International evaluation of the SciLifelab infrastructure 2020

Report from the International Evaluation Committee (IEC)

SciLifeLab

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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.

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Overall Feedback on the SciLifeLab Infrastructure

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

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

Cellular and Molecular Imaging

Chemical Biology and Genome Engineering

Genomics

Proteomics and Metabolomics

Swedish NMR Centre/Integrated Structural Biology

Diagnostics Development

Drug Discovery and Development

Data Centre

Summary

Summarising Table with Grades and Funding Recommendations

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 leadership 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.

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.

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.

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.

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 decentralize 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.

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.

[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.

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**		
2	Support, Infrastructure and Training	8		
3	Compute and Storage	8		0
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**		
18	Chemical Biology Consortium Sweden	6		
19	Chemical Proteomics	8		0
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

Appendix I.

Bioinformatics Platform – Separate Assessment by Rolf Apweiler

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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.