLifeLab, Sweden's largest and most complete infrastructure in life science, has played an important role during the COVID-19 pandemic. Between 2021-2024, SciLifeLab will develop a pandemic laboratory preparedness for the future, but long-term investments at the same level are required if SciLifeLab is to play a key role during future pandemics. Thus, resources should be permanent within SciLifeLab from 2025 to maintain and develop the built capacity.

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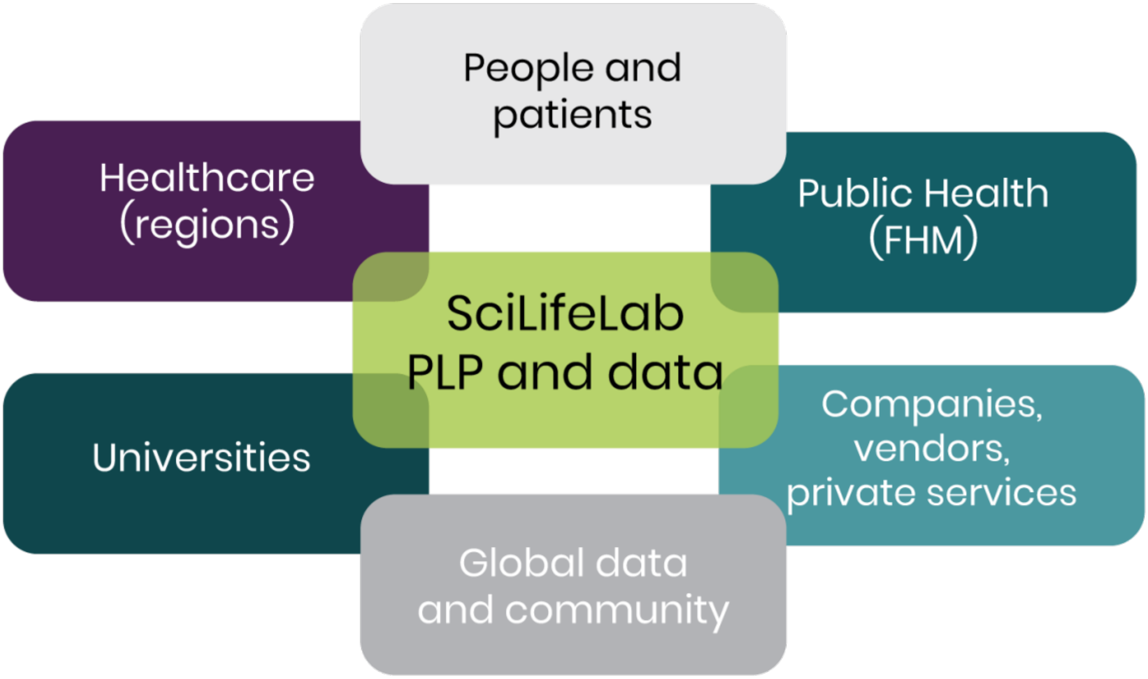

Figure 3. SciLifeLab Pandemic Laboratory Preparedness (PLP), with strong focus on research and data, is one central building block that together with other parties will work to ensure better preparedness for future challenges.

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How this report was compiled

This report is based on internal interviews held with people engaged in central initiatives within SciLifeLab Covid-19 efforts during 2020. The first version of the report was completed in April 2021, but is likely to be updated with new versions as more viewpoints in this multifaceted effort have been gathered. Written by Mia Phillipson (Co-Director from 2021-01-01), Staffan Svärd (Scientific Director, Uppsala University) and Sandra Falck, approved by Olli Kallioniemi (Director), Siv Andersson (Co-Director until 2020-12-31) and the SciLifeLab Management Group.

Interview questions:

- Vad var den största utmaningen från ditt/ert perspektiv i Covid-19 arbetet under våren 2020? Hösten 2020? Vad var de största lärdomarna?
- Utvecklade du/ni någon ny process/metod/produkt/resurs som du ser kan ha värde även för framtida behov? – utveckla gärna
- Med lärdom från pandemin 2020 hur ser du att vi kunde vara bättre förberedda nästa gång och vad behövs för att SciLifeLabs ska kunna bidra fullt ut?

Interviewed people:

Lars Engstrand & Per Sikora (Virus testing and Sequencing), Peter Nilsson & Sophia Hober (Serology), Johan Rung (Data Centre), Hans-Gustaf Ljunggren (patient sample collections/ Biobanking etc), Maria Pernemalm & Janne Lehtiö (Research area Serology), Marjo Puumalainen (BSL-3 work), Annika Jenmalm Jenssen & Lars Johansson (SciLifeLab infrastructure)

This document will be drafted in two versions. A longer version (current) targeted for internal use aiming to improve internal processes and define prioritized areas and modes of action where SciLifeLab is best equipped to act for maximum value for society. A shorter summary for distribution to relevant governmental authorities (i.e., the Life Science Office, the Government pandemic group (Corona-kommissionen), FoHM and other stakeholders) to concretely highlight the challenges and possibilities to be considered in connection to fully utilizing the potential of SciLifeLab for pandemic preparedness and rapid response.

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Appendix F.

SciLifeLab Infrastructure Report to the Evaluation by the International Evaluation Committee (IEC) 2020

To manage file size, Appendix F. is not included in this document. Instead, please:

- Read the digital version online (full address: https://www.scilifelab.se/wp-content/uploads/2020/11/Infrastructure-Evaluation-2020_Report_1.pdf).
- Read the print version in the separate document included in the delivery of your IAB report.

Read the report online - ⟶

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Appendix G.

Infrastructure evaluation report from the International Evaluation Committee (IEC) 2020

International evaluation of the SciLifelab infrastructure 2020

Report from the International Evaluation Committee (IEC)

SciLifeLab

Karolinska Institutet

KTH Vetenskap och Konst

Stockholms universitet

Uppsala Universitet

Report from the International Evaluation Committee (IEC) prepared by:

Geert Van Minnebruggen (Chair)
Head of VIB Core Facilities | Head of VIB Science & Technology Unit, VIB, Belgium.

Janna Saarela (Co-chair)
Professor of Medicine at University of Oslo | Director of the Centre for Molecular Medicine Norway (NCMM), Norway.

Ellen Berg
Chief Scientific Officer, Translational Biology at Eurofins Discovery, US.

Justin Bryans
Executive Director, Drug Discovery at LifeArc, UK.

Rainer Pepperkok
Director of Scientific Core Facilities and Scientific Services, European Molecular Biology Laboratory (EMBL), Germany.

Michael Sattler
Professor of Biomolecular NMR, Dept of Chemistry, Technical University of Munich | Head of Institute of Structural Biology, Helmholtz Center Munich, Germany.

Hanno Steen
Associate Professor of Pathology at Harvard Medical School | Director of Proteomics at Boston Children's Hospital, US.

Riitta Lahesmaa
Academy Professor, Director of Turku Bioscience Centre, University of Turku | Co-Director of BioCity Turku Centre for Life Span Research, Finland.

Appendix I prepared by: [1]

Rolf Apweiler
Director of European Molecular Biology Laboratory, European Bioinformatics Institute (EMBL-EBI) United Kingdom

[1] Rolf Apweiler was originally assigned as IEC panel member, but was not able to attend the virtual panel meeting and has not been involved in the joint IEC assessments of the platforms and facilities. He did, however, kindly contribute with an individual, separate assessment of the Bioinformatics Platform, based on the written infrastructure report and the video recording from the IEC panel meeting with the platform. He has assessed the Bioinformatics Platform only, and did not evaluate it in in relation to the other platforms (unlike IEC). Rolf´s assessment of the Bioinformatics platform is given in Appendix 1.

Foreword from the International Evaluation Committee (IEC)

The *SciLifeLab evaluation* was foreseen to take place April 20–22 as a three days on-site visit. However, due to the COVID-19 pandemic outbreak this format was not possible. Instead, a three days online meeting (via Zoom) with presentations from the individual Platforms and Facility Units – alternating with private breakout sessions from the International Evaluation Committee (IEC) – was organized.

Prior to the meeting, the IEC was provided with the 2020 *Report of the International Evaluation of the SciLifeLab Infrastructure*. This report was of very high-quality and formed the base for the *initial written assessment* that each individual IEC member had to make by *April* 6, 2020.

Although COVID-19 prohibited the face-to-face interviews, the final format of the evaluation was well-thought out and executed smoothly. The roles for each stakeholder involved (i.e. SciLifeLab presenters, IEC members, IAB and other observers) were clearly defined. The evaluation started with a welcome of the IEC, an introduction to the procedure and subsequent presentations of the respective Platforms and individual Facility Units. At the end of each platform´s presentations, a 25 min Q&A session, followed by a private IEC break-out session, was organized.

Tasks of the SciLifeLab 2020 IEC panel were:

1. To evaluate the Platforms and their individual Facility Units and to make recommendations on their inclusion into the SciLifeLab infrastructure for the next term 2021–2024.
2. To make recommendation on SciLifeLab funding on platform level as compared to current (2020) funding (indicated with +/0/-)

The IEC had full consensus in its opinion that the SciLifeLab infrastructure is a major driver of research excellence within the research cluster in Sweden and Europe. SciLifeLab is recognized for its infrastructure settings and is a *gold standard* in *Europe* for how top-notch life science platforms and facilities should be implemented and operated. Indeed, the IEC would like to congratulate and commend the SciLifeLab leadership for the extraordinary success and importance of the infrastructure. This success is well supported by Key Performance Indicators (KPIs) such as co-authorships, acknowledgements and number of research groups that make use of the Platforms and/or individual Facilities. The achievements have been extraordinary. Chief among the achievements has been:

1. SciLifeLab Platforms offer open access to unique, game-changing techniques in various life sciences-related fields. While offering service is the key activity, the Platforms and Facilities have also a strong tradition in pushing the boundaries of tech- and application development, up to the level of software designs.
2. All SciLifeLab Platforms have succeeded to offer the Swedish life sciences community access to cutting-edge instrumentation, expertise and a pool of highly talented expert operators.
3. Without any exception all Platforms have shown timely implementations of state-of-the-art techniques.
4. The Genomics Platform operates according to the very highest standards and is definitely leading in Europe.
5. The Drug Discovery and Development Platform is a unique setting that has shown to be capable of translating basic science findings into value for society.
6. SciLifeLab Platforms have a good culture of communication (which is difficult to achieve in hybrid environments) which is, amongst others, illustrated by some of the virtually integrated service portfolios. One prime example that has enormous future potential is the proposed set-up of the so-called Targeted Spatial Omics (TSO) Facility.

Contents

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Overall Feedback on the SciLifeLab Infrastructure

G.

Overall Feedback on the SciLifeLab Infrastructure

Before going into the evaluation of the individual Platforms and Facilities, the IEC wants to comment on some key aspects of the overarching SciLifeLab modalities.

Governance and leadership

Overall, SciLifeLab is managed extremely well. This is definitely a result of the steering power of the Management Group and its bi-directional communication with the IAB as well as with respective platforms. Also, the Operation Office has done a terrific job in managing all the operations. Especially as SciLifeLab operates in a centralized-decentralized model interacting with several universities this is difficult to achieve. Also, the individual Platforms & Facilities have good overall leadership

Political landscape

The political landscape is sometimes complex, though mostly handled adequately. Care needs to be taken for some crucial aspects related to the future success of DDD Platform, the Diagnostics Development Platforms as well as the key mission of the Bioinformatics Platform related to its national mission.

Data as the key asset

As Data-driven Science is identified as a spearhead theme of the SciLifeLab 2020-2030 roadmap, the data have to be handled with care - they form the key asset. The IEC welcomes various initiatives that have been started. However, to exploit the data to the fullest on the mid-to-long run it will be essential to create a strong(er) mandate for building a data culture in part through the Data Centre, improve the alliance between the Bioinformatics Platform and the Data Centre, as well as to define the right approach for the bulk of (local) image analyses activities that will only increase. Furthermore, more sample-centric data management and long-term storage of (published, i.e. no question about 'ownership') should be considered.

Budget & funding landscape

G.

The spread between disciplines forces SciLifeLab to invest in a significant number of platforms. The IEC is of the opinion that also in the future (as it is the case now) the DDD Platform should be funded via a separate earmarked internal budget source. Further, the IEC questions whether the same is true for the Diagnostics Development Platform; in- or outside of SciLifeLab. Further, it is a strategic choice up to the discretion of SciLifeLab leadership to accept several (often small) new candidate facilities, or alternatively to invest more in the existing ones. Particularly in microscopy this was recognized as a challenge, with no less than 6 new candidates.

Meta-data collections

With the clear ambition to start more integrative projects (often including cross-platform / facility workflows) it will be important to build meta-data catalogues that adequately describe study procedures including experimental conditions, enabling the connection of data through treatments of targets, compounds, samples, etc. As data analytics including Artificial Intelligence and machine / deep learning will also take a more prominent role and data form the base for this, the importance of meta-data is re-exemplified. Coordination of meta-data initiatives e.g. by the Data Centre will motivate accurate curation that may form the base later on for additional community-driven large-scale cohort studies.

Bio(statistics)

Especially in the NBIS Platform some of the services can benefit from hiring extra bio(statisticians). They may help more users with the design of their experiments *PRIOR to starting any study*. The same is true for the Chemical Biology- and Drug Discovery-related work and probably for all Platforms.

Integrated Structural Biology

The proposed platform for Integrated Structural Biology (ISB) is an excellent idea to establish and strengthen interactions between SciLifeLab and key Swedish structural biology infrastructures (MAX IV, ESS), which are not part of SciLifeLab. The IEC recommends that a convincing strategic plan for this Platform be developed with strong support by SciLifeLab leadership in discussions with MAX IV and ESS.

Assessments of Platforms, Facilities and Data Centre

Bioinformatics Platform

Grade: 7

Motivation

Bioinformatics (NBIS) is a nation-wide, well-resourced (i.e. ~ 75 FTE's) Platform that provides expert knowledge, data integration capabilities, advanced training, (custom) data analysis pipelines, help in efficient data publication and access to high-performance data analysis methods. Its user base is broad, increasing, though not (yet) fully inclusive.

At the facility level, the IEC realizes that some units are still relatively young (small) and that care needs to be taken these will not be(come) sub-critical. To avoid such a scenario, a (virtual) merge or line up of e.g. Compute and Storage with Data Centre and the newly accepted AIDA with Diagnostics Development may be considered.

The capabilities offered by NBIS cover a broad spectrum of multimodal omics-related activities (up to the level of compute support) that form the key of modern data-driven science. However, to date, emphasis is still mainly on genomics/transcriptomics-related services. With its highly talented staff it should be possible for NBIS to broaden this scope to 'real' integrative multi-omics analyses (that also cover proteomics, metabolomics, lipidomics and/or other disciplines) in the near-to-mid future.

When dissecting a classical bio-it service project in its different aspects the panel has concerns that specific support at the upfront stage of experimental design (including rigid management of assay meta-data) is a bit less developed. As high-quality support at the beginning of a project is of course crucial to success it is recommended by the IEC to bring additional (bio)statistical expertise on board.

Overall, the IEC is highly supportive for the NBIS Platform and complements its leadership. Together, all Facility Units served the needs of most – if not all – users. The IEC fully agrees that the strong focus on the user's perspective has paid off. However, for a sustainable future of the Platform it will also be important to stimulate a crosstalk with the Data Centre, and to emphasize the computational/bioinformatic analysis of other omics platforms than DNA-/RNA-sequencing-based methods. A clear strategic vision with a good mix of top-down and bottom-up initiatives, surrounded by strong data governance procedures, will be key to success. The IEC is of the opinion that setting out such a strategy should be a top priority to maximally benefit from complementary expertise levels, to avoid redundancy, and especially to stay at the forefront of data-driven science. As the latter is formulated as a key mission by SciLifeLab leadership in its 2020–2030 roadmap, attention is needed.

The NBIS in all its dimensions performed very well which is translated in a score of 7. The Platform is definitely on a good track and has both the resources and financial means to build out a successful future. A status quo (0) in budget should be considered (see also below).

Recommendations for 2021–2024

- A better line up with the Data Centre is highly recommended (i.e. essential)
- The current focus is directed mainly towards genomics. It is proposed that this shifts also to other omics disciplines (including proteomics, metabolomics, lipidomics) up to the level of integrative, multi-omics support
- Experimental design needs to be supported by extra (bio)statistics expertise. More training activities at this level could also be useful to disseminate these skills
- The Image Informatics Unit will benefit from a better connection to the local image analysis resources

Support, Infrastructure and Training

Grade: 8

Motivation

The Support, Infrastructure and Training Facility for Bioinformatics is an important and internationally competitive Facility, well connected within Swedish Universities. This Facility is at a mature state providing a broad array of bioinformatic analyses, tools and pipelines to over 240 PIs annually. The overall expertise in this Facility is very high. The development plans include expansion of bioinformatics support in single cell transcriptomics, comparative genomics, multi-omics, biodiversity, and ancient DNA analyses as well as infrastructure to support the amount of human data in the federated European landscape (1+M Genomes), and projects for web-interfaces to specific databases/tools, development of databases and development of analytical pipelines.

The IEC noted increasing challenges of project complexities and timelines, thus project prioritization and a rigorous strategic review of legacy projects or tools (e.g. outdated technology, diminishing user base) will be needed. The overall balance between small and large(r) projects is good, though care needs to be taken that it's not shifted towards mainly the bigger ones. The 20% time allocated to staff for personal development is commendable given that this is a fast-changing field and that data science is a highly competitive area. This team represents a valuable resource to underpin advances in algorithm development and AI, including training opportunities for the next generation of data scientists.

While we acknowledge the increased demand for bioinformatics services including needs in projects, training and development of user-friendly tools and databases, there are additional data-related priorities to be addressed. These include support for non-genomic-based data management and analyses, multi-omics integration projects, and the need for biostatistics, statistics and project design/planning support. Some of these may be served by other Facilities such as the Data Centre, Proteomics Facility or others. However, there remains a need for an overarching strategy to build a comprehensive data culture. It is unclear whether this would reside within bioinformatics, the Data Centre, or outside.

Recommendations for 2021–2024

- Due to the internationally recognized position of this Facility and national scope, we recommend continuing support.
- While we recognize the importance of this Facility, we do not recommend the full additional support requested due to competing needs for data services support by the Data Centre and for non-genomic data.
- Alignment of some tasks & services with the Data Centre is seen as being crucial for the future.
- We recommend continuing support of 'Advisory Mentorship Programme' and 20% allocated time for professional development.

Compute and Storage

Grade: 8

Motivation

The access to adequate computing resources is one of the corner stones of the data-driven life science. Compute & Storage is a mature and well-functioning Facility supporting over 700 research groups annually. It functions as a bridge between the SciLifeLab Bioinformatics Platform NBIS and the SNIC infrastructure at Uppsala University's Computing Center, making the nationally available HPC resources more accessible to the life-science researchers. Furthermore, the Facility maintains and develops a digital research environment for life science research on SNIC HPC systems and provides training and project management for the HPC users.

Considering the increasing demand for HPC in life science, the active development of novel analysis methods, and limited personnel resources of the Facility, the IEC highly recommends the use of technologies like Conda, Singularity, and EasyBuild to generate a more portable and robust environment.

Challenges/points of concern/improvement

- Division of tasks and collaboration with the Data Centre in supporting the development of AI/machine learning solutions and data management needs.
- Coordination of activities towards the adoption of good practices with regards to long-term data storage and publication according to FAIR principles and legal requirements with the Data Centre.
- Management of data and user transfer to a new computing environment.

Recommendations for 2021–2024

- This is a facility of high importance for life science in Sweden and should thus be supported strongly.
- Coordination of (some) activities with the Data Centre should be considered

BioImage Informatics

Grade: 6

Motivation

Image bioinformatics is becoming increasingly important in modern life sciences. Integrating imaging data with those obtained by other large-scale techniques (e.g. multi-omics data) is essential for modern cutting-edge life science research and as such the BioImage Informatics SciLifeLab Facility has and will play in the future an important role in enabling Swedish scientists to conduct cutting edge research with international impact. In this context, the plans to integrate BioImage Informatics into the Bioinformatics Platform is an important step forward. It can thus be expected that image data will become better integrated with other SciLifeLab Platform's data and essential quality control, including rigorous statistical analyses, can become standard for any imaging related project within SciLifeLab.

The Facility is currently connected to the Imaging Facilities within SciLifeLab. Its scientific environment is excellent and internationally recognized and participation in international networks in image analysis (e.g. NEUBIAS) exists.

Points of concern/improvement

- Although this altogether should enable broad usage of the Facility, user statistics appear to reveal a focus on KI and UU scientists.
- Very little inclusion of BioImage Informatics into the future plans of Imaging Facilities was observed by the evaluation panel from the respective reports.
- The current size of the Facility (5 FTEs) appears limited compared to the demand for such services that can be expected in the future.

Recommendations for 2021–2024

- This is a facility of high importance for life science in Sweden and should thus be supported strongly.
- Development of a strategic plan stating how to involve and connect better to local image analysis resources in e.g. SciLifeLab imaging platforms, collaboration with the Data Hub AIDA and future Data Centre are strongly recommended and would strengthen SciLifeLab services altogether.
- The IEC panel argues that a financial increase in the period 2021–2024 enabling the facility to adjust its size and capacity to the expected demand should be made conditional to the approval of the strategic plan by SciLifeLab leadership.

AIDA Data Hub (candidate)

Grade: 7

Motivation

The AIDA Data Hub will 1) advance AI-based analysis of clinical images and 2) associate this AI-based analysis of clinical images with omics data. Data management, storage, curation and access is critical for this undertaking to be successful. The AIDA Data Hub provides such a repository and makes data available for analysis. This is a key part of the bioinformatics environment as sharing data sets will be critical to solving some major healthcare issues.

AIDA is at an early stage, hence the small number of publications and FTEs. However, this Facility has a convincing concept allowing to identify a large number of collaborators mostly in health care and industry, but also at several universities. The focus on biomedical imaging and diagnostics has significant potential and relevance for clinical use.

AIDA will leverage the expertise in the BioImage Informatics Facility, the Bioinformatics Platform, the Diagnostics Development Platform and Data Centre, providing at the same time expertise in clinical imaging data analysis and handling of sensitive clinical data, i.e. the AIDA data hub is fully compliant with current privacy and ethics laws. All these considerations make the AIDA data hub partially unique to SciLifeLab.

It was appreciated that the AIDA Data Hub has a 'clinical review committee' to provide guidance and prioritization of the projects, which is particularly important at this early stage. However, even at a late stage, independent review of the ongoing projects is important to focus efforts and resources.

Points of concern/improvement

- It is recommended to initially keep the user fees low (or do not charge at all) in order to establish a sound user base. However, about 60% of the collaborators are from healthcare and industry, as such some costs should be recoverable by fees from these two groups of users, in order to subsidize academic pilot and basic research projects.
- Initial focus of AI analysis on clinical imaging is appropriate, but after consolidating this activity, AI support should be expanded to other SciLifeLab domains.

Recommendations for 2021–2024

- Add the AIDA Data Hub to the SciLifeLab community.
- Provide the requested funding to sustain the proposed activities.
- While low/no user fees for academics, pilot projects and method development are appropriate, recovering some expenses through user fees from industry and healthcare is suggested.
- AI is of major interest for many other areas in life science (e.g. biological imaging, structure-based drug discovery, metabolomics, etc) Thus, expansion and support to other life science areas within SciLifeLab is strongly recommended. This should be considered within the context of the Bioinformatics Platform and the AI Innovation Sweden Initiative, as the Facility is currently in its infancy with minimal staffing, and thus focusing on one relevant area is recommended.

Bioinformatics Platform – Funding Recommendation

Funding recommendation: 0

Motivation

The Bioinformatics Platform is performing very well and definitely deserves to be, and stay, part of SciLifeLab. Its funding of approximately 20 MSEK is justified, with Support, Infrastructure and Training being the main component. A re-orientation of the key focus of 10% of the expert bioinformaticians in this facility should allow the platform to respond to the main recommendations, and as such to secure a successful and sustainable future. Further, re-shuffling some of the service activities of Support, Infrastructure and Training and/or Compute and Analysis to the Data Centre (as also suggested by the IEC) may even free up a small internal budget that can be re-allocated within the platform. The requested budget increase is thus seen as not essential and therefore not supported by the IEC.

Cellular and Molecular Imaging Platform

Grade: 7

Motivation

Imaging has become an essential tool for current life sciences and as such this platform has a very high relevance for the Swedish life science community. The Platform has a strong user base, provides service at the national level, is internationally competitive and some Facilities can be considered as amongst the leaders internationally. The Platform aims to include from 2021 onwards several new additional service facilities, in particular to complement Cell Profiling with In Situ Sequencing and Advanced FISH Technology to form a comprehensive service in targeted single cell omics. This is an excellent move forward and will further strengthen the Swedish life science community.

Points of concern/improvement

- Some of the new candidate facilities are considered by the panel to miss the uniqueness in terms of technology service offered.
- Some of the new candidate facilities appear to be suited for collaborative research projects rather than for service provision.
- Image analysis service solutions exist in all relevant Facilities, however, each of them is focusing on its own local solutions rather than on forming an integrated network amongst image analysis experts within SciLifeLab. This is considered as a lost opportunity.
- AI methods could strengthen data analysis by exchange and joint development for image analysis.
- Development of a strategic plan how to establish a FAIR data concept in collaboration with the Data Centre and Bioinformatics Platform appears not to exist.
- The IEC would recommend a more streamlined leader-ship with clear goals and vision for the entire Platform.

Recommendations for 2021–2024

This Platform is of high importance for life science in Sweden and should thus be further supported strongly. A financial increase in the 2021–2024 period is recommended for some of its members to enable necessary growth, especially to support the cryo-EM network.

- Development of a strategic plan how to involve and connect better the local image analysis resources amongst themselves and integrate them with BioImage Informatics.
- Compared to the other platforms this particular one has received the largest number of new candidate applications. Although some new candidates may be taken on board, care needs to be taken to not dilute the existing ones too much. Coordination in terms of complementarity and prioritisation of new technology is strongly recommended.
- Establish a strategic plan stating how to establish a FAIR data concept in collaboration with the Data Centre and Bioinformatics Platform.

Advanced Light Microscopy

Grade: 7

Motivation

General Comments

The ALM Facility offers state-of-the-art fluorescence applications with a strong focus on super-resolution microscopy. It is internationally competitive and connected and some of the services offered are unique in Sweden. Therefore, the facility plays an important role for the Swedish life science community. It is embedded in a strong scientific environment (Biophysics at KTH). The user base increased significantly from 2017 to 2018, though kept stable since then.

Recommendations for 2021–2024

- The Facility's focus is on super-resolution microscopy with only few other types of services. It would be beneficial to include other cutting-edge imaging technologies for correlative approaches into the Facility or strengthen collaborations with other Imaging Platform Facilities (e.g. correlative light and electron microscopy).
- The Facility could play a central role for data organization/storage and handling for the Imaging Platform as a whole

Biochemical Imaging Centre Umeå/Umeå Core facility for Electron Microscopy (candidate)

Grade: 7

Motivation

This candidate Facility provides support for electron microscopy, with a unique focus on FIB-SEM, and CLEM applications. The TFS Scios DualBeam FIB-SEM seems to be the only instrument of its kind in Sweden and this service is unique within SciLifeLab. The Facility offers cutting-edge technology for 3D volume EM, with strong facility leadership and a broad user base, exceptional in Sweden. The ability to image and view 3D visualizations of cells and cell-cell contacts will undoubtedly drive some very interesting research. For the Viewing Platform building a VR capability might be transformative for viewing complex 3D images and gaining buy-in from research teams.

There is a significant increase in the number of papers. The joint Facility has an impressive, still growing user base, which is still very much dominated by UmU users, although an increasing number of non-UmU users is detectable. The joint effort of two units operating together at the local level is sensible, but the national significance of the two parts is not equal. In contrast to the FIB-SEM applications the imaging and CLEM support is not unique within Sweden.

Points of concern/improvement

- The reach to other universities and national visibility should be strengthened. The unbalanced user base would have to be addressed by outreach and training at other institutions in order to make it a truly national resource.
- The Facility as proposed is not very unique, quite a number of similar facilities exist (inter)nationally.
- How much overlap is there with the Centre for Cellular Imaging and other local imaging facilities? Even if the local imaging facilities are considered part of a distributed imaging platform, the activities and services could be better coordinated at the level of the Cellular and Molecular Imaging Platform, while unique services at the various sites should be stressed.
- The report lacks a data concept for open data access, handling, analysis and a reference to the Data Centre to potentially support data management at the level of SciLifeLab.

Recommendations for 2021–2024

- Accept unique technologies, i.e. the FIB-SEM volume imaging, as proposed by this candidate Facility to be provided as SciLifeLab services. The CLEM and other imaging activities provide local support and are partially redundant with similar activities in other SciLifeLab facilities and should not be added to SciLifeLab.
- The budget request should be adjusted based on the recommendation that only FIB-SEM is added to SciLifeLab.
- The number of outside Umea University users should be increased under the SciLifeLab membership, and external usage should be strongly encouraged, for example by organizing a roadshow aiming to advertise the unique strengths of the facility (FIB-SEM) across the country. Including the FIB-SEM technology in the Facility's name may be useful in this context.

Centre for Cellular Imaging (candidate)

Grade: 6

Motivation

The Centre for Cellular Imaging is a well-established Facility which provides already a strong service within the Swedish national microscopy consortium. The user base is quite stable with however only very few users from outside the Gothenburg area.

The Facility and its leadership are internationally well connected, the staff running the facility is very experienced and provides services in light and electron microscopy at an advanced level. The strength of the facility is in 3D correlative microscopy. The acquisition of the Correlative Array Tomography (CAT) technology in 2019 and the plans to offer it as a service under the SciLifeLab label are an excellent move forward and should bring the necessary aspect of uniqueness to the Facility within Sweden.

Recommendations for 2021–2024

- Within the SciLifeLab activities the focus of the Facility should be in the near future to develop the CAT technology. Such service would be unique within Sweden. None of the other listed services are unique and thus should not be part of a future SciLifeLab facility.
- The budget request should be adjusted based on the recommendation that only (A)CAT is added to SciLifeLab.
- Data management in the Facility is currently largely left to the users as data owners. With the existence of the Data Centre and the BioImage Informatics Facility within SciLifeLab, the Centre for Cellular Imaging should develop and practice an open and FAIR data concept. This would enable data sharing and integration with other SciLifeLab services and the possibility to strengthen the image analysis service capabilities.

Intravital Microscopy (candidate)

Grade: 7

Motivation

Intravital microscopy is an important technology for life science research relying on animal models. As such Intravital Microscopy can be expected to play an important role for local and Swedish life science as a whole. The Facility's imaging technology is state-of-the-art but not unique internationally and not within Sweden. However, the set-up of the Facility, in particular its excellent animal handling capabilities in close proximity to the imaging environment, make the Facility unique within Sweden and possibly also beyond. Therefore, Intravital Microscopy may become a strong asset within SciLifeLab. The user base of Intravital Microscopy is currently small and most users come from the hosting institution. This situation should change though once Intravital Microscopy is a member of SciLifeLab.

Recommendations for 2021–2024

Intravital Microscopy should become a member of SciLifeLab and be supported in its future plans.

- The imaging technology portfolio offered could be extended to more advanced/diverse technology whenever possible.
- Collaboration with Advanced Light Microscopy and/or electron microscopy services for correlative light and electron microscopy could be envisaged.
- Development of workflows for integrating data from Intravital Microscopy with e.g. the planned TSO should be encouraged.

Cryo-EM

Grade: 9

Motivation

The Cryo-EM Facility is a cutting-edge Facility with top level equipment, strong leadership and staff. It provides state-of-the-art expertise and training for cryo-EM single particle analysis, cryo-ET, FIB milling. The Facility is competitive, well connected and amongst the top in Europe. There is a high, still increasing number of national users; with a wide spread amongst different universities, 160 PIs, 50 publications since 2017.

It is important to note that the Facility is involved in methods development (Relion, Scipion) together with international leading groups, an aspect that should be part of the mission of any academic Core Facility.

The CryoNet facility/personnel/training network (Danish/Swedish) is a strong and important training activity.

Future plans: The concept of two central nodes and the establishment of a National Grid Screening Network is sensible and a convincing strategy to provide national user service and access within SciLifeLab.

The planned activities on Micro-ED, CLEM, processing support are important. There are interesting synergies regarding CLEM, Cryo-ET, super-resolution microscopy and Micro-ED, also with material science.

Given the large amounts of data generated, being a pilot tester for the SciLifeLab Data Centre is an excellent idea and useful for both parties.

The increased budget request is well justified and so is the overall budget request, which amounts to 25 to 30% of the overall facility budget. Given the excellent Facility and services provided and the still growing user base, an increased income by user fees should be able to compensate the foreseen reduction of co-funding from universities/foundations in the period 2021–2024.

Points of concern/improvement

- The data management concept and support/integration with the Data Centre was not clearly described.
- Given the number of users, the number of publications could be larger, although a clear upward trend is visible.

Recommendations for 2021–2024

- This is an excellent top-level Facility, with a growing user base and clever and convincing concepts and strategies, a flagship Facility in SciLifeLab.
- Provide the requested funding to support the convincing concept.

Cell Profiling

Grade: 8

Motivation

This Facility is internationally competitive and provides a world-wide unique and comprehensive resource of antibody collection against most human proteins. Its role in SciLifeLab goes well beyond the provision of this resource and technology to exploit the antibody collection. For example, the CODEX Platform for highly multiplexed immunostaining is also offered for large scale and high impact projects. As such this activity can be considered as one of SciLifeLab's flagships. The publication record of the Facility is impressive and underlines the internationally leading role.

The future plans – merging with the ISS and Advanced FISH Facilities into the TSO – will keep the Facility at the exceptional level internationally and will allow Swedish and international scientists to conduct outstanding basic and medical research. It can also be expected that integrating the ISS and Advanced FISH Facility services would generate operational synergies.

The overall user base of cell profiling is, however, quite small, possibly due to the focus on large-scale and high impact projects. More opening towards a larger user base with smaller projects might be desirable and could enhance the application portfolio of Cell Profiling even further.

Recommendations for 2021–2024

- Cell Profiling should be significantly supported further within SciLifeLab.
- The merger with ISS and advanced FISH Facility into the TSO should be strongly supported.
- Developments towards a broader and diverse user base should be encouraged.

In Situ Sequencing

Grade: 8

Motivation

In Situ Sequencing is a highly relevant technology for basic and translational research. The Facility has been developed and set-up based on Mats Nilsson's pioneering technology developments and is still benefitting considerably from Nilsson's leadership. This activity is at the leading edge internationally and can be expected to remain there for the next few years.

The plans to merge with Cell Profiling and advanced FISH Facility into the TSO is excellent. TSO can be expected to become a world leading facility and highly beneficial for Swedish life scientists. The merger will also create an operational synergy and thus saving of staff costs and gaining significant complementary expertise. Although the current user base is relatively small it can be expected to grow significantly. The publication record of the Facility is impressive and includes several high ranking and cited publications.

Recommendations for 2021–2024

- In Situ Sequencing should be significantly supported further within SciLifeLab.
- The merger with Cell Profiling and advanced FISH Facility into the TSO should be strongly supported.
- Developments towards a larger user base should be encouraged.

Advanced FISH Technologies (candidate)

Grade: 6

Motivation

Advanced FISH Technologies has been difficult to assess as the Facility is currently still in its planning/set-up phase. The PIs developing and leading the Facility have an international reputation and are connected internationally. The planned probe repository may become a unique resource, at least for Sweden. It is not so clear though to which extent the imaging infrastructure required, e.g. for MERFISH, is or will become available. Also, in which form service would be provided is unclear as the automation that is required for this is not yet available and still needs to be developed.

Integrating the Facility into the planned TSO is an excellent plan and many research and operational synergies may arise by this merger. Advanced FISH gains its attractiveness for Swedish life sciences at this stage predominantly via this merger to TSO rather than via its standalone activities, which still need to mature in order to provide a robust service.

Recommendations for 2021–2024

- Advanced FISH Technologies should be included into SciLifeLab services under the umbrella of the planned TSO.
- The merging of the Advanced FISH Facility with In situ Sequencing and Cell Profiling into the TSO should be strongly supported.
- A robust service including the necessary imaging technology needs to be developed, likely benefitting from the expertise of merging partners.
- Development towards a larger and divers user base should be encouraged.

Gothenburg Imaging Mass Spectrometry Imaging (candidate)

Grade: 4

Motivation

This candidate Facility has a unique offering in chemical imaging with a unique high-end instrumentation. NanoSIMS is an advanced specialized technique for chemical imaging of cells and subcellular structures, as well as materials, and is unique in being the only instrument of its kind available nationally. The Facility head has an impressive scientific track-record and is clearly an internationally visible expert in these techniques.

The user base is very thin, and (based on the written report) consists of three PIs, of which one is from industry. During the interview it was mentioned that there are more users and projects and a significant number of publications compared to the numbers provided in the written SciLifeLab report. However, overall it remains unclear how much the Facility will be used, presumably, as this is a very specialized area of imaging application although with unique potential.

It is unclear why this candidate Facility is proposed separately from the National Resource for Mass Spectrometry Imaging at UmU. Although it seems that complementary techniques are offered by the two sites, the national significance of the Gothenburg Facility is not obvious. At present the Facility is a strong local Facility that provides a unique technique that is of high potential for the Swedish scientific community but does not have a significant user base.

Points of concern/improvement

- The number of current users is very small and it remains unclear how many users are expected for the Facility in the future.
- Some outreach activities and national networking seem important to establish a broader user base.
- The specialized NanoSIMS technique is potentially very interesting but might be better offered as a service provided within a national platform for MS-based imaging.
- The concepts for data management seem very much focused on local users with little thought put to connect with the SciLifeLab Data Centre.

Recommendations for 2021–2024

- The Facility should currently not be included in SciLifeLab, until a significant, national user base is established.
- A national strategy and integration of mass spectrometry-based imaging should be developed, where NanoSIMS would be a unique offering of the GU site.
- Potential contributions to the Targeted Spatial Omics Facilities should be considered.

National Resource for Mass Spectrometry Imaging (candidate)

Grade: 7

Motivation

The molecular-specific Mass Spectrometry Imaging (MSI) Facility is one of the most modern in the world and has an impressive array of equipment, including the only ultrahigh mass resolution MALDI-FTICR MSI instrument in Scandinavia. Led by Per Andren, a pioneer in the field, the Facility does not only apply but also develops advanced MSI technologies. Applications include chemical imaging of, e.g., metabolites, nucleotides, neurotransmitters, drugs, in biological tissue sections, which are also of significant interest for pharmaceutical industry.

The MSI Facility is well connected and has grown to a 25 PIs user base in 2019, this includes however, mainly local and/or medium and large pharma companies, i.e. AZ and international. The services offered are of high potential and represent a relevant technology that enables basic and applied research in Sweden. It is complementary to the planned TSO.

The publication record is somewhat variable and does not completely fulfill the expectations on a national Facility.

Points of concern/improvement

- Supporting the Facility as a national resource is of interest for SciLifeLab, but should include raising awareness, and aim at increasing the Swedish academic user base. The Facility should reach out to attract more national users. This could also include national training and networking of future users.
- Given the high interest from pharmaceutical industry, the user fee revenue seems to be low and should be adjusted (aiming at a 25% support from user fees).
- In the future it might be considered to include complementary NanoSIMS offered at GU into a joint Facility, which might strengthen national visibility and increase the user base.

Recommendations for 2021–2024

- Include the Facility into SciLifeLab.
- Broaden the national user base and increase user fees to support the activities.
- Consider and strengthen interactions with the TSO Facility.

Cellular and Molecular Imaging Platform – Funding Recommendation

Funding recommendation: +

Motivation

The Cellular and Molecular Imaging Platform represents an essential activity within SciLifeLab and the Swedish Life Science community. It proposes expansion by 6 new facilities in addition to the well performing existing 4 facilities. In order to take on board 5 new facilities as recommended (see individual reports) and integrate them into the platform to achieve highest levels of synergies between the individual services it will be important to support the new members adequately and ensure that the existing ones can maintain their strengths.

The IEC proposes to strengthen in particular the cryo-EM facility and support strongly the merging of Cell Profiling, In Situ Sequencing and Advanced FISH Technologies into the TSO. In addition to the increased funding for the entire platform additional necessary funding for this could also be achieved by modest cutting of the new candidates “Centre for Cellular Imaging” and “Biochemical Imaging Centre Umeå”, which are recommended to focus their SciLifeLab activities on the technologies which are unique in Sweden (see specific reports).

Chemical Biology and Genome Engineering Platform

Grade: 7

Motivation

Chemical Biology and Genome Engineering are central technologies for understanding the molecular basis of biology and are critical for moving life science discoveries into drug development. The CBGE Platform consists of four facilities supporting target validation and mechanism-of-action determination: Chemical Biology Consortium Sweden (CBCS), High Throughput Genome Engineering (HTGE), Chemical Proteomics (ChemProt), and Genome Engineering Zebrafish (GEZ). Together these facilities are delivering phenotypic chemical screens, CRISPR-based genetic screens; med chem SAR's, target-based screens, HT-proteomics and zebrafish-based validation studies.

Chemical proteomics and HTGE are newly established, so it may be early to judge their progress (e.g. numbers of publications, etc.). Given that this Platform encompasses activities that immediately precede DDD-related activities, it benefits from a close working relationship. The close contacts with AstraZeneca (via e.g. access to their phenotypic compound collection) are also a plus.

Points of concern/improvement

- Better integration with the Data Centre is required to ensure all data is properly curated and available for future use.
- It is important that this Platform integrates effectively with the DDD.

Recommendations for 2021–2024

- Recommend building an overarching data management architecture that facilitates cross-comparison of chemical and genetic screening results. Such a knowledge framework will be critical for executing on a vision to build a multi-omics understanding of biological systems including those relevant for human disease and environmental stewardship. This effort would support FAIR data goals.
- Particular attention should be paid to screen design to ensure both the libraries and the screen are appropriate for the expected outcomes.
- Consider and enact the savings and user cost increases as outlined within each sub-platform.

Chemical Biology Consortium Sweden

Grade: 6

Motivation

The Chemical Biology Consortium Sweden supports small molecule screening and compound characterization for target identification and mechanism of action downstream of phenotypic screens. This Facility appears to be at a steady state with users and publications at a plateau state (noting that Figure 1 shows cumulative numbers and not annual numbers) as opposed to increasing its reach and impact. Given the funding, higher productivity would have been expected, but perhaps the cost of maintaining the compound collection accounts for this.

There is some concern that 4 Chemistry FTEs is too few to maintain a competitive effort. In addition, there has been insufficient support of data management and cross-platform data analysis. This is required to accurately interpret results of phenotypic screens and prevent investigators from prioritizing hits with polypharmacology.

Points of concern/improvement

- Chemistry resources appear too small to effectively support this Facility.
- Data management needs to be improved to ensure all data is captured, curated and made available for analysis and future use.
- The diversity of PI access seems low with many coming from just two institutions.

Recommendations for 2021–2024

- Consider the ROI on supporting the Compound Center, versus outsourcing this asset.
- Building capabilities in data management and cross-assay data analysis will be important to the growth and success of this platform. Recommend close collaboration with the Data Centre and attention to FAIR.
- Address the limited chemistry capacity as this will become a bottleneck for hit validation and library expansion.
- Understand how the 200,000 compound library compares to other libraries available or accessible. This is particularly important for tailoring screening campaigns versus specific phenotypes or outcomes.
- Consider outsourcing the management of the Library (e.g. SPECS) to reduce overhead of curation and plate provision.
- Proactively seek PI engagement across the landscape – at present over 50% of the PIs come from just two universities (KI and UU).
- Is there an opportunity to create industry partnerships, aside from AZ, around specific diseases in order to access a larger and potentially more diverse library for specific projects?

Chemical Proteomics

Grade: 8

Motivation

Chemical Proteomics is an important technology for target deconvolution and for increasing our understanding of the proteome. Although the Chemical Proteomics Facility is relatively new, the publications and user base have nicely expanded year-over-year. This Facility aims at deciphering small molecule-induced proteome signatures for elucidation of molecular mechanism of action.

The Facility has state-of-the art mass spectrometry instrumentation, methods and expertise in place and there is a good fit for this platform. The rationale for personnel increase is justified to adequately operate the recently upgraded instrumentation.

Recommendations for 2021–2024

- The user fees are relatively small in comparison to the requested SciLifeLab funding. An increase of the user fees might be advisable.
- Proactively seek PI engagement across the landscape – although relatively new, at present only 24 PIs access the service, primarily spread across only 3 universities (KI, International Universities and UU).
- Consider if the anticipated growth of this area might need a larger personnel increase than that proposed.

High Throughput Genome Engineering

Grade: 8

Motivation

Genome engineering using CRISPR-Cas9 and related technologies enables true precision gene editing and represents a critically important area of research to remain competitive. The HTGE Facility is focused on pooled genetic screens offering advanced CRISPR technologies, including CRISPR DIVA.

Although relatively new, the HTGE Facility user base has increased year-over-year, and it is expected that publications will begin to track with time. There is good support from the local research and Core Facilities as well as national and international collaborators. There is some concern that nearly 2/3 of the users come from a single institution.

Points of concern/improvement

- There is not enough diversity in the PI access with many coming from a single institution.

Recommendations for 2021–2024

- Close collaboration with Bioinformatics and Data Centre activities will be important.
- Expand reach and engagement across Swedish universities to increase user base from a broader set of universities – currently 62% come from KI.
- Potentially worth seeking partnerships with the Broad Institute or AZ who both also have leading expertise.

Genome Engineering Zebrafish

Grade: 7

Motivation

Zebrafish offer the opportunity for high throughput screening in a whole organism. The Genome Engineering Zebrafish (GEZ) Facility has relatively recently been established with a reasonable number of users and relevant new services planned. Zebrafish are a useful tool for phenotypic screening, although with limitations for translation to humans. Users are primarily local. GEZ is in the process of developing advanced informatics (Zii) in collaboration with the BioImage Informatics Facility.

Points of concern/improvement

- Budget requests seem very high considering the user fees are low.

Recommendations for 2021–2024

- Continuation of the Facility with increase in user fees (versus doubling of the requested budget).
- Potential to seek international collaborations, for example with the University of Sheffield who have a large aquarium.
- Consider if it is worth creating bespoke compound libraries for screening with a focus on solubility.
- The team should consider the impact in the rise of human cell based phenotypic and CRISPR based screening – will zebrafish still be relevant in 5–10 years' time considering the rise in human relevant models?

Chemical Biology and Genome Engineering Platform – Funding Recommendation

Funding recommendation: 0

Motivation

The CBGE is looking for a very significant increase in funding (13.2 MSEK up to 25.0 MSEK). Although this is a critical platform for identifying targets and chemical equity, without which there would be little opportunity to create high quality drug discovery programs and ultimately deliver patient impact, we feel that the team needs to make significant inroads into improving data management and should work hard to integrate this with the Data Centre. In addition, there are some opportunities to make overhead savings, for example outsourcing compound library management. The Chemical Proteomics Platform should also try to increase user fees which are very modest. This is also true for the Zebrafish Platform that should try to increase user fees rather than double the budget. Until these items are addressed we feel there is no real need for such a large increase as requested.

Genomics Platform

Grade: 8

Motivation

The Genomics Platform is one of the largest Facilities in Europe and has a very important role and high impact for Swedish life sciences. This Platform consisting of four Facilities provides comprehensive complementary expertise and services in a wide range of genomics technologies.

The expertise of this unique Platform ranges from genome wide sequencing to eukaryotic and microbial single-cell genomics (including a BSL3 laboratory) and special ultraclean facility for the analysis of ancient DNA. It has a well-developed organization and plans in place to meet the needs of rapidly developing technology in a timely fashion. The user base is large and well-spread nationally. The Platform has an impressive track record with 50% of all SciLifeLab affiliated publications. In 2019, the Platform served > 1200 projects.

Challenges/points of concern/improvement

- How to keep up with the rapid development of emerging technologies and increase in demand of new PIs and projects?
- Optimal use of SciLifeLab Data Centre and Bioinformatics Platform.
- Integration of data with other types of data as part of the data-driven science mission (e.g. FAIR, etc.).
- Education of PIs across country in the optimal use of cutting-edge technologies.
- Balancing between coordinating/participating to large international grants vs. providing high quality national services.

Recommendations for 2021–2024

- This Platform has demonstrated its ability to deliver and should be strongly supported also in the future.
- Development of shared project handling and a common LIMS system are excellent directions and could be further expanded to other platforms.
- Strengthen the use of SciLifeLab Data Centre and Bioinformatics Platform for data handling, management, storage and analysis.
- Support efforts to lead the concept of data-driven science.

National Genomics Infrastructure

Grade: 9

Motivation

This is a large Facility (81 FTE, 51.5 funded by SciLifeLab) distributed in four organizations. It has a very large and stable user base (428 PIs in 2019) and impressive output (contribution to 878 i.e. 45% of all SciLifeLab publications between 2017 and 2020). Evidently, NGI has succeeded in meeting the rapidly changing needs of genomics technologies in research and in successful division of tasks and co-operation between the units. It serves other genomics platform facilities by performing sequencing for them.

The plans are well presented and 30% of resources will be used for research and development of new technologies. This is important to gain knowledge, and test and develop the rapidly emerging technologies into services. Perhaps in the next period more income could be expected from user fees from some of the services that are routinely up and running.

Challenges/points of concern/improvement

- Further increase in demand of new technologies by current and new users.
- Optimal use of SciLifeLab Data Centre and Bioinformatics Platform.
- Integration of data with other types of data as part of the data-driven science mission (and support of FAIR principles).
- Education of PIs across country in the optimal use of cutting-edge technologies.
- Balancing between coordinating/participating to large international grants vs. providing high quality national services.

Recommendations for 2021–2024

- To meet the increased demand the Facility should be supported on the current or slightly increased level.
- Strengthen the use of Data Centre and Bioinformatics Platform for data handling, management, storage and analysis.
- Support efforts to lead the concept of data-driven science, building a data culture and supporting FAIR principles.
- Monitor for the optimal balance between providing national services and participating in large, externally funded international projects.

Ancient DNA

Grade: 7

Motivation

The Ancient DNA Facility was initiated as a SciLifeLab Facility in 2017 and has 2.7 FTEs. It has provided services since August 2019, which was preceded by establishment of state-of-the-art ancient DNA laboratory with stringent procedures and clean-room facilities as well as proper experimental procedures and data analysis. In 2019 the Facility had 9 PIs as users and is now, after a relatively slow start, expecting to increase its services and user base significantly.

This is an early phase and unique Facility with specialized expertise and with high potential for increasing its customer base and importance nationally and internationally. Its integration with SciLifeLab Genomics Platform is very well-justified.

Challenges/points of concern/improvement

- This early phase Facility is now facing a window of opportunity to expand its user base nationally and internationally.
- Further efforts to continue development of technology and related bioinformatics in collaboration with NBIS and the Data Centre.
- Need for active advertising of the services and training.

Recommendations for 2021–2024

- Active outreach and training both nationally and internationally.
- To meet the goals the Facility should be supported, either through slight increase in direct funding or allocating resources from another facility/platform including Bioinformatics, NBIS and The Data Centre.
- Strengthen the use of SciLifeLab Data Centre and Bioinformatics Platform for data handling, management, storage and analysis.
- A mid-term evaluation in two years to facilitate positive development according to the plans.

G.

Eukaryotic Single Cell Genomics

Grade: 8

Motivation

Eukaryotic Single Cell Genomics Facility has been a SciLifeLab Facility since 2015, has 5.4 FTEs and is hosted by KI. This Facility has pioneered in sc-genomics, has been in the frontier of technology development and has produced a number of high-profile papers. In 2019 it had 40 PI users, 80% of which were from KI and 50% of which were new. The Facility is supported by world-class research environment and is actively involved in international expert networks.

The plans include evaluating and implementing new emerging methods in a timely fashion, and also investing in and taking a bigger role in coordinating single-cell genomics activities at a national level. This would include transfer of knowledge and expertise as well as training to local facilities across the country, which is important considering the currently mostly local user base. It is reassuring that the Facility has already started implementing means to reach better national coverage.

Challenges/points of concern/improvement

- Rapid increase in demand of new technologies by current and new users.
- Implementation of means to increase national usage.
- Optimal use of SciLifeLab Data Centre and Bioinformatics Platform.
- Integration of data with other types of data as part of the data-driven science mission.
- Education of PIs across country in the optimal use of cutting-edge technologies.
- Educate the customers in selection of technology – overlap vs synergies with other technologies by SciLifeLab Facilities providing similar solutions to biological questions.

Recommendations for 2021–2024

- To meet the increased demand the Facility should be supported on the current or slightly increased level.
- Further development of solutions allowing efficient national distribution of services.
- Increase in training and workshops to educate users in selection of optimal solution.
- Strengthen the use of SciLifeLab Data Centre and Bioinformatics Platform for data handling, management, storage and analysis.
- Support efforts to lead the concept of data-driven science.
- Take advantage of synergistic opportunities and develop joint services with other SciLifeLab Facilities.

Microbial Single Cell Genomics

Grade: 7

Motivation

Microbial Single Cell Genomics has been SciLifeLab Facility since 2017, has 2 FTEs and is hosted by Uppsala University. It has 16 PIs as users in 2019 and 4 publications since 2017.

This is a unique Facility as it provides expertise in carrying out sc-genomics experiments with pathogenic organisms up to level BSL3. This provides excellent possibilities e.g. for host-microbe interaction studies or development of new therapies and vaccines. The Facility has a strong local research environment, interacts well with other relevant SciLifeLab Facilities and has strong international collaborations. It has a significant potential for growth and should actively reach out for wider national usage.

Recommendations for 2021–2024

- Active outreach and training both nationally and internationally.
- Strengthen the use of SciLifeLab Data Centre and Bioinformatics Platform for data handling, management, storage and analysis.
- Opportunities for increased funding base due to COVID-19 pandemic and increased awareness of the need of such facilities to combat similar future threats.

Genomics Platform – Funding Recommendation

Funding recommendation: +

Motivation

This Platform is one of the largest facilities in Europe and has a very important role and high impact for Swedish life sciences. It has well-developed organization and plans in place to meet the needs of rapidly developing technology in a timely fashion. Platform's aims to invest in new sequencing infrastructures, to maintain and improve national coordination and accessibility, as well as to further develop capabilities for single cell analysis and analysis of novel sample types (sediments and other sample types) should be further supported. The platform is also encouraged to apply funding from other sources, and to participate in large national and international programs.

G.

Proteomics and Metabolomics Platform

Grade: 7

Motivation

The Proteomics and Metabolomics Platform (PaMP) is a big Platform that combines 6 existing and 3 candidate facilities, which are based on antibody- and/or mass spectrometry-based technologies. An impressively wide range of complementary expertise is covered by the PaMP, ranging from auto-immune profiling over mass cytometry and glycoproteomics to metabolomics and exposomics. Even though genomics technologies have been prioritized by SciLifeLab in the past, the PaMP is key to rounding out a multi-omics effort at SciLifeLab.

Strengths of PaMP

- A wide range of services is offered, with even more being proposed (glycoproteomics, exposomics and structural proteomics).
- Staff is highly skilled and should be retained.
- The IEC was enthusiastic about the staff rotation idea. However, IEC members thought that 'a few days' are not sufficient. Instead, a 1–3 month 'mini-sabbatical' might be more effective in order to ensure knowledge transfer and training.
- An external advisory board is in place for the PaMP, which is always useful to calibrate internal and external expectations. However, the size and the expertise of the members might have to be revisited. E.g. while sample quality is essential, biobanking expertise might be more relevant for SciLifeLab overall, and not only for the PaMP.

Weaknesses/points of concerns/challenges ahead

- While the current proposal requests funds for a *Bioinformatics Hub*, unfortunately no details are provided, making it impossible to assess this request. Furthermore, it is strongly suggested to establish closer ties with the Bioinformatics Platform which is in existence to support the users of the SciLifeLabs including PaMP. Such an effort may also be best served in coordination with the Data Centre (e.g. management of assay data, research materials, metadata and knowledge bases, etc.).
- Whilst offering a raft of high-quality technologies, the offerings are not necessarily unique and can be accessed elsewhere from a wide range of sources; as such, it is more important than ever to establish and emphasize the 'unique selling points' of each facility. An increased number of cross-facility projects that benefit from the complementary expertise may help in this effort.

Recommendations for 2021–2024

- A restructuring of a major part of the antibody-based facilities is suggested as the IEC did not find compelling reasons to offer plasma profiling and autoimmunity profiling as two separate facilities. Instead, the same services can be offered with lower overhead when these two facilities merge – while the IEC is agnostic about the leadership of any new, merged facility, slight preference is given towards the autoimmunity profiling facility being the junior partner in such merger. In this context, the requested funding increases of 33–37% increase per facility are not considered justified.
- The Proximity Proteomics Facility in its current organization was not considered to be an asset for SciLifeLab or PaMP. Whilst the different assays are important and relevant, a clear structure and system to the offered services was largely missing – neither from the written proposal, nor from the oral presentation.
- The PaMP currently defines itself by the technologies and target analytes, i.e. proteins and metabolites analyzed by antibodies and/or mass spectrometry. Unfortunately, no clear vision is formulated as to how to advance the integration of the data from these various omics modes applied to the same sample.
- Actively monitoring new developments such as the SOMAlogic Platform is advisable.
- Overall, the inter-connecting capabilities between facilities as well as platforms can be exploited better.

Autoimmunity Profiling

Grade: 6

Motivation

This Facility (as does the Plasma Profiling Facility) originates from the Human Protein Atlas Initiative and offers proteome-wide screening for autoantibody reactivity with one of the world's largest protein coverages on planar arrays, complemented with strong expertise, technology and instrumentation. Given its roots, it is a unique capability in Sweden (and beyond) and as such an important resource.

Given that the autoimmune aspect is considered for many more disease areas these days, i.e. the autoimmunity aspect is growing in importance. So, it is surprising to note that there is not more attention from healthcare (i.e. drug development sector) for the services of this Facility. As such, outreach to these potential user bases is strongly advised.

Weaknesses/points of concerns/challenges ahead

- Given that >70% of the users are from KI and international universities, the national relevance is not clear. In this context, given that the users from the international universities 'don't pull their weight' it should be considered reprioritizing the limited FTEs to Swedish users.
- While the user base seems to improve (with the caveat of a slim Swedish academic user base (see also below)), the publication output shows an unfortunate trend (in 2019, only 7 papers).
- It is not fully clear why this Facility is so focused on autoimmunity profiling, which is a niche application, while protein array technologies have broader applications.

Recommendations for 2021–2024

- The Autoimmunity Profiling Facility will have to broaden its user base amongst Swedish universities if they want to be considered a facility of national relevance during the next funding cycle.
- More emphasis on publications, i.e. it has to be conveyed to the users that the highly subsidized user fees come with one string attached: results should be published (as a matter of fact, offering (almost) free services is often associated with this problem that it is taken for granted and publishing any results are not a priority).
- It is mentioned that 'additional competency in bioinformatics is being added'. Given that this is a key aspect and will become even more so, a much closer interactions with the Bioinformatics Platform and Data Centre are also strongly advised.
- One third of the users are from international universities. These users should be charged so that the true expenses are covered, it is expected that the user fee income also covers ~1/3 of the operating expenses. Since this is not the case, the user fee structures should be adjusted. Alternatively, the attention of the 2.8 FTEs currently covered by SciLifeLab should redirect their attention to new users from Swedish universities/hospitals.
- Upon review of the different facilities, the IEC concluded that the current Autoimmunity Profiling Facility should merge with the Plasma Profiling Facility given the common background (the human proteome atlas) and instrumentation platform. Furthermore, such merger is expected to reduce any administrative overhead and increase the integration of the data. Alternative considerations include: i) either refocusing into a general antibody or protein technologies group, possibly in collaboration with one of the other facilities, or ii) if autoimmunity remains to be the focus, merging into an immune-monitoring facility with e.g. the Mass Cytometry Facility.

Plasma Profiling

Grade: 6

Motivation

This Facility (as does the Autoimmunity Profiling Facility) originates from the Human Protein Atlas Initiative and offers antibody-based detection and quantification of proteins of interest. Given the interest of SciLifeLab in translational research, this is an essential resource/expertise to have on board in order to move a biomarker from discovery to a stage which may be attractive for commercialization (either for a start-up or for out-licensing). This is even more so the case as the Facility aims to be GLP and ISO certified, which is very laudable and will be a milestone for the Facility.

In short, this Facility is a must for any true Diagnostic Development Platform. This Facility, despite the relatively small user base has delivered a steady stream of publications over the last few years

Weaknesses/points of concerns/challenges ahead

- From the written proposal, it is not obvious why more personnel is needed, i.e. why a >35% funding increase is requested.
- As for the Autoimmunity Profiling Facility, the user base is steady, but not very large. Furthermore, it is very KI-centric, raising the question of relevance as NATIONAL facility.
- The new efforts for "protein characterization such as PTMs or protein complexes" are not obvious (the IEC would have expected this to be the stronghold of a mass spec-based facility) and requires additional explanation.
- The technology developments as presented to the IEC are endorsed.

Recommendations for 2021–2024

- As described for the Autoimmunity Profiling Facility, given the common 'heritage', the proximity and the overlap in the technology and even some aims (p128: we therefore invested into the validation of antibodies"), the IEC recommends a merger with the Autoimmunity Profiling Facility.
- Alternatively, a change in focus towards biomarker validation/diagnostic development instead of Plasma Profiling will highlight the importance of this Facility for e.g. the DDD as (almost) any drug will hugely benefit a companion diagnostic.
- Establishing closer collaboration with the Bioinformatics Platform and the Data Centre will be essential for this Facility as parallelization of assays, miniaturization and increased throughput will put additional pressure on data management, QC/QA and reproducibility.
- The Facility should aim for closer collaborations with the hospitals, pharma and/or diagnostics companies. The valorization aspect of biomarkers will be strengthened as such.

G.

Proximity Proteomics

Grade: 4

Motivation

Protein Proximity Facility was established in 2013 and is offering standard and customized assays for detection of proteins, protein interactions and protein modifications in fixed cells or tissue sections, or in liquid samples such as blood fractions or cell lysates, as well as custom DNA-conjugated antibodies for combined detection of proteins and transcripts using CITE-seq. Furthermore, the Facility is actively involved in the development of highly relevant assays. Given the rather larger number of different service components covering a wide range of assays and targets, the naming of this Facility is not clear/too narrow. Similarly, the small number of users and the publication record with a decreasing trend is surprising given this wide range of offered services.

The rationales for the previous and future mergers with the Clinical Biomarker Facility and the Single Cell Proteomics Facility, respectively, are not clear. However, the IEC is very concerned about the apparent lack of integration of the services from the previous merger. Thus, there is worry at the level of the IEC that yet another merger will result in an even longer list of disconnected services, which will make it difficult for the Facility to establish any focus and any unique selling point. Instead, a Biochemical and Cell Biological Assay Facility is presented.

Of note: the IEC would like to emphasize that they do not question: i) the assay quality, ii) the importance of the assays, iii) the quality of the assay execution, or iv) the quality/experience/expertise of the involved scientists.

In summary, the lack of focus and lack of leadership to create a unit with a clear vision and deliverable significantly reduced the enthusiasm of the IEC for this Facility.

Recommendations for 2021–2024

The IEC cannot recommend the continued funding of this Facility in its current shape and form. Currently, it seems to be a wide range of different often disconnected assays, without providing an integrative vision; a notion underscored by the misleading name which only covers a small subset of the offered services.

Mass Cytometry

Grade: 8

Motivation

Mass cytometry is one of the up-and-coming methods that will become increasingly important and the Mass Cytometry Facility has state-of-the-art capabilities. The unit also has developed a range of cutting-edge methods. This notion of excellence is underscored by the user and publication statistics of the Mass Cytometry Facility: the user base is steadily increasing and diversifying. Furthermore, the well-functioning facility is associated with an excellent number of papers, including several publications in high impact journals. The IEC was also enthusiastic about the fact the Facility is actively involved in method development thereby boosting the publication output of the Facility. Overall, leadership of the Facility is strong and pro-active.

It is expected that the user base will further grow, especially amongst clinicians/clinician scientists once the immune-monitoring aspect will be emphasized. In this context, the IEC expects that the proposed additional services to be offered as of 2021 will open-up new opportunities for existing and new users of this Facility. The IEC was particularly excited about offering also the VirScan technology moving forward.

Weaknesses/points of concerns/challenges ahead

- Need for better bioinformatic support. Thus, closer collaboration with the Bioinformatics Platform and Data Centre is needed as many data analytics tools and pipelines remain to be developed.
- While it was noted as a plus that the Facility leadership is looking for (potential) synergies with other platforms details about how to establish these synergies are lacking.
- Moreover, the division of tasks between KI and LiU is not completely clear and requires better definition.

Recommendations for 2021–2024

- As the IEC sees many applications of Mass Cytometry beyond immuno-monitoring (which admittedly is the most obvious target), the IEC expressed some reservation to fully focus on this aspect. Given that the Mass Cytometry Facility comprises two sites, it might be worth considering focusing only one site on immuno-monitoring while keeping the other open for a wider range of applications.
- If the Facility thought about focusing on immuno-monitoring it might want to consider thinking bigger by establishing a multi-omics immuno-monitoring/ immunophenotyping platform.
- Given these considerations the requested funding increases are justified, although the change of name/ focus has not found unanimous support.
- Having said that, the Facility should consider to also increase the user fees, current fees cover only ~25% of the expenses.

Proteogenomics

Grade: 8

Motivation

The Proteogenomics Facility is equipped with state-of-art instrumentation, offers a solid set of services and has numerous ongoing research projects (including applications and technology development). The premise of the Proteogenomics Facility is the realization that searching standard protein sequence databases defeats the purpose of 'personalized proteomics' in support of individualized medicine, i.e. it is expected that there will be increasing demand especially from the clinical field.

The team has contributed over the years several important method developments and improvements, highlighting their interest in actively shaping the direction the field is taking. In this context, the IEC is excited to see the plans to offer new services, which will make the Facility even more attractive for translational and clinical research. Furthermore, the Facility has close connection to the Genomics and Bioinformatics Platforms, and they are proposing to expand the bioinformatic services. These aspects are laudable as they are a prerequisite for a successful expansion of the proteogenomics services into the clinical field.

SciLifeLab is currently only covering ~25% of the operating budget of the Proteogenomics Facility (with matching funding from the user fees), i.e. a relatively low level of funding provides the SciLifeLab community with access to a much larger set of instrumentation and expertise.

Weaknesses/points of concerns/challenges ahead

- Quite a bit of fluctuation in the user base was noted. While not worrisome at this stage, it is suggested to monitor the situation in order to ensure a stable or (preferably) an increasing user base.
- Given the excellent track record of the Facility, it is bit surprising that they have not yet ventured into the realm of data independent acquisition. Establishing DIA is long overdue, and thus an integration before 2022 should be considered.

Recommendations for 2021–2024

The IEC did not find appropriate justification for a doubling of the requested funding. E.g. will the Facility ADD 2 to 4 new mass spectrometers, or will they replace that many instruments (?). While the IEC highly recommends keeping the Proteogenomics Facility on the SciLifeLab roster, they are not supporting the doubling of the budget (albeit a modest increase is justified).

Glycoproteomics (candidate)

Grade: 7

Motivation

The Glycoproteomics Facility is part of the National MS-based Proteomics Infrastructure (BioMS), and provides advanced analytical services in glycobiology and glyco-technology, including, but not limited to, medium to large scale glycomics and glycoproteomic studies.

Proposing the addition of glycoproteomics to SciLifeLab is very timely due to increased importance of the role of glycosylation in infectious disease and pathophysiology. Although glycoproteomics is a niche domain, the Facility offers strong and unique expertise to a nation-wide base of 80+ users. This number of users, a solid publication record, and excellent instrumentation is a premium starting point for a new SciLifeLab Facility. The IEC was also enthused about the fact that the Facility is actively involved in method- and software solution development, both of which are still dearly needed in the field of glycoproteomics.

Weaknesses/points of concerns/challenges ahead

- The IEC suggests aiming for a better (deeper) integration with existing MS-based Proteomics Facilities, especially in the context of PTM mapping. This PTM mapping is a nice addition/complementation to the envisioned glycoproteomics services but might overlap with already offered services.
- The current proposal misses out on the opportunity to attempt to integrate the glycoproteomics data with any of the other omics data to be generated within the PaMP or the wider SciLifeLab community. Outreach to other platforms, including Bioinformatics Platform, Data Centre and others, may be useful along this line of advice.
- Currently, the user base, albeit large and relatively diverse, is very GU-centric. As such, more outreach is needed to ensure that researchers at other institutions are aware of the offered services.
- Based on the oral presentation, the IEC felt that a stronger leadership is needed to drive the Facility, and its vision and mission to ensure that glycoproteomics will be part of a multi-omics-based system biology.

Recommendations for 2021–2024

- The IEC recommends adding the Glycoproteomics Facility to the PaMP Platform.
- Given the current funding climate and the fact that the glycoproteomics facility is well established, a reduced ‘start-up’ funding is suggested (in addition to increasing the share of user fees).
- As strong leadership of the Facility will be crucial for future success, it is advised to monitor this.

Targeted and Structural Proteomics (candidate)

Grade: 7

Motivation

The Targeted and Structural Proteomics Facility candidate will offer a slew of state-of-the-art structural proteomics services, which are currently not offered by any other SciLifeLab-funded platform and/or facility. The only exception is H/D exchange, which is also offered by the Chemical Proteomics Facility. However, the IEC did not consider this to be a problem as it is only one of many service aspects. The location of the candidate Facility was considered excellent given its close proximity to MAX IV, the future ESS and the Swedish NMR Center at Gothenburg University.

Weaknesses/points of concerns/challenges ahead

- Although not considered a problem that H/D exchange already exist as a service provided by the Chemical Proteomics Facility, it was still noted that these two facilities should consider this a strength and establish a productive working relationship with shared protocols and SOPs. As such, they will both benefit from such closer interaction.
- The user base is currently very Lund University centric. Obviously, with MAX IV and (future) ESS, structural biology is a mainstay for Lund University, i.e. there is more interest for this kind of service from LU in comparison to other universities. Nevertheless, the IEC felt that efforts should be made to broaden the user base in order to ensure that it is truly a national Facility.
- Currently almost 16% of the users are from industry and/or international institutions, which should pay at-cost service fees, recovering at least as much of the running expenses. As such, the user fee schedule should be revised.
- The name of the candidate Facility confused the IEC as neither in the written nor in the oral presentation details about the 'targeted proteomics' aspect were provided. Thus, it is highly recommended a) to focus on the structural proteomics aspect and b) change the name of the Facility to reflect this aspect. As a consequence, it may be advised to re-orient tasks of some staff accordingly.
- Closer ties to the Swedish NMR Centre/Integrated Structural Biology Platform have to be formulated and established.
- Given that samples for structural proteomics experiments are not easily prepared remotely and then shipped to a Facility in Lund, it is recommended to consider offer 'internships' with lab space so that samples can be prepared onsite.

Recommendations for 2021–2024

- The IEC recommends adding the Structural Proteomics Facility to the PaMP (upon changing the name and dropping the 'targeted' part). It is thought that a modest investment of 2 MSEK will provide the SciLifeLab community with access to currently missing expertise and technology.
- Given the current funding climate and the fact that the targeted and structural proteomics facility is well established, a reduced 'start-up' funding is suggested (in addition to increasing the share of user fees).

Swedish Metabolomics Centre

Grade: 7

Motivation

The Swedish Metabolomics Centre is a well-established entity, with a large, steadily increasing and very diverse user base, and a good publication record – in terms of numbers as well as IF distribution. As such, the Swedish Metabolomics Centre can be considered an important corner stone of the SciLifeLab environment. The IEC duly noted that the service offers from the Swedish Metabolomics Centre go beyond the services that are offered by e.g. Metabolon, which is a bit of a gold standard for commercial metabolomics services.

While the IEC was quite impressed by the operation, a lack of bigger vision (beyond incremental methodological advances) for the Swedish Metabolomics Centre was noted, which might become a problem in the future.

Weaknesses/points of concerns/challenges ahead

- Given the constantly evolving landscape of life science technology and methodology, there is a bit of lack of vision noted in the written proposal and the oral presentation. This notion is also underscored by the fact that very few technology development publications have been published by the Swedish Metabolomics Centre.
- Thinking more about 'metabolomics 2.0' and being more on the forefront of defining 'metabolomics 2.0' might be a worthwhile undertaking. One possibility would be to think about more integrated LC/MS- and NMR-based metabolomics studies. Even methodologically (incl. data analysis), there is still a lot to be done.
- Following this line of thought, it was noted that no clear vision was provided for data analysis, interaction with the bioinformatics platform and/or multi-omics data integration. As metabolomics often forms a crucial part of integrative, multi-omics studies we see this as a prerequisite for the future.
- From the budget projections and personnel planning, it is not obvious how the Swedish Metabolomics Centre is planning to accommodate the increasing demand for its services. Furthermore, the entire set-up across the three sites was not fully clear – neither in the written report, nor in the oral presentation.

Recommendations for 2021–2024

Given that i) the Facility has served the SciLifeLab community well, ii) the requested funds are relatively small for such well-established entity (with SciLifeLab's contribution in the 20% range) and iii) less funds are requested for 2021–2024, the IEC strongly recommends keeping the Swedish Metabolomics Centre as a key member of the PaMP.

Exposomics (candidate)

Grade: 7

Motivation

The IEC was very excited about the written proposal and the oral presentation, which conveyed a clear idea, plan and vision for bringing exposomics into the Swedish life science community. The state-of-the-art instrumentation and facilities are to date exclusively used by the applicant; and also a follow-up question during the Q&A session did not identify any additional collaborators of the currently existing exposomics laboratory.

Weaknesses/points of concerns/challenges ahead

- It is not clear how the currently proposed Facility set-up with 1.2 FTEs could provide any meaningful service as it is expected that any (fee-for-service) study will result in large sample numbers. Dedicated staff will be essential to become successful.
- Any meaningful, (relatively) well controlled exposomics study will have to start with homozygous twins. However, no such study idea was described.
- Given that the analytes are similar to metabolites (category: xenobiotics), the IEC felt that closer interactions with the Swedish Metabolomics Centre should be considered.

Recommendations for 2021–2024

The IEC had a lengthy discussion about this facility proposal. While the IEC acknowledges the vision and academic excellence, the IEC is not (yet) convinced that there is a sufficient user base for the exposomics services. However, given the excitement about this project and the vision in written and oral presentation, the IEC decided to give this candidate Facility a 'conditional 7' as a score. This means that the Facility should get funding for two years during which they will have to clearly state how they have developed a growing user base. An interim review to monitor this is strongly advised. If such user base is identified, the funding can continue for the remainder of the funding period. However, if user base cannot be identified, the funding for this Facility should be terminated.

Proteomics and Metabolomics Platform – Funding Recommendation

Funding recommendation: (+); between 2-5%

Motivation

Given the recent economic developments and the likely ramifications for the resulting funding climate, it was particularly difficult for the IEC to make funding recommendations. After lengthy deliberations and given the new situation, the IEC recommends keeping the budget for the PaMP stable. It is the opinion of the IEC that the suggested internal re-structuring (i) merging of autoimmunity profiling and plasma profiling, ii) discontinuation of the proximity proteomics facility; iii) less requested funding by the Swedish Metabolomics Centre) will free up sufficient funding to welcome the new facilities to the PaMP. For the new facilities, a lower than requested initial start-up funding might have to be considered. Furthermore, it is recommended to make the funding to the exposomics facility conditional on them being able to show that there is a national user base within the first two years.

While funding for a bioinformatics hub was requested, this request was not well justified given the existence of the large bioinformatic platform. Connections to and collaborations with the Bioinformatics Platform and Data Centre should be intensified instead. These measures should make it possible to provide a modest increase in funding to the high performers within the PaMP such as the proteogenomics and the mass cytometry facilities.

Given that the Glycoproteomics and the Targeted and Structural Proteomics Facilities are well established and only little revenue is generated through user fees, a reduced start-up package is suggested for those two candidates.

Swedish NMR Centre/Integrated Structural Biology

Grade: 8

Motivation

The **Swedish NMR Centre (SNC)** is a well-established and extremely well-run Facility that provides top-level expertise to the scientific community. It is nationally unique and important and well-embedded into the National Structural Biology Infrastructure.

State-of-the-art NMR infrastructure and advanced methods are available, including DNP, ultrafast MAS-NMR, and support for in cell NMR. Services include NMR-based structural biology applications, but also chemical biology and metabolomics. Thereby the SNC is well integrated into SciLifeLab and provides various links and interactions with other platforms. With future activities and biomaterials additional interactions within SciLifeLab are anticipated. However, the panel agrees that the user fee model should be harmonized with the cost models of other national structural biology infrastructures (Max IV, Cryo-EM).

The SNC serves a large and diverse user group, essentially all universities of Sweden, and has a very good publication record, highlighting the need and relevance of this Centre.

The SciLifeLab contribution to the Facility (less than 25%) is well invested. An increase in user fee might be something to consider, given that currently the average user pays only 15 KSEK.

The virtual **Integrated Structural Biology Platform** aims to link services provided by SciLifeLab facilities (SNC, Cryo-EM, HDX-MS) and major national structural biology infrastructures (MAX IV Laboratory and the European Spallation Source). The Platform is proposed to be a single/central entry point for structural biology questions, especially addressing non-expert users. This is an interesting and convincing proposal, as the Platform will bring together major national infrastructure and expertise with SciLifeLab. However, details of its implementation, governance and management are challenging and need strong commitment of all players involved. The proposal that the SNC serves as the SciLifeLab coordinator of the Platform with strong and tight integration of the Cryo-EM facility seems sensible, given that SNC already has many links to other SciLifeLab Platforms and Facilities.

It will be important that SciLifeLab management provides strong high-level support and establish relations with the leadership of MAX IV and ESS. Details of the Platform governance should be further developed. For example: (i) details of the interface and interactions with MAX IV and ESS, (ii) how to reach out and adequately address non-expert users and (iii) the specific roles of both an IAB and a SAB.

Recommendations for 2021–2024

- Support the NMR Centre and the Integrative Structural Biology Platform in SciLifeLab.
- Link the NMR, Cryo-EM and Structural Proteomics Facilities within SciLifeLab under the Platform.
- Take leadership and support the SNC as spearhead to link the Swedish structural biology communities and to promote a single entry point and user service for integrative structural biology. This should include SciLifeLab facilities, i.e. SNC, mass spectrometry (HDX-MS but also XL-MS), and the nationally and internationally unique facilities (MAX-IV synchrotron, ESS), which are not part of SciLifeLab.
- Details of the Integrated Structural Biology user access and implementation should be worked out.
- SciLifeLab should help to get political support for the ISB Platform from within (cryo-EM, MS) but especially with upper management of MAX-IV and ESS.
- Strong leadership and a clear governance accepted by all partners will be essential to implement the ISB Platform.

Swedish NMR Centre/Integrated Structural Biology – Funding Recommendation

Funding recommendation: (+) ; between 2-5%

Motivation

The NMR facility provides excellent service to a broad user base in SciLifeLab. It is very efficient and professionally managed, including a forward-looking planning of its budget (increasing user fees to compensate for a decrease in KAW and VR-RFI contributions). To maintain the excellent service and support the expensive infrastructure a minor increase of the SciLifeLab contribution seems justified, and an increase of the annual SciLifeLab contribution by 500 KSEK (half of the requested) is proposed.

Funding for the new Integrated Structural Biology platform activities should be decided depending on the detailed management concept to be prepared. Likely, this may mainly involve some personnel and admin support to communicate with and serve users and for networking.

Diagnostics Development Platform

Grade: 6

Motivation

Diagnostic Development Platform has an ambitious plan to have a distributed translational infrastructure providing services for clinical & translational research and clinical trials, as well as adapting new technologies enabling precision medicine and diagnostics in all medical faculties in Sweden. The Platform started with Facilities in two universities in 2014, and after addition of two Facilities in 2016 and further three in 2019, now combines seven nodes operating in all universities with a medical faculty and at all university hospitals in Sweden. The Facilities have variable level of expertise, maturity, and instrumentation. Unlike the name implies, the Platform focuses its services and development efforts to clinical genomics.

During its first operational years the Platform has contributed to implementation of NGS based diagnostic tests for rare diseases, cancer and infectious diseases, by developing a nationally distributed broad gene panels for solid tumors and hematological malignancies for translational research and clinical diagnostics, and making Sweden one of the first healthcare systems to implement whole-genome sequencing in clinical routine. The Platform has also had a major role in the initiation of a national effort to coordinate implementation of precision medicine in Sweden (Genomic Medicine Sweden, GMS).

The national coverage and coordination of the Platform provides unique opportunities by enabling harmonization of new assays and their interpretation across the country, as well as reducing development and running costs. The strategy to closely collaborate with the National Genome Infrastructure, which has extensive experience in setting up and evaluating novel methods and applications, is well thought off and allows rapid adaptation, efficient validation and implementation of the novel tests also to routine genome diagnostics, which are then taken over by GMS or healthcare personnel.

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Another unique asset of the Platform is *clinical bioinformatics* that includes management, analysis and storage of sequence data that supports patient management and care. Thus, the decision to allocate 50% of the Platform staff to bioinformatics, software development or system administration is reassuring, but the Platform is further encouraged to coordinate these activities with the Data Centre.

Diagnostic environment is developing fast thus it is important to have a view of the landscape and what is on the horizon – this is recognized by the team. Furthermore, for rapid transfer of the technologies to the clinic it is reassuring to note that the main operations are ISO accredited, and that the team is actively following the legislation changes on the horizon.

Alarmingly the Platform's plan for 2021–2024 is to de-centralize all the development efforts to all individual facilities, thus wasting the unique opportunities for reduced development costs and harmonization across the country. All the facilities are planning to adopt long-read sequencing to clinical routines, and almost all plan to develop ultra-sensitive mutation testing, transcriptomics and single-cell sequencing. Furthermore, all plan to offer tests for rare diseases, cancer and infectious diseases, and some also to expand their services to pharmacology, complex diseases and immunology.

Points of concern

- Other diagnostic areas besides genomics are not offered/developed
- Plan to decentralize the development of new methods to all facilities is significant waste of unique opportunities created by the Platform.

Recommendations for 2021–2024

- As the diagnostic development at the Platform covers only a narrow, although a very important part of the diagnostic environment, clinical genomics, the Platform should either consider changing its name to better match the focus or include other diagnostic modalities in collaboration with other Facilities.
- Although the national coverage and close connections to local university hospitals are of high importance for some functions, the Platform should seriously revisit the presented plan and division of tasks between the Facilities, and carefully evaluate which operations can be distributed and which will significantly benefit from centralization.
- The Platform should centralize the adaptation of new methods to clinical use to the Facilities with enough resources and close connection to the National Genomics Infrastructure.
- The Platform should avoid unnecessary overlap with the National Genomics Infrastructure and prioritize the use of its expertise and sequencing capacity.
- The Platform shouldn't duplicate the development of bioinformatic solutions within the Platform and should intensify the collaboration with the NBIS and the Data Centre to ensure efficient national distribution of analysis pipelines and interpretation tools already developed for clinical genome diagnostics within the Platform.

Diagnostic Development Platform – Funding Recommendation

Funding recommendation: -

Motivation

The Diagnostic Development Platform requests 6 MSEK/year for 'Platform Coordination' and 'Platform New Initiatives'. However, no information is given as to how these funds are to be spent on top of the annual funds dedicated to the 7 Facilities. Furthermore, it is not clear how the services and development are shared between the different Facilities, and why every Facility needs its own set of 2 to 3 FTEs. Many of the Facilities only serve local operations, which should receive mainly local funding. Similarly, the cost structure of the Facilities has not been specified and is not clear: some of them have significant user fee revenue, while others plan for minimal amounts.

Importantly, there is no need to reinvent the wheel. Adapting new methodologies across many different centres is much more efficient if one centre takes responsibility of the initial adaptation and validation, so that other centres can learn from their successes, mistakes and problems, and robustness of the new test can readily be evaluated in a ring test by the other centres.

In short, it would be very beneficial to reconsider the division of tasks between the different centres, to concentrate the method development in two or three of the centres, to re-evaluate what tasks should be centralized and which require local operations (sequencing is not one of those), and whether each centre needs 2 to 3 FTEs.

Drug Discovery and Development Platform

Grade: 8

Motivation

The Drug Discovery and Development (DDD) Platform is critical to success in translating academic projects towards patient benefit. As such it is central to the SciLifeLab's effort and over the last 5 years has proved its worth by delivering 2 Phase 1 projects, 3 other partnered projects and 4 startups. The Platform contains significant industrial expertise across a range of modalities, including small molecule and antibodies, and also undertakes some technology development work. Projects are selected by a Steering Group and are worked up to deliver milestone driven plans encompassing a Target Product Profile.

The Platform has good reach across the Swedish universities with 68 PIs engaged in 2019. The Platform has a capacity of about 18 projects and has evaluated over 300 projects. It is important that the Drug Discovery Platform is also aligned with other relevant platforms, such as the Swedish NMR Center, Cryo-EM, Chemical Biology and Chemical Proteomics Facilities – this provides a more integrated approach to drug discovery without the DDD Platform having to house each of these additional capabilities. DDD also has access to a number of leading-edge technologies, such as DNA Encoded Libraries and PROTACS.

Points of concern/improvement

- The team is quite small for the size of portfolio – this is a key aspect of translating academic biology towards patient benefit – so may need expanded resources to sustain the throughput.
- Better integration with the Data Centre is essential for capturing, curating and future use of data.
- There are no real KPIs to measure performance of the Platform. These should be developed.
- There is the potential for conflict of interest at the Steering Group level.

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Recommendations for 2021–2024

- Develop an educational program on what constitutes good target validation. This would serve to improve the quality of the projects being proposed by academics and allow them to think in a more translational way.
- The team is modest in size and seem to be spread thinly with SM, Abs, other modalities and new technologies being covered by only ~40 staff. If income can be generated by revenue share, then this can be used to expand the team.
- There should be an international membership of the Steering Group in order to dilute conflicts of interest and to access additional expertise to enable better decision making.
- Better integration with the Data Centre would be of benefit, allowing access to and storage of key data in a centralized accessible portal. This may allow other ideas to be generated by analyzing the datasets in different ways and would act as an historical archive for all data in time The DDD Platform needs to take more control over commercialization by recruiting a Tech Transfer Officer to lead commercialization. This would benefit the academics by providing a dedicated resource, well connected into Pharma, to drive commercialization.
- In order to support the Platform financially, the DDD should take a revenue share of any deal which would potentially provide future funding streams. Indeed, it seems strange that a PI can take advantage of the DDD, gain significant benefit free of charge, and not have to share any upside. This would provide the benefit of incentivizing the DDD to both select good projects and deliver. The PI can of course retain ownership of the IP and would benefit from the assistance of a dedicated TTO as few may have the time or motivation to pursue this themselves and obtain the best deal.
- In order to gain an insight into the performance of the DDD, KPIs should be developed. These don't need to be based purely on partnered assets but could also include measures such as proportion of milestones achieved within one month of the planned date and progression of projects through the various phases from assay development to exit. Another measure could be the amount of funding from other sources obtained for each of the projects (e.g. research or grant funding). These would give a feeling of how dynamic the portfolio is. Publications and conference presentations could also be used as well as patent filings.
- An education program for academics should be developed to ensure a good understanding of what makes a viable drug discovery project and what goes on, an essential commodity for patent protection, amongst other things.

Data Centre [1]

Grade: 9

Motivation

The Data Centre was kick-started in 2017 with the mission to support all SciLifeLab Platforms with the adequate access, storage and sharing of all type of data. So far, the Centre has been instrumental at different levels. They e.g. set-up facility- and user access interfaces, offer access to scalable (active and passive) cloud storage modalities and design DM systems & plans. The Unit also configured the iLab Facility Management system (together with the KI and UU facilities) that promotes collaboration and integration at various levels of project requests (i.e. manage the requests; track the projects; schedule resources; integrate with finance; search publication databases; facilitate cross-collaboration between facilities, etc.).

Unlike the NBIS Platform that also has a national role, Data Centre has a pure SciLifeLab-centric role. This offers Data Centre a unique positioning to really make the difference for its community.

Points of concern/improvement

- The Data Centre does not yet always have the buy-in from all platforms/facilities.
- Central data-driven initiatives could (should) be undertaken to create more awareness and/or dilute some of the initial resistance (if there is any). Integrative multi-omics projects could form a show-case example as cross-platform knowledge (including meta-data sets) are key to their success.
- Some of the (missing) interactions with the NBIS Platform should be clarified.
- The current Data Centre team is relatively small (6 FTE's only)
- As SciLifeLab leadership identified Data-Driven Science as one of 'the' flagship of the 2020–2030 roadmap the crucial role of data management is currently still under-estimated

Recommendations for 2021–2024

- The IEC under-scribes that SciLifeLab (and Sweden as a whole) is uniquely positioned to make Data-Driven Science a success. To do so, it's strongly recommended to create a stronger mandate for the Data Centre.
- Top-down policies that make collaboration with the Data Centre compulsory may be needed. The IEC believes that it's now 'the' momentum to position SciLifeLab at the forefront in this field.
- Some of the current roles of the NBIS Platform may be considered to shift the Data Centre. At least a better communication/coordination between the two Platforms is needed.
- Scale the resources of Data Centre
- Local initiatives should always be possible, though a better alignment is suggested.
- In order to successfully execute SciLifeLab's future vision to create a National Framework for Data-driven Life Science (2020–2030 Roadmap), there is a need to advance the data culture within the organization. Increasing the impact of research data generated by the Platforms and supported researchers is of utmost importance. Leadership will be needed to drive the development and adoption of data governance processes, best practices for data management, and initiatives to disseminate these practices through training programs. Achieving FAIR objectives (Findable, Accessible, Interoperable and Reusable), which has been addressed, involves attention to documentation, experimental and reagent tracking and metadata annotation (e.g. through use of shared ontologies, etc.). Equally important, however, is the need to ensure high data quality through effective design of experiments, data reproducibility assessments and use of appropriate statistical methods. While attention to these elements will be spread across the different Facilities and technologies, there is a role for centralized coordination. Those processes that are Platform independent and impact multi-omics data analysis could be driven by the Data Centre. The data quality issue will become critical particularly if the use of AI and ML methods increase (e.g. imaging, etc.) as they are particularly sensitive to data issues.

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[1] Although it was not requested given the strategic importance the IEC opted to give a grade and make a budget recommendation for Data Centre given its crucial future role.

Data Centre – Funding Recommendation

Funding recommendation:
significant increase (equivalent of ++)

Motivation

The IEC has emphasized in several sections the crucial importance of the Data Centre for the future success of SciLifeLab its overall data-driven science mission. Therefore, (although it was not explicitly asked for) the panel want to stress that a significant increase in budget will be important for this pure sang SciLifeLab initiative.

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Summary

At risk of re-iterating some of the aspects mentioned already as overall feedback on SciLifeLab platforms (see also page 4), the IEC takes this opportunity to recognise in the summarizing chapter the overall excellent quality of the SciLifeLab Platforms, which may be considered world-class and competitive.

Of the feedback we have provided per platform/per facility our intentions have been motivated specifically toward providing suggestions on how to optimise and improve service accessibility, research performance and added-value impact. For example, continuation of existing units, welcoming new candidate facilities, potential mergers and/or changes in service-offer portfolios; eventually also leadership. These can be associated mainly with clear goals and directives. The reflected grades and funding recommendations of the IEC can be found in the *Summarising Table on the next page.*

On the other hand, for the global SciLifeLab feedback we have tried to suggest what might be missing and associate it with the possible risks incurred. For example, the strong(er) institutional mandate that Data Centre could get, the suggested close(r) interplay between Data Centre and Bioinformatics Platform, the need for prioritization in some platforms (including Cellular and Molecular Imaging Platform) as well as the high level of redundancy in technology development activities in Diagnostics.

It is in the hands of SciLifeLab leadership to prioritise between these recommendations and plan accordingly a strategy for the next four years; and as a part of the same scientific community all members of this IEC recognise the importance of what SciLifeLab offers and proffer therein our unreserved support.

As a final word, the panel would like to thank SciLifeLab for the excellent set-up of the evaluation and also for its openness with regard to sharing its research excellence with the community. All IEC members view the provision of top-level infrastructure for research and open access to state-of-the-art technology to be the key element of Europe's competitiveness for a knowledge-based economy and consequently, research institutions should collaborate and not compete to provide a top-level landscape of research infrastructure. SciLifeLab is setting an excellent example in this regard.

Summarising Table with Grades and Funding Recommendations

No.	Unit	IEC Joint Grade (1–9)	IEC Comment	IEC Funding Recommendation (+ / 0 / –)
1	**Bioinformatics Platform**	**7**		0
2	Support, Infrastructure and Training	8		
3	Compute and Storage	8		
4	BioImage Informatics	6		
5	AIDA Data Hub (Candidate)	**7**	Yes	
6	**Cellular and Molecular Imaging Platform**	**7**		+
7	Advanced Light Microscopy	7		
8	Biochemical Imaging Centre Umeå/Umeå Core facility for Electron Microscopy (Candidate)	7	Yes, FIB-SEM focus	
9	Centre for Cellular Imaging (Candidate)	6	Yes, CAT focus	
10	Intravital Microscopy Facility (Candidate)	7	Yes	
11	Cryo-EM	9		
12	Cell Profiling	8		
13	In Situ Sequencing	8		
14	Advanced FISH Technologies (Candidate)	6	Yes, as part of TSO	
15	Gothenburg Imaging Mass Spectrometry (Candidate)	4	No	
16	National Resource for Mass Spectrometry Imaging (Candidate)	7	Yes	
17	**Chemical Biology and Genome Engineering Platform**	**7**		0
18	Chemical Biology Consortium Sweden	6		
19	Chemical Proteomics	8		
20	High Throughput Genome Engineering	8		
21	Genome Engineering Zebrafish	7		
22	**Genomics Platform**	**8**		+
23	National Genomics Infrastructure	9		
24	Ancient DNA	7		
25	Eukaryotic Single Cell Genomics	8		
26	Microbial Single Cell Genomics	7		
27	**Proteomics and Metabolomics Platform**	**7**		(+)
28	Autoimmunity Profiling	6	Should merge	
29	Plasma Profiling	6		
30	Proximity Proteomics	4	Phase out	
31	Mass Cytometry	8		
32	Proteogenomics	8		
33	Glycoproteomics (Candidate)	7	Yes	
34	Targeted and Structural Proteomics (Candidate)	7	Yes	
35	Swedish Metabolomics Centre	7		
36	Exposomics (Candidate)	7	Yes, conditional	
37	**Swedish NMR Centre**	**8**		(+)
38	**Diagnostics Development Platform**	**6**		–
39	**Drug Discovery and Development Platform**	**8**		N/A
40	**Data Centre**	**9**		Significant increase

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Appendix I.

Bioinformatics Platform – Separate Assessment by Rolf Apweiler

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Bioinformatics Platform – Separate Assessment by Rolf Apweiler

Grade: 8

Motivation

The Bioinformatics platform goes from strength to strength. Data Science is getting more and more important in the life sciences, and therefore of course also at the SciLifeLab and in Sweden as a whole. The Bioinformatics activities of the SciLifeLab are core for providing the necessary support, infrastructure and training in a more and more data-driven scientific environment. While the user base seems to have reached a plateau over the last years, the interactions with other platforms got even more strengthened. The future developments probably with the highest impact appear to be EGA-SE and the planned increased activities in Imaging Bioinformatics.

The largest activity of the Bioinformatics platform is Support, Infrastructure and Training with more than 80% of the FTEs. It is great that the Swedish Life Scientists are now supported by a national team of senior support staff scientists at all 6 major University sites in Sweden. The support staff is getting involved in many cases already early in projects and are thus able to support the projects through the whole data life cycle, realising that a lot of bespoke work is necessary to provide the appropriate support.

The infrastructure is built on the principle of essential value on a national level but incorporated in international efforts to make the impact global. Especially good examples of these principles are the efforts of EGA-SE and of the Human Protein Atlas, an ELIXIR Core resource.

The Support, Infrastructure and Training facility runs substantial and very relevant training efforts across Sweden, and again, very well embedded through ELIXIR-SE into the international landscape. There is a clear recognition of future challenges, especially around FAIR data and reproducibility, as well as around Omics Integration, Big data and AI.

The Support, Infrastructure and Training facility understands the tasks at hand and are driving forward work in addressing the challenges in these fields.

The NBIS Compute and Storage facility is facing more and more complex projects with increasingly complex needs. They react to address this with new technologies for deploying software (Docker, Singularity, etc) in more portable environments (Cloud solutions). New activities are planned around Image data, AI/ML and environments like Galaxy. Again, the NBIS Compute and Storage facility understands the tasks at hand and are driving forward work in addressing the challenges in these fields

The BioImage Informatics is reacting to the increase in need for image analysis due to the growth of image-based research by developing new methods, applying deep learning, as well as automating of analysis. They seem to be well linked to and interacting with the National Microscopy Infrastructure.

The AIDA Data Hub was proposed as a candidate to incorporate this Medical Imaging Diagnostics AI Facility into the SciLifeLab Bioinformatics Platform activities, specifically as a Unit of the BioImage Informatics facility. This facility is right now a rather small effort with 1.5 FTEs and from the presentation and the material presented it was not clear to me how the growth path of this area was envisaged. However, there is no doubt that the more clinical oriented activities are a growth area.

This leads me also to the only weak point in the presented material. I believe that the Bioinformatics Platform should and hopefully will play in future a very fast growing role in the clinical area as exemplified by EGA-SE and the AIDA data Hub. However, an explicit medical strategy how to engage with the clinical field and the healthcare sector, was not presented.

Nevertheless, I expect that such a strategy exists, but was not made explicit. Therefore I can only congratulate the Bioinformatics platform to their stellar success in the past. Since they have clearly identified the future challenges and understand the tasks at hand the Bioinformatics Platform will also in future be driving forward the devlopment of solutions to address the challenges to come.

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Appendix H.

General Terms and Conditions for Funding of Infrastructure

H.

SciLifeLab Infrastructure

General Terms and Conditions for Funding

(preliminary version)

H.

Table of Contents

Introduction

SciLifeLab (Science for Life Laboratory) is a national centre for life science research in the field of molecular biosciences. The mission includes offering researchers from across Sweden access to advanced technical analyses of samples, support for data analysis and specialist expertise in molecular biosciences. SciLifeLab is regulated by a special governmental ordinance (förordningen (2013:118) om Nationellt centrum för livsvetenskaplig forskning) and university directives (regleringsbrev) to KTH and UU. In addition, there are steering documents that describe the agreements among the Host Universities on how to manage SciLifeLab (see www.scilifelab.se).

The SciLifeLab Infrastructure is operated with funding from the National SciLifeLab budget and is available to all Swedish researchers. The Infrastructure is organized into technology Platforms, which are further composed by Units. The Platforms and Units are approved by the SciLifeLab Board based on international evaluations and national discussions carried out every four years. The Infrastructure is organized, financed, managed, and developed with a long-term view to promote high quality interdisciplinary research in Sweden within and between academic institutions, industry, and healthcare.

This document aims to clarify the conditions and expectations linked to the appointment of Platforms and Units as part of the SciLifeLab Infrastructure, the criteria for services provided, funding issues, governance, organizational structure, and other operational principles and policies.

General

Each Infrastructure Unit is hosted by and integrated with one or several departments within one or several universities. The Units are part of the Host Department operations and must follow applicable rules of procedure, delegation of authority and guidance of its Host University and Department.

National SciLifeLab funding that the Board approves is provided to the specific Host Department at the Host University of the Unit or Unit Node, based on instructions from the Platforms and Units. The funding must remain at the specific Host Department and cannot not be transferred to any other University. The Head of the Host Department will agree in writing to the terms and conditions of the SciLifeLab funding, including the financial, HR, legal and reporting requirements.

SciLifeLab follows the directives of the Host Universities, for example that all employees and students must be treated with respect and be given the opportunity to work and study on equal terms regardless of sex, transgender identity or expression, ethnicity, religion or other belief, disability, sexual orientation, age, or social background. Equal opportunities are a quality issue for the organization and a justice issue for the individual as regulated in the Higher Education Act (SFS 1992:1434), Discrimination Act (SFS 2008:567).

This *Terms and Conditions for Funding* document applies by default to all SciLifeLab Platforms and Units. Exceptions may be described in a separate version of this document.

Criteria for Funding of SciLifeLab Infrastructure Units

Nominations as SciLifeLab Infrastructure Unit and funding decisions are made by the SciLifeLab Board, after recommendations from the Director and the Management Group. The decisions will be based on international evaluations, internal discussions in the Management Group, as well as discussions with Host University representatives and the National SciLifeLab Committee (NSC). Below are the most important criteria that a SciLifeLab Infrastructure Unit should ideally meet:

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- **Facilitate** world-leading research in molecular life sciences
- **Enable** research that otherwise would not be possible in Sweden
- Provide high-quality services to **academic researchers, industry, healthcare, and other organizations in Sweden**
- Serve **multiple research groups** in high-quality research projects **across the nation**
- **Function in** a high-quality research environment supporting continuous development of the technologies and services

- Provide **internationally competitive** services
- Have a **long-term plan** for instrumentation renewal, technology development, data management and sharing, scientific domains and user communities being served, as well as for a sustainable and versatile funding base
- Provide complementary and **synergistic opportunities** within and across SciLifeLab Platforms
- Participate in **national coordination** of similar facilities at other universities in Sweden (when applicable)
- Promote **translational implementation** of research findings into healthcare, industry, and society (when applicable)

Evaluation and Decisions on Funding

SciLifeLab Platforms and Units are evaluated by international panels every four years (2016, 2020, 2024 and so on) complemented by strategic discussions with representatives from the Host Universities and the National SciLifeLab Committee (NSC). Based on the outcome of the evaluations and discussions, the SciLifeLab Board decides on the organization and funding of Platforms and Units for the next two + two years. A midterm check-up of Platforms and Units will be performed halfway through the four-year funding period to ensure that conditions, expectations, and suggestions given to Platforms and Units have been acted upon. Based on the check-up, the SciLifeLab Management Group and the Board will decide upon the continued funding for the second two-year period. This may involve adjusting the funding or undertaking organizational changes to Platforms or Units.

Phasing out of Funding

If the SciLifeLab Board decides to phase out funding of an Infrastructure Unit, funding is decreased to 80% level compared to the previous funding year for an 18-months phase-out period after the decision. The Unit should provide service corresponding to the funding level during the entire phase-out period and deliveries should be reported for the first year of the period. Once the SciLifeLab funding ends (after the 18-months period), the SciLifeLab brand/name cannot be used in association with the Unit. Units may also be merged or reorganized across Platforms. In exceptional circumstances, such as gross negligence of good infrastructure practice or proven scientific misconduct, funding to a Unit may be withdrawn immediately based upon a Board decision (see below).

Governance

Based on research area, technologies provided, and synergies with respect to user base, the SciLifeLab Infrastructure Units are divided into Platforms that are organized according to the figure below. Special terms and conditions may apply for some Platforms, and deviations from the generic Platform organization scheme can be approved by the Board, if appropriate.

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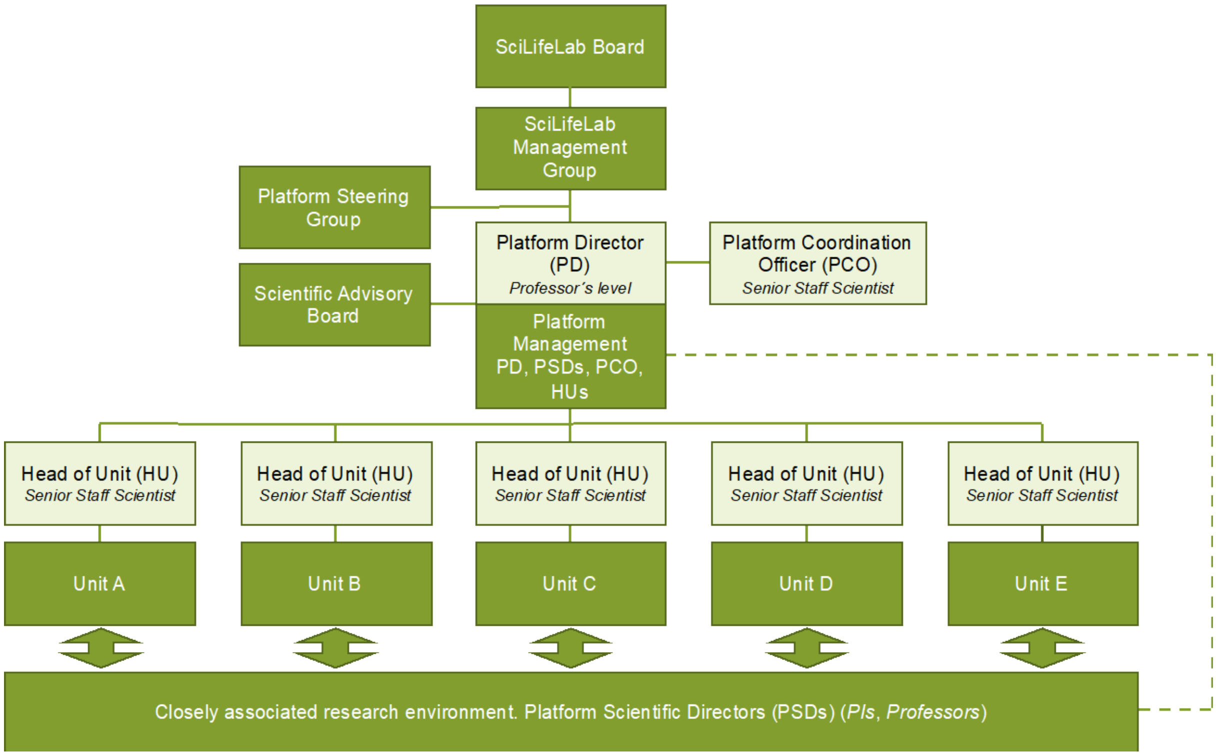

Platform Director (PD). Each Platform is managed by a Platform Director (PD). The PD should be a researcher on Professor´s level or have equivalent experience from infrastructure work, healthcare, or industry, with a strong scientific knowledge of the Platform technologies and their research applications. The PD should exhibit excellent leadership qualifications and be a skilled team leader. The PD should also have a genuine interest in developing and improving research infrastructures and devote at least 10% of working time on Platform operations. A flat-rate compensation corresponding to an effort of 0.1 FTE for the PD may be covered by SciLifeLab funding via a Board decision, while any additional compensation must be covered by the Platform Units´ budget. The PD is appointed by the SciLifeLab Board on a two + two-year basis via an open call, or through a letter of interest procedure among the Platform Management Group members. Replacement of PD must be approved by the SciLifeLab Board. The SciLifeLab Director may nominate a temporary PD until the next Board meeting. The PD reports to the SciLifeLab Management Group (MG).

The PD is responsible for:

- Leading the work in the Platform Management Group (see below) according to Mission and Specific Terms and Conditions for SciLifeLab funding to the Platform and its Units given in a separate document
- Platform strategy and operational plans, including participation in cross-Platform service offerings (“capabilities”)
- Platform budget (for any dedicated SciLifeLab funding on Platform level)
- Overall Platform deliverables (KPIs)
- Representing the Platform at SciLifeLab meetings, in communication with the MG and the Board, as well as in external communication and outreach
- Assembling feedback reports and material on Platform level requested for evaluations by the International Evaluation Committee (IEC) and International Advisory Board (IAB)
- Communication with the Platform Steering Group (see below) on strategic and operational issues on a regular basis
- Annual Platform reporting to SciLifeLab

Co-Platform Director (Co-PD). Optionally, Platforms can appoint a Co-PD if shared leadership of the Platform is desirable and appropriate. The profile of qualification for the Co-PD is equal to that of the PD, as well as the procedure for appointment.

Platform Coordination Officer (PCO). Each Platform must appoint a Platform Coordination Officer (PCO) that reports to the PD. The PCO role is to assist the PD in coordinating the Platform operations and should devote at least 20% of working time on Platform related activities. A flat-rate compensation corresponding to an effort of 0.2 FTE for the PCO may be covered by SciLifeLab funding via a Board decision, while any additional compensation must be covered by the Platform Units´ budget. The PCO should be a senior staff scientist, with strong scientific knowledge of the Platform technologies and their research applications and be a skilled team leader. The PCO may be a Head of Unit (see below), or a senior staff scientist with the above-described qualifications from any of the Platform Units. The PCO is appointed by the Platform Management Group (see below) and approved by the SciLifeLab Director on a two + two-year basis in conjunction with the funding decision. Replacement of PCO must always be reported to the Infrastructure Coordinator at the SciLifeLab Operations Office and be approved by the SciLifeLab Director and Infrastructure Director.

The PCO is responsible for:

- Organizing Platform Management Group meetings on a regular basis and making sure that meeting minutes are recorded, appropriately stored, and made available to all Platform staff as well as the Infrastructure Director/Coordinator.
- Communication on the Platform including all staff at the Units
- Executing and following-up on the Platform operational plan and Platform Management Group decisions
- Representing the Platform at SciLifeLab meetings, in communication with the Operations Office and the MG, as well as in internal and external communication and Platform outreach.
- Assisting the PD with feedback reports and material on Platform level requested for evaluations by the International Evaluation Committee and International Advisory Board (IAB)
- Assisting the PD with annual Platform reporting to SciLifeLab
- Assisting the PD in coordination of Platform equipment inventory and applications to SciLifeLab internal instrument calls
- Maintenance of the SciLifeLab Platform webpage
- Coordinating user workshops and courses on the Platform level
- Data management and user guidance on the Platform level together with Data Centre on open access, FAIR and GDPR requirements

Head of Unit (HU). Each Unit of the Platform is managed by a Head of Unit (HU) that reports directly to the PD. Units may have operations at several departments and can have one or more co-HUs. The HU should devote at least 50% of working time on Unit and Platform related activities. The HU should be a senior staff scientist, have a strong scientific knowledge of the Unit technologies and their research applications, and be a skilled team leader.

The HU is responsible for the budget and everyday operations at the Unit, including project management and allocation of Unit resources. The HU is, with support from the corresponding PSD (see below), also responsible for the scientific and the strategic development of the Unit, in line with the operational plan of the Platform. The HU should always be accessible for communication with the PD, MG, and OO. The HU is appointed by the Platform Management Group and approved by the SciLifeLab Director on a two + two-year basis in conjunction with the funding decision. For Units with several sources of funding, the HU should be jointly appointed by the SciLifeLab Director and other significant external funding bodies. Replacement of HU must always be reported to the Infrastructure Coordinator at the SciLifeLab Operations Office and be approved by the SciLifeLab Director and Infrastructure Director.

The HU is responsible for:

- Management of staff
- Unit operational plan
- Unit budget and build-up of economy structure according to instructions from Operations Office
- Annual reporting to SciLifeLab
- Coordinating the Unit´s financial reporting with the SciLifeLab Financial Coordinator at the Host University
- Outreach and communication with users
- Coordination and prioritization of project applications in agreement the Platform Operational Plan
- User fee models for academic users and for full cost models applicable for industry and healthcare users
- User agreements

- User workshops and courses
- Unit deliverables (KPIs)
- Ensuring high-quality and reproducible data production
- Training and competence development of Unit staff
- Collaboration with surrounding research group(s) on technology development, and instrument plans and use.
- Technology development and implementation of new methods and protocols
- Data management and user guidance together with Data Centre on open access, FAIR and GDPR requirements
- Maintenance of the SciLifeLab Unit webpage, including list of services

Platform Scientific Director (PSD). Each Unit should ideally have established a formal association with at least one, preferably co-located, research group. The association should be based on mutual scientific synergies in terms of technology focus, development of new techniques, and sharing of instruments. The PI of the associated research group(s) should be offered to be a member of the corresponding Platform Management Group (see below) with the title of Platform Scientific Director (PSD). PSDs are appointed by the Platform Management Group/PD and approved by the SciLifeLab Director on a two + two-year basis in conjunction with the funding decision. The role of the PSD is to actively contribute to the strategic development of the Platform and serving as scientific expert in the technology field of their respective associated Unit.

Platform Management Group (PMG). The PD, PSDs, PCO, HUs, and additional senior staff scientists according to the choice of PD, constitute the PMG. Preferably, representatives from other relevant Platforms should also be part of PMG as adjunct members. The PMG has the overall responsibility for the strategic and scientific development of the Platform according to the SciLifeLab Specific Terms and Conditions for Funding of the Platform and its Units. The members of the PMG should be approved by the SciLifeLab Director on a two + two-year basis in conjunction with the funding decision. The PMG should meet on a regular basis, and the PCO must make sure that notes from these meetings are recorded, stored, and made available for all Platform staff and the Infrastructure Director and Infrastructure Coordinator. Decision-making on Platform level is performed by the PMG members based on the consensus principle. For important proposals, it is essential that all PMG members that cannot attend a decision-making meeting are informed and have the possibility to provide input on beforehand. If there are significant reservations or disagreement among PMG about a proposal, the MG should be consulted and become the decision-making body for the proposal, if applicable.

Platform Steering Group (PSG). Each Platform should appoint a Platform Steering Group (PSG) to be approved by the SciLifeLab Board. The PSG should ideally have a broad national representation and consist of SciLifeLab-independent technology experts, and user representatives from academia, healthcare, and industry, with the PD and PCO as adjunct members. For Platforms/Units receiving funding from other bodies (e.g. the Swedish Research Council (VR)), the funder typically expects the appointment of a Steering Group. Such Steering Groups can, if agreed with the SciLifeLab Board, assume responsibility for the steering of SciLifeLab funded operations (according to SciLifeLab terms and conditions for funding). The PSG should meet on a regular basis with the main task to give input to the long-term strategy for the Platform and to approve important major proposals to be decided upon by the SciLifeLab MG and Board.

Platform Scientific Advisory Board (SAB). Each Platform are encouraged to appoint a Scientific Advisory Board to advise on long-term scientific development from an international perspective. The SAB should preferably include 3–5 international experts with competences relevant for the Platform research fields and should be selected to cover the range of technologies provided by the Platform.

If appropriate, alternative arrangement of external bodies can be approved by the SciLifeLab MG and Board, e.g., a combined PSG and SAB, User Reference Groups etc.

Project Prioritization. To ensure user access to services on equal terms regardless of the user´s affiliation, Platform and Units should develop, document, and apply appropriate and transparent models for project prioritization. This is especially important when user projects demand significant operational resources. Platforms and Units can appoint a Project Prioritization Committee (PPC) responsible for the prioritizing of project proposals. The PPC function can alternatively be a task of the Platform Steering Group. Project prioritization should primarily be based on scientific quality, technical feasibility, and if applicable, clinical potential. Data handling and data management plan should also be considered, ideally in collaboration with the SciLifeLab Data Centre and the Bioinformatics Platform (see below). The PPC should ensure that services are provided on equal terms to academic users. In addition, all Units should be prepared to allocate up to 15% of the

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services to healthcare, industry, governmental agencies, and international users. In Units dedicated to diagnostic development and healthcare services, these percentages can be higher. Units are also encouraged to make sure that project prioritization considers favourably young principal investigators.

Additional Funding to Platforms and Units

An expectation for a successful and sustainable SciLifeLab Infrastructure Unit is that it continuously receives funding from its Host University(ies), other participating universities or other funding agencies. The Platforms and Units should always contact the SciLifeLab Management Group well in advance before applying for external infrastructure funding, particularly from VR. This is mandatory if the SciLifeLab funding will be used as co-funding in the application since the funding period for the VR grant may exceed the current funding commitment of SciLifeLab.

User Fees

SciLifeLab Infrastructure Platforms and Units should charge user fees according to pre-defined and documented cost models. Units are responsible for the preparation and implementation of cost models, including a full cost model in accordance with Ekonomistyrningsverket's guidelines "Sätt rätt pris" (www.esv.se/publicerat/publikationer/2014/satt-ratt-pris). Cost models should specify what costs the user fees are covering and should be aligned with common practice at the Host University.

Service and Users

The Infrastructure Platforms and Units should provide high quality services to users who are engaged in research projects of high scientific impact. The service should be such that the users can pursue projects without being an expert in the technology. Platforms and Units should define criteria for prioritizing projects primarily based on scientific impact, technical feasibility, and other Unit-specific criteria. The service should be accessible on equal terms to all Swedish academic users including the members of SciLifeLab Board, MG, NSC, PDs, PSDs and SciLifeLab Group Leaders and Fellows. Service should also be accessible to researchers within the private sector, healthcare, and governmental agencies. Part of the capacity, up to 15%, may also be used for service to international users. The users carry the responsibility for any necessary legal or ethical considerations regarding analyses and material (e.g., ethical permits, Nagoya protocol, GDPR etc), and the Unit should make sure the user has understood this responsibility.

The Infrastructure Units are encouraged to actively identify opportunities to participate in large-scale research projects that address grand societal challenges within life science related areas. This includes active participation in the SciLifeLab Research Community Projects as well as interactions with SciLifeLab Fellows, WCMM Fellows, DDLS Fellows, ERC grant recipients and other promising young PIs.

Technology Development

Up to 20% of SciLifeLab funding provided to an Infrastructure Unit can be used to develop, implement, and adapt new or improved services, methods, and technologies. These efforts should not entail resource building or *bona fide* research projects. Method and technology development may involve collaboration with national and international academia, industry, healthcare, and governmental agencies, with young PIs to be considered favourably in research collaborations. SciLifeLab and Host Universities will in addition support technology development through Technology Development Project (TDP) grants.

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Quality control

SciLifeLab Infrastructure Platforms and Units should implement quality control processes to ensure that services are delivered in accordance with the high-quality standards SciLifeLab users have the right to expect. Adherence to good laboratory practices is expected, including documentation of standard operating procedures, use of electronic lab notebooks (ELN or equivalent systems), electronic sample and data workflow systems (LIMS or equivalent), project planning systems (ProjectPlace or similar), and electronic systems for communication with users (Data Centre's Order Portal, for example). Units should consult the SciLifeLab Data Centre for guidance on systems to use, and to communicate any needs regarding IT systems and data management tools.

Data Management and Sharing

SciLifeLab Infrastructure Platforms and Units should guide users with the analysis, storage, availability, and accessibility of the data produced by the Units. Supported projects must be assigned a unique identifier, and Units should collect the appropriate project information to enable tracking and reporting. Units will be required to submit such data to a central database to facilitate cross Platform services, at the time when SciLifeLab will provide the Infrastructure Platform for this.

In accordance with increasing demands from funders and scientific journals, we recommend that projects that include data management of any type set up a Data Management Plan (DMP). For example, all projects receiving supported from VR are required to have DMPs. We recommend that Platforms and Units ensure users set up a plan that estimates at least existing and requested resources to deal with data analysis and management, including computing, storage, archiving, security, and accessibility. Templates and guidelines for DMPs can be provided by the SciLifeLab Data Centre. In the near future, DMPs will be required for all SciLifeLab supported projects.

The Infrastructure Units are required to inform supported projects about the obligations:

a) to acknowledge SciLifeLab support in publications, using the unique identifier assigned at the start of the project, and
b) to report back to SciLifeLab when data has been used in a publication and where the data has been deposited.

SciLifeLab supported projects should adhere to the principles of open science, including open access to both publications and data to the greatest extent possible, given ethical, legal, and intellectual property considerations. The Units must ensure that sensitive and confidential information (e.g., from healthcare-related projects) is handled in accordance with current laws, regulations, and Host University practices, including GDPR directives.

The SciLifeLab Data Centre will provide support to the Infrastructure Units to address requirements and recommendations in this section.

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Courses and Training

The Platform and Units should provide courses and training related to technologies, analyses and application of the technologies and data generated by the Units. Courses and training should be offered to national academic user communities. Preferably, courses and training should also be offered to users within healthcare, governmental agencies, industry as well as international user according to rules and regulations for “uppdragsutbildning”. Costs for courses and training are usually covered by the Unit budgets or through participant fees (if applicable).

Communication and Branding

The Infrastructure Platforms and Units should actively communicate to potential users regarding opportunities for existing and new services, both through own initiatives and by participating in events organized centrally at the SciLifeLab level. New possibilities and important research results produced using technologies and service provided should actively be communicated to the research community and to the society.

SciLifeLab Platform and Units should keep their website up to date and be active towards SciLifeLab Communications Office in terms of how communication and web traffic can be improved. With SciLifeLab web site being continuously developed, the Units should participate in making the web site as attractive as possible and well branded.

All SciLifeLab Platforms and Units should be primarily branded under the SciLifeLab name. The VR- and KAW-funded network names can be used as secondary, but not alone. VR networks that only partially overlap with SciLifeLab Platforms and Units are suggested to negotiate branding with the SciLifeLab management (contact Infrastructure Coordinator).

All Infrastructure Units should follow the SciLifeLab communication handbook guidelines (www.scilifelab.se/staff/documents-and-templates) and policies for the use of the SciLifeLab logotype. For the SciLifeLab brand to be clear, strong, and recognizable, it is important that it is handled consistently and purposefully. The handbook is available as a tool for this and differentiates SciLifeLab from other organizations.

National and International Strategic Collaborations

SciLifeLab Platforms and Units should, whenever applicable, have a national role in developing and maintaining infrastructure networks in their specific service area. The Platforms and Units should interact with other national infrastructures as well as relevant local core facilities across the country.

SciLifeLab Platforms and Units should participate in international networks, including EU networks and infrastructures (e.g., European Strategy Forum on Research Infrastructures (ESFRI), European Molecular Biology Laboratory (EMBL), and European Bioinformatics Institute (EMBL-EBI) and other global partners to sustain a cutting-edge, internationally competitive development.

Reporting

SciLifeLab Platforms and Units must report to the MG annually and upon request. The yearly report normally includes project deliveries, number of users and their national distribution, quality and efficacy metrics for data production, publications, financial report, and budget for the coming year. The financial report should contain complete financial information for the Unit including national funds, funds for drug discovery and development, Strategic Research Area (SFO)-funding, VR, KAW and additional funding and user fees. This information should be extracted from the Host University’s financial system twice a year by an economist at the Host Department and/or Host University. Every Host University has an appointed SciLifeLab Financial Coordinator that is responsible for coordinating all SciLifeLab financial reporting at their University. The Financial Coordinator is responsible for delivering the financial reporting to KTH in a predefined format. Reported deliverables will be used in the annual reports to the Ministry of Education and Research, as well as in other web-based or printed material that describes SciLifeLab activities.

For the major evaluation of the Infrastructure every fourth year, more detailed evaluation material and future plans will be requested. This will include general descriptions of Platforms and Units (e.g. instruments, staff, service etc.), SWOT analysis, benchmarking and operational plans (incl. four-year budget).

Units with phased-out funding from SciLifeLab or under reorganization should report during their first year of phasing out.

Agreements

Agreement between SciLifeLab and Infrastructure Units. All SciLifeLab Units are organized under a department (or sometimes several departments) at a Swedish university. To clarify funding conditions and the responsibilities of the department and SciLifeLab respectively, SciLifeLab will provide an agreement to be signed by the Head of Department, the Head of Unit, the SciLifeLab Director, and the SciLifeLab Infrastructure Director. The agreements only need to be signed with departments receiving direct national funding from SciLifeLab. The departments should ensure that the personal research funding of the scientists operating the Units is kept separate from the infrastructure funding. Thus, infrastructure funding cannot be used to support the research funding of PD, HU, PSD or Unit staff. Conversely, research funding of the of the PD, HU or PSD should not be applied to back up salaries if the Infrastructure Unit is subject to phase-down or loses other infrastructure funding.

Agreement between Infrastructure Units and Users. SciLifeLab Units should prepare and employ User Agreements. The agreements should specify the conditions, responsibilities for each party, estimated fees, and timelines. In User Agreements, Units must include writing to collect consent to process personal data in accordance with GDPR. Consent must also be given to cover the presumption that any user is a user of SciLifeLab as a national infrastructure and data, such as project specific information, is collected to serve that purpose, and therefore may be shared with other platforms. User agreements should be prepared in consultancy of the legal department of the Unit´s Host University.

Other agreements. Agreements that concern national VR-funded infrastructures that substantially overlap with SciLifeLab funded Platforms/Units, need to be discussed with the Infrastructure Director and the Management Group to clarify mandate and responsibility of potential steering groups. Unless otherwise agreed, the SciLifeLab Management Group and Board are fully responsible for strategic decisions of the Unit.

Principles for Publications

When SciLifeLab Infrastructure staff make significant intellectual contributions to research, the persons involved should be included as co-authors in accordance with the Vancouver principles. For all other publications that are the result of the use of routine infrastructure services, SciLifeLab Unit(s) should be included in the acknowledgment section of the paper. The Units should actively encourage users to undertake such acknowledgements.

Freedom to operate and non-competition

SciLifeLab expects that the Infrastructure Platforms and Units can provide the services to its users without interfering with commercial interests and with companies providing similar services. Freedom to operate and non-competition are particularly critical when providing full-cost services to industry and healthcare.

Conflicts of Interest

Infrastructure staff and Platform Management Group members should avoid personal conflicts of interest e.g. being involved in companies providing instruments, equipment or reagents to the Infrastructure Units. Infrastructure staff can be engaged in external activities according to permissions from the Host University. These may include spin-off companies arising out from the SciLifeLab Infrastructure, which should be carefully structured not to act in a competitive manner. Infrastructure staff must disclose to the SciLifeLab Infrastructure Director any such potential conflicts of interest.

Scientific and Infrastructure Misconduct

If there is a suspicion of scientific misconduct either by SciLifeLab Infrastructure users or by the staff, the suspicion should be disclosed according to the practices of the Host Universities involved. The PD and the SciLifeLab Infrastructure Director should also be notified, and MG should be made aware of each such case. The Host Universities are in charge of investigating whether there is evidence of scientific misconduct as well as potential consequences and should keep the SciLifeLab MG well informed of the progress of the investigation. In exceptional documented cases of misconduct, infrastructure funding to a Unit may be discontinued based on a Board decision without an 18-month grace period.

Updates and Changes

The SciLifeLab Management Group and Board reserves the right to change and make additions to this document at any time, and such changes or modifications shall be effective after being discussed with the Host University SciLifeLab committees and communicated to the Platforms, Units and Host Departments.

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Appendix I.

Platform Specific Terms and Conditions for Funding

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Platform Specific

Terms and Conditions for Funding

(Preliminary version)

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Bioinformatics

This document concerns the terms and conditions for SciLifeLab funding of the Bioinformatics Platform and Units from 2021 and onwards. The mid-term checkup in the middle of the 4-year funding period will focus on how well the Platform and Units have taken into account the following items:

- Ensure that SciLifeLab funds are used in the platform in a manner that will align with the priorities and goals of the entire SciLifeLab organization
- Provide resources within the SciLifeLab platform funding to engage in the SciLifeLab capabilities, integrating data and know-how from several different platforms
- Require supported projects to commit to FAIR data sharing
- Together with the SciLifeLab management suggest a platform governance and steering structure in line with the general policy for SciLifeLab platforms and the NBIS consortium agreement
- Brand itself in line with the SciLifeLab policy on platform branding, while taking into account that the Platform is funded from multiple sources
- Work as an integral part of the SciLifeLab infrastructures, facilitating the combination of technology-driven and data-driven research services
- Contribute to the Spatial and Single Cell Biology capability with resources from BioImage Infromatics Unit
- Support projects with data produced at SciLifeLab, and in mining existing datasets that can feed validation projects for the laboratory infrastructure, to a degree that matches the SciLifeLab platform funding
- Dedicate one responsible contact person for each SciLifeLab laboratory platform to jointly improve user consultation and support
- When needed, participate in user planning meetings together with the laboratory platforms to evaluate project feasibility, improve study design, and promote data sharing
- Collaborate with the Data Centre to enable good data management practices according to the Open Science and FAIR principles for users of the SciLifeLab infrastructures
- Contribute to the planned concept of SciLifeLab national nodes at non-host universities, where multiple platforms can integrate their national actions and links to the national SciLifeLab organization as well as to the local user base and local infrastructures
- Aid the Data Centre and SNIC/SUNET to develop a prospective plan for the storage and compute requirements, needed by the life science users, at SNIC/SUNET and other sites for high-performance computing

- Provide the necessary infrastructure for sensitive human data storage, e.g. EGA-SE, to support translational and clinical research, clinical diagnostics, and health data mining, enabling the necessary support for the Swedish participation in the European 1+ Million Genome project (1 + MG)

- Together with the SciLifeLab management and the DDLS steering group develop a plan for the use of AI and machine learning as part of the bioinformatics platform and for the SciLifeLab infrastructures as a whole

- Aid the research community as a whole to carry out data-driven mining of existing data sets and resources, to build data-driven hypotheses, and to promote efficient usage of SciLifeLab wet lab infrastructures to validate these

- Continue to be a key driver in providing advanced training and Ph.D./post-doc course work at SciLifeLab and in collaboration with the DDLS training initiatives

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Genomics

This document concerns the terms and conditions for SciLifeLab funding of the Genomics Platform and Units from 2021 and onwards and also outlines the strategic direction and vision MG wants the Genomics platform to take. The mid-term checkup in the middle of the 4-year funding period will focus on how well the Platform and Units have taken into account the items in this document.

- Use SciLifeLab funding to the Genomics Platform for providing nationally important technologies and services within genomics, including services from the National Genomics Infrastructure (NGI), Ancient DNA and Microbial Single Cell Genomics units
- Focus on providing services that are in high demand by the Swedish research community and not commonly available from other providers, such as comprehensive support for study design and quality control, customization of services, long reads, epigenetics, and integrated multi-omics analysis.
- Ensure that SciLifeLab funds are used in the platform in a manner that aligns with the priorities and goals of the entire SciLifeLab organization
- Together with the SciLifeLab management provide a clear platform governance and steering structure according to the *SciLifeLab Infrastructure General Terms and Conditions for Funding*
- Provide access to high quality genomics services to other SciLifeLab platforms.
- Contribute to cross-platform SciLifeLab capabilities in precision medicine, biodiversity, pandemic preparedness, and others
- Coordinate, develop and provide services within single cell sequencing and spatial biology together with the Spatial and Single Cell Biology platform
- Collaborate with the Clinical Genomics platform with regard to e.g. technology development and evaluation, sample handling, and data and automation pipelines.
- Coordinate and integrate NGI functions between Stockholm and Uppsala
- Take art in large-scale national research efforts as a partner and collaborator, contractor, or service provider.
- Promote that recipients of platform services handle their data in accordance to FAIR principles, and direct them to other resources for assistance when appropriate.
- Plan and develop efforts as a key partner and data producer within the DDLS program.
- Collaborate with the Bioinformatics platform and Data Centre in a way that aligns with the technology- and data driven operations at SciLifeLab.

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- Inform the Swedish research community about established and novel genomics technologies. Engage with the research community to inquire about the needs regarding technology and training about genomic technologies.
- Support the generation of high-quality genomics data enabling publication in internationally competitive journals.
- Be actively involved in developing national SciLifeLab nodes at each non-host university, primarily built around the Clinical Genomics, Bioinformatics, Spatial and Single Cell Biology and Genomics platforms, along with DDLS activities and WCMM centers

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Clinical Genomics

This document concerns the terms and conditions for SciLifeLab funding of the Clinical Genomics Platform and Units from 2021 and onwards and also outlines the strategic direction and vision MG wants the Clinical Genomics Platform to take. As a help to follow and measure the progress towards the vision, a separate document outlining specific KPIs for the Clinical Genomics platform has been established (Appendix 1). The mid-term checkup in the middle of the 4-year funding period will focus on how well the Platform and Units have taken into account the items in this document.

- SciLifeLab funding to the Clinical Genomics Platform and Units is meant for:

  i) collaboration and coordination of Clinical Genomics Units at a national level

  ii) providing state-of-the-art genomic services for translational research and clinical trials

  iii) adapting and implementing genomic technologies into clinical utility

  iv) training and education

  vi) achieving data sharing
- The platform should actively contribute towards the Government's ambition of making Sweden a leading life science nation
- As a translational Platform with Units at all medical faculties, maintain important links between SciLifeLab, Genomic Medicine Sweden, healthcare, and biobanks, both at national and regional level
- Together with the Clinical Proteomics and Immunology platform and other platforms promote a *globally leading capability for Precision Medicine and Biomarker Discovery* at SciLifeLab. The capability should be built on and take advantage of existing national initiatives, e.g., Genomic Medicine Sweden.
- The platform is expected to play an important role in the development of *Laboratory Capabilities for Pandemic Preparedness*, where an important priority is data sharing and data availability of the pandemic in a real-time manner and shared to the public domain
- The platform as well as the SciLifeLab Precision Medicine capability should be closely integrated and engaged in the planned DDLS activities on precision medicine and diagnostics as well as in infection biology and epidemiology
- Together with other platforms, Data Centre and SciLifeLab centrally, support approaches for data sharing for research and society purposes, including more sensitive, clinical data. Also, efforts should be made to promote all users of the Clinical Genomics Platform to have patient consents and ethical permissions for data sharing.
- Substantially enhance the collaboration and synergies with the Genomics platform in technology development and adaptation of new methods for translational research and clinical diagnostics
- Be actively involved in developing national SciLifeLab nodes at each non-host university, primarily built around the Clinical Genomics, Bioinformatics, Spatial and Single Cell Biology and Genomics platforms, along with DDLS activities and WCMM centers

Clinical Proteomics and Immunology

This document concerns the terms and conditions for SciLifeLab funding of the Clinical Proteomics and Immunology Platform and Units from 2021 and onwards and also outlines the strategic direction and vision MG wants the Genomics platform to take. The mid-term checkup in the middle of the 4-year funding period will focus on how well the Platform and Units have taken into account the items in this document.

- SciLifeLab funding to the Clinical Proteomics and Immunology Platform and Units is meant for providing nationally unique clinical proteomics services with a focus on immuno-monitoring of people and patients
- Ensure that SciLifeLab funds are used in the platform in a manner that aligns with the priorities and goals of the entire SciLifeLab organization
- Define how to integrate the services under the new platform and the added value to the users.
- Together with the SciLifeLab management suggest a clear platform governance and steering structure according to the general *SciLifeLab Infrastructure Terms and Conditions for Funding* document
- Provide resources to engage in the SciLifeLab capabilities, integrating data and know-how from several different platforms
- Require supported projects to commit to FAIR data sharing
- Integrate functions and coordination between the Affinity Proteomics units in Stockholm and Uppsala.
- Contribute to the Precision Medicine and Biomarker Discovery capability, working together with the Clinical Genomics platform, GMS, biobanks, Metabolomics platform and the Bioinformatics platform.
- The platform is expected to play an important role in the development of the *Laboratory Capabilities for Pandemic Preparedness*.
- Enhance collaboration with Bioinformatics and Data Centre on promoting integration of technology and data-driven services, as well as integration of healthcare data.
- Contribute in data production for the DDLS program (precision medicine and diagnostics) with focus on data sharing.

Metabolomics

This document concerns the terms and conditions for SciLifeLab funding of the Metabolomics Platform and Units from 2021 and onwards and also outlines the strategic direction and vision MG wants the platform to take. The mid-term checkup in the middle of the 4-year funding period will focus on how well the Platform and Units have taken into account the items in this document.

- SciLifeLab funding to the Metabolomics Platform and Units is meant for providing nationally unique technologies and services within metabolomics and exposomics
- Ensure that SciLifeLab funds are used in the platform in a manner that aligns with the priorities and goals of the entire SciLifeLab organization
- Together with the SciLifeLab management suggest a clear platform governance and steering structure according to the suggested general policy for governance and steering of SciLifeLab infrastructure
- Integrate and support the establishment of Exposomics as a new Pilot Unit to be evaluated again in 2022
- Enhance collaboration and coordination between the Metabolomics nodes at Umeå and Chalmers to optimize guidance and service offerings to users
- Contribute to cross-Platform and -Unit use with e.g. the Clinical Proteomics and Immunology platform and the Swedish NMR Centre at GU and UU
- Contribute to the Precision Medicine and Biomarker Discovery Capability
- Enhance collaboration with the Bioinformatics platform and Data Centre to establish FAIR data sharing and links to the DDLS initiative, as well as integration of healthcare data

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Single Cell and Spatial Biology

This document concerns the terms and conditions for SciLifeLab funding of the Single Cell and Spatial Biology Platform and Units from 2021 and onwards and also outlines the strategic direction and vision MG wants the platform to take. The mid-term checkup in the middle of the 4-year funding period will focus on how well the Platform and Units have taken into account the items in this document.

- SciLifeLab funding to the Single Cell and Spatial Biology Platform and Units is meant for providing advanced, nationally unique, and integrated services combining single cell and spatial biology and keep Sweden in the forefront of technologies in these areas
- Ensure that SciLifeLab funds are used in the platform in a manner that aligns with the priorities and goals of the entire SciLifeLab organization
- Together with the SciLifeLab management suggest a clear platform governance and steering structure according to the suggested general policy for governance and steering of SciLifeLab infrastructure.
- Integrate and support the establishment of the Advanced FISH Technologies as a new Pilot Unit to be evaluated in 2022
- We suggest the ECSG Unit should focus on i) continued technology leadership, adaptation, and dissemination, ii) setup of a national network and iii) integrating its functions and services with the spatial biology capabilities as part of the platform. The platform should also continue its own single cell services in collaboration with the Genomics platform, which will also be active in national single cell services. Good coordination is essential here.
- Contribute to cross-platform capabilities such as the spatial biology itself as well as the precision medicine / diagnostics capability
- Contribute to the national SciLifeLab nodes formed on the backbone of Bioinformatics, Genomics and Clinical Genomics. Incorporate single cell / spatial biology capability.
- Take a lead in developing national training in single cell and spatial biology and promote transfer of technologies to local facilities and networks
- Enhance collaboration with Bioinformatics platform and Data Centre to provide each user a bioinformatics services on one side, and a data sharing responsibility and links to the DDLS initiative on the other

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Cellular and Molecular Imaging

This document concerns the terms and conditions for SciLifeLab funding of the Cellular and Molecular Imaging Platform and Units from 2021 and onwards and also outlines the strategic direction and vision MG wants the platform to take. The mid-term checkup in the middle of the 4-year funding period will focus on how well the Platform and Units have taken into account the items in this document.

- SciLifeLab funding to the Cellular and Molecular Imaging Platform and Units is meant for providing nationally unique technologies and services within advanced light and electron microscopy and cryo-EM services
- Ensure that SciLifeLab funds are used in the platform in a manner that aligns with the priorities and goals of the entire SciLifeLab organization
- Together with the SciLifeLab management suggest a clear platform governance and steering structure according to the suggested general policy for governance and steering of SciLifeLab infrastructure.
- Focus on integrating CAT and FIB-SEM technologies at GU and UmU units in the overall platform service offerings
- Launch a coordinated Cryo-EM National Grid Screening Network with personnel stationed at the universities in Lund (LU), Gothenburg (GU), Uppsala (UU), and Karolinska Institutet (KI).
- Expand services in cellular Cryo-tomography and FIB-SEM technologies which will provide a bridge to structural biology and cell biology.
- Establish a network with local Imaging Core Facilities at universities across the country. Take a national responsibility to organise courses and workshops keeping Sweden nationally in the forefront of imaging technologies.
- Contribute to cross-platform capabilities, e.g. Integrated Structural Biology (particle Cryo-EM), Precision Medicine and Biomarker Discovery
- Enhance collaboration with the Bioinformatics platform and Data Centre to establish FAIR data sharing and links to the DDLS initiative

Integrated Structural Biology

This document concerns the terms and conditions for SciLifeLab funding of the Integrated Structural Biology Platform and Units from 2021 and onwards and also outlines the strategic direction and vision MG wants the Genomics platform to take. The mid-term checkup in the middle of the 4-year funding period will focus on how well the Platform and Units have taken into account the items in this document.

- SciLifeLab funding to the Integrated Structural Biology Platform and Units is meant for providing nationally unique technologies and services within structural biology
- Ensure that SciLifeLab funds are used in the platform in a manner that aligns with the priorities and goals of the entire SciLifeLab organization
- Provide resources to engage in the SciLifeLab capabilities, integrating data and know-how from several different platforms
- Together with the SciLifeLab management define an organization, governance and steering for the platform, with representation also from MAX IV and ESS, according to the suggested general policy for governance and steering of SciLifeLab infrastructure
- Coordinate the service area *Integrated Structural Biology* in collaboration with Cryo-EM, MAX IV, ESS, the national protein production network, and other relevant stakeholders.
- Form a single/central entry point for structural biology questions, especially addressing non-expert users and contribute to the construction of the new SciLifeLab infrastructure web page for guiding users
- Collaborate with the InfraLife initiative at the External Relations Offices at SciLifeLab and MAX IV/ESS and contribute in outreach activities towards industry and health care users
- Enhance collaboration with the Bioinformatics platform and Data Centre to establish FAIR data sharing and links to the DDLS initiative

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Chemical Biology and Genome Engineering

This document concerns the terms and conditions for SciLifeLab funding of the Chemical Biology and Genome Engineering Platform and Units from 2021 and onwards and also outlines the strategic direction and vision MG wants the platform to take. The mid-term checkup in the middle of the 4-year funding period will focus on how well the Platform and Units have taken into account the items in this document.

- SciLifeLab funding to the Chemical Biology and Genome Engineering Platform and Units is meant for providing nationally unique technologies and services within chemical biology, chemical proteomics and CRISPR-based functional genomics
- Ensure that SciLifeLab funds are used in the platform in a manner that aligns with the priorities and goals of the entire SciLifeLab organization
- Together with the SciLifeLab management suggest a clear platform governance and steering structure according to the suggested general policy for governance and steering of SciLifeLab infrastructure.
- Create a plan for the development and integrated services for the new platform in the next four-year period, involving the research community, considering renewal at the international cutting edge with e.g. information management. For example, information management at all levels is essential in order to reach to the level of data-driven SciLifeLab operation.
- Consider how CBGE can join the set-up of cross-platform capabilities, such as pandemic preparedness, precision medicine and biomarker discovery and integrated structural biology.
- The platform, and in particular CBCS, should further strengthen links with the DDD platform and improve the ability to feed projects for the DDD. Work on things that are not part of the DDD; but also acquire capabilities from DDD for chemical biology work.
- CBCS should continue to provide multidisciplinary approaches for chemical biology studies of biological processes as well as for target identification and mechanism of action determination of drugs. The services should make use of the HTGE and Chemical Proteomics Units in a coordinated fashion.
- When CBCS is applying to VR infra funding, please consider how to best distinguish the SciLifeLab and VR funded components. Platforms can be jointly funded, but SciLifeLab funds should not be used to simply co-fund VR infrastructure activities (or vice versa). There will need to be a good and logical role for both funds that can support each other, but not directly overlap.
- In collaboration with the Bioinformatics platform and Data Centre, continue to develop chemoinformatics and data-driven capabilities, such as open science and FAIR data bases
- Consider interactions with external sites and strategic partnerships, such as with SGC Stockholm node, EU-ESFRI programs, etc

Drug Discovery and Development

This document concerns the terms and conditions for SciLifeLab funding of the Drug Discovery and Development Platform and Units from 2021 and onwards and also outlines the strategic direction and vision MG wants the Drug Discovery and Development platform to take. The mid-term checkup in the middle of the 4-year funding period will focus on how well the Platform and Units have taken into account the items in this document.

- Continue DDDs core objective “Turn academic ideas into innovations”
  - Develop DDD into a national drug discovery innovation hub
- Assure that DDD offers state of the art drug discovery technologies and training to Swedish researchers
  - Optimize throughput of DDD related ideas and output of deliverables (prototype drugs based on small molecules, antibodies, oligonucleotides, and other modalities)
  - Implement Oligonova HUB at Göteborg University as an integrated part of the DDD platform in a way that allows development of therapeutic oligonucleotide programs
- In accordance with SciLifeLab Roadmap 2021–2030,”build translational capabilities” for drug discovery projects
  - Work towards a closer collaboration with the Swedish innovation system in projects that aim to develop new therapeutics
- Make use of DDDs legal agreement to promote public-public and public-private partnerships as a mean to increase overall budget and critical mass
  - Consider interactions with external sites and strategic partnerships, such as with SGC-Stockholm node, EU-ESFRI programs, etc.
- Ensure that SciLifeLab funds are used in the platform in a manner that will align with the priorities and goals of the entire SciLifeLab organization, specifically for DDD:
  - Be responsible for SciLifeLab´s DDD capability
  - Help build SciLifeLab´s translational capabilities (as defined in point 3 above)
- Provide resources to engage in the SciLifeLab capabilities, integrating data and know-how from several different platforms
- In collaboration with the CBGE platform, the Bioinformatics platform and Data Centre, continue to develop chemoinformatics and data-driven capabilities, such as open science and FAIR data bases for drug discovery and chemical biology related data
- Consider the financial basis and long-term sustainability for drug discovery by alternative models of operations. In collaboration with MG and OO investigate the possibility to generate income by revenue share to expand the platform. Driven by MG and OO, this could eventually make a systems transformation concerning sustainable of infrastructures in Sweden

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Appendix J.

Infrastructure Report 2020

Content

Infrastructure Organization 2020

During 2020, the SciLifeLab infrastructure was organized into seven platforms as shown below.

Please note that the infrastructure was re-organized in 2021 (the new organization is described in *Section* 7.3 in the main IAB report), and hence, names and organization of platforms and units for 2020 may differ from the new ones.

Bioinformatics
- Compute and Storage [U]
- Long-term Support [G, Li, Lu, S, U, Um]
- Support and Infrastructure [G, Li, Lu, S, U, Um]
- Systems Biology [G]

Cellular and Molecular Imaging
- Advanced Light Microscopy [S]
- BioImage Informatics [U]
- Cell Profiling [S]
- Cryo-EM [S, Um]
- Swedish NMR Centre [G, Um]

Chemical Biology and Genome Engineering
- Chemical Biology Consortium Sweden [S, Um]
- Genome Engineering Zebrafish [U]
- High Throughput Genome Engineering [S]

Diagnostics Development
- Clinical Genomics Gothenburg [G]
- Clinical Genomics Linköping [Li]
- Clinical Genomics Lund [Lu]
- Clinical Genomics Stockholm [S]
- Clinical Genomics Umeå [Um]
- Clinical Genomics Uppsala [U]
- Clinical Genomics Örebro [Ö]

Drug Discovery and Development
- ADME (Absorption, Distribution, Metabolism, Excretion) of Therapeutics [U]
- Biochemical and Cellular Assay [S]
- Biophysical Screening and Characterization [U]
- Human Antibody Therapeutics [Lu, S]
- In Vitro and Systems Pharmacology [U]
- Medicinal Chemistry – Hit2Lead [S]
- Medicinal Chemistry – Lead Identification [U]
- Protein Expression and Characterization [S]

Genomics
- Ancient DNA [U]
- Eukaryotic Single Cell Genomics [S]
- In Situ Sequencing [S]
- Microbial Single Cell Genomics [U]
- National Genomics Infrastructure [S, U]

Proteomics and Metabolomics
- Autoimmunity and Serology Profiling [S]
- Chemical Proteomics [S]
- Mass Cytometry [Li, S]
- PLA and Single Cell Proteomics [U]
- Proteogenomics [S]
- Swedish Metabolomics Centre [Um]
- Translational Plasma Profiling [S]

G - Gothenburg
Li - Linköping
Lu - Lund
S - Stockholm
U - Uppsala
Um - Umeå
Ö - Örebro

Infrastructure Funding 2020

The total direct funding from SciLifeLab to the infrastructure platform operations was 191 MSEK for 2020. In addition to SciLifeLab support and income via user fees (amounting 223 MSEK in 2020), the infrastructure units also received funding from their host universities, the Swedish research council (VR), and KAW, among others. The total funding in 2020 (user fees not included) supporting the entire infrastructure was ca. 407 MSEK.

The distribution of the total funding sources to the infrastructure in 2020 is given in *Figure* 1.

In *Figure* 2, the distribution of total funding 2020 is presented across the SciLifeLab reporting units.

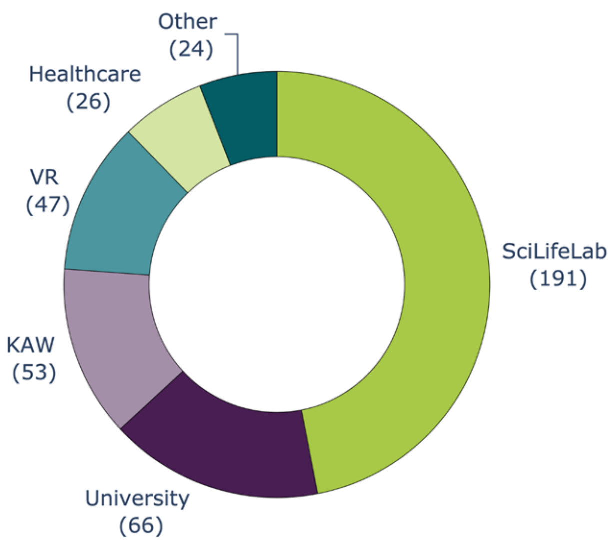


Figure 1. Distribution of total funding sources to the SciLifeLab infrastructure in 2020, excluding user fee income (MSEK).

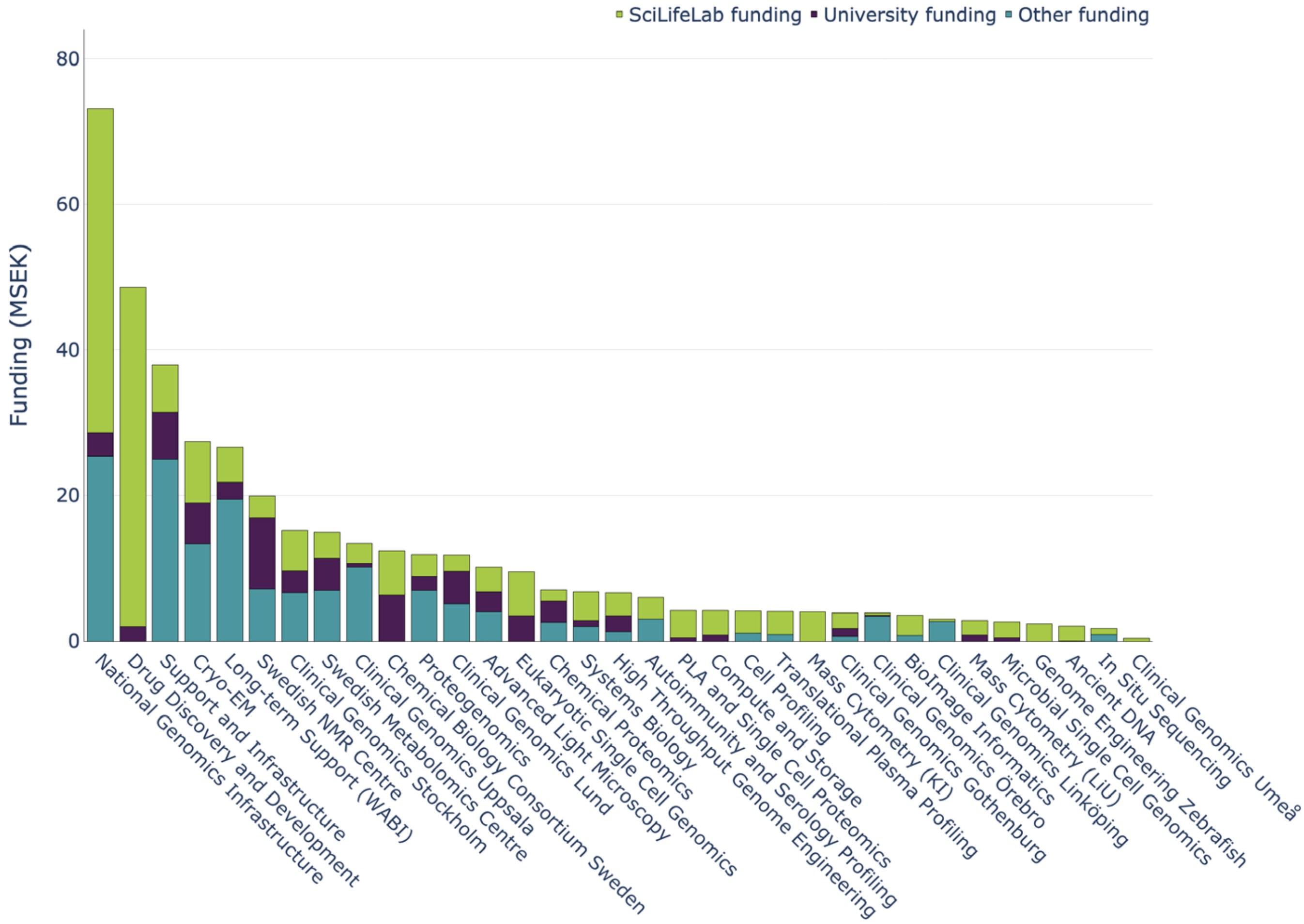


Figure 2. Distribution of total funding across SciLifeLab units in 2020. Funding for DDD is shown at the platform level.

Infrastructure Statistics and Metrics for 2020

In 2020, there were over 1,300 individual academic users of the SciLifeLab infrastructure, and the distribution of users based on the affiliation of the PI is shown in *Figure* 3. In addition to the users included in *Figure* 3, the bioinformatics unit Compute and Storage in Uppsala reported 883 active user accounts spread across Sweden that have utilized the data storage and computing capacities that the unit provides.

The infrastructure also provides services to users in non-academic sectors (healthcare, industry, and governmental organizations). Based on the total infrastructure FTE resources during 2020, 84% were spent on academic user projects, 12% on healthcare projects, 2% on industry projects, and 2% on projects from other governmental organizations. Distribution of user affiliation (including healthcare and industry sectors) across infrastructure units is illustrated in *Figure* 4.

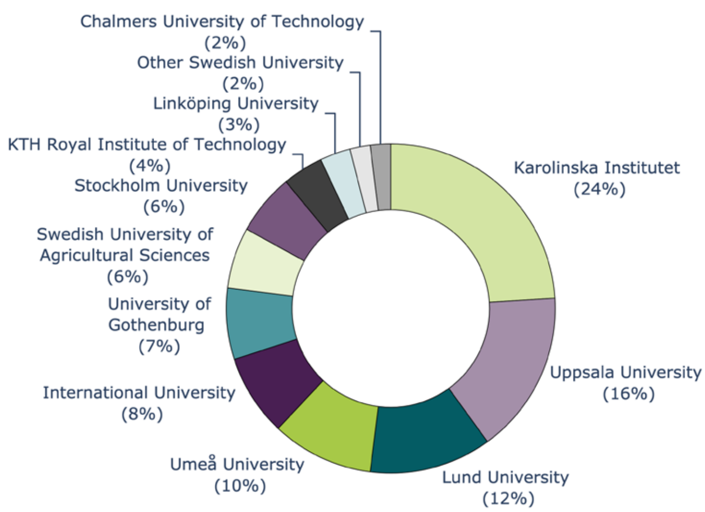


Figure 3. Academic user distribution 2020 based on affiliation of individual PIs.

Figure 4. Distribution of users 2020 from universities, healthcare, industry, and governmental organizations across all SciLifeLab infrastructure units. The size of the circles corresponds to the number of users.

Training and Courses

The SciLifeLab infrastructure actively engages in education and training of researchers nationally. Technology-focused SciLifeLab training oppotunities are currently being offered at UU, KI, UmU, SU, LiU, GU and LU. During the pandemic, most training activities were organized remotely or postponed to 2021. Overall, during 2019–2020, SciLifeLab organized or contributed to, a total of 178 major training events at undergraduate and post-graduate levels, with participants representing all major Swedish universities. In *Figure* 5, the number and geographical distribution of major training events organized by SciLifeLab 2019–2020 are presented.

Of the training efforts described above, 14 per year got support from SciLifeLab centrally via a course-package call that was launched in 2018. The supported events included courses and workshops within spatial proteomics, chemical proteomics, cryo-electron microscopy, drug development, and single cell genomics. In addition, as the need for analytical support due to increasing data production has grown tremendously, SciLifeLab has since 2013 offered centrally supported course packages focusing specifically on bioinformatics and handling of data.

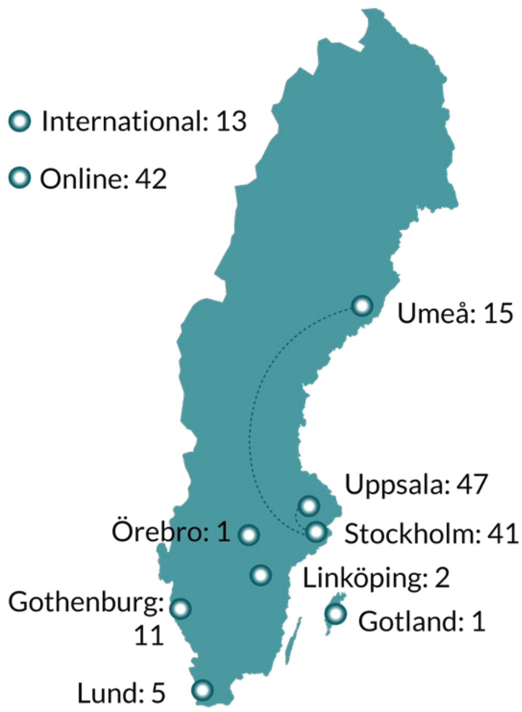


Figure 5. Number and geographical distribution of training events organized by SciLifeLab infrastructure 2019–2020. Dotted lines show co-organized courses at different sites.

Statistics and Metrics for Individual Infrastructure Units 2020

In the following pages basic information, statistics, and deliverables for 2020 are summarized for each of the SciLifeLab infrastructure units. The material is primarily based on the annual reporting from the units for 2020 and the SciLifeLab Publication Database. The units are presented platform-wise according to the infrastructure organization 2020.

Explanations

- **Basic information:** Facility Directors (from 2021 entitled Platform Scientific Directors), Heads of Facilities (from 2021 entitled Heads of Units) and FTE resources during 2020.
- **Resource allocation 2020:** Estimated distribution of total FTE resources spent on different user categories.
- **User Fees 2020:** Total amount of user fees, and estimated distribution of cost categories covered by the user fees.
- **User fees by sector:** Distribution of user fee income from different user categories.
- **Services:** A short description of services and technologies provided.
- **Users 2020:** Distribution of unique individual users during 2018 based on PI user affiliation.
- **Publications:** Total number of publications 2018–2020
- **Publications by category:** Service: infrastructure unit mentioned in acknowledgement; Collaborative: infrastructure staff as co-author; Technology Development: infrastructure staff as main author.
- **Publication by Journal Impact Factor:** The Journal Impact Factors for 2020 were used for all analyses.

Abbreviations

Akademiska sjukhuset	University Hospital, Uppsala
ALF	County Council funding
EPF	The Ehrling-Persson Family Foundation
FTE	Full Time Equivalent
GU	University of Gothenburg
KAW	Knut and Alice Wallenberg Foundation
KI	Karolinska Institutet
KTH	Royal Institute of Technology (Kungliga tekniska högskolan)
LiU	Linköping University
LU	Lund University
NRM	Naturhistoriska riksmuseet (Swedish Museum of Natural History)
Sahlgrenska	Sahlgrenska University Hospital, Gothenburg
SLL	Stockholms Läns Landsting (Stockholm County Council)
SLU	Swedish University of Agricultural Sciences
SNIC	National center for high-performance computing
SSF	Swedish Foundation for Strategic Research
SU	Stockholm University
UU	Uppsala University
UmU	Umeå University
VR	Vetenskapsrådet (Swedish National Research Council)
VINNOVA	Sweden's Innovation Agency
WABI	Wallenberg Advanced Bioinformatics network (part of the SciLifeLab Bioinformatics network)
ORU	Örebro University

Compute and Storage

Bioinformatics platform

Basic information

Facility director(s): Elisabeth Larsson
Head(s) of facility: Marcus Lundberg
SciLifeLab facility since: 2013
Host university: UU
FTEs: 3.8
FTEs financed by SciLifeLab: 3.0

Funding in 2020 (kSEK)

SciLifeLab: 3400
UU: 800

Total: 4200

Resource allocation 2020

Academia (national): 80%
Academia (international): -
Internal tech. dev.: 20%
Industry: -
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 0

Reagents: -
Instrument: -
Salaries: 100%
Rent: -
Other: -

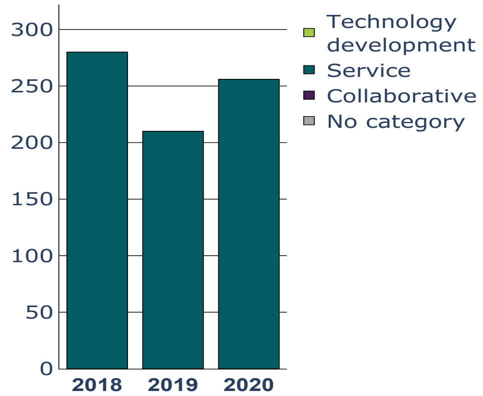
User fees by sector 2020

Academia (national): 100%
Academia (international): -
Industry: -
Healthcare: -
Other gov. agencies: -

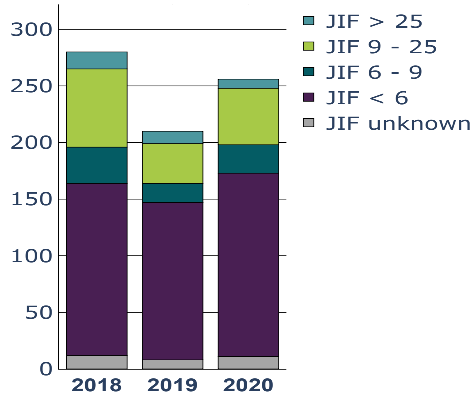
Services

• High-performance computing and storage resources, maintenance of relevant bioinformatics software and data (e.g. reference genomes), and associated user support. The facility is hosted at Uppsala Multidisciplinary Center for Advanced Computational Science (SNIC-UPPMAX), which is Uppsala University's resource forhigh-performance computing and related know-how.

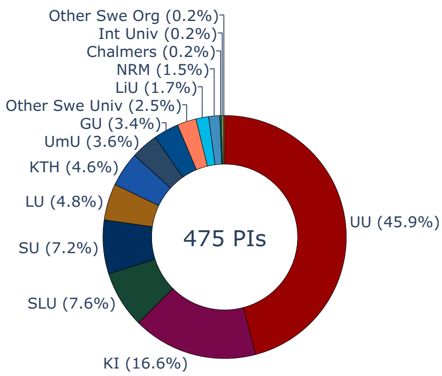
Publication by category



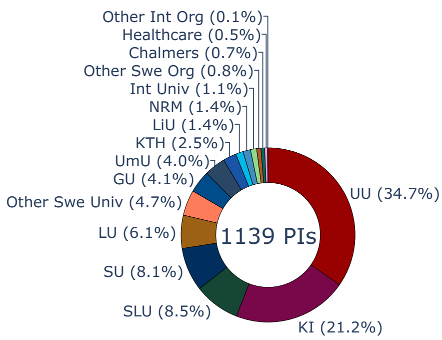
Publication by Journal Impact Factor



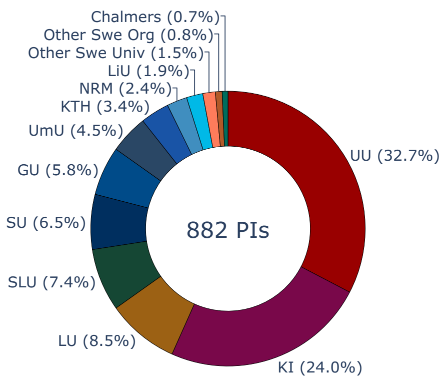
Users 2018



Users 2019



Users 2020



Long-term Support (WABI)

Bioinformatics platform

Basic information

Facility director(s): Gunnar von Hejine, Björn Nystedt
Head(s) of facility: Pär Engström, Björn Nystedt
SciLifeLab facility since: 2013
Host university: SU, UU, LU, UmU, LiU, Chalmers
FTEs: 23.75
FTEs financed by SciLifeLab: 4.5

Funding in 2020 (kSEK)

SciLifeLab: 4800
Chalmers: 300
KAW: 19500
LiU: 300
LU: 600
UmU: 300
UU: 800

Total: 26600

Resource allocation 2020

Academia (national): 95%
Academia (international): -
Internal tech. dev.: 5%
Industry: -
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 0

Reagents: -
Instrument: -
Salaries: -
Rent: -
Other: -

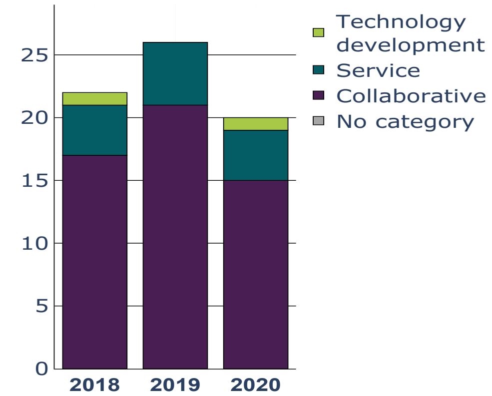
User fees by sector 2020

Academia (national): -
Academia (international): -
Industry: -
Healthcare: -
Other gov. agencies: -

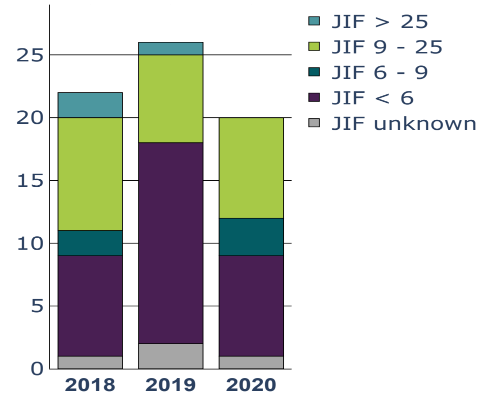
Services

- Bioinformatics support to scientifically outstanding projects selected by peer-review, in genomics, proteomics, metabolomics, epigenetics, spatial/single-cell biology & metagenomics
- Tool development
- Consultations & weekly drop-in sessions
- National & international workshops
- PhD mentorship program

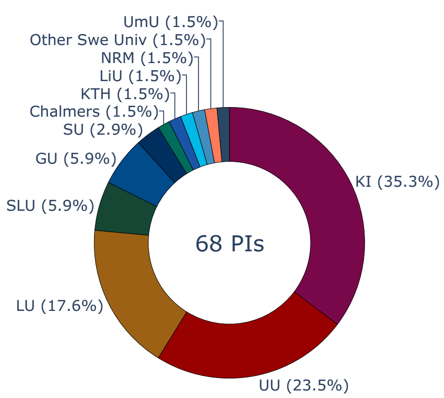
Publication by category



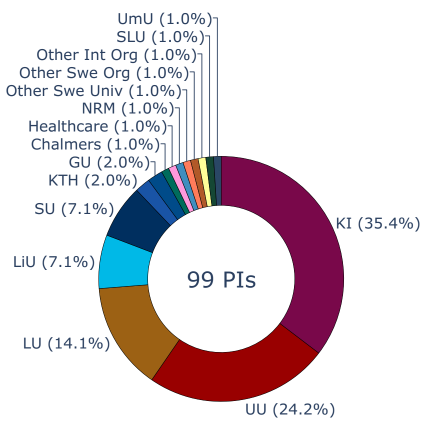
Publication by Journal Impact Factor



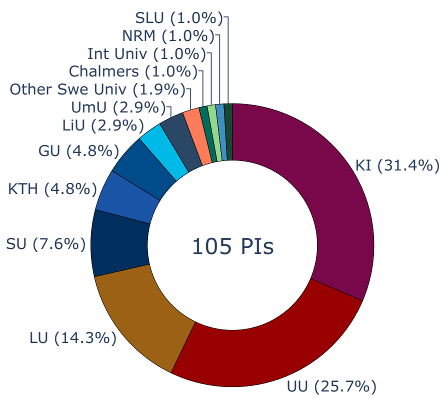
Users 2018



Users 2019



Users 2020



Support and Infrastructure

Bioinformatics platform

Basic information

Facility director(s): Bengt Persson
Head(s) of facility: Jonas Hagberg, Henrik Lantz, Jessica Lindvall
SciLifeLab facility since: 2013
Host university: Chalmers, GU, LiU, LU, KI, KTH, NRM, SLU, SU, UmU, UU
FTEs: 49.6
FTEs financed by SciLifeLab: 7.4

Funding in 2020 (kSEK)

SciLifeLab: 6500
Elixir: 1000
Nordforsk: 2000
Other: 1000
Universities: 6442
VR: 21000

Total: 37942

Resource allocation 2020

Academia (national): 88%
Academia (international): -
Internal tech. dev.: 10%
Industry: -
Healthcare: 1%
Other gov. agencies: 1%

User Fees 2020

Total (kSEK): 6800

Reagents: -
Instrument: -
Salaries: 100%
Rent: -
Other: -

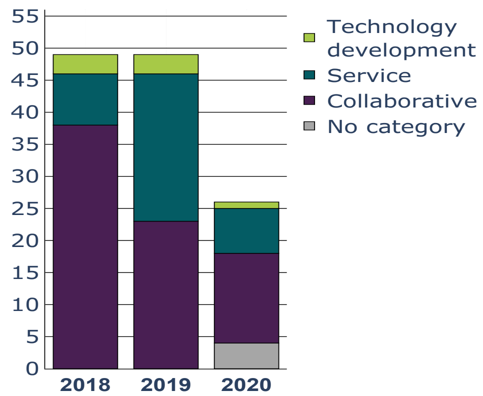
User fees by sector 2020

Academia (national): 90%
Academia (international): -
Industry: -
Healthcare: 8%
Other gov. agencies: 2%

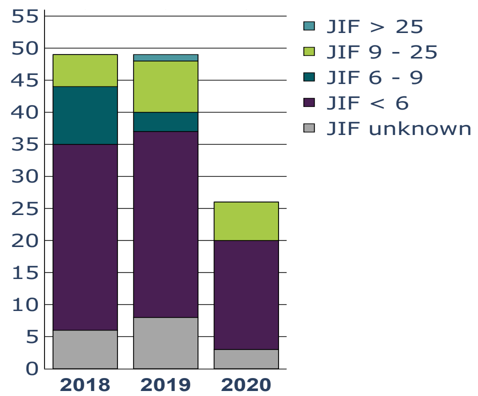
Services

- Drop-in sessions and consultation meetings
- Short- and medium-term support
- Pipeline development
- Infrastructure development and maintenance
- Data management support
- Advanced training at national and international level

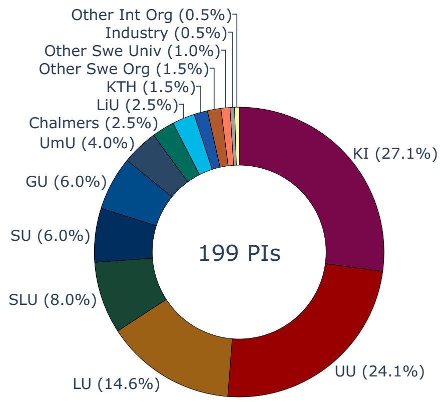
Publication by category



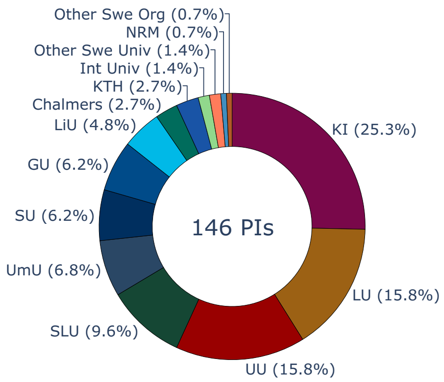
Publication by Journal Impact Factor



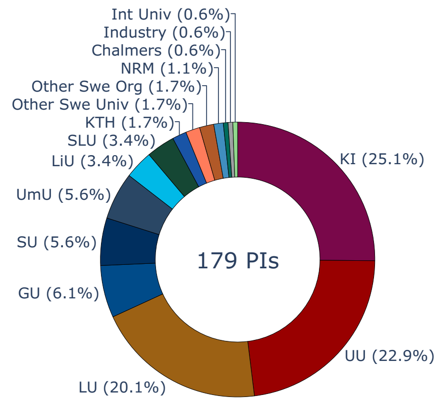
Users 2018



Users 2019



Users 2020



Systems Biology
Bioinformatics platform

Basic information
Facility director(s): Jens Nielsen
Head(s) of facility: Thomas Svensson
SciLifeLab facility since: 2016
Host university: Chalmers
FTEs: 8.0
FTEs financed by SciLifeLab: 3.0

Funding in 2020 (kSEK)
SciLifeLab: 4000
Chalmers: 800
KAW: 2000

Total: 6800

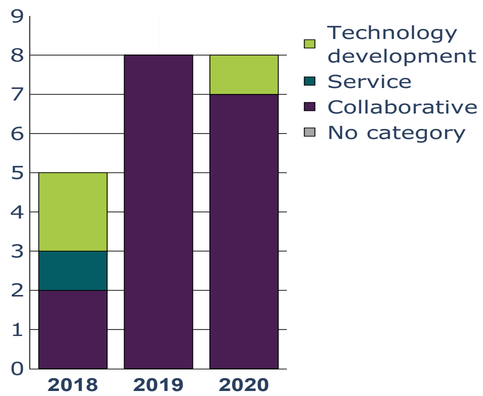
Resource allocation 2020
Academia (national): 77%
Academia (international): -
Internal tech. dev.: 20%
Industry: 3%
Healthcare: -
Other gov. agencies: -

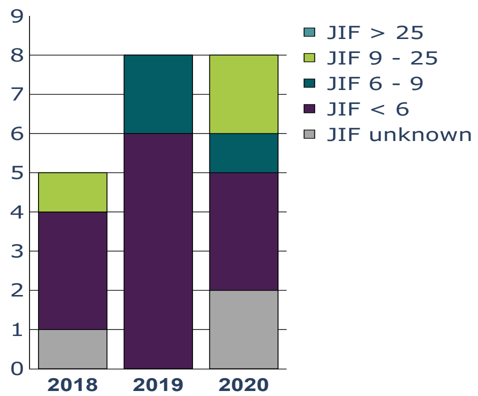
User Fees 2020
Total (kSEK): 1700

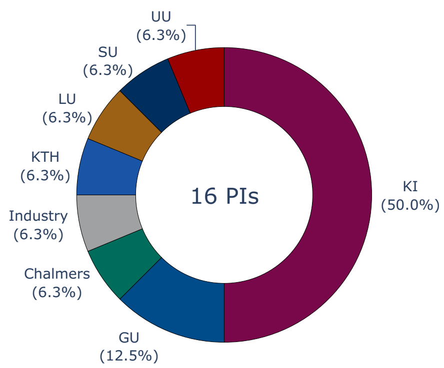
Reagents: -
Instrument: -
Salaries: 100%
Rent: -
Other: -

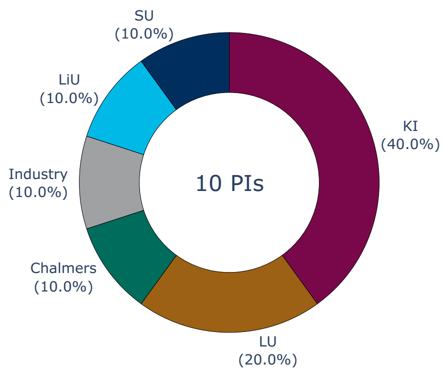
User fees by sector 2020
Academia (national): 97%
Academia (international): -
Industry: 3%
Healthcare: -
Other gov. agencies: -

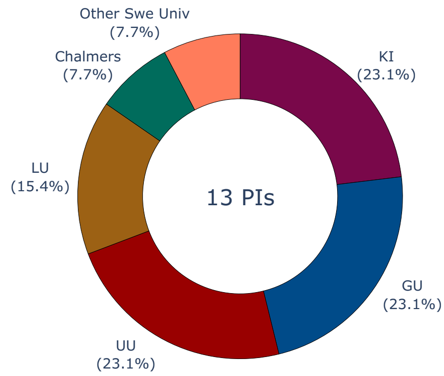
Services
- Bioinformatics long-term support to a limited set of scientifically outstanding projects
- Tool development
- Focus on systems biology projects
- Bioinformatics teaching at national and international workshops

Publication by category


Publication by Journal Impact Factor


Users 2018


Users 2019


Users 2020


Advanced Light Microscopy

Cellular and Molecular Imaging platform

Basic information

Facility director(s): Hjalmar Brismar
Head(s) of facility: Hans Blom
SciLifeLab facility since: 2013
Host university: KTH
FTEs: 4.9
FTEs financed by SciLifeLab: 3.0

Funding in 2020 (kSEK)

SciLifeLab: 3400
KTH: 2800
SSF: 3000
VR: 1000

Total: 10200

Resource allocation 2020

Academia (national): 65%
Academia (international): 5%
Internal tech. dev.: 20%
Industry: 5%
Healthcare: 5%
Other gov. agencies: -

User Fees 2020

Total (kSEK): 200

Reagents: 50%
Instrument: 50%
Salaries: -
Rent: -
Other: -

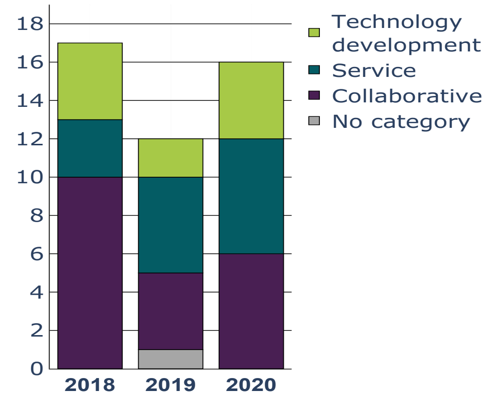
User fees by sector 2020

Academia (national): 100%
Academia (international): -
Industry: -
Healthcare: -
Other gov. agencies: -

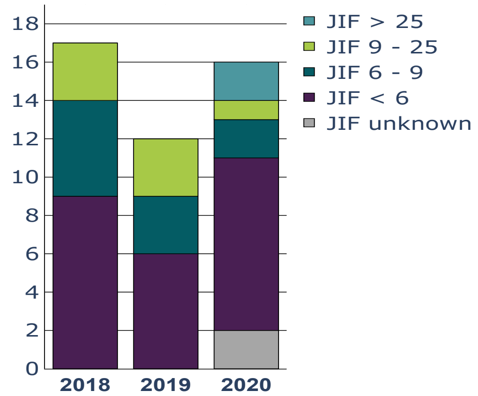
Services

- Nanoscale biological visualization with super-resolution fluorescence microscopy (SIM, STED, PALM/STORM).
- Single molecule dynamical measurement & analysis to evaluate molecular mobilities, concentrations & interactions (FCS/STED-FCS)
- Volumetric imaging of live &/or optically cleared larger samples at unprecedented speed & low phototoxicity (Light-sheet microscopy (LSFM))
- Single cell ultra-fast volumetric imaging of biological processes (Lattice LSFM)

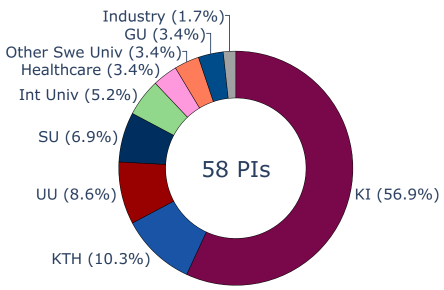
Publication by category



Publication by Journal Impact Factor



Users 2018



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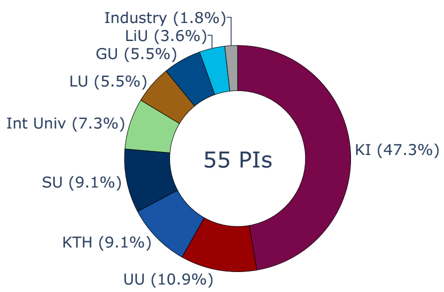
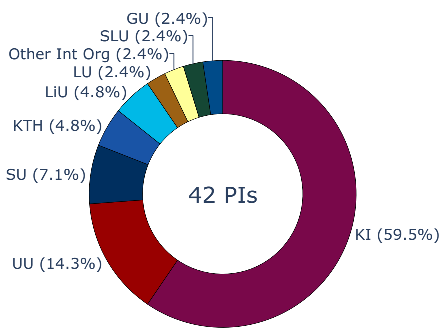


Users 2020



BioImage Informatics

Cellular and Molecular Imaging platform

Basic information

Facility director(s): Carolina Wählby, Kevin Smith
Head(s) of facility: Anna Klemm
SciLifeLab facility since: 2016
Host university: UU, KTH
FTEs: 4.25
FTEs financed by SciLifeLab: 3.83

Funding in 2020 (kSEK)

SciLifeLab: 2800
VR: 750

Total: 3550

Resource allocation 2020

Academia (national): 55%
Academia (international): -
Internal tech. dev.: 45%
Industry: -
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 81

Reagents: -
Instrument: -
Salaries: 95%
Rent: 5%
Other: -

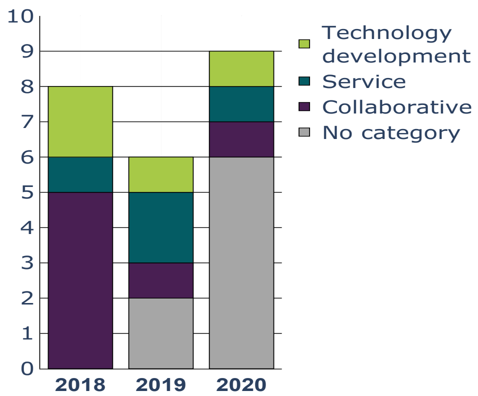
User fees by sector 2020

Academia (national): 100%
Academia (international): -
Industry: -
Healthcare: -
Other gov. agencies: -

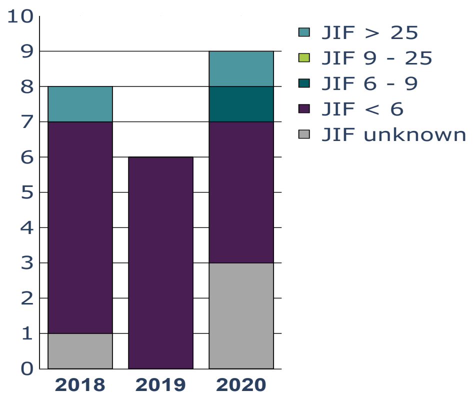
Services

- Microscopy imaging and quantitative data analysis
- Image analysis assay development and image processing algorithm development and software engineering
- High throughput/large-scale image processing using computing clusters, including data transfer and storage.
- Large-scale data analysis and visualization

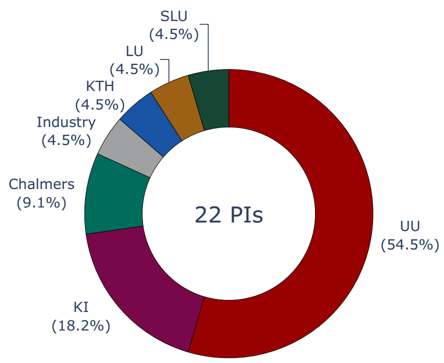
Publication by category



Publication by Journal Impact Factor



Users 2018



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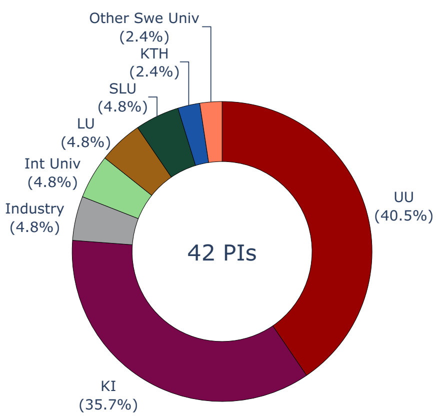
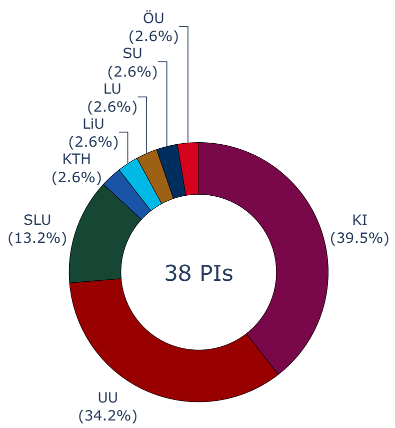


Users 2020



Cell Profiling

Cellular and Molecular Imaging platform

Basic information

Facility director(s): Emma Lundberg
Head(s) of facility: Charlotte Stadler
SciLifeLab facility since: 2013
Host university: KTH
FTEs: 3.5
FTEs financed by SciLifeLab: 2.0

Funding in 2020 (kSEK)

SciLifeLab: 3000
Other: 600
VR: 500

Total: 4100

Resource allocation 2020

Academia (national): 60%
Academia (international): 25%
Internal tech. dev.: 5%
Industry: 10%
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 300

Reagents: 20%
Instrument: 50%
Salaries: 30%
Rent: -
Other: -

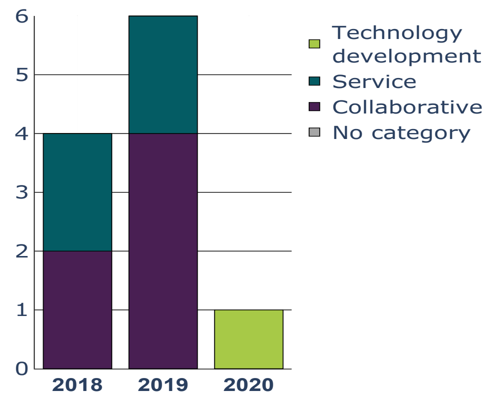
User fees by sector 2020

Academia (national): 20%
Academia (international): 20%
Industry: 60%
Healthcare: -
Other gov. agencies: -

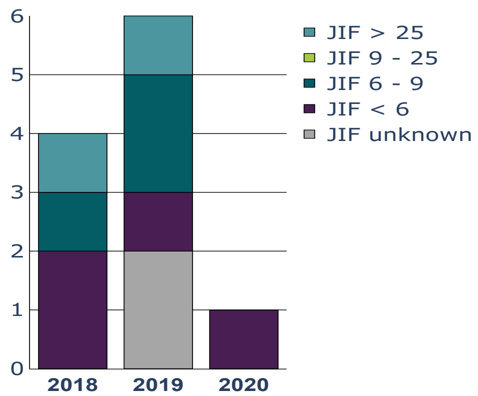
Services

- Highly multiplexed immunofluorescence of cells and tissues using CODEX
- Custom antibody conjugation for CODEX
- High throughput immunofluorescence of cells using Human Protein Atlas antibodies
- Initial image analysis support of generated data

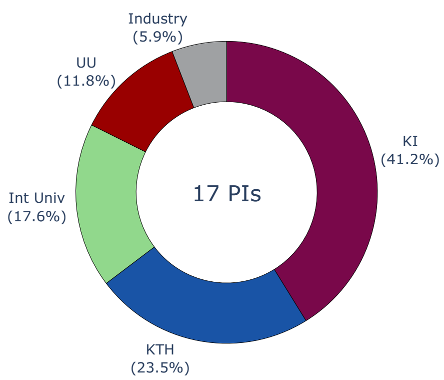
Publication by category



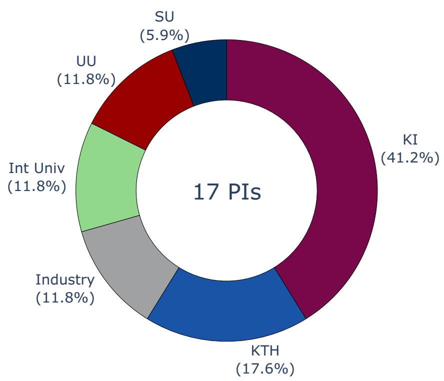
Publication by Journal Impact Factor



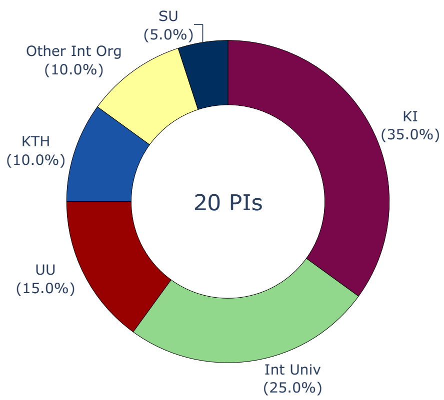
Users 2018



Users 2019



Users 2020



Cryo-EM

Cellular and Molecular Imaging platform

Basic information

Facility director(s): Gunnar von Hejine, Linda Sandblad
Head(s) of facility: Marta Carroni, Michael Hall
SciLifeLab facility since: 2016
Host university: SU, UmU
FTEs: 14.5
FTEs financed by SciLifeLab: 6.75

Funding in 2020 (kSEK)

SciLifeLab: 8500
KAW: 12592
SU: 2300
UmU: 3250
VR: 780

Total: 27422

Resource allocation 2020

Academia (national): 83%
Academia (international): 4%
Internal tech. dev.: 9%
Industry: 2%
Healthcare: -
Other gov. agencies: 2%

User Fees 2020

Total (kSEK): 2440

Reagents: 90%
Instrument: -
Salaries: -
Rent: -
Other: 10%

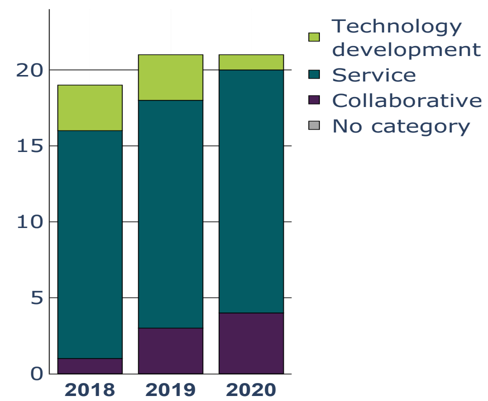
User fees by sector 2020

Academia (national): 93%
Academia (international): 5%
Industry: -
Healthcare: -
Other gov. agencies: 2%

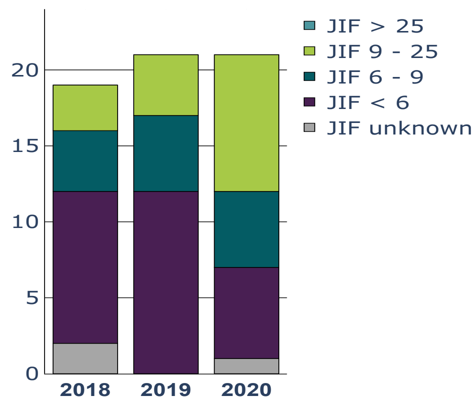
Services

- Single-particle Cryo-EM screening and data collection on a 200kV Talos Arctica and three Titan Krioses 300kV equipped with Falcon 3, K2 and K3 detectors.
- Cryo-electron tomography
- Cryo lamella preparation with a Scios DualBeam focused ion beam (FIB)-SEM
- Sample screening using a Talos L120 TEM
- Micro-ED on a Titan Krios with CetaD camera
- Drop-in service for image processing

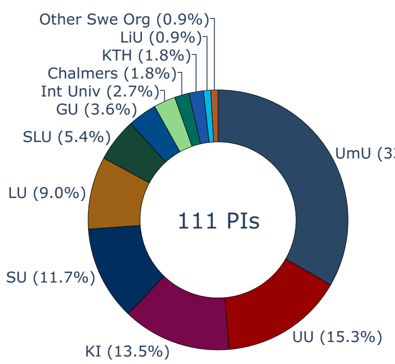
Publication by category



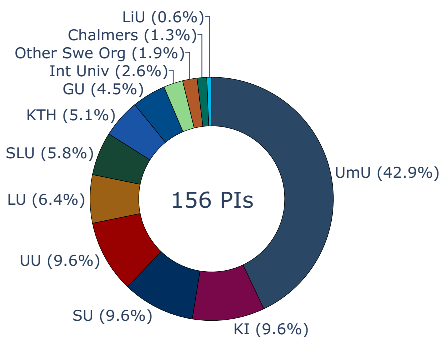
Publication by Journal Impact Factor



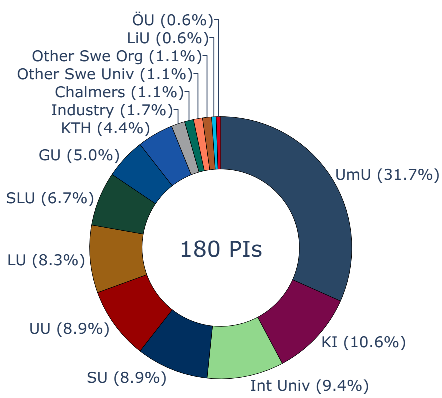
Users 2018



Users 2019



Users 2020



J.

Swedish NMR Centre

Cellular and Molecular Imaging platform

Basic information

Facility director(s): Göran Karlsson, Gerhard Gröbner
Head(s) of facility: Cecilia Persson, Tobias Sparrman
SciLifeLab facility since: 2016
Host university: GU, UmU
FTEs: 11.1
FTEs financed by SciLifeLab: 2.7

Funding in 2020 (kSEK)

SciLifeLab: 3000
GU: 8400
KAW: 7000
UmU: 1350
VR: 200

Total: 19950

Resource allocation 2020

Academia (national): 52%
Academia (international): 4%
Internal tech. dev.: 25%
Industry: 5%
Healthcare: 13%
Other gov. agencies: 1%

User Fees 2020

Total (kSEK): 2030

Reagents: 20%
Instrument: 48%
Salaries: 8%
Rent: 13%
Other: 11%

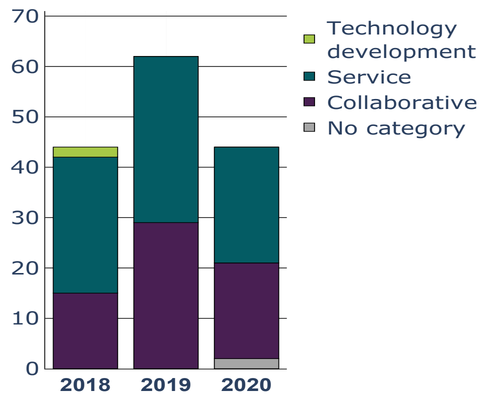
User fees by sector 2020

Academia (national): 60%
Academia (international): 3%
Industry: 23%
Healthcare: 13%
Other gov. agencies: 1%

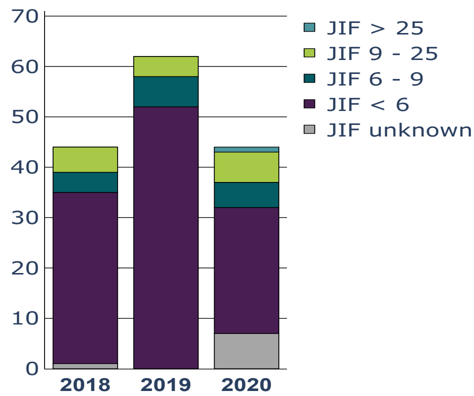
Services

- Structural biology
- Metabolomics
- Chemical biology and small molecule NMR
- Diffusion, microimaging and MAS NMR

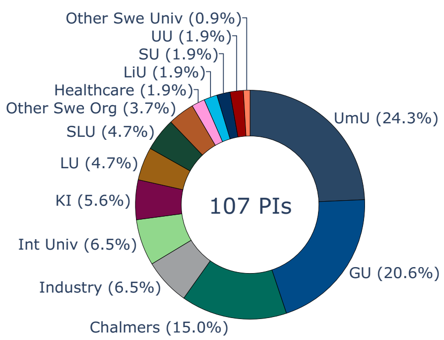
Publication by category



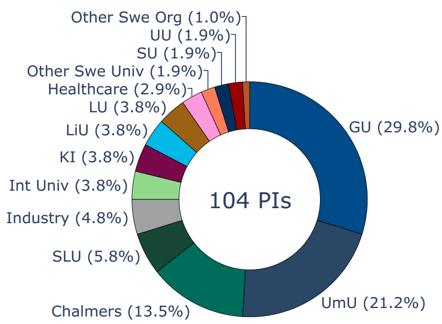
Publication by Journal Impact Factor



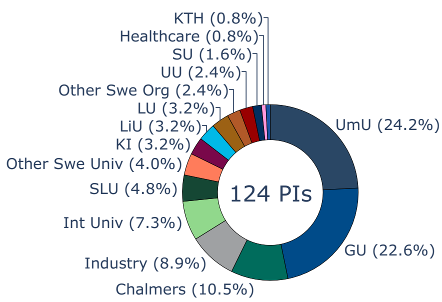
Users 2018



Users 2019



Users 2020



J.

Chemical Biology Consortium Sweden

Chemical Biology and Genome Engineering platform

Basic information

Facility director(s): Anna-Lena Gustavsson, Erik Chorell
Head(s) of facility: Anna-Lena Gustavsson, Stina Berglund Fick
SciLifeLab facility since: 2013
Host university: KI
FTEs: 9.0
FTEs financed by SciLifeLab: 6.0

Funding in 2020 (kSEK)

SciLifeLab: 6000
KI: 4800
UmU: 1570

Total: 12370

Resource allocation 2020

Academia (national): 86%
Academia (international): 2%
Internal tech. dev.: 8%
Industry: 4%
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 3700

Reagents: 23%
Instrument: 10%
Salaries: 55%
Rent: 12%
Other: -

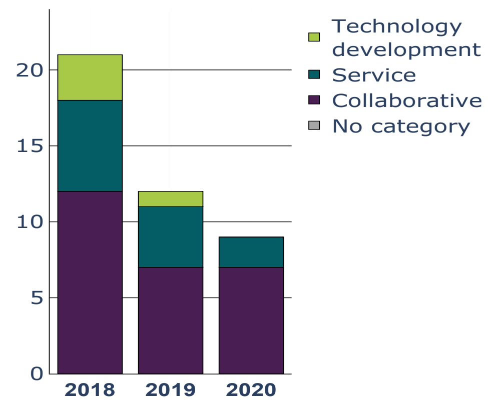
User fees by sector 2020

Academia (national): 90%
Academia (international): 5%
Industry: 5%
Healthcare: -
Other gov. agencies: -

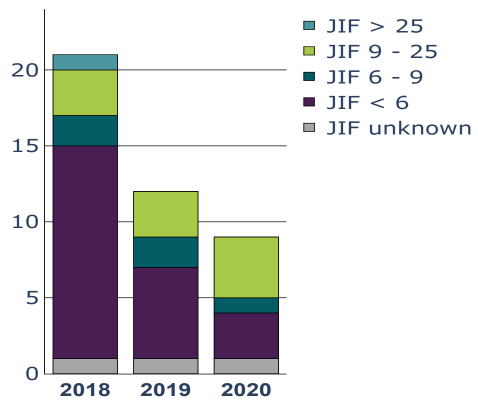
Services

- Assay development
- Biochemical, cell-based and phenotypic high-throughput screening of small-molecule screening libraries
- Chemical proteomics & target identification of small molecule ligands
- Computational chemistry and modelling
- High-throughput imaging technology
- Hit optimization and medicinal chemistry

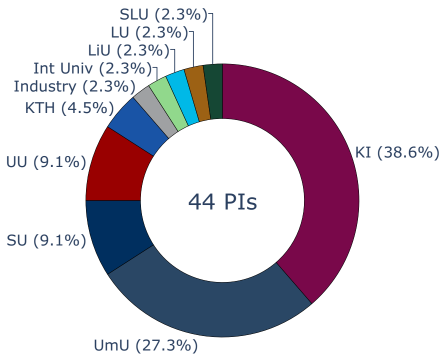
Publication by category



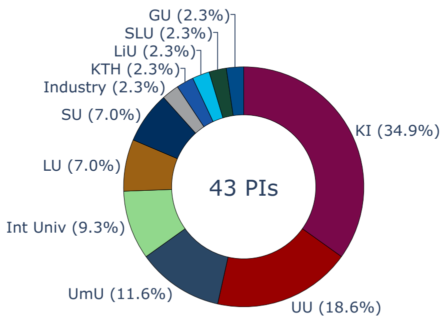
Publication by Journal Impact Factor



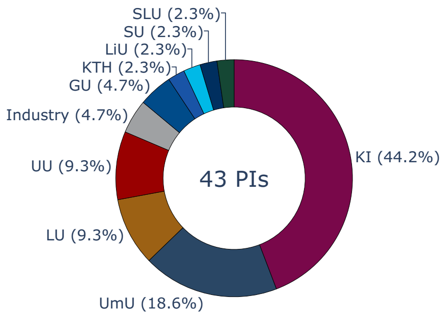
Users 2018



Users 2019



Users 2020



Genome Engineering Zebrafish

Chemical Biology and Genome Engineering platform

Basic information

Facility director(s): Johan Ledin
Head(s) of facility: Tiffany Klingström, Beata Filipek
SciLifeLab facility since: 2016
Host university: UU
FTEs: 6.5
FTEs financed by SciLifeLab: 2.4

Funding in 2020 (kSEK)

SciLifeLab: 2400

Total: 2400

Resource allocation 2020

Academia (national): 80%
Academia (international): 5%
Internal tech. dev.: 15%
Industry: -
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 2292

Reagents: 20%
Instrument: 5%
Salaries: 50%
Rent: 20%
Other: 5%

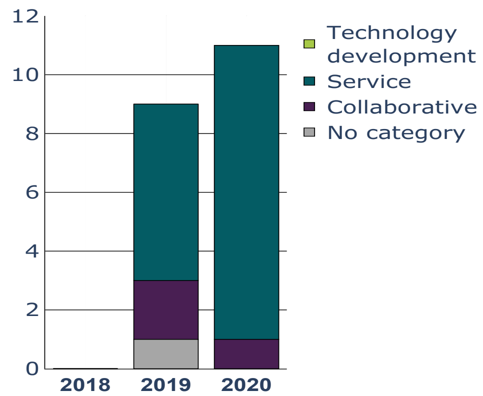
User fees by sector 2020

Academia (national): 95%
Academia (international): 5%
Industry: -
Healthcare: -
Other gov. agencies: -

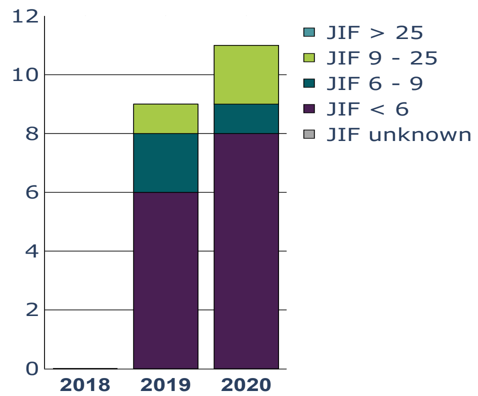
Services

- CRISPR/Cas9 induced loss of function zebrafish line generation in our selection of readout models
- Development and analysis of CRISPR/Cas9 induced disease models combined with small molecule exposure
- High through-put fluorescent imaging service combined with large scale analysis of imaging data
- Project planning/management

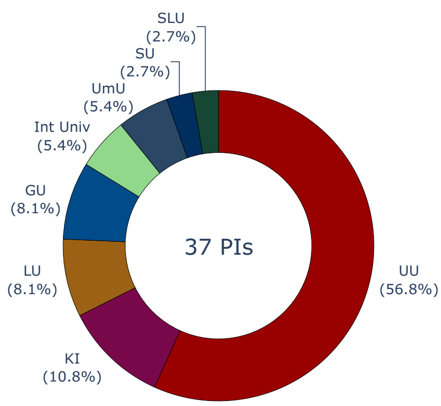
Publication by category



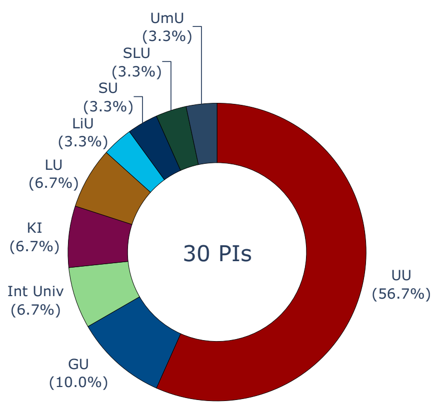
Publication by Journal Impact Factor



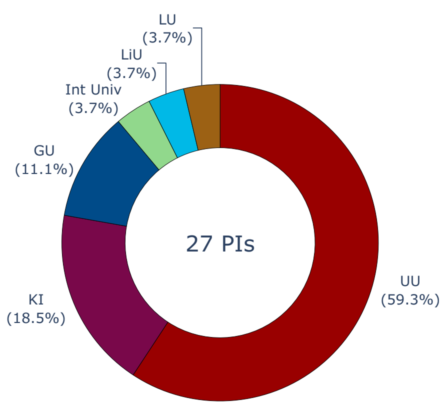
Users 2018



Users 2019



Users 2020



High Throughput Genome Engineering

Chemical Biology and Genome Engineering platform

Basic information

Facility director(s): Bernhard Schmierer
Head(s) of facility: Bernhard Schmierer
SciLifeLab facility since: 2017
Host university: KI
FTEs: 6.3
FTEs financed by SciLifeLab: 3.2

Funding in 2020 (kSEK)

SciLifeLab: 3200
KI: 2162
Other: 1300

Total: 6662

Resource allocation 2020

Academia (national): 53%
Academia (international): 10%
Internal tech. dev.: 30%
Industry: -
Healthcare: 7%
Other gov. agencies: -

User Fees 2020

Total (kSEK): 2535

Reagents: 20%
Instrument: 10%
Salaries: 50%
Rent: 20%
Other: -

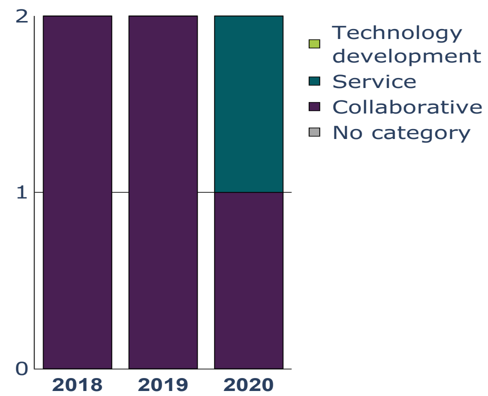
User fees by sector 2020

Academia (national): 87%
Academia (international): -
Industry: 2%
Healthcare: 11%
Other gov. agencies: -

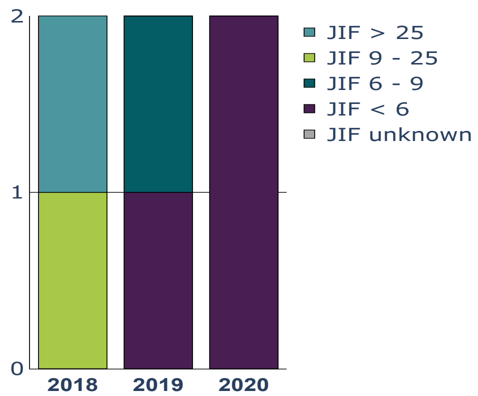
Services

- Cas9-expressing cell lines
- Genome-wide, pooled CRISPR screens
- Protein coding genes, lncRNAs, non-coding elements
- CRISPR-KO, CRISPR-inhibition, CRISPR-activation
- Screen design and guide design for all types of screens
- Creation of customized guide libraries
- Small pooled CRISPR screens with single cell readout

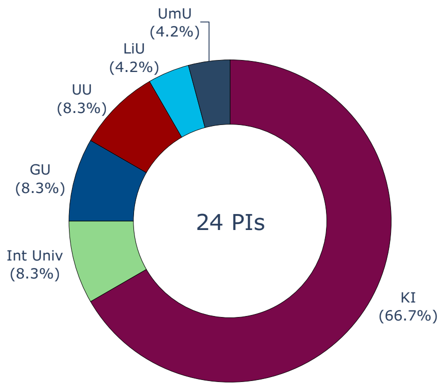
Publication by category



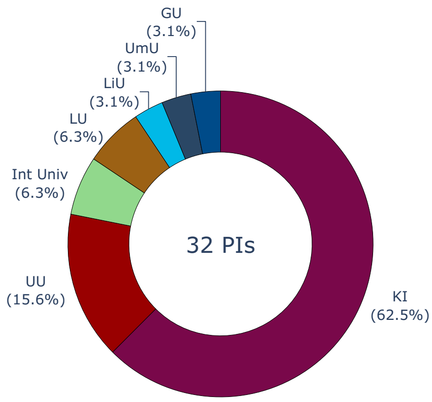
Publication by Journal Impact Factor



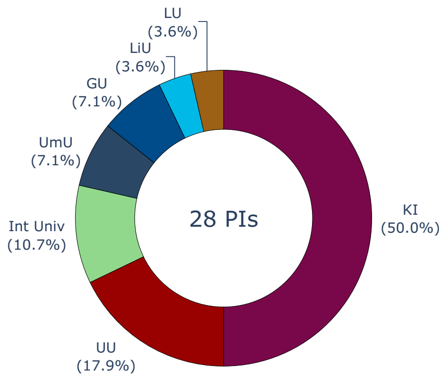
Users 2018



Users 2019



Users 2020



Clinical Genomics Gothenburg

Diagnostics Development platform

Basic information

Facility director(s): Lars Palmqvist
Head(s) of facility: Per Sikora
SciLifeLab facility since: 2016
Host university: GU
FTEs: 8.2
FTEs financed by SciLifeLab: 3.0

Funding in 2020 (kSEK)

SciLifeLab: 2200
GU: 1100
University hospital: 600

Total: 3900

Resource allocation 2020

Academia (national): 10%
Academia (international): -
Internal tech. dev.: 15%
Industry: -
Healthcare: 75%
Other gov. agencies: -

User Fees 2020

Total (kSEK): 2695

Reagents: -
Instrument: -
Salaries: 90%
Rent: -
Other: 10%

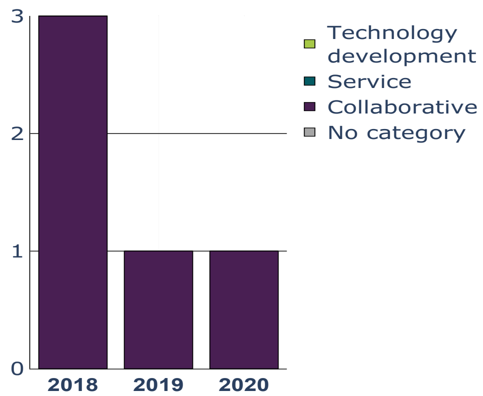
User fees by sector 2020

Academia (national): 5%
Academia (international): -
Industry: -
Healthcare: 95%
Other gov. agencies: -

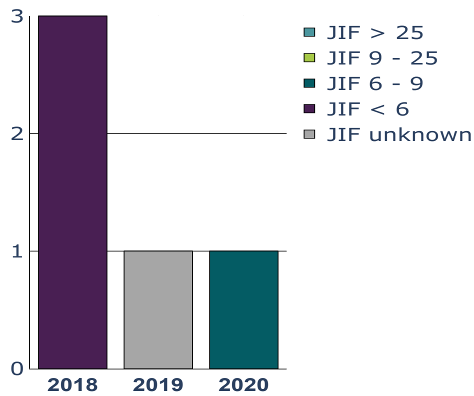
Services

- Sequencing and bioinformatics support for clinical research and implementation projects with a focus on NGS. Support on a wide range of NGS applications including WGS for clinical applications. The sequencing facility performs RNA-seq, exome sequencing, panels, metagenomics and bacterial genome sequencin glocally, including 10x single-cell, exome and WGS. General consulting and support on cluster hardware and software infrastructure development and storage for NGS applications.

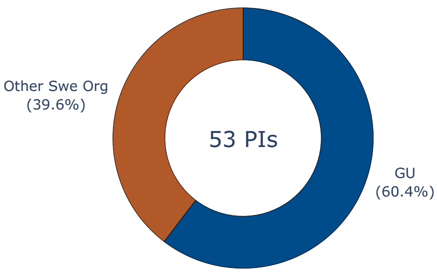
Publication by category



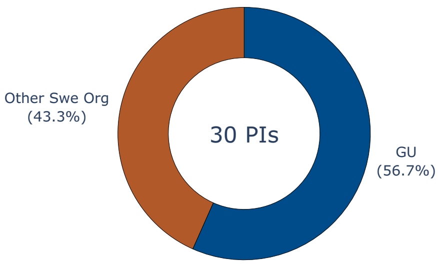
Publication by Journal Impact Factor



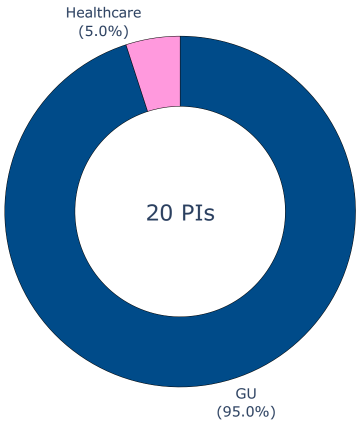
Users 2018



Users 2019



Users 2020



Clinical Genomics Linköping

Diagnostics Development platform

Basic information

Facility director(s): Peter Söderkvist
Head(s) of facility: Tobias Strid
SciLifeLab facility since: 2019
Host university: LiU
FTEs: 3.0
FTEs financed by SciLifeLab: 0.5

Funding in 2020 (kSEK)

SciLifeLab: 333
ALF: 1800
Vinnova: 900

Total: 3033

Resource allocation 2020

Academia (national): 70%
Academia (international): -
Internal tech. dev.: 20%
Industry: -
Healthcare: 10%
Other gov. agencies: -

User Fees 2020

Total (kSEK): 250

Reagents: 100%
Instrument: -
Salaries: -
Rent: -
Other: -

User fees by sector 2020

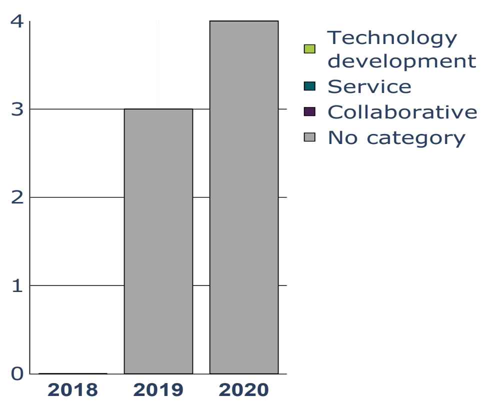
Academia (national): 90%
Academia (international): -
Industry: -
Healthcare: 10%
Other gov. agencies: -

Services

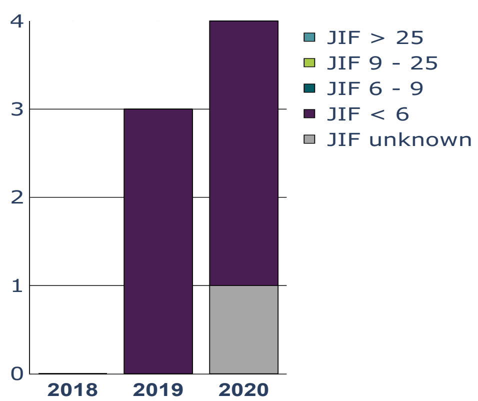
We provide sequencing, molecular assays and bioinformatics service/support on a wide range of applications:

- DNA Exome-sequencing
- DNA-sequencing using targeted panels
- Microbial whole-genome sequencing
- SARS-CoV2-whole genome sequencing
- Gene expression and methylation arrays (Affymetrix, Illumina)
- Molecular genetic analysis (genotyping and RNA expression)

Publication by category



Publication by Journal Impact Factor



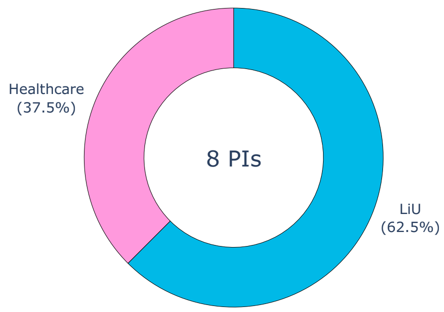
Users 2018

No user information

Users 2019

No user information

Users 2020



Clinical Genomics Lund

Diagnostics Development platform

Basic information

Facility director(s): Thoas Fioretos
Head(s) of facility: Markus Heidenblad
SciLifeLab facility since: 2016
Host university: LU
FTEs: 11.0
FTEs financed by SciLifeLab: 3.0

Funding in 2020 (kSEK)

SciLifeLab: 2200
ALF: 3800
LU: 4470
Vinnova: 1309

Total: 11779

Resource allocation 2020

Academia (national): 70%
Academia (international): -
Internal tech. dev.: 15%
Industry: 1%
Healthcare: 14%
Other gov. agencies: -

User Fees 2020

Total (kSEK): 10627

Reagents: 75%
Instrument: 15%
Salaries: -
Rent: -
Other: 10%

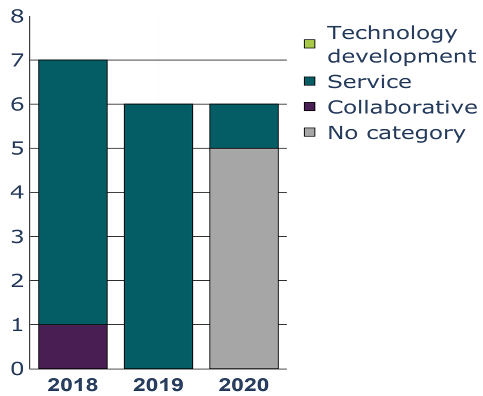
User fees by sector 2020

Academia (national): 84%
Academia (international): -
Industry: 1%
Healthcare: 15%
Other gov. agencies: -

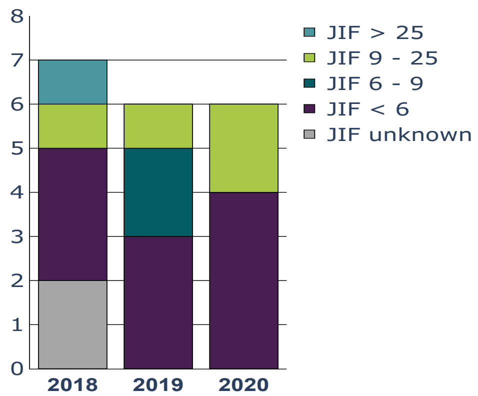
Services

• Service in NGS-based technologies for investigators at Lund University and Region Skåne in projects with a strong translational edge or aiming at clinical implementation of new diagnostics assays. National services within specific high-profile areas of the facility.

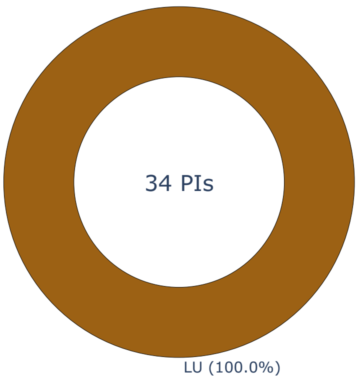
Publication by category



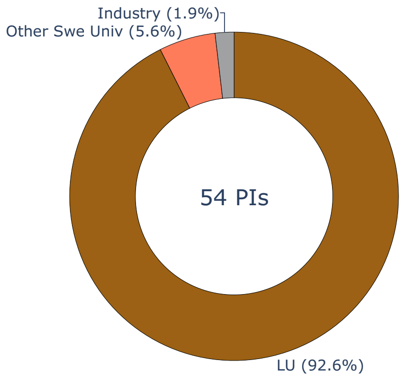
Publication by Journal Impact Factor



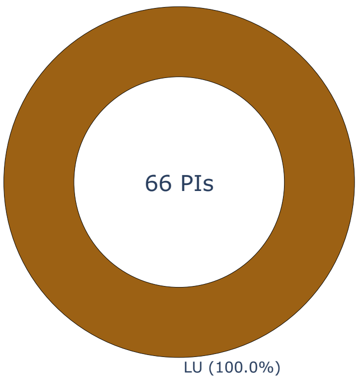
Users 2018



Users 2019



Users 2020



Clinical Genomics Stockholm

Diagnostics Development platform

Basic information

Facility director(s): Valtteri Wirta
Head(s) of facility: Valtteri Wirta
SciLifeLab facility since: 2014
Host university: KI, KTH
FTEs: 27.0
FTEs financed by SciLifeLab: 3.0

Funding in 2020 (kSEK)

SciLifeLab: 5500
KI: 3000
Other: 178
University hospital: 5000
Vinnova: 1479

Total: 15157

Resource allocation 2020

Academia (national): 26%
Academia (international): -
Internal tech. dev.: 4%
Industry: -
Healthcare: 63%
Other gov. agencies: 7%

User Fees 2020

Total (kSEK): 46000

Reagents: 53%
Instrument: 10%
Salaries: 33%
Rent: 4%
Other: -

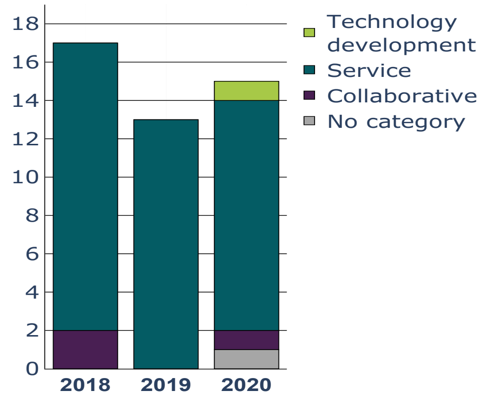
User fees by sector 2020

Academia (national): 19%
Academia (international): -
Industry: -
Healthcare: 79%
Other gov. agencies: 2%

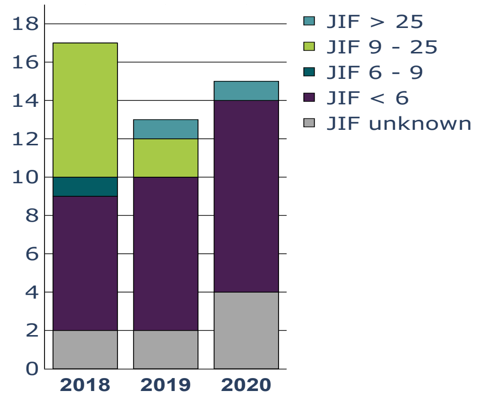
Services

• DNA sequencing
• Clinical exome and whole-genome sequencing
• Microbial whole-genome sequencing
• Targeted panels using various bait sets (contact fordetailed information)
• RNA Seq using both poly A and random priming
• Ready-made libraries (prepared by collaborator)

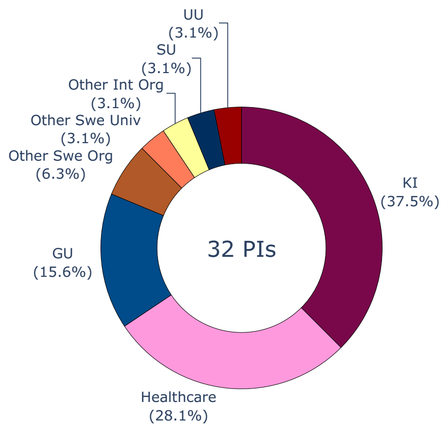
Publication by category



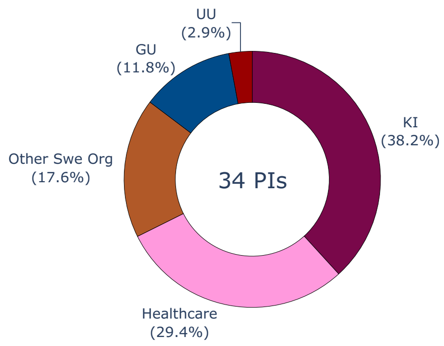
Publication by Journal Impact Factor



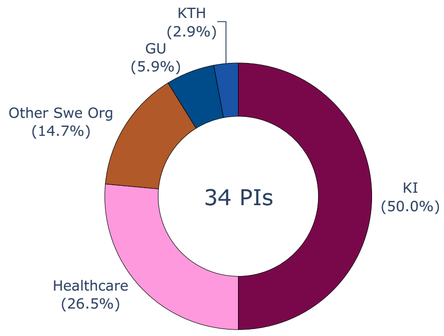
Users 2018



Users 2019



Users 2020



Clinical Genomics Umeå
Diagnostics Development platform

Basic information
Facility director(s): Richard Palmqvist
Head(s) of facility: Per Larsson
SciLifeLab facility since: 2019
Host university: UmU
FTEs: 1.0
FTEs financed by SciLifeLab: 0.4

Funding in 2020 (kSEK)
SciLifeLab: 333

Total: 333

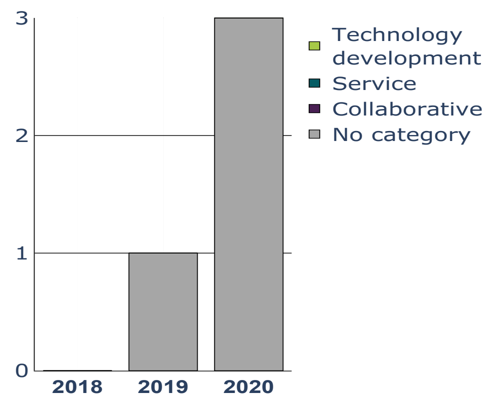
Resource allocation 2020
Academia (national): 55%
Academia (international): 5%
Internal tech. dev.: 20%
Industry: -
Healthcare: 20%
Other gov. agencies: -

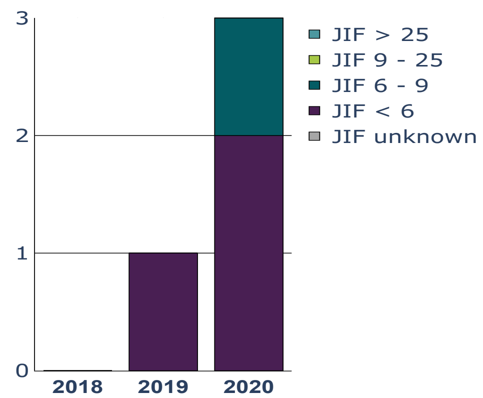
User Fees 2020
Total (kSEK): 400

Reagents: 18%
Instrument: 9%
Salaries: 67%
Rent: 6%
Other: -

User fees by sector 2020
Academia (national): 90%
Academia (international): -
Industry: -
Healthcare: 10%
Other gov. agencies: -

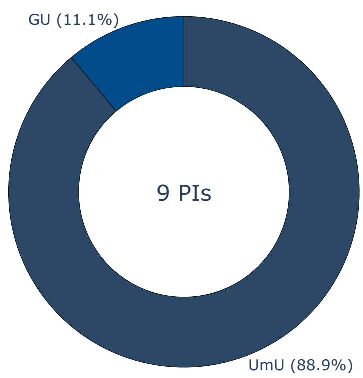
Services
- Meta-, microbial, human genomics
- Archer Analysis server
- Guppy and R-studio server
- Microarray
- Telomer length analysis
- Digital PCR
- Fusion gene detection
- Myeloid, Solid tumor, cardiogenetics panels
- Custom sequencing (illumina, nanopore)
- Data storage / backup and Linux accounts to users for supported projects

Publication by category


Publication by Journal Impact Factor


Users 2018
No user information

Users 2019
No user information

Users 2020


Clinical Genomics Uppsala

Diagnostics Development platform

Basic information

Facility director(s): Lucia Cavelier
Head(s) of facility: Malin Melin
SciLifeLab facility since: 2014
Host university: UU
FTEs: 16.7
FTEs financed by SciLifeLab: 4.7

Funding in 2020 (kSEK)

SciLifeLab: 2700
ALF: 3000
University hospital: 4540
UU: 500
Vinnova: 2666

Total: 13406

Resource allocation 2020

Academia (national): 35%
Academia (international): -
Internal tech. dev.: 20%
Industry: 5%
Healthcare: 40%
Other gov. agencies: -

User Fees 2020

Total (kSEK): 6700

Reagents: 69%
Instrument: 4%
Salaries: 27%
Rent: -
Other: -

User fees by sector 2020

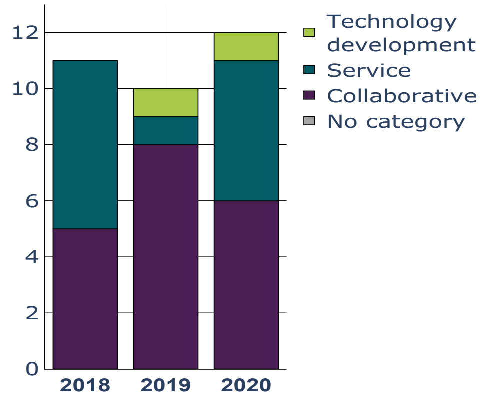
Academia (national): 42%
Academia (international): -
Industry: 58%
Healthcare: -
Other gov. agencies: -

Services

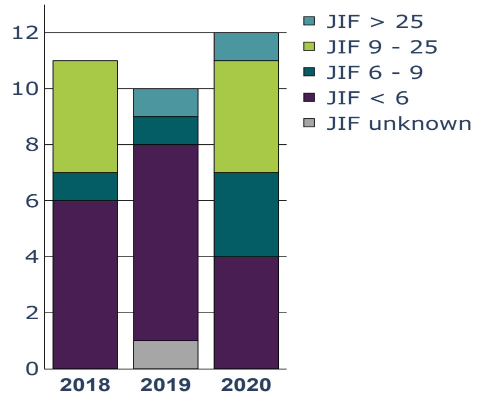
Fully tailored support with translational research projects. Development and clinical implementation of new diagnostic tests. Examples of applications:

- Exome and gene panel sequencing
- Gene expression and gene fusion analysis with NanoString
- Mutation detection with digital PCR

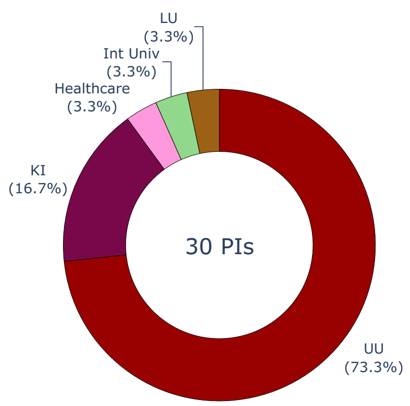
Publication by category



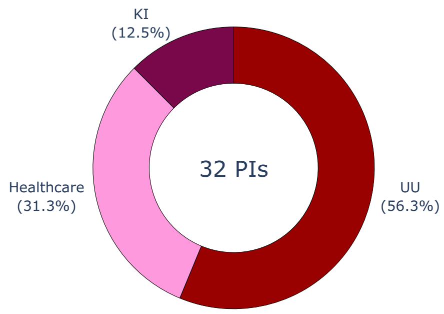
Publication by Journal Impact Factor



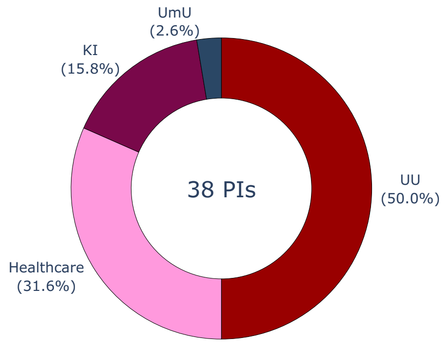
Users 2018



Users 2019



Users 2020



Clinical Genomics Örebro

Diagnostics Development platform

Basic information

Facility director(s): Gisela Helenius
Head(s) of facility: Bianca Stenmark
SciLifeLab facility since: 2019
Host university: ÖRU
FTEs: 2.0
FTEs financed by SciLifeLab: 0.0

Funding in 2020 (kSEK)

SciLifeLab: 333
ALF: 2200
County council: 1246
ÖRU: 100

Total: 3879

Resource allocation 2020

Academia (national): 20%
Academia (international): -
Internal tech. dev.: 20%
Industry: -
Healthcare: 60%
Other gov. agencies: -

User Fees 2020

Total (kSEK): 300

Reagents: 100%
Instrument: -
Salaries: -
Rent: -
Other: -

User fees by sector 2020

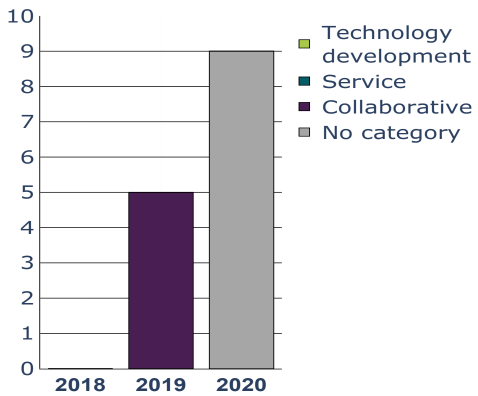
Academia (national): 50%
Academia (international): -
Industry: -
Healthcare: 50%
Other gov. agencies: -

Services

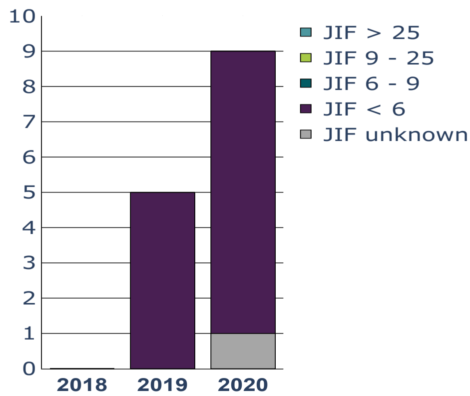
Support with translational research projects from design to clinical interpretation. Development of new diagnostic tests. Examples of applications:

- Microbial whole-genome sequencing
- Metagenomic sequencing
- Exome sequencing
- Targeted sequencing using panels
- Ultrasensitive detection of genetic variants using digital droplet PCR

Publication by category



Publication by Journal Impact Factor



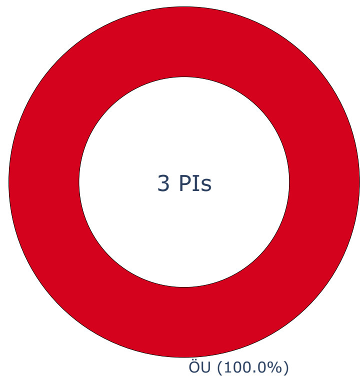
Users 2018

No user information

Users 2019

No user information

Users 2020



Drug Discovery and Development

Drug Discovery and Development platform

Basic information

Platform directors: Per Arvidsson, Kristian Sandberg
SciLifeLab platform since: 2014
Host university: KI, KTH, LU, SU, UU
FTEs: 37.3
FTEs financed by SciLifeLab: 37.3

Funding in 2020 (kSEK)

SciLifeLab: 46593
UU: 2008

Total: 48601

Resource allocation 2020

Academia (national): 82%
Academia (international): -
Internal tech. dev.: 17%
Industry: 1%
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 3484

Reagents: 59%
Instrument: 38%
Salaries: 1%
Rent: 1%
Other: 1%

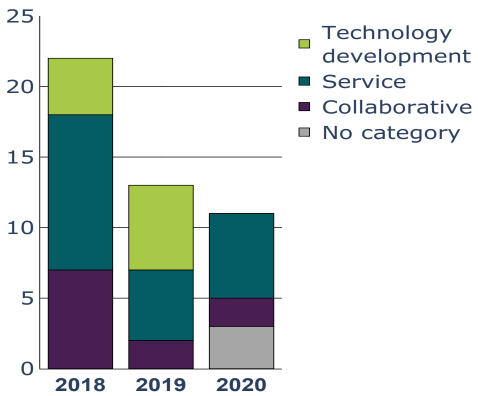
User fees by sector 2020

Academia (national): 92%
Academia (international): -
Industry: 8%
Healthcare: -
Other gov. agencies: -

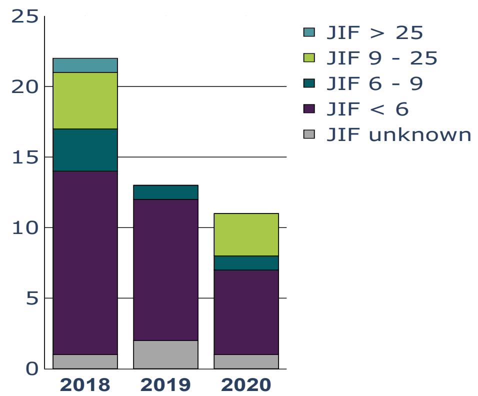
Services

- Integrated drug discovery efforts to the Swedish academic research community. Industry standard infrastructure, expertise, and strategic support to help progress projects towards a pre-clinical proof-of-concept. The drug leads can be either a small molecule drug or ahuman antibody therapeutic.

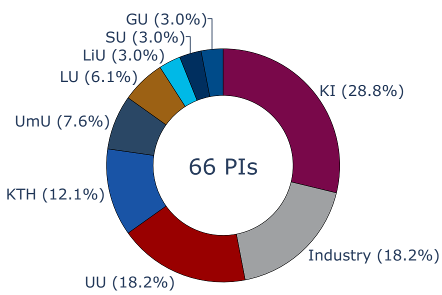
Publication by category



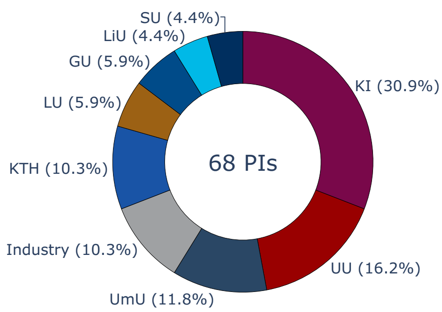
Publication by Journal Impact Factor



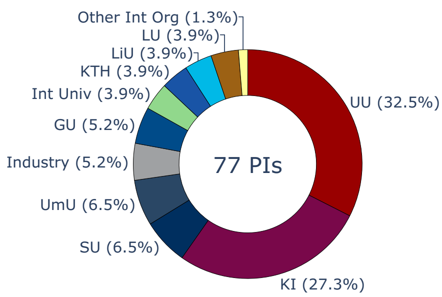
Users 2018



Users 2019



Users 2020



J.

Ancient DNA

Genomics platform

Basic information

Facility director(s): Mattias Jakobsson, Anders Götherström
Head(s) of facility: Magnus Lundgren
SciLifeLab facility since: 2017
Host university: UU, SU
FTEs: 2.8
FTEs financed by SciLifeLab: 2.8

Funding in 2020 (kSEK)

SciLifeLab: 2000
Other: 40

Total: 2040

Resource allocation 2020

Academia (national): 47%
Academia (international): 1%
Internal tech. dev.: 5%
Industry: 20%
Healthcare: -
Other gov. agencies: 27%

User Fees 2020

Total (kSEK): 783

Reagents: 24%
Instrument: 2%
Salaries: 69%
Rent: 3%
Other: 2%

User fees by sector 2020

Academia (national): 50%
Academia (international): 1%
Industry: 20%
Healthcare: -
Other gov. agencies: 29%

Services

- Extraction and processing of ancient DNA from different types of samples
- Processing of ancient DNA data incl. mapping to reference genome
- Analysis of ancient human DNA for sex, haplogroup, kinship and other features
- Analysis of ancient microbial DNA, including from pathogenic microorganisms

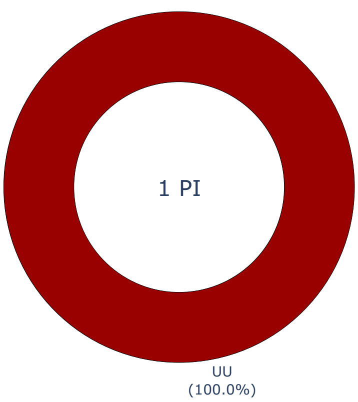
Publication by category

No publication data available

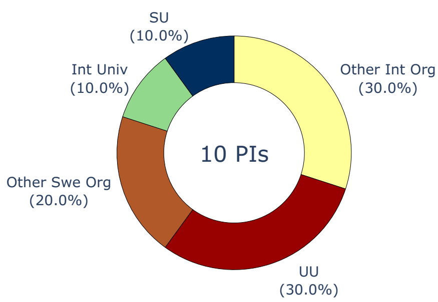
Publication by Journal Impact Factor

No publication data available

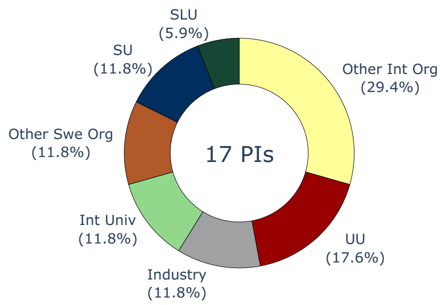
Users 2018



Users 2019



Users 2020



Eukaryotic Single Cell Genomics

Genomics platform

Basic information

Facility director(s): Rickard Sandberg
Head(s) of facility: Karolina Wallenborg
SciLifeLab facility since: 2015
Host university: KI
FTEs: 6.0
FTEs financed by SciLifeLab: 6.0

Funding in 2020 (kSEK)

SciLifeLab: 6000
KI: 3500

Total: 9500

Resource allocation 2020

Academia (national): 85%
Academia (international): 5%
Internal tech. dev.: 10%
Industry: -
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 9007

Reagents: 85%
Instrument: 5%
Salaries: 10%
Rent: -
Other: -

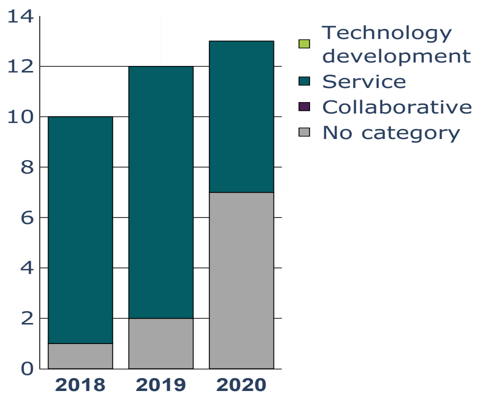
User fees by sector 2020

Academia (national): 90%
Academia (international): 10%
Industry: -
Healthcare: -
Other gov. agencies: -

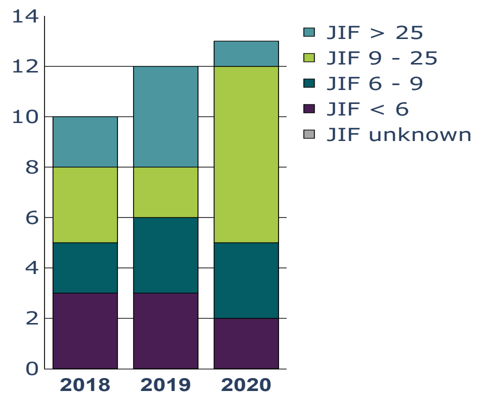
Services

• SC Genomics Analysis: Gene expression, Immune profiling, Chromatin accessibility, Epigenetics, Protein detection, Multiomics, Multiplexing, Sequencing, Biosafety level 1/2/3, Fresh/frozen/fixed samples
• Platform: Smart-seq3, 10x Genomics, Takara/iCELL8
• Project planning, Bioinformatics

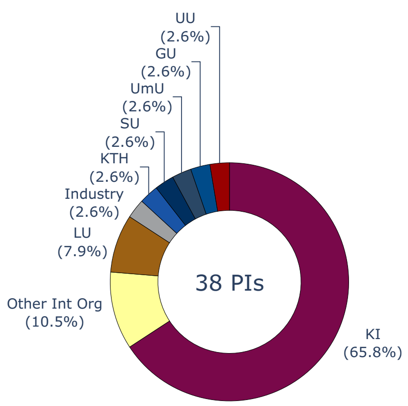
Publication by category



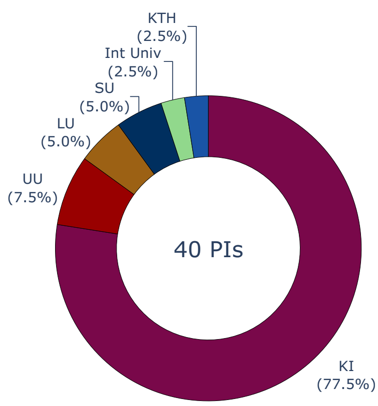
Publication by Journal Impact Factor



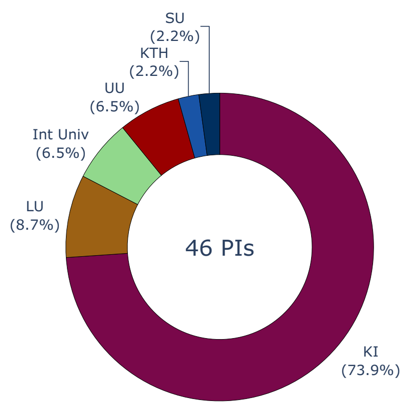
Users 2018



Users 2019



Users 2020



J.

In Situ Sequencing

Genomics platform

Basic information

Facility director(s): Mats Nilsson
Head(s) of facility: Chika Yokota
SciLifeLab facility since: 2019
Host university: SU
FTEs: 2.05
FTEs financed by SciLifeLab: 1.0

Funding in 2020 (kSEK)

SciLifeLab: 800
KAW: 890
Other: 10

Total: 1700

Resource allocation 2020

Academia (national): 60%
Academia (international): 20%
Internal tech. dev.: 15%
Industry: -
Healthcare: -
Other gov. agencies: 5%

User Fees 2020

Total (kSEK): 394

Reagents: 31%
Instrument: 5%
Salaries: 50%
Rent: 14%
Other: -

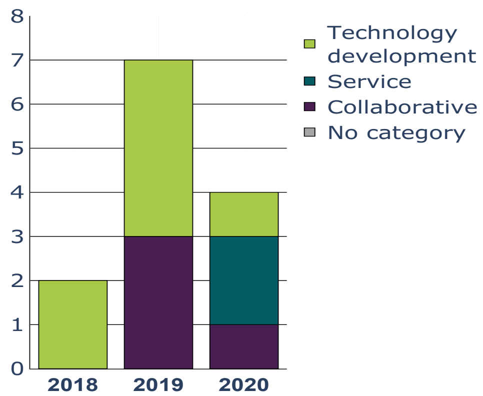
User fees by sector 2020

Academia (national): 100%
Academia (international): -
Industry: -
Healthcare: -
Other gov. agencies: -

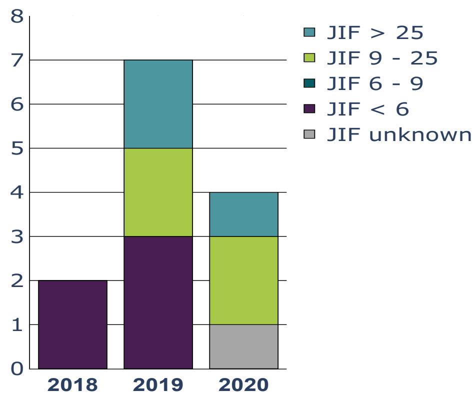
Services

- Multiplex mRNA profiling in situ
- In situ sequencing probe and assay design
- In situ sequencing library preparation and training
- In situ sequencing barcode decoding
- Primary image analysis (transcript and cell coordinates in tissues)

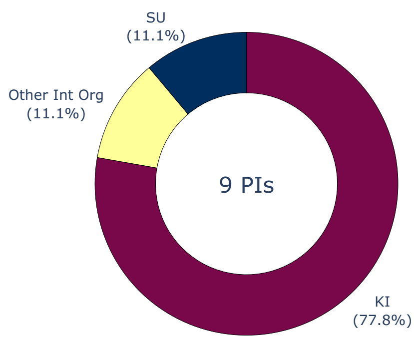
Publication by category



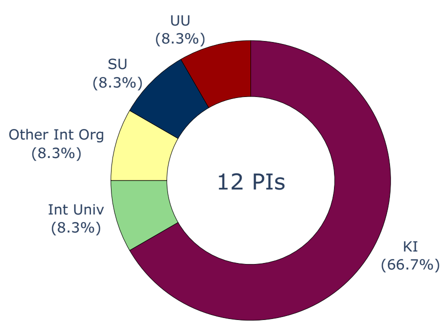
Publication by Journal Impact Factor



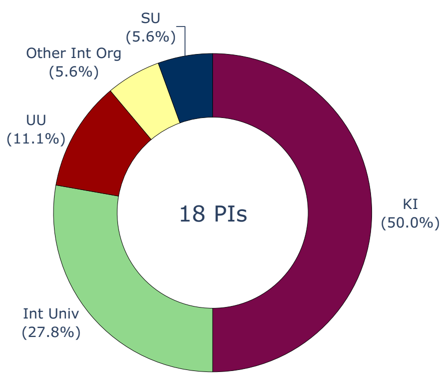
Users 2018



Users 2019



Users 2020



Microbial Single Cell Genomics

Genomics platform

Basic information

Facility director(s): Johan Ankarklev, Fabien Burki
Head(s) of facility: Johan Ankarklev
SciLifeLab facility since: 2017
Host university: UU
FTEs: 2.0
FTEs financed by SciLifeLab: 2.0

Funding in 2020 (kSEK)

SciLifeLab: 2200
UU: 429

Total: 2629

Resource allocation 2020

Academia (national): 50%
Academia (international): 5%
Internal tech. dev.: 10%
Industry: 5%
Healthcare: 10%
Other gov. agencies: 20%

User Fees 2020

Total (kSEK): 184

Reagents: 55%
Instrument: 10%
Salaries: 15%
Rent: -
Other: 20%

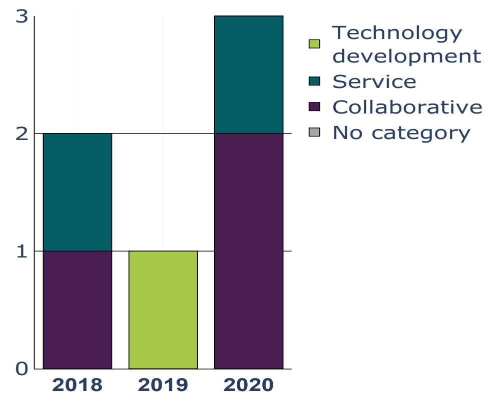
User fees by sector 2020

Academia (national): 55%
Academia (international): 5%
Industry: 10%
Healthcare: 10%
Other gov. agencies: 20%

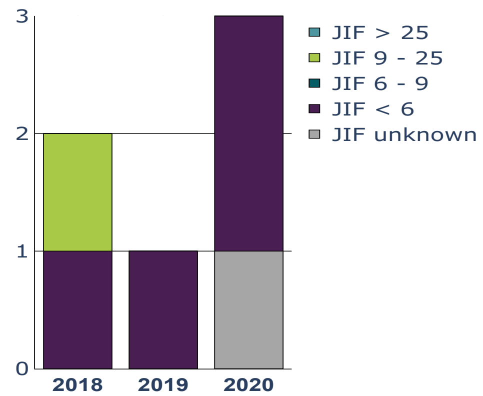
Services

- Single-cell sorting in microwell plates using FACS or the C1 Single-Cell Auto Prep system
- Lysis and WGA of individual cells using MDA
- PCR screening of amplified single cell genomes formarker genes
- Design of single-cell experiments, WGS, genome assembly and bioinformatics support
- BSL3 facility for sample handling of live pathogens
- 10X chromium controller

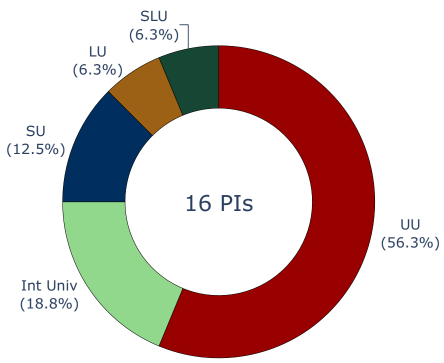
Publication by category



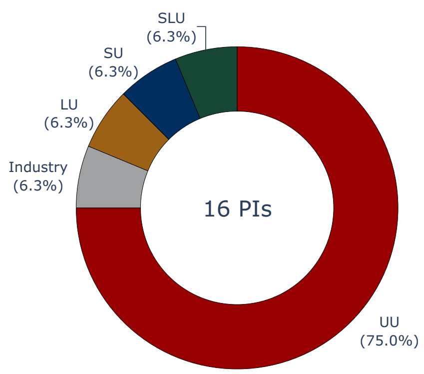
Publication by Journal Impact Factor



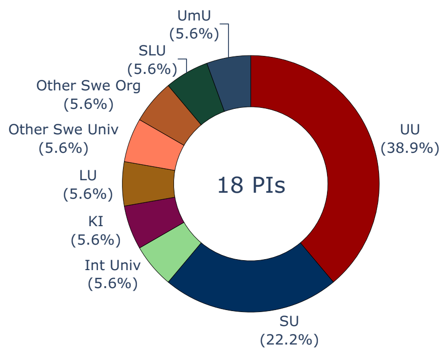
Users 2018



Users 2019



Users 2020



National Genomics Infrastructure

Genomics platform

Basic information

Facility director(s): Carsten Daub, Lars Feuk, Jessica Nordlund, Ellen Sherwood
Head(s) of facility: Susanne Hellstedt Kerje, Max Käller, Ulrika Liljedahl, Anja Mezger
SciLifeLab facility since: 2013
Host university: KI, KTH, SU, UU
FTEs: 76.6
FTEs financed by SciLifeLab: 49.7

Funding in 2020 (kSEK)

SciLifeLab: 44500
KAW: 1016
KTH: 250
Other: 8065
UU: 3000
VR: 16300

Total: 73131

Resource allocation 2020

Academia (national): 87%
Academia (international): 4%
Internal tech. dev.: 3%
Industry: 1%
Healthcare: 4%
Other gov. agencies: 1%

User Fees 2020

Total (kSEK): 96985

Reagents: 73%
Instrument: 9%
Salaries: 4%
Rent: 4%
Other: 10%

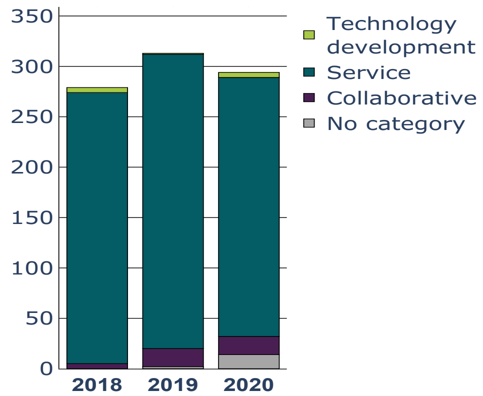
User fees by sector 2020

Academia (national): 89%
Academia (international): 6%
Industry: 1%
Healthcare: 3%
Other gov. agencies: 1%

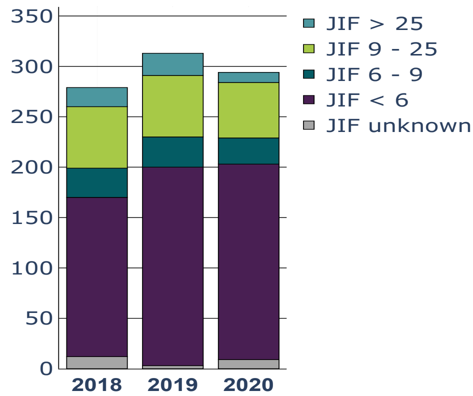
Services

• Sequencing on all scales using Illumina, PacBio, Oxford Nanopore, and Ion instruments
• SNP genotyping and methylation analysis using the Illumina Infinium assay
• Spatial transcriptomics using the 10x Genomics Visium assay
• Single cell analysis using 10x Genomics Chromium and Dolomite Nadia instruments
• Bioinformatics QC and initial analysis
• Scientific support for all projects

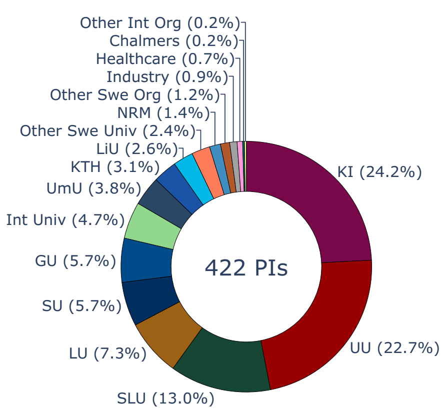
Publication by category



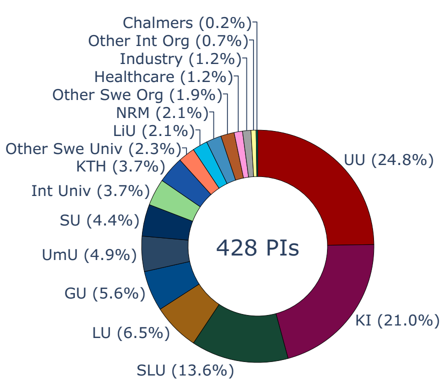
Publication by Journal Impact Factor



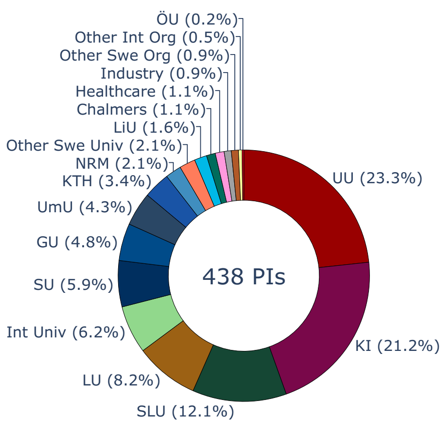
Users 2018



Users 2019



Users 2020



Autoimmunity and Serology Profiling

Proteomics and Metabolomics platform

Basic information

Facility director(s): Peter Nilsson
Head(s) of facility: Ronald Sjöberg
SciLifeLab facility since: 2013
Host university: KTH
FTEs: 8.0
FTEs financed by SciLifeLab: 2.8

Funding in 2020 (kSEK)

SciLifeLab: 3000
County council: 1000
KAW: 2000

Total: 6000

Resource allocation 2020

Academia (national): 5%
Academia (international): -
Internal tech. dev.: 35%
Industry: 20%
Healthcare: 20%
Other gov. agencies: 20%

User Fees 2020

Total (kSEK): 7000

Reagents: 30%
Instrument: 10%
Salaries: 60%
Rent: -
Other: -

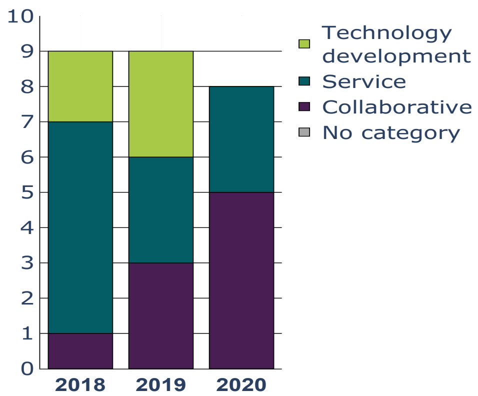
User fees by sector 2020

Academia (national): 5%
Academia (international): -
Industry: 25%
Healthcare: 30%
Other gov. agencies: 40%

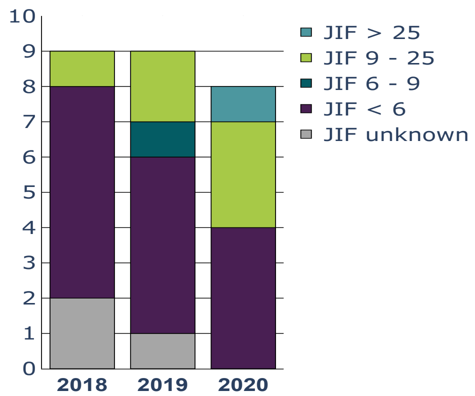
Services

- Autoantibody profiling
- Epitope mapping
- Antibody validation
- Infrastructure for commercial protein arrays
- SARS-CoV-2 Serology

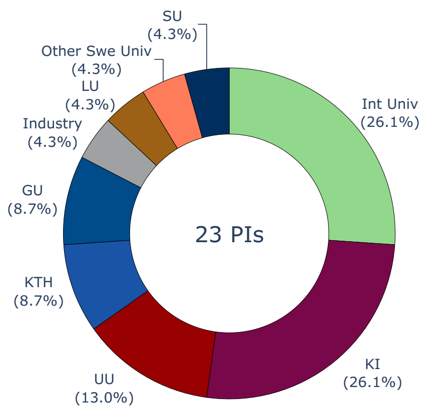
Publication by category



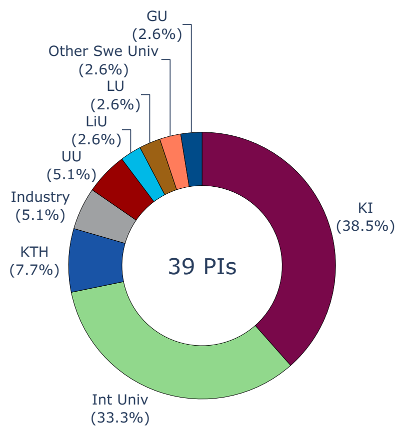
Publication by Journal Impact Factor



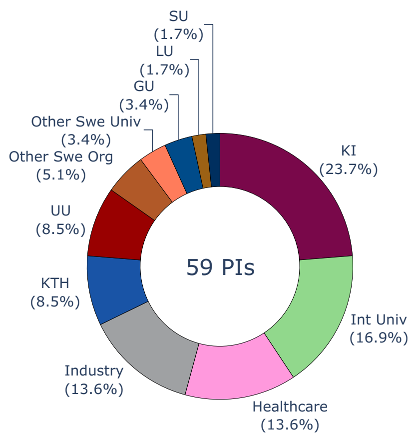
Users 2018



Users 2019



Users 2020



Chemical Proteomics

Proteomics and Metabolomics platform

Basic information

Facility director(s): Roman Zubarev
Head(s) of facility: Massimiliano Gaetani
SciLifeLab facility since: 2017
Host university: KI
FTEs: 4.33
FTEs financed by SciLifeLab: 2.13

Funding in 2020 (kSEK)

SciLifeLab: 1600
KI: 2905
VR: 2568

Total: 7073

Resource allocation 2020

Academia (national): 75%
Academia (international): 4%
Internal tech. dev.: 14%
Industry: 7%
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 1467

Reagents: 11%
Instrument: 62%
Salaries: 19%
Rent: 8%
Other: -

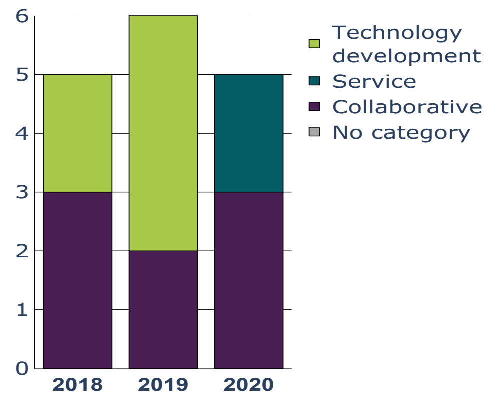
User fees by sector 2020

Academia (national): 66%
Academia (international): 6%
Industry: 28%
Healthcare: -
Other gov. agencies: -

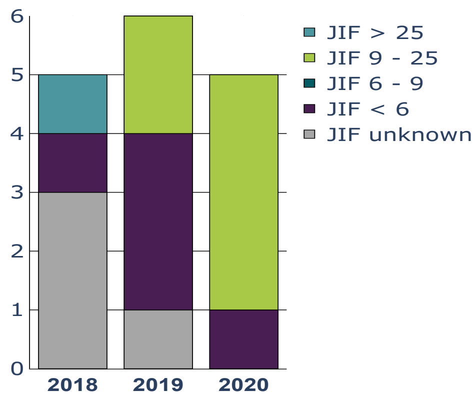
Services

- MS-based chemical proteomics for target discovery and MoA (deep, high throughput, also for low sample amount): Proteome solubility/thermal stability profiling, Expression/degradation proteomics, Interactomics, RedOx proteomics
- H/D exchange MS to map protein binding sites and conformational changes

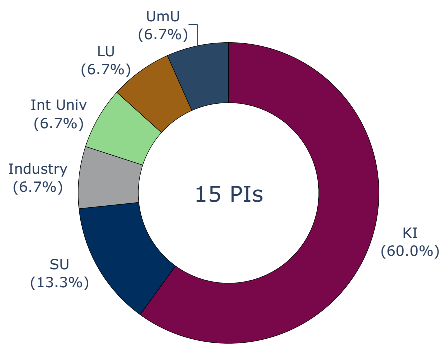
Publication by category



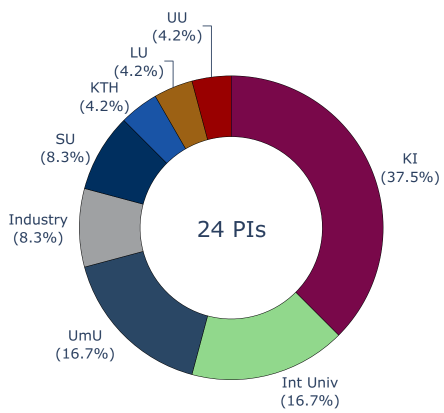
Publication by Journal Impact Factor



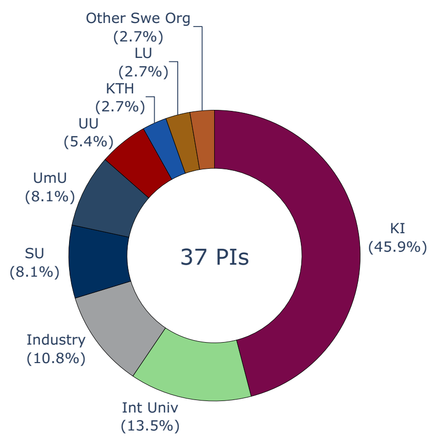
Users 2018



Users 2019



Users 2020



Mass Cytometry (KI)

Proteomics and Metabolomics platform

Basic information

Facility director(s): Petter Brodin,
Head(s) of facility: Lakshmikanth Tadepally
SciLifeLab facility since: 2015
Host university: KI
FTEs: 2.5
FTEs financed by SciLifeLab: 2.5

Funding in 2020 (kSEK)

SciLifeLab: 4000

Total: 4000

Resource allocation 2020

Academia (national): 60%
Academia (international): 30%
Internal tech. dev.: 10%
Industry: -
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 987

Reagents: 50%
Instrument: 50%
Salaries: -
Rent: -
Other: -

User fees by sector 2020

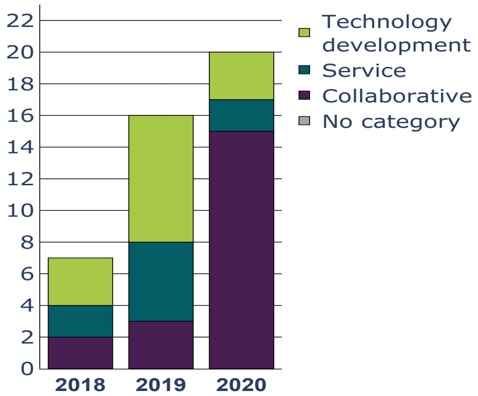
Academia (national): 100%
Academia (international): -
Industry: -
Healthcare: -
Other gov. agencies: -

Services

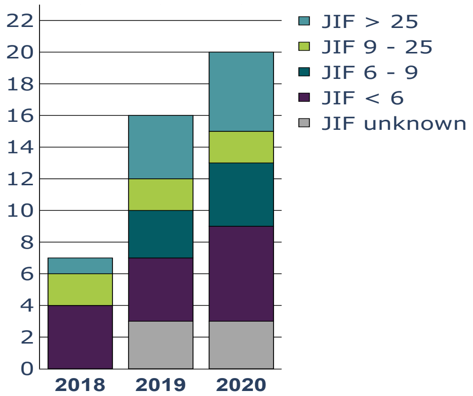
- Single-cell functional analysis based on intracellularcytokine/chemokine production
- Single-cell phenotypic analysis by mass cytometry (CyTOF)
- Single-cell phospho-proteomic analysis of intracellular signalling pathways upon drug treatment or stimulation.

Note: publication data is combined for the two Mass Cytometry facilities

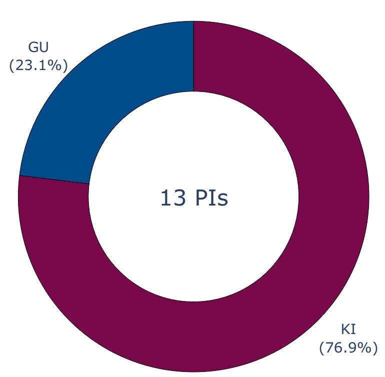
Publication by category



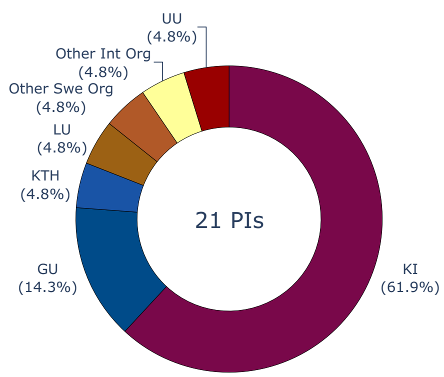
Publication by Journal Impact Factor



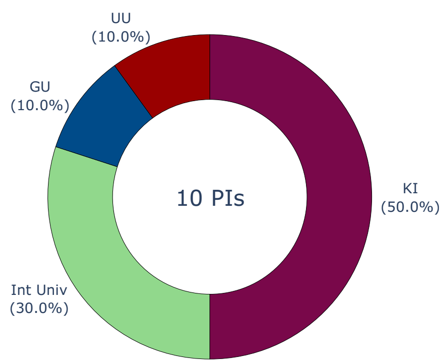
Users 2018



Users 2019



Users 2020



Mass Cytometry (LiU)

Proteomics and Metabolomics platform

Basic information

Facility director(s): Jan-Ingvar Jönsson
Head(s) of facility: Jörgen Adolfsson
SciLifeLab facility since: 2015
Host university: LiU
FTEs: 2.0
FTEs financed by SciLifeLab: 1.0

Funding in 2020 (kSEK)

SciLifeLab: 2000
LiU: 800

Total: 2800

Resource allocation 2020

Academia (national): 100%
Academia (international): -
Internal tech. dev.: -
Industry: -
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 240

Reagents: 100%
Instrument: -
Salaries: -
Rent: -
Other: -

User fees by sector 2020

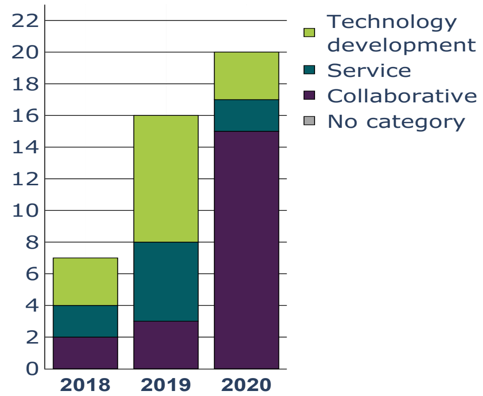
Academia (national): 100%
Academia (international): -
Industry: -
Healthcare: -
Other gov. agencies: -

Services

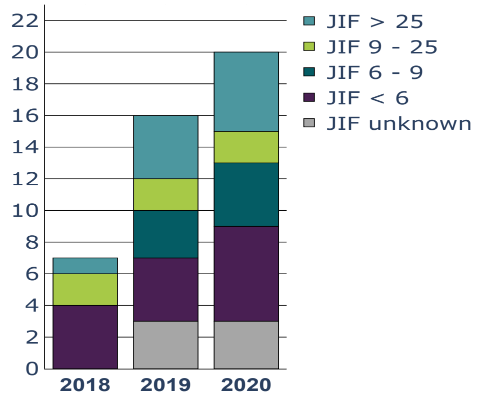
- Single-cell functional analysis based on intracellularcytokine/chemokine production
- Single-cell phenotypic analysis by mass cytometry (CyTOF)
- Single-cell phospho-proteomic analysis of intracellular signalling pathways upon drug treatment or stimulation.

Note: publication data is combined for the two Mass Cytometry facilities

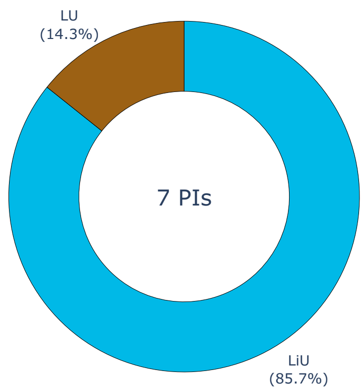
Publication by category



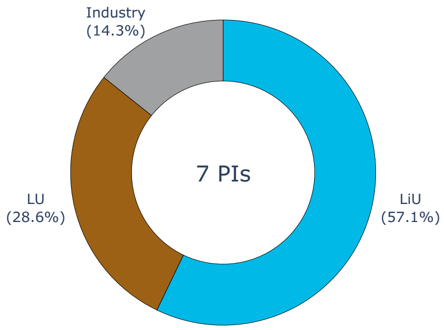
Publication by Journal Impact Factor



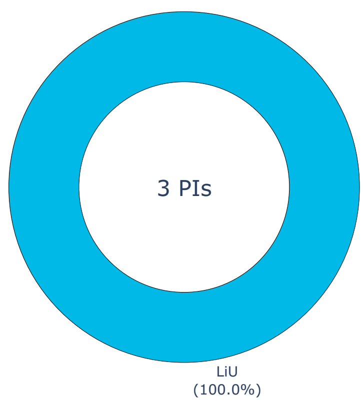
Users 2018



Users 2019



Users 2020



PLA and Single Cell Proteomics

Proteomics and Metabolomics platform

Basic information

Facility director(s): Masood Kamali-Moghaddam
Head(s) of facility: Maria Hammond
SciLifeLab facility since: 2013
Host university: UU
FTEs: 3.5
FTEs financed by SciLifeLab: 3.25

Funding in 2020 (kSEK)

SciLifeLab: 3800
UU: 400

Total: 4200

Resource allocation 2020

Academia (national): 73%
Academia (international): 7%
Internal tech. dev.: 20%
Industry: -
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 287

Reagents: 75%
Instrument: 5%
Salaries: 5%
Rent: -
Other: 15%

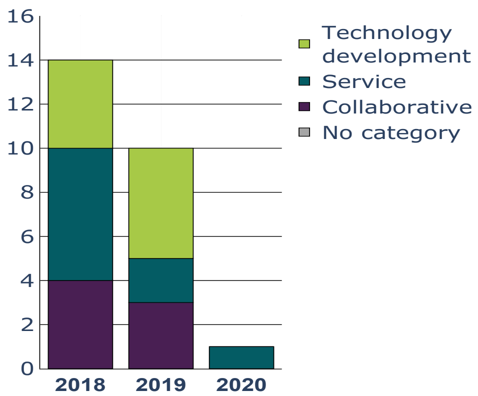
User fees by sector 2020

Academia (national): 41%
Academia (international): 59%
Industry: -
Healthcare: -
Other gov. agencies: -

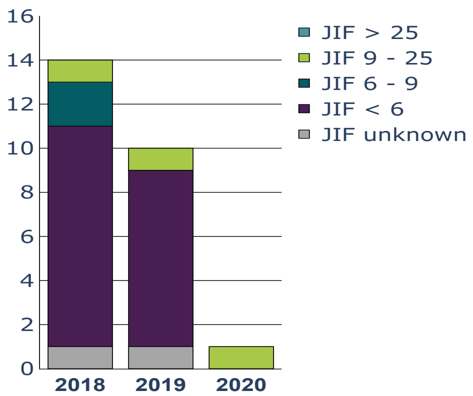
Services

- In situ PLA applied for detecting proteins, their interactions and post-translational modifications in fixed cells or tissues
- Protein detection in body fluids or lysates using PEA
- Custom conjugation of oligonucleotides to antibodies for customized PLA, PEA, or CITE-seq
- Validation, optimization and assay development using client-selected antibodies

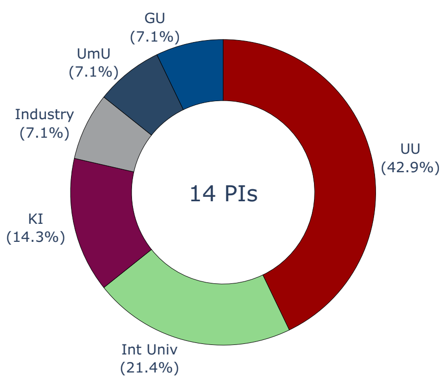
Publication by category



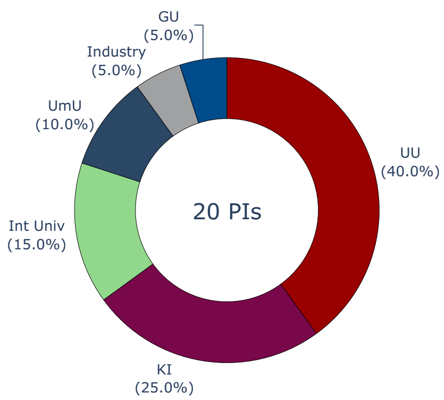
Publication by Journal Impact Factor



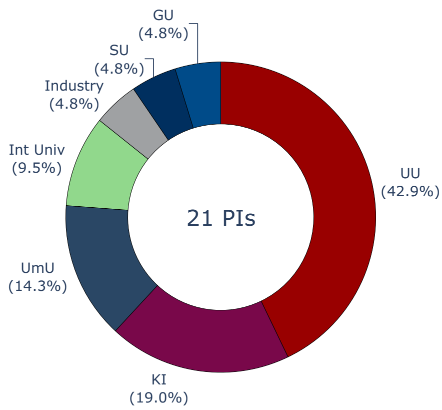
Users 2018



Users 2019



Users 2020



Proteogenomics

Proteomics and Metabolomics platform

Basic information

Facility director(s): Janne Lehtiö
Head(s) of facility: Maria Pernemalm
SciLifeLab facility since: 2017
Host university: KI
FTEs: 6.56
FTEs financed by SciLifeLab: 1.57

Funding in 2020 (kSEK)

SciLifeLab: 3000
County council: 3175
KI: 1850
VR: 3832

Total: 11857

Resource allocation 2020

Academia (national): 80%
Academia (international): 5%
Internal tech. dev.: 15%
Industry: -
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 2680

Reagents: 36%
Instrument: 43%
Salaries: 18%
Rent: 3%
Other: -

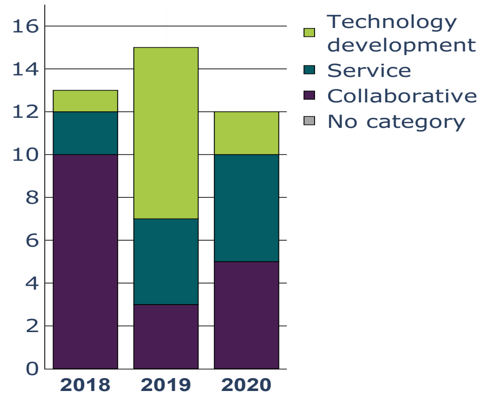
User fees by sector 2020

Academia (national): 93%
Academia (international): 7%
Industry: -
Healthcare: -
Other gov. agencies: -

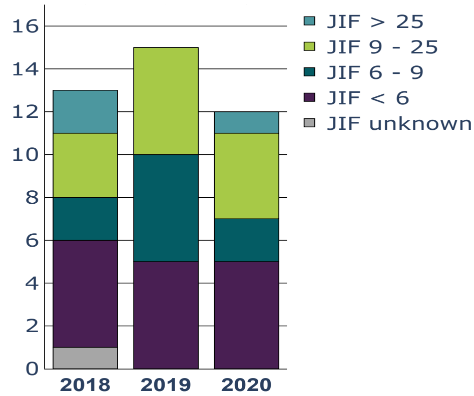
Services

- Unbiased proteogenomics in any species with asequenced genome
- Personalized proteomics. Variant analysis at the protein level coupled with in-depth quantitative proteomeanalysis
- Disease state/Variant proteomics. Database supplemented with all known SNPs and disease causing genetic alterations
- XenoProteomics

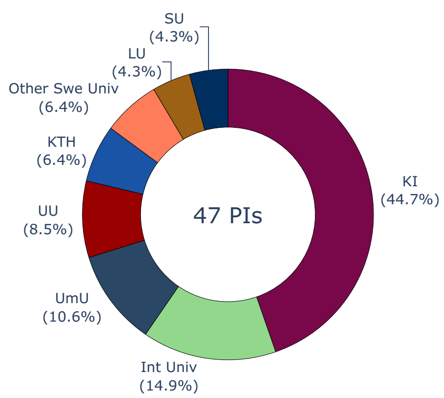
Publication by category



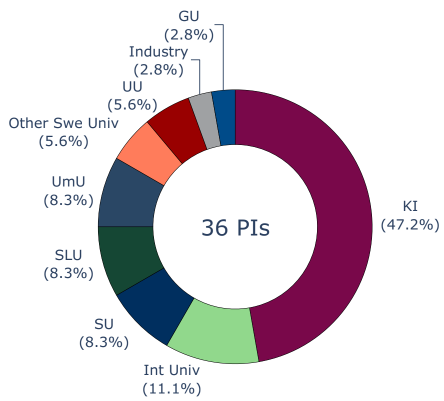
Publication by Journal Impact Factor



Users 2018



Users 2019



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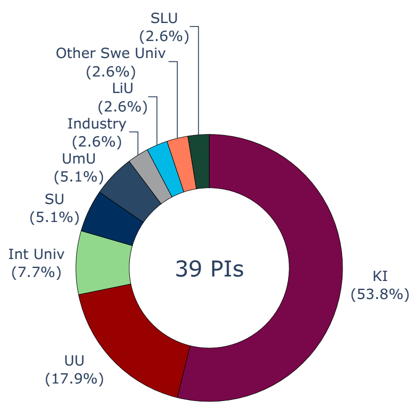


Swedish Metabolomics Centre

Proteomics and Metabolomics platform

Basic information

Facility director(s): Thomas Moritz, Anders Nordström
Head(s) of facility: Annika Johansson
SciLifeLab facility since: 2017
Host university: SLU, UmU, Chalmers
FTEs: 6.5
FTEs financed by SciLifeLab: 1.2

Funding in 2020 (kSEK)

SciLifeLab: 3600
Chalmers: 350
KAW: 7000
SLU: 2000
UmU: 2000

Total: 14950

Resource allocation 2020

Academia (national): 77%
Academia (international): 2%
Internal tech. dev.: 20%
Industry: 1%
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 3600

Reagents: 20%
Instrument: 40%
Salaries: 30%
Rent: 10%
Other: -

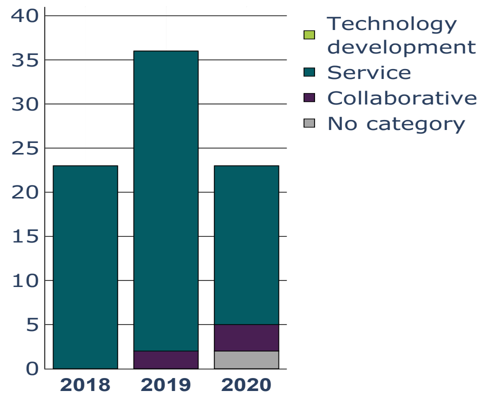
User fees by sector 2020

Academia (national): 95%
Academia (international): 1%
Industry: 4%
Healthcare: -
Other gov. agencies: -

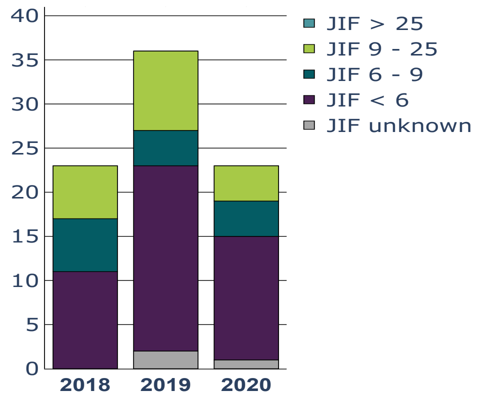
Services

- Untargeted and targeted metabolite profiling
- Targeted lipid profiling
- Study design and method development
- Basic statistics
- Open lab access services

Publication by category



Publication by Journal Impact Factor



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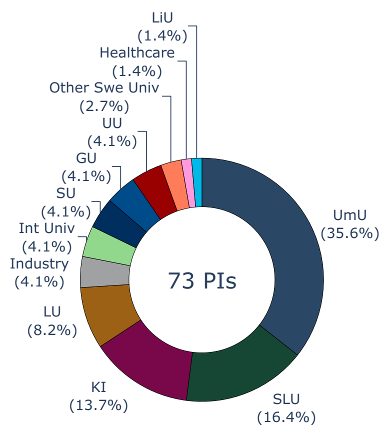

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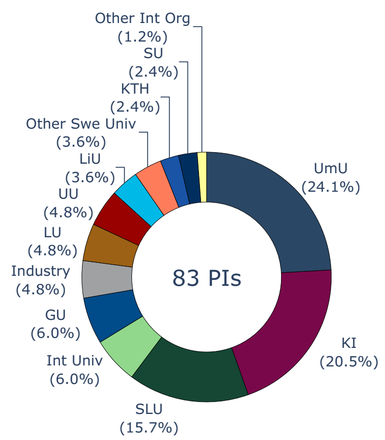

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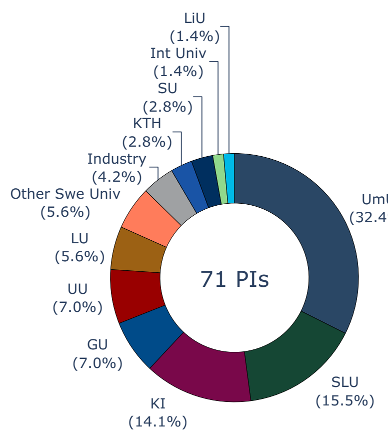


Translational Plasma Profiling

Proteomics and Metabolomics platform

Basic information

Facility director(s): Jochen Schwenk
Head(s) of facility: Claudia Fredolini
SciLifeLab facility since: 2013
Host university: KTH
FTEs: 4.1
FTEs financed by SciLifeLab: 4.1

Funding in 2020 (kSEK)

SciLifeLab: 3200
KAW: 850

Total: 4050

Resource allocation 2020

Academia (national): 70%
Academia (international): 5%
Internal tech. dev.: 25%
Industry: -
Healthcare: -
Other gov. agencies: -

User Fees 2020

Total (kSEK): 8112

Reagents: 85%
Instrument: 11%
Salaries: -
Rent: 3%
Other: 1%

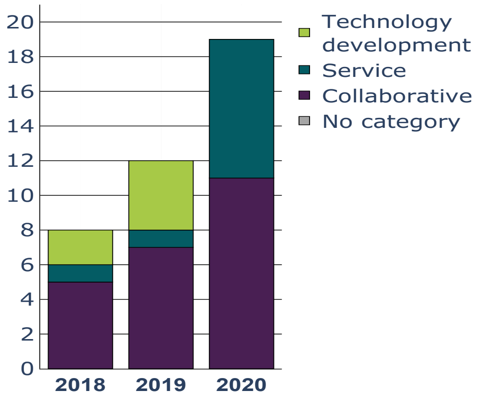
User fees by sector 2020

Academia (national): 94%
Academia (international): 6%
Industry: -
Healthcare: -
Other gov. agencies: -

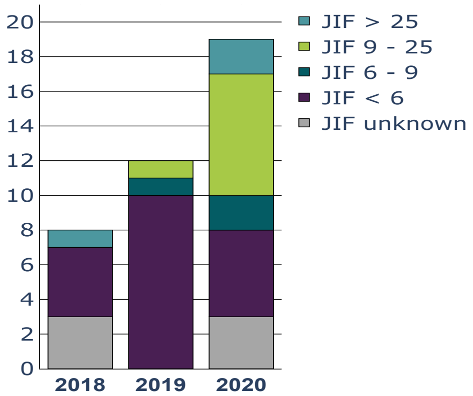
Services

- Discovery and validation of circulating biomarkers (all)
- High-throughput protein profiling (Olink, Luminex)
- Quantitative protein analyses (Quanterix, Luminex, ProteinSimple, Olink)
- Development of novel and customized immunoassays (all)
- Consultation about protein analysis by affinity proteomics (all)

Publication by category



Publication by Journal Impact Factor



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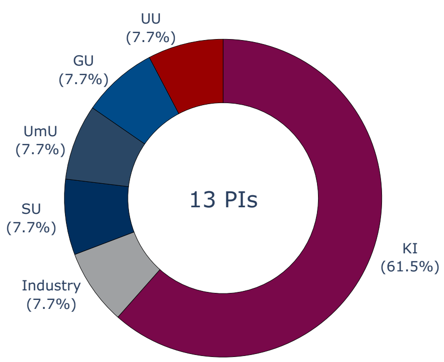

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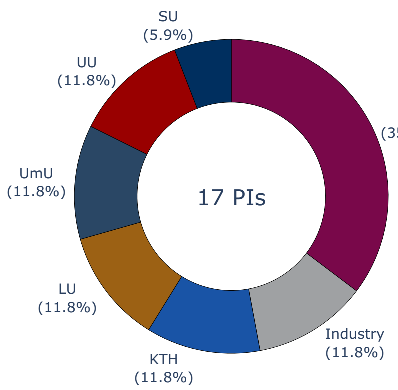

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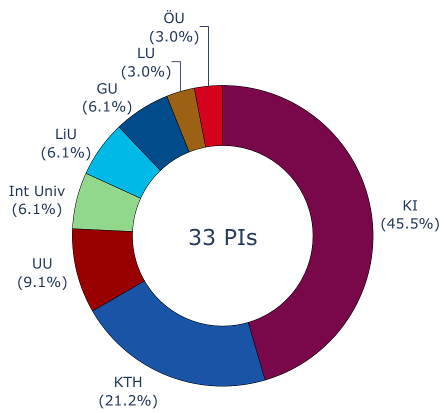

Appendix K.

SciLifeLab Group Leader Definition (SciLifeLab Board Protocol from 2019-11-11)

Appendix C:

Definition of SciLifeLab group leader

Background:
As a national infrastructure, Science for Life Laboratory is composed of infrastructure that serves, as well as is developed by the research community. Strong connections between research and infrastructure platforms are crucial to ensure long-term usage and to keep the platform technologies cutting edge. A clear definition of SciLifeLab group leaders, composing the associated research community, is necessary for defining the profile of the SciLifeLab community. For this, the inclusion criteria, as well as the responsibilities and benefits for a group leader need to be clarified and harmonized across the two nodes in Uppsala and Stockholm, but also for allowing scientists at the other universities in Sweden to join the SciLifeLab community. The words “faculty” and “PI” will not be used since these are defined differently at each university and often do not take into account infrastructure and technology expert roles.

Objective:
Define SciLifeLab group leader in a way that is inclusive, logical, easy to understand, but that also regulates the responsibility that comes with the definition.

Definition:

A group leader at SciLifeLab is defined by the following three criteria:

1. Doctoral degree in a relevant research area and relevant post PhD research experience.
2. Scientific and financial responsibility for a research group in Life Science, consisting of at least two other persons, or least one of the technology platforms or a facility at SciLifeLab.
3. Documented strong affiliation to SciLifeLab, by an active, close working relationship with SciLifeLab research and infrastructure that contribute to the scientific development of SciLifeLab. Preferably, with a physical presence at the Stockholm, Uppsala or any of the other national nodes or otherwise documented strong contribution to SciLifeLab development.

Opportunities and benefits of a SciLifeLab Group Leader:

1. To be formally designated as a SciLifeLab research group and presented at the SciLifeLab web site.
2. Opportunity to join SciLifeLab events such as internal group leader workshops.
3. Part of SciLifeLab general mailing list and community outreach.

Responsibility as SciLifeLab Group Leader:

1. Include SciLifeLab together with the university affiliation on all scientific publications.
2. Cooperate with the SciLifeLab management by updating information on the SciLifeLab web-site regularly and reporting figures necessary for official reports, such as number of researchers, extent of external funding as well as publications.
3. Take an active part in fostering the SciLifeLab community, for example by

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organizing and attending seminars, workshops and other community activities.

4. Comply with good ethical, scientific and infrastructure practices.

Governance

Each of the four host university SciLifeLab committees nominate researchers from their own university as SciLifeLab group leaders to the respective Scientific director. Nominations as SciLifeLab group leaders from non-host universities are sent to the co-director of SciLifeLab. Platform directors can nominate facility directors and related people in the platforms as SciLifeLab group leaders to the infrastructure director. Nominations are welcomed throughout the year. The management group subsequently decides on whether to approve the nominees as SciLifeLab group leaders. The fulfilment of the criteria listed above will be evaluated every second year and if status has changed the affiliation can be terminated. It is possible to re-apply one year after the termination if the criteria are full-filled.

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Appendix L.

SciLifeLab Fellows Program Survey 2020–2021

Contents

1. Introduction

The SciLifeLab Fellows program is a career program that was initiated in 2014, and aims at strengthening Swedish research in Molecular Biosciences with a long-term perspective of making a tangible societal impact. The SciLifeLab Fellow positions are appointed in international competition, where the positions are announced in international media, coordinated by SciLifeLab and the host university. This is also reflected in the fact that 92% (35 of 38) of Fellows that have been recruited to the program so far have international experience, either through an international PhD (24/35 Fellows) or post-doc (31/35 Fellows). Recruitment and appointment of the positions are operated by the host universities according to common routines, with an MG representative adjunct in the respective appointments board. The substantial starting package (3M SEK per year for four years + up to SEK 2 million per year for two years, with some variation due to host-university specific agreements, funded by SFO-funds at the four founding universities) is key when recruiting these excellent young researchers to the program. As to June 2021, the program has led to the recruitment of 38 young PIs that are employed at different Swedish universities (Chalmers, KI, KTH, SLU, SU, UmU and UU), of which 6 have completed the program, 29 are active in the program and 3 are recently recruited and have preliminary starting dates in the autumn 2021 or spring of 2022.

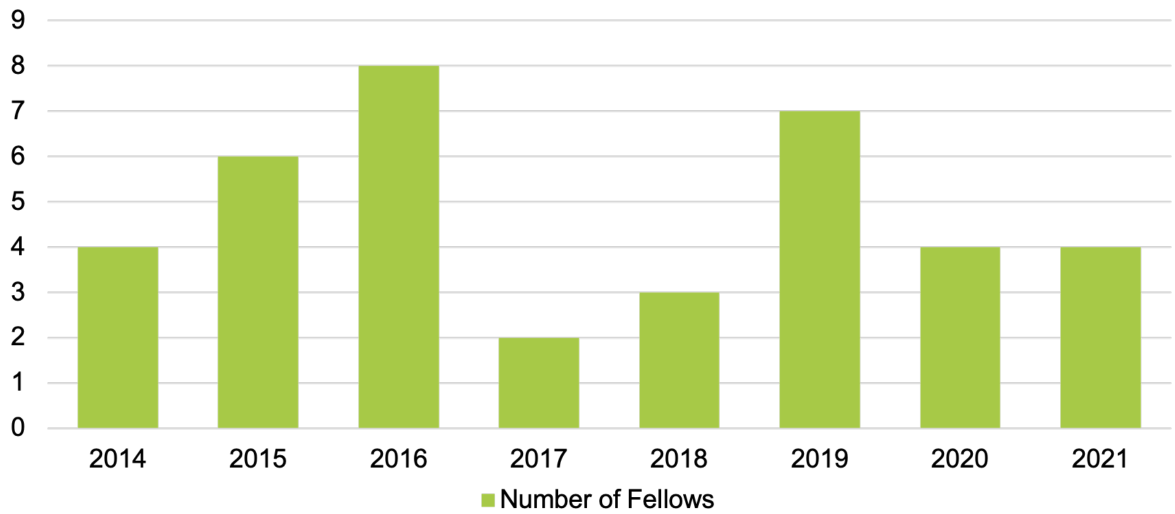


Figure 1. Number of recruitments per year to SciLifeLab's Fellow program 2014-2021 (total 38 Fellows).

2. SciLifeLab Fellow program survey

The SciLifeLab Fellows program is essential for the SciLifeLab profile, and SciLifeLab actively works to continuously promote and advance the program further in close collaboration with the four founding universities.

In 2020-2021, SciLifeLab conducted a survey of the SciLifeLab Fellow program with the aim of gathering information to measure how successful the SciLifeLab Fellows program has been, as well as finding out how the program can be further developed. The survey, that focused on the program as a whole, was important for several reasons: I) motivating the founding universities to continue to fund the program; II) formulating recommendations for the future of the SciLifeLab Fellows program and for the SciLifeLab & Wallenberg National Program for Data-Driven Life Science; III) documenting information of value for other career programs; and IV) to support communication with funding agencies.

The survey included three major parts:

- Questionnaires to key stakeholders
- Fellows grants received during 2014-2020
- Bibliometric analyses focused on output and impact of Fellows' research

The results of the complete survey are found in this report.

This is version no. 1 of the report, dated 210907. Written by Disa L. Hammarlöf, Alice Sollazzo, Liane Hughes and Johan Rung, approved by Olli Kallioniemi (Director) and Mia Phillipson (Co-Director).

3. Questionnaires to key stakeholders

3.1 How information was collected

The SciLifeLab Fellows program encompasses several aspects that are important to monitor. Those include the Fellows recruitment process, funding opportunities, interaction with host universities, interaction with SciLifeLab's research community, collaboration with the infrastructure, teaching tasks, and leadership skills. To monitor these aspects, to get a good overview of the overall importance of the program and potential further developments, information from three key stakeholders was gathered: I) SciLifeLab Fellows, II) Host university representatives, and III) SciLifeLab Infrastructure.

To assure that all of the important aspects of the program were addressed, a working group was created, composed of SciLifeLab's Co-Director, four Fellow representatives, and two Operations office coordinators. The working group designed three different questionnaires in close collaboration with SciLifeLab's Management Group and the Operations Office Infrastructure coordinator.

The different questionnaires were sent to I) SciLifeLab Fellows, II) Host university representatives (Fellows' Head of department and SciLifeLab committee members), and III) Infrastructure (Heads of units and Unit Directors) in April 2021.

The three questionnaires can be found via the following links:

- SciLifeLab Fellows program Survey - Fellows
- SciLifeLab Fellows program Survey - Host university representatives
- SciLifeLab Fellows program survey - Infrastructure

3.2 Questionnaire to Fellows

The questionnaire directed to the Fellows focused on the following aspects: Recruitment process, Interaction with SciLifeLab, host universities, and the wider research community, Funding possibilities, Teaching, Leadership skills, Major contribution to the intellectual environment at SciLifeLab and host university, Engagement in SciLifeLab's efforts to combat COVID-19, and Suggestions on how the program can be further improved and developed. The questionnaire was completed by 30 Fellows.

3.3. Summary of the Fellows' answers

The Fellows program can be described as dynamic, with some Fellows being newly recruited, some Fellows are at the end of the program, while others have become alumni. Of the 30 (out of 35) Fellows who answered the questionnaire, there was an even representation of Fellows from the different phases in the program (*Figure* 2).

Recruitment phase

To recruit international and excellent researchers requires broad announcements of the positions, and a prompt and organized recruitment process ensuring that the top candidates do not accept other positions.

SciLifeLab Fellows positions are internationally announced, and the questionnaire show that many Fellows learnt about the open positions through advertisements in job portals and advertisement on the host university web-page, even though most were informed via recommendation from a colleague (*Figure* 3). Further, 20 out of 30 responding Fellows reported that they did not live in Sweden when applying for the Fellow position, and 19 state that they only moved to Sweden due to the SciLifeLab Fellow position offer (*data not shown*). This clearly demonstrates the importance of the Fellows program for recruiting international research excellence.

Overall, the recruitment process is considered to be at a satisfactory standard by the Fellows, including communication and involvement from both SciLifeLab and host universities, even though there are room for improvements for all measured parameters (*Figure* 4).

Among the reason why Fellows choose to accept the offer to join the program, the generous program starting package was considered the most important factor, followed by the scientific environment offered by SciLifeLab, the proximity to SciLifeLab infrastructure and the scientific environment provided by the host university

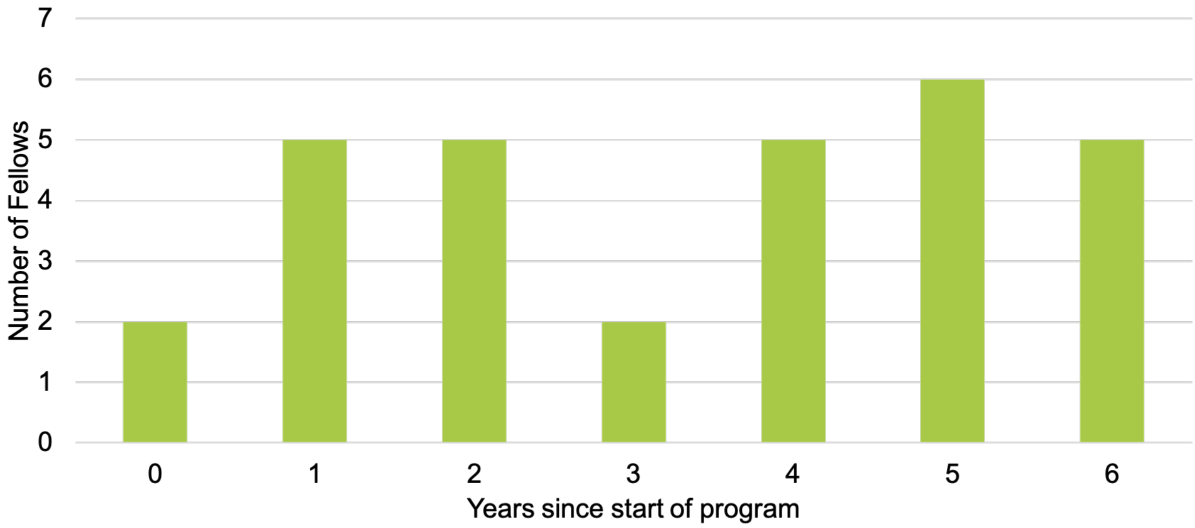


Figure 2. Active time in the Fellows program by the Fellows that completed the survey. Zero represent the starting year. The Fellows in year 6 have completed the program and are now alumni.

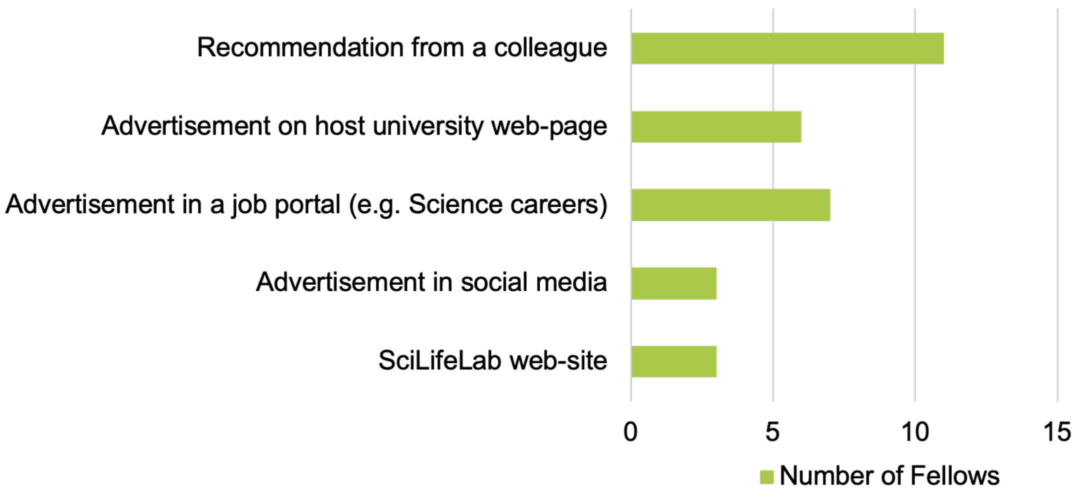


Figure 3. How the Fellows first learnt about the possibility to apply for an open SciLifeLab Fellows position.

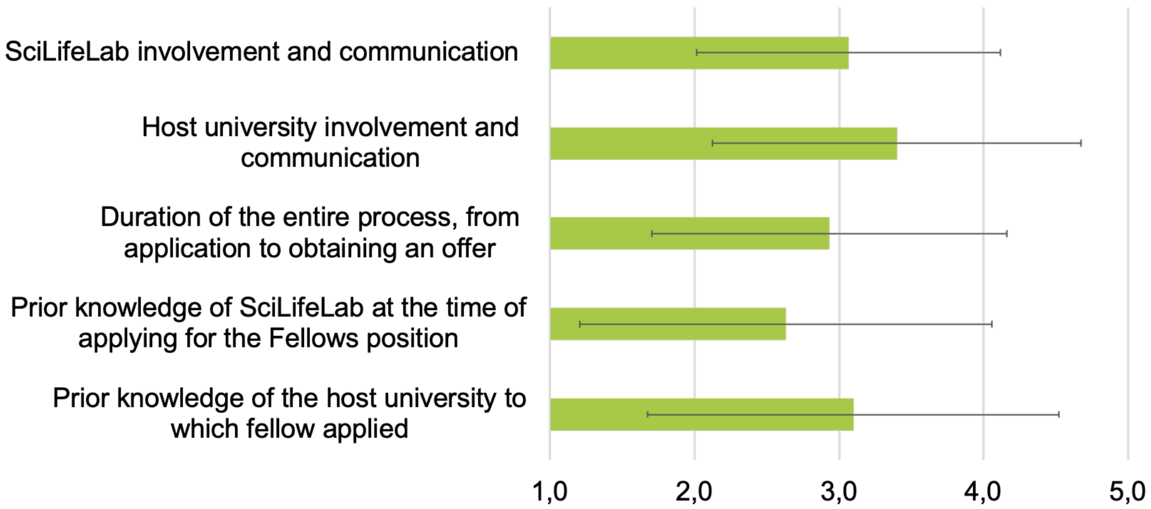


Figure 4. How the Fellows rate the recruitment phase (1-5, poor – excellent).

(*Figure* 5). Notably, the tenure track position was not one of the main reasons to accept the SciLifeLab fellowship. However, it must be noted that, the lack of tenure track position offered by some university has been of concern for several Fellows later in the program.

Interaction with SciLifeLab Infrastructure, host universities, and the wider research community

One of the main aims of the program is that SciLifeLab Fellows, can strengthen both the research and technology development of the SciLifeLab infrastructure, as well as of the wider research community. The questionnaire shows that the Fellows research interests are highly compatible with the technological focus of SciLifeLab infrastructure, and that their research thrive in SciLifeLab's intellectual environment (*Figure* 6).

It is clear that the Fellows have actively engaged in establishing collaboration with, as well as developed SciLifeLab's infrastructure. 13 out of the 30 Fellows have engaged in collaboration with SciLifeLab units, where 6 of these Fellows engage in at least two of the following activities: 10% of the respondents are part of the key research community of the facility, 7% have applied for technology development project funding, 15% of the Fellows participated in creating a facility service and 30% shared application with a SciLifeLab infrastructure (*Figure* 7).

In total, 80% of the Fellows have used SciLifeLab's infrastructure, and on average Fellows have used at least two units. Most highly used units for service are: Compute and Storage (8 users), National Genomics Infrastructure (5 users) and Bioimage Informatics (3 users), and Fellows have collaborations with the following units: Cryo-EM, Advanced Light Microscopy (ALM), High Throughput Genome Engineering, National, Genomics Infrastructure, Protein Science Facility (PSF), National Genomics Infrastructure, Bioimage Informatics, DDD, Cryo-EM, Eukaryotic Single Cell Genomics, Protein Science Facility (PSF) (*data not shown*).

SciLifeLab Fellows have also been very active in establish collaborations within their host university (24 of 30 respondents), between host universities as well as internationally. During their Fellowship time, 80% of Fellows have established research collaborations such as traditional bi-lateral intensive collaborations or small intensive consortia with high significance for their own work (*Figure* 8).

Fellows also actively engage in administrative tasks at their host university, where 83% (25/30) take part in committees or working groups at their host department, for example in Facility steering committee, Coordinating research centers, Education board/PhD committees, SFO committee, Working environment group and Department strategy groups (*data not shown*).

Funding

The start-up package is generally considered by the Fellows to provide sufficient funding for starting an independent group (4.3±1.0 on scale 1-5, insufficient – optimal). To quote one Fellow in the survey "*The funding package provides a good start with funds that are not earmarked*". Also, one Fellows estimate to have used the funding according to *Figure* 9.

All Fellow respondents have applied for Swedish and international grants, and based on reported estimated numbers of applied and awarded grants, the average success rate is 47% for Swedish grants and 69% for international grants (*Figure* 10). 83% of Fellow respondents have applied for grants with collaborators (*data not shown*). The complete lists and graphs of Fellows grants and grant givers during 2014-2020 based on economical reporting is shown in the section 4. *Fellows grants received during 2014-2020*.

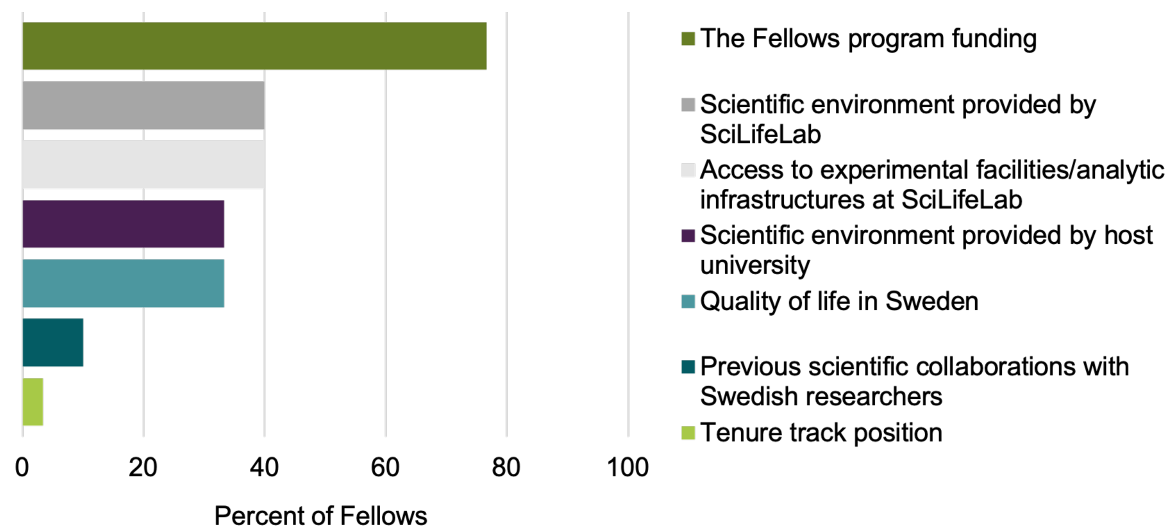


Figure 5. The major reasons why the SciLifeLab Fellows decided to accept the offer to join the program.

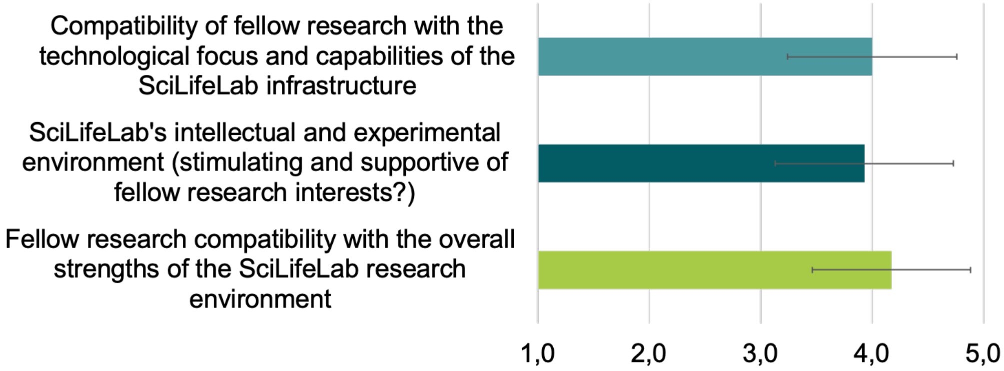


Figure 6. Fellows' compatibility with SciLifeLab (scale 1-5; compatibility poor - excellent fit; intellectual and experimental environment insufficient – highly stimulating; Fellow research combability poor fit – excellent fit).

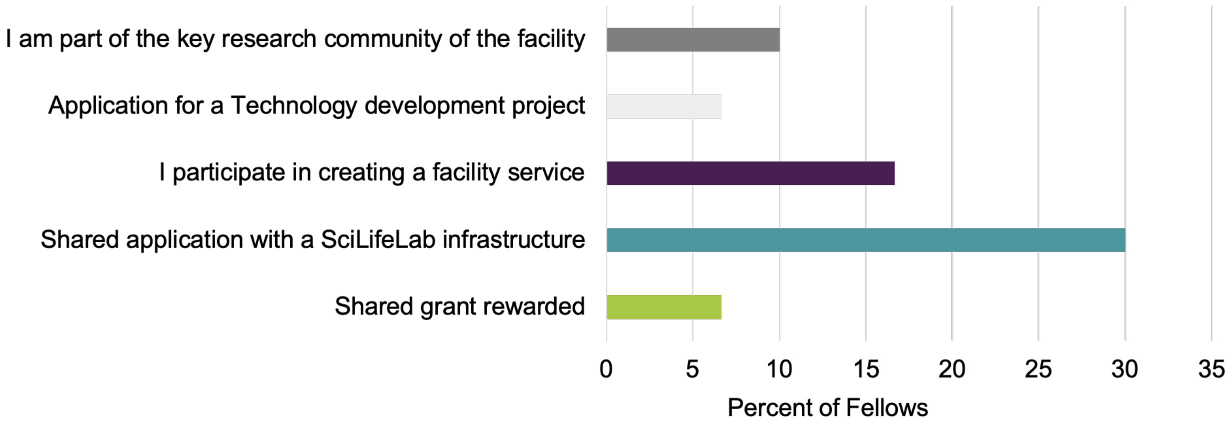
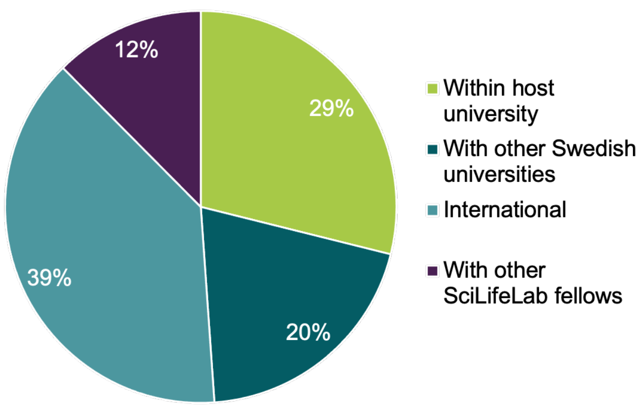


Figure 7. Activities Fellows have engaged with in collaboration with SciLifeLab's infrastructure.



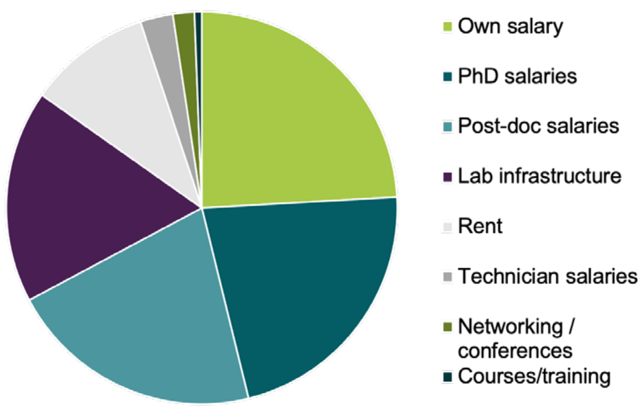


Figure 8. Nature of Fellows' collaborations with high significance for their own work (n=225).

Figure 9. Use of Fellow program funding (SFO), percent of grant.

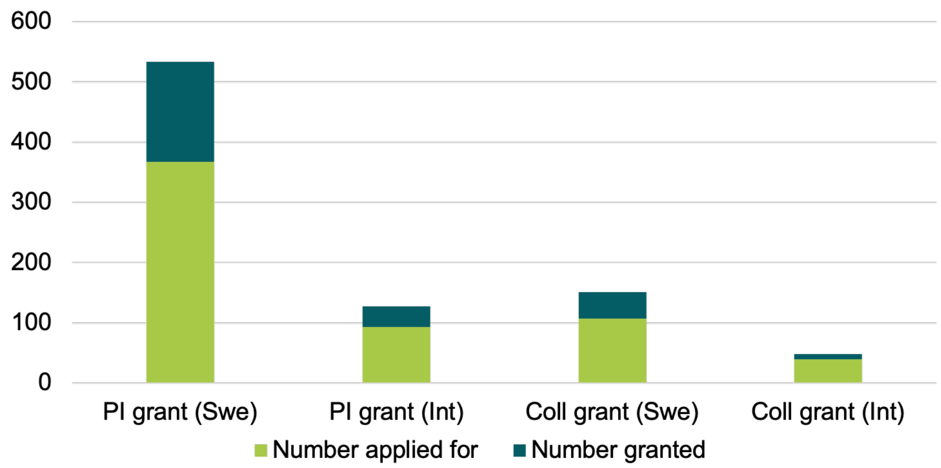


Figure 10. Estimated number of grants applied for and granted to the Fellow individually (PI), or in collaboration (Coll), from Swedish (Swe) and international (Int) funding agencies during their Fellow time, as reported by the Fellow respondents.

PhD supervision, teaching and pedagogic meriting

As academic group leaders, Fellows are responsible for supervision of PhD students, and they supervise on average 5 PhD students at their own university. In addition, two thirds of the Fellows supervise PhD students affiliated to another Swedish university *(data not shown)*. In 2020, the Fellows actively supervised 86 PhD students in total, with nine of them completing their PhD degree. In addition, seven PhD students were co-supervised by Fellows and completed their PhD degrees the same year (data from Annual Report 2020 in Swedish).

Twenty-nine of 30 respondents have contributed to teaching activities at their host university and 20/30 have also taught at non-host universities. The Fellows report that they devote 14±6% of their time to teaching, at undergraduate, post-graduate, Master's and PhD level, and consider this to be an acceptable teaching load (3±0.8, scale 1-5, no teaching – too much teaching, *Figure* 11). 48% have developed new teaching methods and 73% have developed new courses related to their field of research. Fellows apply several Interactive teaching methods (eg. Mentimeter and polls), video lab exercises, remote teaching via zoom (during the pandemic), peer-evaluation, development of teaching platform, etc. *(Figure 11)*.

Importantly, 28% of the Fellows state to have not been offered a sufficient amount of teaching to qualify for promotion, where hindrances identified are that requirements for promotion are unclear and difficulty to integrate in existing courses (although most Fellows consider that they have been integrated in and contribute to teaching at their host university, *Figure* 11). This issue has been brought to the attention of respective SD to communicate with the Fellows' departments.

Leadership

To become established as a researcher in Sweden, it is important that the Fellows develop leadership and administrative skills. 24/30 respondents have taken part in a leadership course, either organized by SciLifeLab (14 Fellows), host university, or other organization (EMBO, The Foundation for Strategic Research (SSF)). Twenty-seven of the 30 Fellows report to take part in various administrative responsibilities (*Figure* 12).

Fellows' reported major contributions and suggestions to improve program

As a final part of the questionnaire, the Fellows were asked to consider what has been their major contribution to the intellectual environment at SciLifeLab and at their respective host university, how they suggest that SciLifeLab's Fellow program can be developed, and how they have engaged in the SciLifeLab efforts in combatting the COVID-19 pandemic. The answers are summarized below *(based on free text)*.

Fellows' reported major contribution to the intellectual environment at SciLifeLab:

- *New research/topics, models and knowledge*
- *Innovative interdisciplinary projects and scientific approaches*
- *Technology development*
- *Interaction with the core facilities to co-develop new methods*
- *Actively engaged in the community*
- *Share of expertise, actively participate in meetings, take part in committees/working groups*
- *New collaborations*
- *Presenting SciLifeLab at external events in Sweden and abroad*
- *Publications*

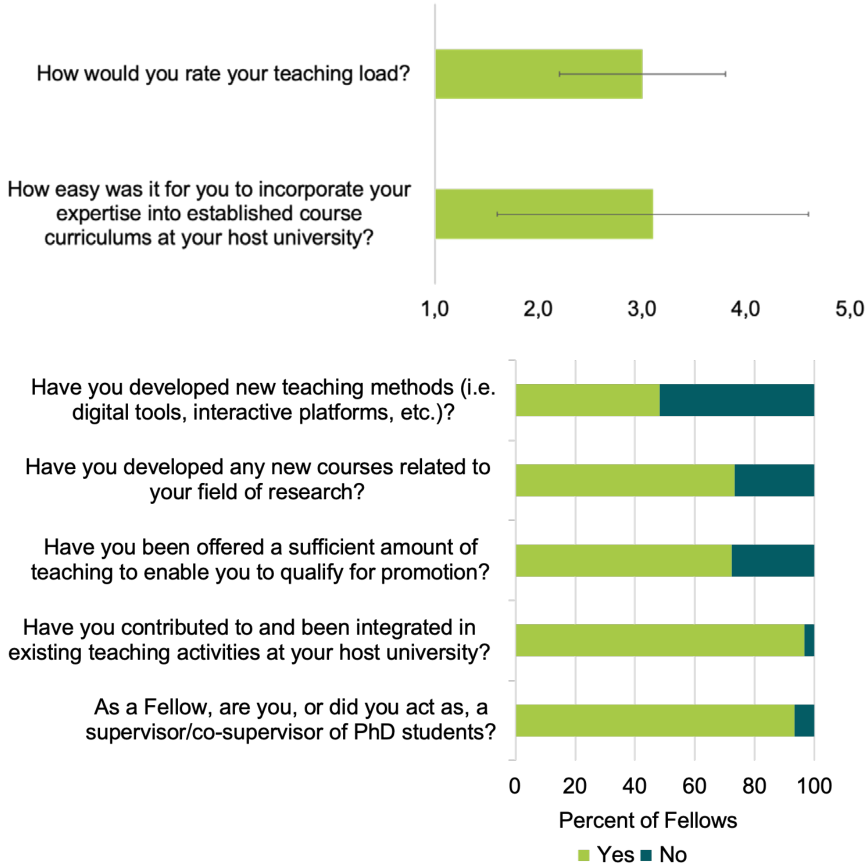


Figure 11. Fellow teaching. Upper panel: Fellow rating of teaching load (scale 1-5, no teaching – too much teaching) and opportunity given to develop course curriculums based on their expertise (scale 1-5, very difficult - very easy). Lower panel: Fellows reported teaching and supervision activities (percentage of Fellows respondents).

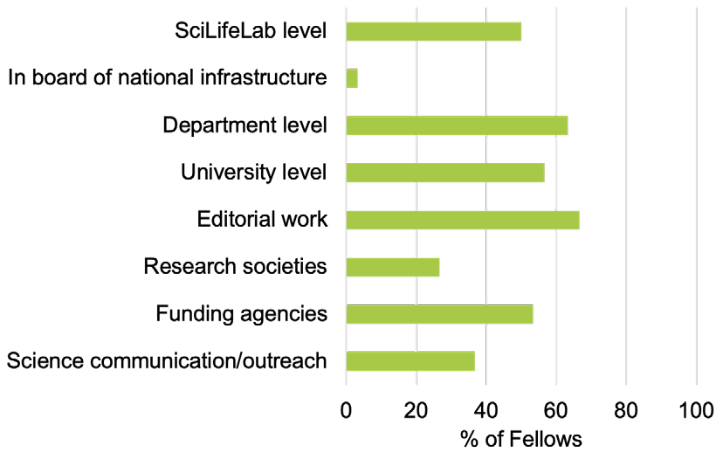


Figure 12. Fellows' administrative responsibilities.

Fellows' reported major contribution to the intellectual environment at host university

- *Expertise (in various research areas, computational skills), novel techniques, model systems*
- *Bridge different scientific areas and interdisciplinary approaches (eg. computational and experimental)*
- *Support to colleagues in scientific discussions and technologies*
- *Good fit with departmental courses/teaching*
- *Departmental management and structuring of communication*
- *Enthuse and engage in community*
- *Ambassador for host university and abroad and at symposia organized in Sweden, publications*

Fellows suggestion on how the Fellow program be improved

- *Improved onboarding regarding locality assignment during (pre program start)*
- *Information regarding Swedish funding for junior group leaders, preferably pre-start of Fellow position (Comment: we plan to have annual grant days at SciLifeLab to support our community in interaction with grant agencies and to guide them to what is available)*
- *Mentoring: Host university & SciLifeLab mentor*
- *"support in navigating host institutions policies, easing the hard-to-access university regulations"*
- *Better introduction to SciLifeLab infrastructure units (Comment: plans for open infrastructure day)*
- *Access to shared instruments (Comment: survey carried through at CS by Site Support to update info on shared instruments)*
- *Follow-up meetings with host university and SDs (Comment: since 2021 follow-up meeting at year 1-2 with Fellow, HoD & SD)*
- *Networking*
- *More involvement of SciLifeLab and its community*

Fellows engagement in SciLifeLab's efforts to combat COVID-19

Seven out of 30 respondents reoriented their research to engage in new studies addressing COVID-19. Their studies focused on for example immune cell memory responses, immune cell markers in COVID-19 (clinical PET study in preparation, treatment options, virus diagnosis, molecular basis of viroprotein function, Sars-Cov2 sequencing. Several projects were funded through SciLifeLab's KAW-supported national COVID-19 research program, for example the set-up and validation of an efficient, low-budget and reliable virus diagnosis test that will be used in developing countries.

3.4 Summary of host university representatives' answers

The questionnaire was completed by 25 representatives from the host universities (nine Fellows' Head of department, two Integration Directors and 14 SciLifeLab host university committee members).

SciLifeLab Fellows' host university engagement

The host university representatives consider Fellows to overall engage and contribute to the host university functions and activities, especially by improving the quality of teaching and by developing and share new techniques.

Importance of the Fellow program for the host universities

Host universities consider the SciLifeLab Fellow program for junior faculty to be a very good investment, and recruitment of these excellent researchers would have been difficult without the SciLifeLab Fellow program (*Figure 14*).

As a final part of the survey to the Host university representatives, they were asked to report the major associated advantages to the program, and how it could be improved (*free text, below*).

Major advantages associated with the SciLifeLab Fellows program

From the host university perspective, the major advantages associated with the SciLifeLab Fellows program are (*based on free text*):

- *Recruitment of excellent researchers*
- *Build, renewal and expansion of a strong research community*
- *Strong links to SciLifeLab, within & between universities, nationally and abroad*
- *"The international recruitment (good visibility and reputation), the excellent starting package, and the fact that the Fellows become part of a community (that could be made even stronger).*
- *"We hire highly competent young researchers that have the opportunity to fast and efficiently build up a research group of their own and develop as scientists."*
- *"The program offers security to young recruits for a 4-6 year period, which is necessary to develop excellence. Thus, the financial package contributes to scientific excellence.*

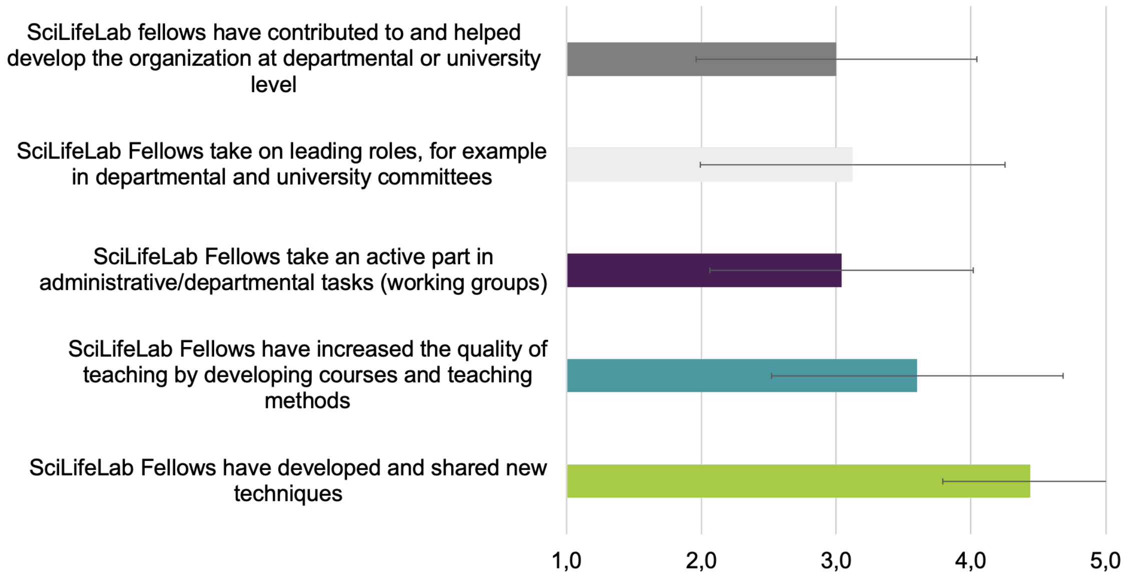


Figure 13. Contributions of the SciLifeLab Fellows to the intellectual environment at the hosting university (scale 1-5, Strongly disagree - Strongly agree), as reported by the host university representatives.

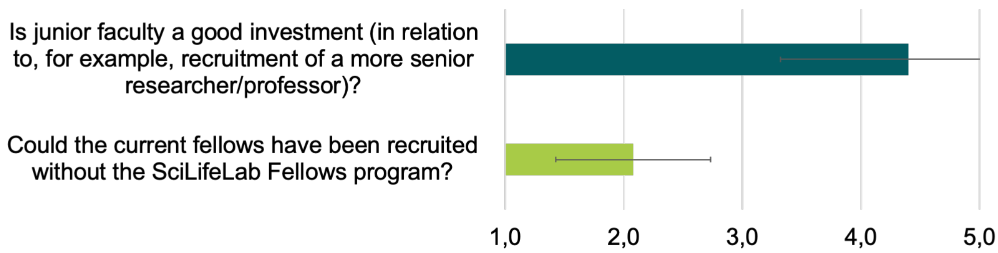


Figure 14. Importance of the SciLifeLab Fellow program for the host universities (scale 1-5, Strongly disagree - Strongly agree).

- *“The matching of Fellows with priorities within the SciLifeLab facilities also contributes to high level technology maintenance and evolution within our University.”*
- *”The program has a big impact on the possibilities to recruit internationally at the top level, also in research areas where the local department or university is not yet that strong, to it means creating a strong faculty for the future.”*

Improvements to the program

From the host university perspective, what could be improved with the SciLifeLab Fellows program *(based on free text, grouped in categories when analyzing data)*:

Improvements to the program: Recruitment

- *More discussion between the universities on joint strategic recruitments, for example in a topic which not yet is so established, to then recruit several Fellows who can complement each other and also form a network/ critical mass.*
- *Announce SciLifeLab Fellow positions in broad areas of science and avoid very narrow areas that only benefit a small section of research activity within the University.*
- *Better coordination with the future host departments during the recruitment process. For example, invite the candidates to give talks at the departments and meet with faculty.*
- *Accept the generation of a special SciLifeLab recruitment committee within the University that can respond to the needs of rapid and high-quality recruitment more effectively.*
- *Host universities should have been able to attract more international young group leaders. A major problem is the 5 year time limit for the BUL positions, which seriously hampers the ability to recruit internationally where postdoc periods are often longer. We miss out on talent.*

Improvements to the program: Program format

- *The rules should be the same for Fellows from all participating universities.*
- *Make the Fellows, their projects and their expertise more visible to other departments.*
- *More mentoring to support Fellows in navigating in a new and often hard-to-understand environment, and Swedish university system (including mentors from outside the Fellow's own department)*
- *Stronger focus on how the Fellows contribute to development of SciLifeLab*
- *Yearly follow-up should have a standardized questionnaire to guide the discussion with the Fellows*.*

*Follow-up meetings are organized regularly and a standardized questionnaire is currently being designed.

Improvements to the program: Teaching considered

- *Integrate positions better with field where teaching can be integrated*
- *Coordination with the university's teaching needs.*

Improvements to the program: Campus Solna

- *Make SciLifeLab (CS) more dynamic (fewer researchers should be ’permanent’)*
- *Lab space and research infrastructure have been problematic issues that should be improved.*
- *Improve interaction with host university, eg encourage Fellows to share knowledge on cutting edge methodology with staff and students at the host uni (eg. workshops, seminars)*
- *We need to be better at integrating Fellows in our University structure. This is somewhat difficult, since the Fellows generally associate themselves with SciLifeLab rather than the host University. It is something that not only needs to be addressed by the University but also needs support from SciLifeLab (e.g. to highlight the different Universities, contact persons etc.).*
- *I think we need to force all (DDLS) candidates to sit 100% at SciLifeLab, because we are recruiting to *develop* a new environment. It would be great to have Stockholm trio have more direct steering over SciLifeLab, and why not encourage co-affiliations between the Stockholm universities to further strengthen collaborations?*
- *More of a dual and flexible localisation type, where both Fellows and also other senior faculty members could spend physical time both at SciLifeLab/Campus Solna and the host university's main campus.*
- *Stronger focus on how the Fellows contribute to development of the Solna Campus.*

▶ 3.5 Answers from infrastructure representatives

The questionnaire was completed by 16 representatives of SciLifeLab's infrastructure (ten Heads of units and six Unit Directors, representing 12 units).

Infrastructure-Fellow interaction

Of the responding infrastructure representatives, 75% have provided service to one or several SciLifeLab Fellows. Importantly, more than half have developed existing technology in collaboration with Fellow partners. In total, the respondents have applied for 11 grants, of which half have been granted funding (*Figure* 15). Several of the Fellows are considered obvious potential users or collaborative partners of the infrastructure representatives' units (*Figure* 16).

Advantageous aspects of Fellow program

As a final part of the survey to the Infrastructure representatives, they were asked to report what are the most advantageous aspect of working in a research environment with a SciLifeLab Fellows program, and from the Infrastructure perspective, what improvements to the SciLifeLab Fellows program would more optimally benefit and support the infrastructure, and how SciLifeLab better can promote interactions between facilities and SciLifeLab Fellows (*free text, below*).

From the facility perspective, what is the most advantageous aspect of working in a research environment with a SciLifeLab Fellows program (*free text*)?

- *As the Fellows have been picked based on scientific excellence, the hope is that they will bring scientifically*

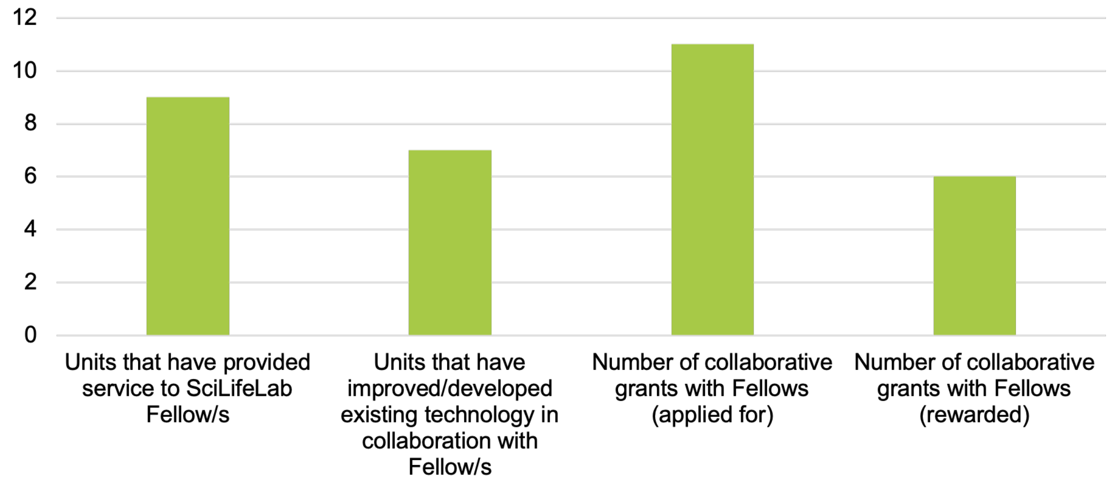


Figure 15. Infrastructure – Fellow interaction as reported by the infrastructure respondents.

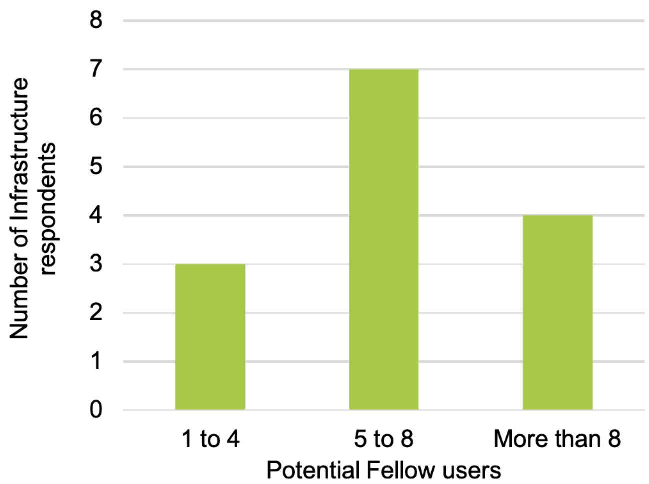


Figure 16. How many of the SciLifeLab Fellows that the Infrastructure representatives see as obvious potential users or collaborative partners of their units.

Figure 17. Advantageous aspects of Fellow program according to the Infrastructure based on keyword analysis using wordcloud.

interesting projects to our facility, and thus encourage us to be at the forefront of what is happening in the field.

- *We get the opportunity to support excellent research.*
- *1. technical developments in the Fellows research group that lead to new capacity or technology in the facility. 2. inspiration and motivation from the Fellows research that stimulate a development of the facilities*
- *Interesting projects requiring* ***state-of-the-art*** *methods and approaches*
- *To run* ***collaborative projects*** *where our focus can be on technology development or optimisation. There is then a possibility to apply for joint grants where we could get funding to support having* ***more personel.***
- *For the facility to be cutting edge it needs a world class research enviroment*
- *The* ***driving force of young PIs*** *and ability to co-develop methods and apply for shared grants, or provide service with higher chances of publishing the results.*
- *Collaborations with driven PIs,* ***ability to tailor our services for their needs,*** *ability to transfer methods from research settings into services at the facility*
- *It is important to have* ***young researchers, together with the PhD students and postdocs that they bring, to provide a bridge between SciLifeLab and the academic environment.*** *The risk of being only a service hub would take out the scientific liveliness provided by students and researchers.*
- *The SciLifeLab Fellows program has the potential to give r****apid access to new technologies and methodologies*** *at the forefront of highly relevant research areas.*
- *We see great potential in having close* ***collaboration with young and talented Fellows*** *recruited within the program, and we have already multiple lines of contacts with the Fellows as users in research projects (consultations, support), PhD student and post-doc support, technology development and expansion of support areas, and engagement as* ***teachers on our courses.***
- *The opportunity to establish with them collaborations focused on the development and applications of new tool useful for their current and future research. Keeping a regular interaction with the Fellows will help to understand which services will be needed in the future.*

Suggested improvements to the Fellows program

From the facility perspective, what improvements to the SciLifeLab Fellows program would more optimally benefit and support your infrastructure (*free text*)?

Suggested improvements: Communication/networking

- *A better introduction of new Fellows to the platforms could be helpful. By organizing introductory lectures, perhaps pre-recorded, the platforms would make the Fellows aware of more complex collaboration forms apart form services*
- *Some PR needs to be done. Are the Fellows aware of the facilities that exist in SciLifeLab and the potential support they can receive?*
- *More structured possibility of contacts between Facilities and Fellows should be organised. This will help Fellows to understand what the facility can offer to them. This would be helpful also to establish interdisciplinary projects.*
- *The SciLifeLab Fellows program has the potential to give rapid access to new technologies and methodologies at the forefront of highly relevant research areas. To make this happen, new opportunities for interaction between the Fellows and the platforms need to be created.*
- *The idea behind the Fellows program and its goals, and how those relate to the facilities, are not clear.*

Suggested improvements: Recruitment

- *More focused recruitment based on the techniques where SciLifeLab needs to develop or where SciLifeLab is already unique but can grow stronger from a recruitment of a supporting research group (Fellow)*
- *Involve facilities in recruitment process, establish links between Fellows and facilities*
- *Future Fellow Programs should be probably more focused to recruit groups that could benefit from multiple facilities.*
- *Identify if there are technology/research areas where expertise is missing, and focus new Fellow recruitments to these (which would benefit connected infrastructure units)*

Suggested improvements: Practical points to ease use of service/support or establishment of collaborations

- *Encourage Fellows to define their projects in a way where we can support them, it is not always easily done and they are therefore not prioritized*
- *Possibility of applying for funding in collaboration with Fellows*
- *"We have limited personnel resources to support tech development and also are limited in how we can support smaller projects from eg a SciLifeLab Fellow, who may benefit from a small so-called service project with us."*
- *More technology driven projects to develop better methods/tools at facilities*
- *If the Fellows had some granted data analysis support from WABI or similar as part of their contract it would be of mutual benefit as the data would be easier to analyze and thus publish. Maybe this would lead to more use of the infrastructures where complex data is generated - especially for cutting edge technologies.*

How Infrastructure:Fellow interaction can be further promoted

From the facility perspective, how can SciLifeLab better promote interactions between facilities and SciLifeLab Fellows (*free text*)?

- *Would it be possible to list the facilities to the Fellows and ask them which facilities they are potentially interested in working with? Based on this information, it would be easy to set up meetings where the facilities could present what they offer. (Comment: great suggestion!)*
- *A better introduction of new Fellows to the platforms could be helpful. By organizing an introductory lecture, perhaps a pre-recorded package, the platforms would make the Fellows aware of the more advanced collaboration forms (apart form services)*
- *It is important that the (new) Fellows can easily find out which services are available and whom to contact so that they get a smooth introduction.*
- *More regular information about the Fellow programs progress would be appreciated i.e. regular (quarterly half-year?) seminars on specific programs.*
- *Ask Fellows to develop more new tools/methods for facility use - not just do research*
- *Invite the Platform coordination officers or directors (a few at the time) to Fellow meetings to briefly present the possibilities within the platform and first of all to give them a contact person at the platform of interest that will enable further discussions. (Comment: another great suggestion! This will be considered for upcoming meetings, first one on May 24)*
- *More focused and strategic recruitments aiming at strengthening the facilities with competence and techniques in the long run - not only recruiting users.*
- *Encourage the SciLifeLab Fellows to perform short-term practice during the program at one of the SciLifeLab units (would be beneficial for both sites)*
- *Organise "SciLifeLab days" (Comment: plan for Open SciLifeLab/infra day!)*
- *Social events with science topics (post Covid).*
- *Organize seminar/meetings with Fellows and Facility representatives, and promote interdisciplinary collaborations. For example, the covid19 findings created a ground for brainstorming, which opened opportunity for collaboration between area of research apparently not connected.*
- *There is in general too little interaction between the different platforms/groups/PIs/facilities etc within SciLifeLab and consequently most groups are only aware of those who happen to be situated on the same floor.*
- *Some common teaching program, eg. part of the master program*
- *Shared PhDs or Postdoc positions*
- *Give specific funding for collaborations*
- *In order to improve interactions between the facilities and the SciLifeLab Fellows it would be preferable to place the Fellows closer to the facilities i.e. in host groups for the facilities.*

4. Fellows grants received during 2014-2020

As part of the overall survey of the program, the Fellows' funding was reviewed the for the time period of program start in 2014 until 2020. During the autumn 2020, grant information was collected from department financial officers. It included data for 29 Fellows on the program base funding and external grants: contract sums, funding agencies, date granted and grant period. The collected data was manually curated so that the Fellow program base funding was separated from other funding from the host university (such as co-financing for ERC, different starting packages, research support grants, and salary) and other SciLifeLab grants (such as RCP, TDP, Shared post-doc funding, Fellows' instruments, event support, and Pilot facility grants). The complete list of grant-givers is shown in *Table 1*. Grants received before the starting year were removed from the analysis.

The analysis showed that SciLifeLab Fellows received a total of 1.2 BSEK during 2014-2020 from different grant givers (*Figure* 18).

During the first year as SciLifeLab Fellow, the program funding (SFO) is expected to represent a larger fraction of the total grants received. We therefore investigated the subset of Fellows that had been appointed at least 3 years from the time of data collection (September 2020). Analysis of the grants of the 18 Fellows that started between 2014 and 2017, showed that the program funding is 1/4 of the total amount grated by Fellows that started the program during 2014-2017 (*Figure* 19), whereas it makes out 1/3 of the total funding when analyzing funding to all 29 Fellows (starting in 2014-2020). In summary it can be concluded the Fellows have been exceptionally successful at attracting external research funding.

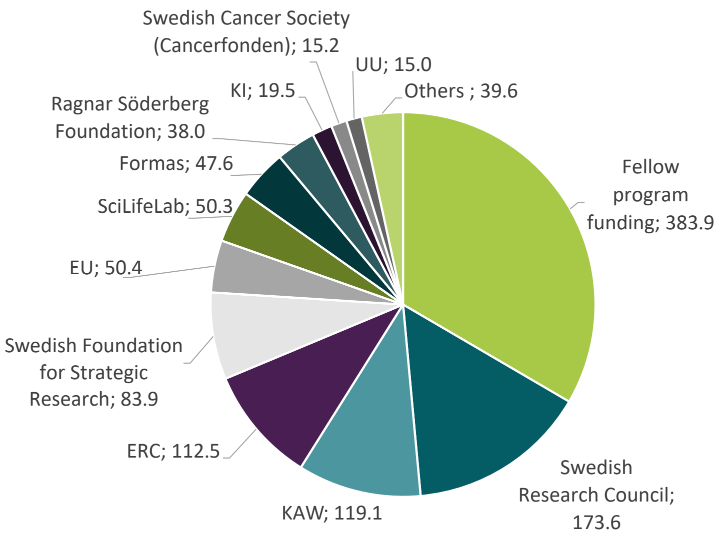


Figure 18. Grants received by 29 Fellows during 2014-2020, total 1.2 BSEK. Grants below 10 MSEK were summed into "Others". The complete list of grant-givers is shown in the Table 1. SciLifeLab funding includes funding for pilot facility, shared post-docs, RCP, TPD, and Fellows' instruments.

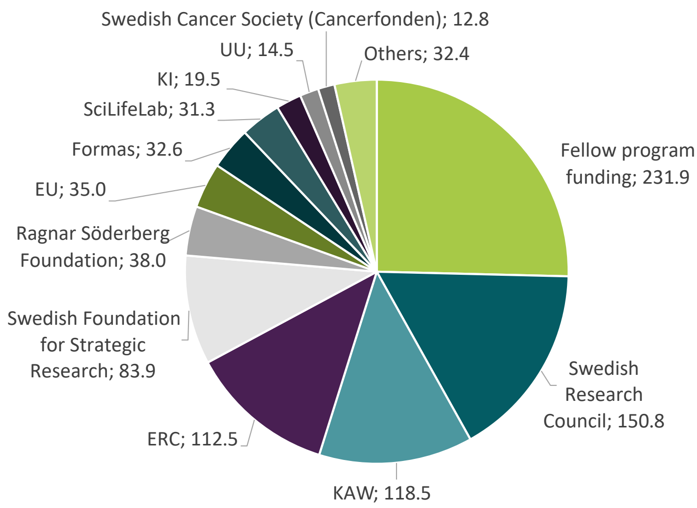


Figure 19. Grants received by the 18 Fellows that started 2014-2017. Fellows that started the program during 2014-2017 have been granted 3 times the program funding. Total 0.9 BSEK. "Others" represent grant givers with less than 10MSEK. SciLifeLab funding includes funding for pilot facility, event support, shared postdocs, RCP, TDP, and Fellows instrument.

Table 1. List of Fellows' grant givers 2014-2020.

Grant givers	Total amount
Fellow program funding	383,9
Swedish Research Council	173,6
KAW	119,1
ERC	112,5
Swedish Foundation for Strategic Research	83,9
EU	50,4
SciLifeLab	50,3
Formas	47,6
Ragnar Söderberg Foundation	38,0
KI	19,5
Swedish Cancer Society (Cancerfonden)	15,2
UU	15,0
Sophia Genetics AS	5,9
Swedish Childhood Cancer Fund	5,2
NovoNordisk foundation	4,8
Göran Gustavssons Foundation	4,8
Sven and Ebba-Christina Hagberg Foundation	2,9
KTH	2,6
Malin o Lennart Philipson Foundation	2,0
Research Executive Agency	2,0
SU	1,9
Ångpanneföreningen Foundation for Research & Development	1,4
STINT	1,1
ETH Zürich	0,9
Carl Tryggers Foundation	0,7
Swedish Brain Foundation	0,6
private fonds	0,5
Juhlins Foundation	0,4
Wenner-Gren Foundation	0,4
Swedish Medical Association	0,3
Erik Philip-Sörensens Foundation	0,2
Marcus Wallenbergs Foundation	0,2
ESCMID	0,2
The Clas Groschinsky Memorial Foundation	0,2
Systembolaget	0,2
Linnaeus Foundation	0,2

5. Bibliometric analyses focused on output and impact of Fellows' research

The scientific output from SciLifeLab Fellows was analyzed with bibliometric methods and the results indicate that the program maintains the high scientific quality and impact that it aims for.

Fellows publish papers across a wide range of topics within life science (*Figure* 20). The Fellows produced 146 publications in 2020 of which 8 were published in journals with an impact factor (JIF) over 25. The program has increased the number of publications annually since the start in 2014 (*Figure* 21), and the proportion of publications in journals with high impact factors is also increasing.

The high impact of the publications from the Fellows is further verified by the increasing number of citations (*Figure* 22) with 7,615 citations in 2020 for publications co-authored by SciLifeLab Fellows. The number of times publications have been cited in each year increases over time. This could partially be explained by the greater number of publications over time, but the trend cannot be explained by this alone. This indicates that newer publications are cited more frequently. The high impact of publications from the Fellows' program is further illustrated by analyzing the fraction of publications each year that are among the 10% most cited from that year, PP(top 10%). In 2018, 22.5% of the publications from SciLifeLab Fellows are among the 10% top cited across all fields (*Figure* 23).

When analyzing scientific fields addressed by Fellows' publications, most publications can be found in the major fields of molecular life sciences, as can be expected since this is the focus of SciLifeLab (*Table* 2). Fellows produce very high impact publications in several such fields.

For example, there is evidence for very high impact publications in areas such as biochemistry & molecular biology (PP(top10) = 33%) and biochemical research methods (PP(top10) = 31%).

The scientific collaborations of Fellows were also analyzed, and the network of institutions with co-authorships to Fellows' publications indicate a broad international network from this community (*Figure* 24). The analysis in particular highlights strong interactions between the Swedish universities that are hosts for SciLifeLab Fellows, but also show high impact interactions with institutions abroad, such as the Technical University of Denmark (DTU).

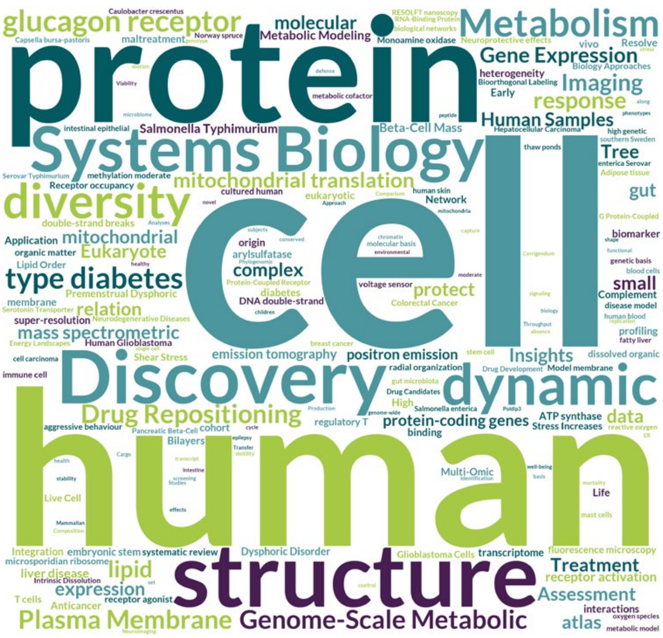


Figure 20. Wordcloud generated using the titles of papers published by Fellows 2019-2020.

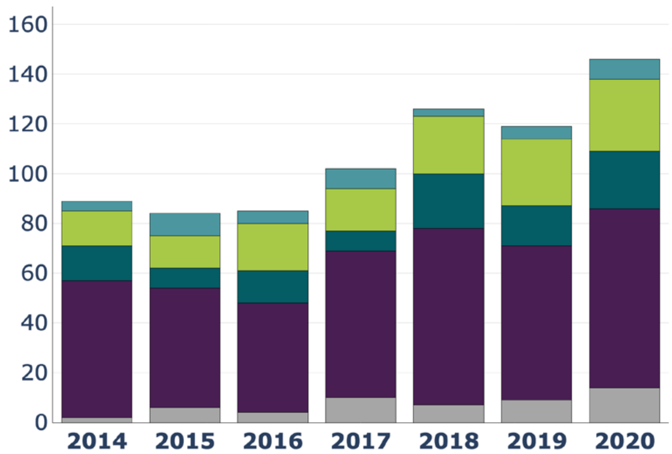


Figure 21. Number of scientific publications produced by Fellows annually, with Journal Impact Factor (JIF) distribution: JIF > 25 (blue), JIF 9–25 (light green), JIF 6–9 (dark green), JIF < 6 (purple), JIF unknown (grey).

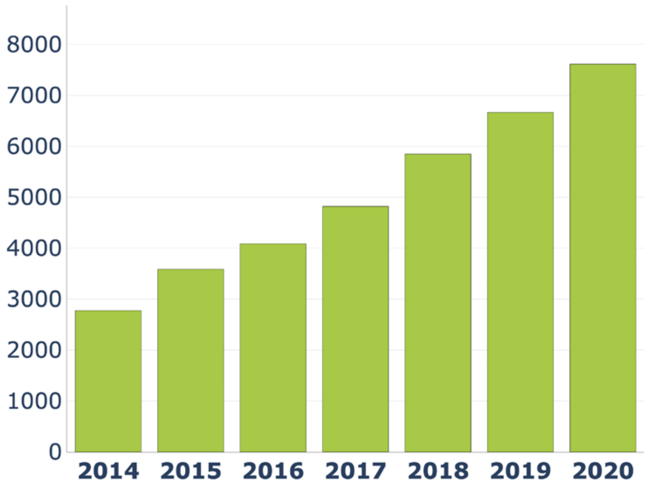


Figure 22. Number of citations received in each year for publications by Fellows.

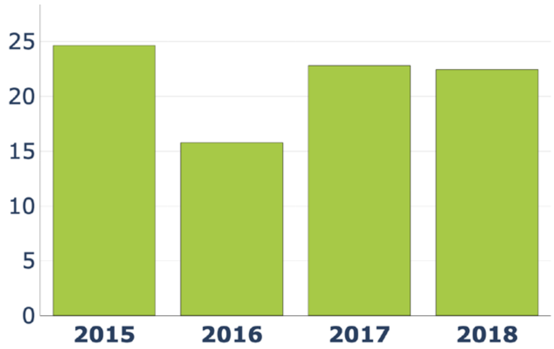


Figure 23. Percentage of publications in the top 10% most cited (PP(top10)) for Fellows.

Table 2. Subject categories in which Fellows published over 20 publications between 2015 and 2018. The percentage of publications in the top 10% most highly cited (PP(top10)) is a measure of research impact.

Subject category	PP(top10)	Number of Publications
BIOCHEMISTRY & MOLECULAR BIOLOGY	33	96
CELL BIOLOGY	35	55
BIOTECHNOLOGY & APPLIED MICROBIOLOGY	27	30
ENDOCRINOLOGY & METABOLISM	16	28
GENETICS & HEREDITY	26	28
MICROBIOLOGY	19	26
BIOCHEMICAL RESEARCH METHODS	31	26
NEUROSCIENCES	10	21

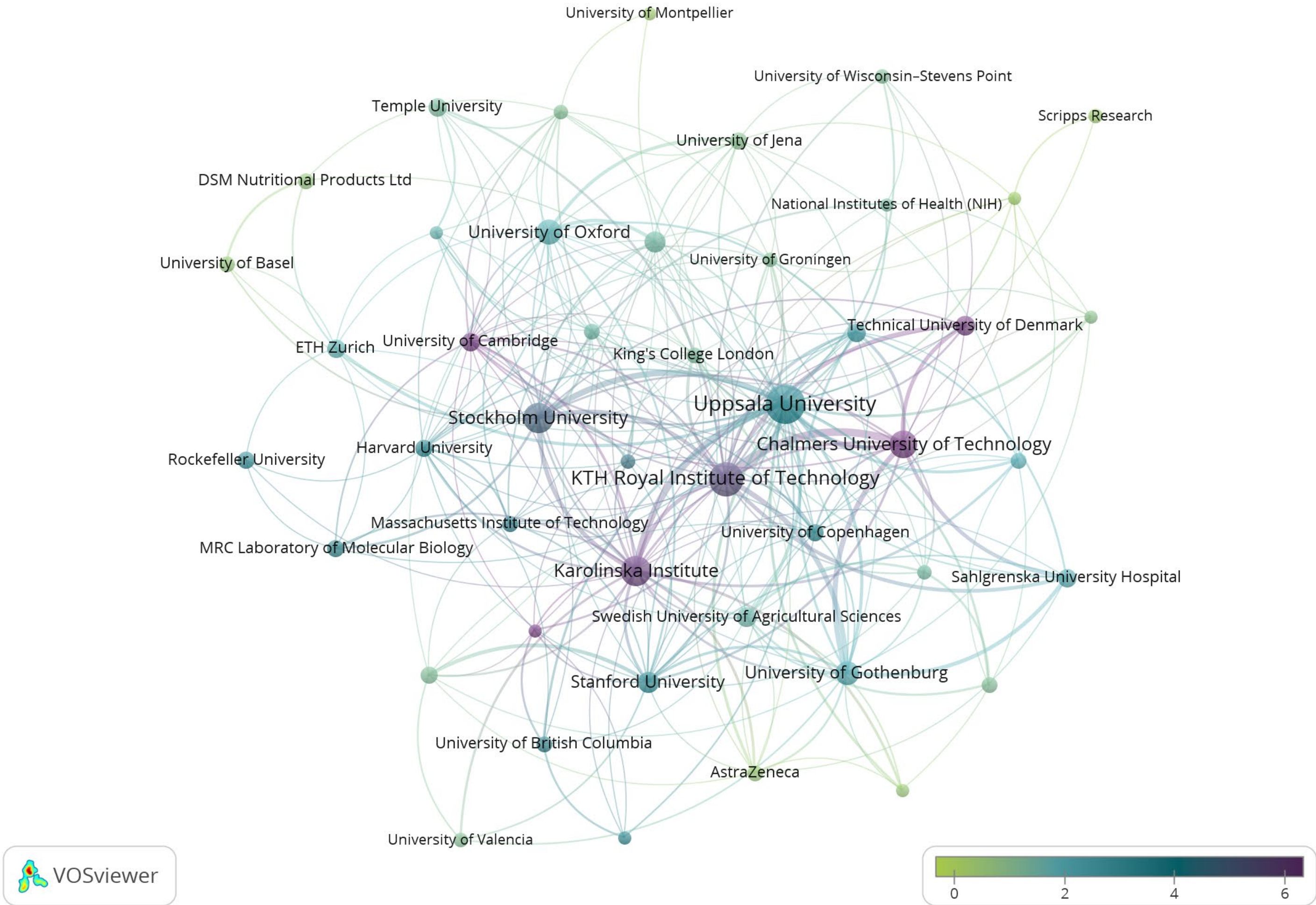


Figure 24. Co-publication network of publications (2015-2018) by SciLifeLab Fellows. Nodes represent institutions, and the node size increases with the number of co-publications. The color of nodes and edges represent mean normalized citation (MNCS) scores, as indicated in the legend.

L.

Appendix M.

Supplementary Bibliometric Data and Analyses

This Appendix includes additional tables containing data on output and impact supporting the bibliometry sections of the main report (Sections 7.4 and 9), and in Appendix L.

Table 1. The number of publications in journals with different Journal Impact Factors (JIF). Data for infrastructure reported publications 2013–2020.

	JIF unknown	JIF <6	JIF 6-9	JIF 9-25	JIF >25
2013	16	220	19	41	19
2014	18	256	30	46	23
2015	13	274	31	79	25
2016	44	404	69	95	28
2017	52	385	71	104	24
2018	32	337	66	109	26
2019	24	416	70	105	28
2020	34	342	60	115	24

Table 2. The number of publications in journals with different Journal Impact Factors (JIF). Data for affiliated researchers 2013–2020.

	JIF unknown	JIF <6	JIF 6-9	JIF 9-25	JIF >25
2013	4	305	36	69	23
2014	14	399	56	72	33
2015	23	434	46	115	38
2016	39	495	102	139	36
2017	27	488	101	168	34
2018	9	494	118	166	35
2019	14	546	103	157	34
2020	21	492	94	134	34

Table 3. The number of publications in journals with different Journal Impact Factors (JIF).
Data for Fellows 2014–2020.

	JIF unknown	JIF <6	JIF 6-9	JIF 9-25	JIF >25
2014	1	55	14	15	4
2015	5	49	8	13	9
2016	3	45	13	19	5
2017	9	60	8	17	8
2018	7	71	22	23	3
2019	9	62	16	27	5
2020	10	76	23	29	8

Table 4. The number of publications per year from categories infrastructure users only (Infrastructure only), affiliated researchers (Affiliated only) or co-authored from infrastructure users and affiliated researchers (Intersection).

	Infrastructure only	Affiliated only	Intersection
2013	198	320	117
2014	209	410	164
2015	222	456	200
2016	358	529	282
2017	387	569	249
2018	336	588	234
2019	407	618	236
2020	348	548	227

Table 5. The number of publications reported by infrastructure for time period used for impact calculations (2015–18), in total and for the three different subcategories used in reporting, and the corresponding impact scores (PP(top 10%)). Figures are also reported for the subsets of reported publications with at least one co-author from a Swedish institution, and with at least one co-author affiliated to SciLifeLab.

	N, all infra 2015-18	N, at least one Swedish 2015-18	N, at least one SciLifeLab 2015-18	PP(top 10%), all infra 2015-18 (%)	PP(top 10%), at least one Swedish 2015-18 (%)	PP(top 10%), at least one SciLifeLab 2015-18 (%)
Service projects	1403	1379	513	25	25	28
Collaborative	590	588	384	19	19	21
Technology development	157	157	117	23	23	24
Total unique	2268	2236	965	24	24	26

M.

Table 6. Subject categories in which infrastructure users published over 100 publications between 2015 and 2018. The percentage of publications in the top 10% most highly cited (PP(top10)) is a measure of research impact.

Subject category	PP(top10)	Number of publications
BIOCHEMISTRY & MOLECULAR BIOLOGY	22	411
GENETICS & HEREDITY	32	399
CELL BIOLOGY	28	195
ONCOLOGY	12	177
MICROBIOLOGY	19	158
BIOTECHNOLOGY & APPLIED MICROBIOLOGY	24	139
BIOCHEMICAL RESEARCH METHODS	20	127

Table 7. Subject categories in which affiliated researchers published over 100 publications between 2015 and 2018. The percentage of publications in the top 10% most highly cited (PP(top10)) is a measure of research impact.

Subject category	PP(top10)	Number of publications
BIOCHEMISTRY & MOLECULAR BIOLOGY	25	583
GENETICS & HEREDITY	29	401
CELL BIOLOGY	23	375
ONCOLOGY	18	282
BIOCHEMICAL RESEARCH METHODS	21	211
BIOTECHNOLOGY & APPLIED MICROBIOLOGY	26	196
MICROBIOLOGY	23	130
MULTIDISCIPLINARY SCIENCES	24	119
CHEMISTRY (MULTIDISCIPLINARY)	7	108
IMMUNOLOGY	14	108
ENDOCRINOLOGY & METABOLISM	26	104

Table 8. Subject categories in which Fellows published over 20 publications between 2015 and 2018. The percentage of publications in the top 10% most highly cited (PP(top10)) is a measure of research impact.

Subject category	PP(top10)	Number of publications
BIOCHEMISTRY & MOLECULAR BIOLOGY	33	96
CELL BIOLOGY	35	55
BIOTECHNOLOGY & APPLIED MICROBIOLOGY	27	30
ENDOCRINOLOGY & METABOLISM	16	28
GENETICS & HEREDITY	26	28
MICROBIOLOGY	19	26
BIOCHEMICAL RESEARCH METHODS	31	26
NEUROSCIENCES	10	21

Table 9. The top three subject categories in which infrastructure users published for each infrastructure unit.

Unit	Subject Categories
Long-term Support (WABI)	GENETICS & HEREDITY, BIOCHEMISTRY & MOLECULAR BIOLOGY, CELL BIOLOGY
Support and Infrastructure	BIOCHEMISTRY & MOLECULAR BIOLOGY, GENETICS & HEREDITY, BIOTECHNOLOGY & APPLIED MICROBIOLOGY
Systems Biology	CELL BIOLOGY, MULTIDISCIPLINARY SCIENCES, BIOCHEMISTRY & MOLECULAR BIOLOGY
Advanced Light Microscopy	CELL BIOLOGY, BIOCHEMISTRY & MOLECULAR BIOLOGY, MULTIDISCIPLINARY SCIENCES
BioImage Informatics	BIOCHEMICAL RESEARCH METHODS, CELL BIOLOGY, ENGINEERING (ELECTRICAL & ELECTRONIC)
Cell Profiling	BIOCHEMICAL RESEARCH METHODS, CELL BIOLOGY, BIOCHEMISTRY & MOLECULAR BIOLOGY
Cryo-EM	BIOCHEMISTRY & MOLECULAR BIOLOGY, CELL BIOLOGY, BIOLOGY
Swedish NMR Centre	BIOCHEMISTRY & MOLECULAR BIOLOGY, CHEMISTRY (MULTIDISCIPLINARY), CHEMISTRY (PHYSICAL)
Chemical Biology Consortium Sweden	CHEMISTRY (MEDICINAL), BIOCHEMISTRY & MOLECULAR BIOLOGY, PHARMACOLOGY & PHARMACY
Genome Engineering Zebrafish	BIOCHEMISTRY & MOLECULAR BIOLOGY, GENETICS & HEREDITY, EVOLUTIONARY BIOLOGY
High Throughput Genome Engineering	BIOCHEMISTRY & MOLECULAR BIOLOGY, CELL BIOLOGY, GENETICS & HEREDITY
Clinical Genomics Gothenburg	BIOCHEMISTRY & MOLECULAR BIOLOGY, ENGINEERING (ENVIRONMENTAL), ENVIRONMENTAL SCIENCES
Clinical Genomics Linköping	BIOCHEMISTRY & MOLECULAR BIOLOGY, CHEMISTRY (MULTIDISCIPLINARY), ENDOCRINOLOGY & METABOLISM
Clinical Genomics Lund	ONCOLOGY, HEMATOLOGY, PATHOLOGY
Clinical Genomics Stockholm	GENETICS & HEREDITY, MICROBIOLOGY, ONCOLOGY
Clinical Genomics Uppsala	HEMATOLOGY, ONCOLOGY, GENETICS & HEREDITY
Clinical Genomics Örebro	INFECTIOUS DISEASES, MICROBIOLOGY, MULTIDISCIPLINARY SCIENCES
Drug Discovery and Development	CHEMISTRY (ORGANIC), BIOCHEMISTRY & MOLECULAR BIOLOGY, CHEMISTRY (MEDICINAL)
Eukaryotic Single Cell Genomics	CELL BIOLOGY, MULTIDISCIPLINARY SCIENCES, NEUROSCIENCES
In Situ Sequencing	BIOCHEMICAL RESEARCH METHODS, BIOCHEMISTRY & MOLECULAR BIOLOGY, CELL BIOLOGY
Microbial Single Cell Genomics	MICROBIOLOGY, BIOLOGY, BIOTECHNOLOGY & APPLIED MICROBIOLOGY
National Genomics Infrastructure	GENETICS & HEREDITY, MULTIDISCIPLINARY SCIENCES, BIOCHEMISTRY & MOLECULAR BIOLOGY
Autoimmunity and Serology Profiling	BIOCHEMICAL RESEARCH METHODS, IMMUNOLOGY, MULTIDISCIPLINARY SCIENCES
Chemical Proteomics	BIOCHEMISTRY & MOLECULAR BIOLOGY, BIOCHEMICAL RESEARCH METHODS, MULTIDISCIPLINARY SCIENCES
Mass Cytometry	IMMUNOLOGY, CELL BIOLOGY, BIOCHEMISTRY & MOLECULAR BIOLOGY
PLA and Single Cell Proteomics	BIOCHEMICAL RESEARCH METHODS, BIOCHEMISTRY & MOLECULAR BIOLOGY, BIOTECHNOLOGY & APPLIED MICROBIOLOGY
Proteogenomics	BIOCHEMISTRY & MOLECULAR BIOLOGY, CELL BIOLOGY, MULTIDISCIPLINARY SCIENCES
Swedish Metabolomics Centre	PLANT SCIENCES, BIOCHEMISTRY & MOLECULAR BIOLOGY, ENDOCRINOLOGY & METABOLISM
Translational Plasma Profiling	BIOCHEMICAL RESEARCH METHODS, BIOCHEMISTRY & MOLECULAR BIOLOGY, IMMUNOLOGY

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