

## Manchester Policy Week 2015 Workshop on Synthetic Biology: Reshaping the Future?

**HOW TO PREPARE FOR A WORLD WHERE SYNTHETIC BIOLOGY CAN RESHAPE OUR LIVES, ECONOMIES, AND ENVIRONMENT** was the theme of the workshop “Synthetic Biology: Reshaping the Future?” held at the Manchester Institute of Biotechnology on November 5, 2015. Co-organized by the **Manchester Institute of Innovation Research** and the **Manchester Synthetic Biology Research Centre**, the workshop formed part of the University of Manchester’s annual **Policy Week**. Speakers at the workshop talked about a range of research and policy issues related to synthetic biology including what is synthetic biology, how it is being developed in Manchester, the biohackers movement, and responsible research and innovation. There were more than 40 attendees from academia (staff as well as students) and industry. The workshop chair was **Philip Shapira** from the Manchester Institute of Innovation Research and lead for the SYNBIOCHEM Responsible Research and Innovation team.

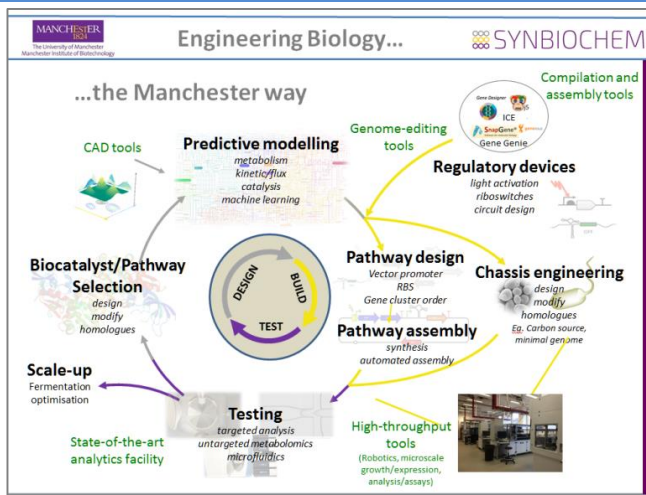


**WHAT IS SYNTHETIC BIOLOGY AND WHO IS DOING IT?** Synthetic biology involves redesigning biological components and systems found in the natural world or making new ones from scratch. Proponents assert that synthetic biology will drive a new worldwide industrial revolution. In Britain, synthetic biology research has been boosted by a network of synthetic biology research centres funded by the Research Councils UK. The centres are university-based, and each has its own research focus. **Rainer Breitling**, Professor at the Manchester Institute of Biology, told workshop participants that the growth of synthetic biology is aided by greatly reduced DNA sequencing costs and the ability not only to read but also to edit cells. New metaphors are emerging where cells can be designed as in electronic circuits and reconstructed like Lego kits into engineered systems. High-value bio-based alternatives to chemical production are being designed, built, and tested in Manchester’s SYNBIOCHEM centre, Breitling explained.

**UNCONVENTIONAL STAKEHOLDERS IN THE SYNTHETIC BIOLOGY LANDSCAPE.** New stakeholders, outside of universities and established companies, are also pioneering synthetic biology. **Asa Calow**, Director of MadLab in Manchester, showed how readily available gene editing software and crowd funding is driving a Biohacker Movement of citizen scientists engaged in synthetic biology. Disruptive new businesses are emerging from this movement, such as Muufri – a San Francisco-based start-up that is making cow-less milk from engineered yeast-cultures. MadLab is opening up a community biotechnology lab in Manchester which will introduce biotechnology and synthetic biology to the public and offer a “do-it-yourself” DIYbio space. While some will use this lab to educate themselves and learn about the methods and tools of synthetic biology, other users may go on to set up companies. Biohacker communities have mushroomed internationally, with leading examples including La Paillasse in Paris and Counter Culture Labs Oakland, California. Calow suggested that an active biohacker community can also flourish in Manchester.

**INSTITUTIONALISING RESPONSIBILITY.** Synthetic biology’s ground-breaking prospects are accompanied by ethical, risk, and equity policy concerns. How can this fast emerging domain be responsibly developed? Increasing attention is being given to responsible research and innovation in synthetic biology, commented **Sally Randles**, Senior Researcher at the Manchester Institute of Innovation Research. As yet, however, responsible research and innovation is still an unstable concept, with multiple meanings. Current understandings of responsibility may not be adequate, while newer interpretations have yet to be deeply institutionalised. Randles presented a series of examples which offer lessons for synthetic biology. These examples highlighted the value of institutional change, leadership, and entrepreneurship in embedding societal values in research, the importance of openness, transparency, and capability building, and the role of multi-level governance, goal alignment, and boundary-crossing processes.

**GOVERNING RESPONSIBLE RESEARCH AND INNOVATION.** For **Phil Macnaghten**, Professor at Wageningen University, responsible research and innovation is about steering the development of science and technology so that it meets widely shared societal goals. This is “an old idea set within a new science and innovation policy context,” adding that “the more disruptive the science, the bigger the questions for society, the more responsibility is required.” Macnaghten said that synthetic biology was among this disruptive set, which also included nuclear technologies, agricultural biotechnologies, nanotechnologies, and climate engineering. He then introduced a framework for



Engineering biology ... the Manchester way (R. Breitling)



Processes for governing responsible innovation (P. Macnaghten)

governing responsible research and innovation, co-developed with colleagues and promulgated by the UK Engineering and Physical Sciences Research Council. This comprised four key processes: anticipation (involving foresight, technology assessment, horizon scanning, and scenarios), inclusion (through such approaches as consensus conferences, focus groups, and deliberative mapping), reflexivity (including multidisciplinary collaboration and embedded social scientists), and responsiveness (for example, through regulation, standards, and open access). Macnaghten showed how this framework was usefully applied in a climate engineering case, the Stratospheric Particle Injection for Climate Engineering (SPICE) project.

**TRANSFERRING RESPONSIBILITY INTO RESEARCH.** A common thread at the workshop was the importance of engagement, collaboration and interactions among all stakeholders. The interface between natural and social scientists was seen to be of high relevance for synthetic biology and its development. Linkages between established researchers and communities of citizen scientists were seen as promising. Connecting responsible research and innovation policy to practice in synthetic biology was a further arena for collaboration. UK synthetic biology now has frameworks for responsible innovation, a Roadmap that stresses public benefit, stakeholder engagement, and responsive regulation, and centres that state the importance of responsibility and public dialogue. But what does responsible research and innovation look like once transferred from policy into research? Sarah Hartley, from the University of Nottingham, suggested that it should include public outreach, interdisciplinary involvement (including social science and humanities) in scientific research, stakeholder involvement and the engagement of expertise, and training and education to develop “social-leaning” scientists over the long term. Yet, tensions are likely, Hartley noted. It should not be assumed that public fears about synthetic biology will be alleviated simply through outreach and education, nor that political and stakeholder debate can be avoided. She was also apprehensive about prioritising economic and commercial benefits above public and societal concerns. Hartley added that “responsible research and innovation is an experiment in reshaping the future.” It challenges existing practices, may “open up” or “close down” opportunities to reshape the future, and will likely generate struggle over meanings and values.

**FEEDBACK.** Participants were asked to voluntarily provide feedback following the workshop (11 participants responded – these responses should be viewed as illustrative rather than representative). Among these respondents, those with greatest prior knowledge about the scientific aspects of synthetic biology were more likely to report considerably or greatly more awareness of responsible research and innovation as a result of the workshop, while those with less prior scientific knowledge reported greater awareness of synthetic biology’s scientific aspects. Two-thirds of the respondents indicated that the workshop made them considerably or greatly more aware of responsible research and innovation. There was a high degree of agreement among respondents that synthetic biology offers viable solutions to some of the world’s grand challenges. “It will change society as much as computers,” commented one participant, although another worried that “public opinion, especially if not well-informed, could have a negative impact on the progression of the field.” At the same time, more than one-half of respondents were concerned that synthetic biology could give particular corporations too much power to change nature. About three quarters of respondents said that more regulation and control is needed to keep up with developments in synthetic biology.

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