Synthetic Biology Leadership Council
Meeting 13
Thursday 10th March 2016

BIS Conference Centre,
1 Victoria Street, London SW1H 0ET

Attendees:

Prof Lionel Clarke	Co-Chair, SBLC
Prof Janet Bainbridge	UKTI
Dr Andy Boyce	Synthetic Biology Special Interest Group, Knowledge Transfer Network
Martin Cannell	Defra
Dr Amanda Collis	RCUK
Prof Tim Dafforn	Department for Business, Innovation & Skills and University of Birmingham
Dr Jackie Hinton	Department for Business, Innovation & Skills
Dr Chris Jones	Innovate UK
Alastair Kent	Genetic Alliance UK
Prof Richard Kitney	Imperial College London
Prof Anne Osbourn	John Innes Centre
Prof Joyce Tait	Innogen Institute, University of Edinburgh
Dr Amy Tayler	Synthetic Biology Special Interest Group, Knowledge Transfer Network
Dr David Tew	GSK

Observers:

Chris Corden	Scottish Enterprise

Apologies:

George Freeman	Department for Business, Innovation & Skills and Department of Health, Co-Chair, SBLC
Sue Dunkerton	Knowledge Transfer Network
Mike Edbury	Government Office for Science
Dr Tim Fell	BioIndustry Association and Synthace
Prof Dale Sanders	John Innes Centre

1 Welcome & Introduction

Prof Lionel Clarke welcomed everyone to the meeting, explaining that Prof Anne Osborne was attending in place of Prof Dale Sanders, and that Chris Corden was here to observe the meeting and to summarise relevant synthetic biology activity at Scottish Enterprise. The SBLC members introduced themselves.

2 SBLC Internal Business

The minutes of SBLC 10 and the latest Governance sub-group meetings were approved. All actions were noted as done.

> ***Action 13-1: Amy Tayler to upload all approved SBLC and GSG minutes to the relevant webpages.***

3 – UK Synthetic Biology Strategic Plan

Lionel thanked Tim Higginson and the SBLC for their efforts in preparing the strategic plan, which was launched by George Freeman at the end of February. To date, the document has been downloaded more than 11,500 times. Lionel explained that now is the time to take stock, to turn the plan into effective action, and to establish the metrics (i.e.: not funding required but outputs, benefits and impact) on which success will be judged.

The SBLC worked through the recommended actions in the strategic plan, identifying who should take responsibility for each item, and who else needs to be involved. The SBLC was mindful that this meeting comes at a sensitive time in terms of settlements and budgets. Each action will have a scale of minimum and optimal levels of activity, and this may be iterative over time. In addition to input on each recommended action (captured elsewhere and regularly updated), a few general comments were made: SynbiCITE should be distinguished from broader activity at Imperial College London; BIS should be distinguished from the SBLC; many actions will fall to the Governance sub-group, which has no dedicated resource; the SynBio SIG, Innovate UK and SynbiCITE regularly share information on the synthetic biology landscape, although it isn't made publically available; the SBLC has members from industry, but lacks a broader industry network.

> ***Action 13-2: SynBio SIG to update spreadsheet of recommendations from the strategic plan as discussed during the meeting.***
>
> ***Action 13-3: Once settlements form BIS are known and allocated, all (especially RCUK and Innovate UK) to revisit the updated spreadsheet of recommendations from the strategic plan and indicate where they can take a lead or make a contribution.***
>
> ***Action 13-4: Those taking the lead in delivering the recommendations from the strategic plan to produce one sentence describing what they are going to do (see new column in spreadsheet).***

The SBLC discussed the importance of a metric around the development of industry, start-ups, products to market in different application areas, number of employees etc. However, since synthetic biology is a technology that can be deployed in a variety of applications, it tends to lose its identity along the innovation pipeline, hence outcomes are hard to monitor.

Alastair Kent noted that the European Medicines Agency (EMA) considers novel therapies under the Advanced Therapy Medicinal Product (ATMP) classification. Five have been recommended for approval so far, including a gene transfer product, stem cells, and engineered tissues etc. Many future ATMPs could use synthetic biology, and lots of investigations are already taking place. However, it's hard to find a model that makes a good case for commercialisation, as many ATMPs are highly specialised for small populations of patients in only a few given institutions (usually academic hospitals). There are other areas of healthcare to which synthetic biology could also contribute: new antibiotics, diagnostics (to aid more targeted therapies), large scale manufacture of complex molecules, reducing the unit cost of monoclonal antibody production etc.

Action 13-5: KTN to consult BIA regarding a potential workshop or activity on the role of SynBio in healthcare.

There are already some examples of the successful commercialisation of synthetic biology in the healthcare sector, such as bioprocessing, biosensors and theranostics. Leaf Systems (formerly Hypertrans) worked with Medicago to rapidly produce vaccines in plants, and the technology could be adapted to manufacture structurally related complex molecules for testing. Investors are increasingly interested in gene therapy, nearly all of which will involve a genetic construct, but the practitioners may not identify with the synthetic biology community.

Action 13- 6: KTN to consult the cell and gene therapy catapult about the use of advanced genetic constructs in gene therapy and whether they identify with the SynBio community.

The original synthetic biology roadmap included a timeline, which was first drawn up at a workshop in March 2011. Five years on, Lionel has revisited the timeline. The majority of things that were planned are up and running, and we are making headway with some areas of application. In time, the SBLC may wish to update the timeline to 2020 and beyond.

Action 13- 7: Amy Tayler to circulate Lionel Clarke's updated metric sheet.

4 Governance Sub-Group

Prof Joyce Tait summarised the three main items discussed at the latest Governance sub-group (GSG) meeting, which took place last week.

The GSG's latest input into the ongoing consultation regarding the Convention on Biological Diversity (CBD) was a paper on how new regulation could be integrated within current regulatory systems. Defra was consulted prior to the submission, and the paper forms a useful basis on which Defra can build. Mike Paton (HSE) is both a member of the GSG and the CBD Ad Hoc Technical Expert Group (AHTEG). Such actions demonstrate the real difference the GSG makes to support the UK position, in developing a constant approach and getting more people involved so the relevant discussions are more balanced.

Action 13-8: Amy Tayler to forward link to AHTEG consultation outcome.

There are ongoing discussions regarding the CBD and Nagoya Protocol, and the SBLC should support proposals for revisions. As such, it would be useful to identify examples of how synthetic biology could benefit developing countries.

Action 13-9: Anne Osbourn and Richard Kitney to ask the Science and Technology subgroup to give an inventory of (i) working with the 3rd world and (ii) healthcare applications of synthetic biology to make a story for the Minister and (iii) an updated 'Carlson Curve' for DNA synthesis.

The strategic plan has been well received by the GSG. However, consideration must be given as to how to meet the commitment to undertake public engagement. At the recent GSG meeting, Sciencewise presented how it could be taken forward as part of a Responsible Research & Innovation (RRI) program. Rather than an activity focused on synthetic biology, it may be more appropriate to frame the discussion about issues to which both synthetic biology and other technologies can contribute.

The SBLC discussed a few possible examples and related documents and activities: Synlogic produces a strain of *E. coli* that harbours enzymes to complement an enzyme deficiency (phenylketonuria), but which could be used as a platform to treat other diseases. The strain is non-viable outside the body; Alastair Kent highlighted a study in which cancer patients were asked whether they would be willing to share their genetic data to contribute to research; synthetic artemisinin (although the SBLC noted it is a complex example); House of Lords review into genetically modified insects; and the upcoming National Academies of Sciences, Engineering and Medicine report on gene drives (to which Joyce Tait is contributing through her role on the committee).

Action 13-10: Amy Tayler to forward link to whole genome sequencing and sharing for the benefit of the patient.

It is important to make sure a broad range of stakeholders is included: the public, industry, researchers, regulators etc. This is an opportunity to demonstrate that synthetic biology can be regulated within existing frameworks, and that a smarter approach to regulation would be welcomed. Prof Anne Osbourn, who is keen to be involved, noted that there are some existing resources for this kind of activity.

5 Science & Technology sub-group

Prof Richard Kitney summarised the most recent meeting, which took place last week. The discussion focused on the strategic plan and how the science & technology community could best support solid foundations and translation (recommendation 2). For example, the Cambridge Strategic Research Initiative OpenPlant and SynbiCITE all offer funding opportunities to foster links between the research base and industry. This meeting focused on BrisSynBio, OpenPlant and SynbiCITE, with other major groups to be covered at future meetings.

BrisSynBio has 25 postdocs on 10 projects focusing on protein engineering and supported by high performance computing.

OpenPlant has 13 postdocs with strengths in metabolite analysis and imaging, trait packages, manufacturing, and the development of a common plant syntax, and is making progress with an open MTA to promote the open innovation culture (kits, parts etc.). OpenPlant has helped develop the plant stream within iGEM, which is based on the common syntax.

SynbiCITE brings together 27 universities, 40 companies (comprising 9 multi-national companies and 31 SMEs) and other collaborators (SBRCs etc.) for the benefit of the whole of the UK. SynbiCITE has administered funding around the UK based of the quality of the applications.

The Science & Technology sub-group also discussed outreach (such as the Science, Art, Writing (SAW) initiative), business-oriented training (Lean Launchpad, LEAP etc.) and their contribution to the development of a skilled workforce (formal courses at undergraduate and postgraduate level, iGEM etc., and suggested that an audit of the curriculum would be a good opportunity to share best practice). It was noted that the learned societies (Royal Society of Biology, Royal Academy of Engineering, Royal Society of Chemistry, Biochemical Society, Royal Society etc.) are building their education sector and may be able to fill the perceived gap. The learned societies are keen to identify opportunities to which they can respond. Collectively, they will have better routes into exam boards than the SBLC has directly.

> ***Action 13-11: Science & Technology sub-group to link to learned societies regarding education and training.***

Richard described the events planned in the margins on SynBioBeta London 2016, 6-7 April 2016. On 5 April, the IET and SynbiCITE will together deliver 'Engineering Biology', a free, one-day conference for those new to synthetic biology and focused on the engineering aspects of the field. The agenda includes tutorials on the basics of synthetic biology, examples of research projects, a policy session, and presentations from industry. On 8 April, an investors breakfast will take place at the House of Lords, followed by a networking cruise on the River Thames.

Other upcoming events of interest to the synthetic biology community include Biotrinity (25-27 April 2016, London), SEED (18-21 July 2016, Chicago), EFIB (18-20 October 2016, Glasgow) UKSB (14-16 November 2016, Edinburgh), and Engineering Biology (13-15 December 2016, London).

6 Leadership Council five-chairs' meeting

Lionel explained that the chairs of the SBLC, Industrial Biotechnology Leadership Forum (IBLF) and Agri-Food Leadership Council (AFLC) have joined forces with those of the Medicines Manufacturing Industry Partnership (MMIP) and the Chemistry Growth Partnership (CGP) to together consider their collective contributions to the

growing UK bioeconomy. Synthetic biology has a role to play at the innovative heart of the bioeconomy, which can link to the different sectors of the other councils. Lionel confirmed that there is no plan to merge the different forums at this stage. The five chairs have met with George Freeman, who is keen to see a UK bioeconomy strategy. The synthetic biology strategic plan titled 'Biodesign for the Bioeconomy' is an important and powerful document in this process.

7 SBLC membership and meetings

The SBLC membership was raised during the consultation for the strategic plan, but discussion by the current SBLC members was deferred until publication when the aspirations of the group were better defined. The SBLC agreed that expansion of the membership should be considered, but noted that the main group should remain small enough to facilitate effective discussion. Sub-groups are an effective way to engage a broader group whilst keeping the SBLC small and agile. The SBLC noted that the SBLC could benefit from the addition of a younger member.

Prof Janet Bainbridge explained the AFLC model, in which members of the councils are accompanied by budget-holding officials (senior figures in Government departments). Such officials only attend when needed, but they can write papers and bring items to the table. For example, it might be useful for Janet, a UKTI specialist, to be accompanied by a senior representative from UKTI. The SBLC agreed that additional attendees (officials or otherwise) should be invited to individuals SBLC meetings to help address particular topics.

Amanda Collis explained that the engagement of the individual research councils is managed through a single seat in the spirit of coordination, collaboration and efficiency, which will only be reinforced with the upcoming transition to UK Research & Innovation (UKRI). EPSRC would like to be more directly involved in discussions related to hardware, automation etc., although coordination and collaboration should continue to be managed through a central point. The SBLC agreed that EPSRC and others could attend and participate as required using the model outlined above.

The SBLC agreed that those with roles to play in standards for synthetic biology could be brought in on an *ad-hoc* basis, as we have done in the past.

The SBLC consider that the research base is adequately engaged through the S&T sub-group, which is scheduled to meet a few weeks ahead of each SBLC meeting in a similar manner to the GSG and RCUK working group. The S&T sub-group already has some industrial members, although this could be broadened.

> ***Action 13-12: Joyce Tait and Richard Kitney to forward dates of the sub-group meetings to Amy so she can make sure SBLC minutes and draft agendas are available in a timely fashion.***

The SBLC agreed that Prof Neil Stansfield (Dstl) should be invited to join the SBLC. Dstl consider synthetic biology to be a disruptive technology. It has made significant

investments in the field and Neil could make valuable contributions to discussions, particularly with regard to biosecurity.

Action 13-13: Lionel Clarke to invite Prof Neil Stansfield, Dstl, to join SBLC.

Whilst the GSG has some representatives of civil society, the GSG agreed that it lacked someone to consider environmental issues and the consumer perspective. The SBLC agreed that Dr Robert Doubleday (Centre for Science & Policy, University of Cambridge) should be invited to join the GSG.

Action 13-14: Joyce Tait to invite Robert Doubleday to join GSG.

The SBLC agreed that it is appropriate for the KTN to have a seat (Sue Dunkerton) as well as a secretariat position (Amy Tayler).

The SBLC agreed that representatives from the learned societies and devolved administrations should be issued with clear invitations for the annual open meeting, but they should not be invited to join the SBLC: it would be unbalanced to have any one without the others.

Amanda Collis shared the policy adopted by the BBSRC strategy advisory bodies, which have an open call to self-nominate and have a staggered turnover, with one-third of the committee being refreshed each year. It was agreed that as an independent body this mechanism would not be appropriate for the SBLC.

The SBLC discussed the possibility of having a couple of positions that are voted on by the community, although the SBLC noted the difficulties in managing the process. However, the open meeting also provides an opportunity to include additional members of the community, to whom the SBLC must listen and take action.

The SBLC agreed that membership should be a standing item at every meeting, and that in the spirit of openness and transparency the secretariat should keep and publish a register of interest for each SBLC member.

Action 13-15: SynBio SIG to consult BBSRC regarding a register of interest for the SBLC.

7 Scottish Synthetic Biology Steering Group

Chris Corden (Scottish Enterprise) explained Scottish Enterprise's interest in synthetic biology. Ian Shott, who chairs the Scottish Industrial Biotechnology Innovation Centre (IBioIC), has identified synthetic biology as important for Scotland, which already has significant expertise in the area. Scottish Enterprise is currently investing £50,000 to evaluate current activity and where it might lead.

Scottish Enterprise has established a steering group to consider how Scotland can contribute to broader UK activities. The membership has been expanded to include Joyce Tait (Innogen Institute, University of Edinburgh), David Venables (Synpromics),

Sandy Dobbie (Chairman, Executive and Non-executive Director in the global chemicals and biotech sectors), Rod MacKenzie (Pfizer), John Cumbers (SynBioBeta), Mike Barrett (University of Glasgow), Linda Brooks (ThermoFisher Scientific), Chris Corden (Scottish Enterprise), Lilian Hamilton (Scottish Enterprise), Sophie Lowry, (Scottish Funding Council), Amy Tayler (Synthetic Biology Special Interest Group, Knowledge Transfer Network), Ian Archer (IBioIC), Frank Sargent (University of Dundee), Susan Rosser (University of Edinburgh), Liz Fletcher (University of Edinburgh), Lorraine Kerr (University of Edinburgh), Ian Stansfield (University of Aberdeen), Andrew Love (James Hutton Institute) and Mark Morrison (Optimat).

IBioIC will shortly launch an international synthetic biology competition, in which both companies and IBioIC will jointly fund projects on an equal basis. The aim is for companies to see the UK and Scotland as a good place to do business.

The Scottish Environmental Protection Agency (SEPA) has commissioned Joyce Tait to conduct a review of the robustness of the relevant regulations with the aim of establishing a clear regulatory environment for synthetic biology. This is in partnership with counterparts in the UK and Northern Ireland.

The Scottish Universities Life Science Alliance (SULSA) is campaigning for more maths in biology courses in schools.

Scotland has been successful in applying to the European Commission to be one of six chemical demonstrator regions. Although the full details are yet to emerge, each regions is likely to receive €40-50m to set up demonstrator facilities, which will be required to consider the impact on the bioeconomy.

The Scottish Synthetic Biology Steering Group is working with SynbiCITE to consider establishing a synthetic biology incubator or hub in Scotland.

The Scottish Futures Group has identified synthetic biology as an opportunity for Scotland, hence there is willingness to invest resources behind it.

Scotland has recently established eight Innovation Centres to support transformational collaboration between universities and businesses. Collaboration between the different centres is encouraged, and synthetic biology is an ideal candidate for cross-sector collaboration.

Prof Susan Rosser (University of Edinburgh) has been appointed to the Scottish Science Advisory Council.

The SBLC noted the potential difficulty in managing the asymmetry between the resultant benefits for the whole of the UK or for Scotland, and noted that more is to be gained by joining up across the whole of the UK. However, there are some very good examples of pan-UK collaboration and models for successful ways of working.

9 Standards

Chris Jones explained that PAS 246 (Use of standards for digital biological information in the design, construction and description of a synthetic biological system) was published a year ago. BSI would like to plan their next activity, but we have encouraged wider consultation first. BSI will shortly publish their RAND Europe report, which will be discussed at a joint meeting (including KTN, Innovate UK, BSI, LGC, NPL, University of Cambridge, University of Edinburgh, Imperial College London, Croda, Dr Reddy's and Synthace) and reported at the next SBLC meeting. Joyce Tait has drafted a report for BSI summarising the role of standards in supporting innovation, in which synthetic biology is a case study.

Action 13-16: Andy Boyce to invite LGC to the standards meeting on 27th April 2016.

10 AOB

George Freeman was unable to attend at short notice. No additional items were raised. Lionel thanked everyone for their participation and drew the meeting to a close.

Action 13-17: Amy Tayler to produce SBLC 13 minutes and a 1-page digest for the minister.

Summary of actions arising from this meeting

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