From Contribution to Co-Evolution: A way to promote responsible innovation in synthetic biology?

Eleonore Pauwels, WWICS

Characteristics of the synthetic biology innovation ecosystem

Changes in our research and innovation ecosystems have started re-shaping the role and practices of researchers in life sciences (Pauwels, 2010). As analyzed by Steven Shapin (2008), the scientific persona itself is progressively evolving into one of entrepreneurship. Unlike traditional biotechnologists, most synthetic biology researchers operate simultaneously in several spheres: as academic researchers receiving government funding for research, inventors seeking patentable discoveries, company founders receiving investment capital from the private sector to finance product development and members of advisory boards for groups engaged in similar activities. There are key questions about how these interrelations can be a positive or negative element in developing a culture of responsibility across research and innovation systems.

Adding complexity, the synthetic biology innovation ecosystem also crosses boundaries within the natural sciences. Synthetic biology's practitioners are not, as a rule, biologists or even molecular biologists. Many are computer scientists or come from disciplines that do not study or work with whole organisms, but instead apply an even more mechanistic perspective to living systems than do traditional genetic engineers. The synthetic biology innovation ecosystem is further fragmented among sectors. Synthetic biology represents an amalgam of public and private funding, public and private institutions, experts and amateurs and, in some cases, new approaches to intellectual property protection. To some extent, the fragmentation and complexity of such an innovation ecosystem plays to the strengths of "responsible innovation," in that the systems-based and adaptive premises of this governance approach provide a more comprehensive and flexible framework for dealing with complexity.

End-points for oversight within the synthetic biology ecosystem

Synthetic biology has advanced to the point where more complex organisms are being developed and the inventory of interchangeable biological parts continues to expand, rapidly enabling more combinatorial designs (the number of new biobricks generated annually could exceed 3,500). Looking ahead, it is worth considering what has not been resolved in the field and the likely changes that could affect research, development and commercialization efforts, creating both challenges and opportunities:

1) The capacity of our regulations, and more generally, the Coordinated Framework for Biotechnology,to deal with synthetically engineered organisms has been barely tested so far.
2) There is almost no funding focused on emerging environmental risks, though the complexity of those risks has become more apparent.
3) Public awareness in the US on synthetic biology remains low. According to a national survey conducted by Hart Research Associates for the Synthetic Biology Project (Hart, 2013), only one in four Americans has heard something about synthetic biology and initial impressions are often negative. The results of the 2010 Eurobarometer survey by the European Commission reveal similar lack of awareness and knowledge gaps in Europe on synthetic biology (EC, 2010).
4) The field does not have a coherent public message, and current messaging and media reporting often provoke public anxieties.

An effective science-policy interface and mechanisms to support productive public engagement surrounding the science, its long-term benefits for society and scientifically grounded appraisals of the risks are needed. This science-policy interface was, in part, the role endorsed by PCSBI in its 2010 report.

However, there has been little to no action on these recommendations. The difficulty for PCSBI to jump-start a learning strategy around the notion of "responsible stewardship" and "prudent vigilance" leaves us with an array of questions: How can responsible innovation help towards improving our oversight culture? How is the synthetic biology innovation ecosystem both a challenge and an opportunity for implementing devices of responsibility?

The research system

RRI plays an insignificant role in the enterprise of academic research and innovation. Structural changes are needed to sufficiently incorporate the ethical and societal aspects into research and innovation. In A 2011 report, the Royal Society of London states that individual researchers are often not cognizant of the societal and ecological impacts or the ethical dimension that their research might have in the future (Mackintosh, 2011). The extent to which societal demands or ecological aspects are taken into account varies significantly, often depending on the awareness of individual researchers. In the career system of academic researchers, there are hardly any incentive for considering ethics and responsible innovation. For instance, with a few exceptions, there is much less funding for problem-oriented, trans-disciplinary research than is needed. Further, very few high-impact journals publish interdisciplinary studies.

The innovation system

Similar to the research system, the innovation system has systemic constraints resulting in a failure to anticipate RRI or future societal needs, especially when it comes to inter-generational problems or issued faced by less empowered and fragmented groups. It is not only challenging for the public sector to foresee future issues and recommend appropriate solutions, but also unattractive for the private sector due to a longer time frame of a return on investment. Although many companies have introduced environmental and/or sustainability management systems (ESMS) and Corporate Social Responsibility strategies, most companies follow procedures in the R&D process that do not explicitly take all these dimensions into account. Most companies comply with the minimum regulatory requirements for environmental and social responsibility, which are quite basic, and do not exceed this baseline. So far, there is no coherent approach for integrating RRI (or aspects of RRI) into the innovation system of companies or research organizations.

Towards Co-Evolution in Research and Innovation Ecosystems

Ideally, the collaborative practices described by von Schomberg (2011) would require continual conversations with those outside of the lab, including policymakers and non-institutional networks, such as DIYbio practitioners. Knowledge sharing between researchers and policymakers, for example, would help identify safety or regulatory uncertainties in synthetic biology so designs could be adapted for more desirable outcomes. Rejeski (2011) explains how this might be a challenge for the legacy institutions: "the old policies and programs, based largely on an 'assessment and regulation' paradigm, need a new operating system, one that moves from Newtonian mechanics to evolutionary biology and shifts the modus operandi from the interminably long process of issue identification, analysis, recommendations and implementation to an emphasis on learning, adaptation and co-evolution (p. 50)." Indeed, policymaking communities need a clear perspective on the challenges posed by synthetic biology to ethics and society, but must also promote deeper thinking inside public policy communities about how to develop and implement learning strategies. If we consider emerging technologies to be complex adaptive systems, then policymakers need to be part of that co-evolving system. Before we try to implement the concept of co-evolution, we still have to confront the challenges posed by our legacy institutions – policy and regulatory.