Organizing Synthetic Biology: Structuring the Social and the Technical at iGEM

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Abstract

Drawing on scholarship in Organizational Communication, this study analyzes communication in the context of the International Genetically Engineered Machine (iGEM) competition—an annual event that will unite undergraduate, graduate, and amateur researchers from 245 universities in 32 countries in 2014—to generate insights into the governance of synthetic biology.

iGEM logo

What can communication tell us about organizing?

Communication is…

- the site of negotiations about how systems should organize (Ashcraft, Kuhn & Cooren, 2009)
- a means of connecting and transporting decision processes across system domains (Norton, 2007)
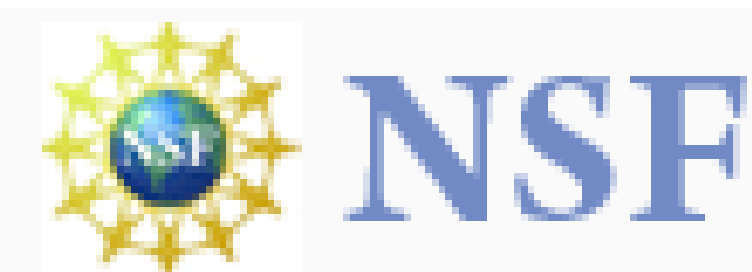- an avenue for exploring how structure affects agency and how agency in turn affects structure (Giddens, 1984)

Graphic by the 2012 Wageningen iGEM team

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Embedding Societal Considerations into Scientific Development

Although synthetic biology holds great potential to advance biomedicine, clean energy, and other social goods, there is also broad awareness of the controversial nature of engineering living organisms for instrumental purposes. Accordingly, scientists, regulators, and Science and Technology Studies scholars are striving to learn from past controversies associated with genetic engineering. A central concern is **how to embed societal and ethical considerations into the process of scientific development and governance**.

Models of achieving this goal fall into 3 overlapping categories:

- "upstream" approaches aim to address societal issues when research and development is first authorized
- "midstream" approaches are geared towards research and development implementation
- "downstream" approaches focus on end-user adoption, modification, or rejection of new technologies (Fisher, Mahajan & Mitcham., 2006, p. 490).

This study considers how social and ethical issues are integrated or distanced from technical issues in the context of the International Genetically Engineered Machine (iGEM) competition. iGEM's efforts to address "Policy and Practices" issues—in other words, social and cultural considerations—represent an attempt to facilitate **midstream modulation** that prompts scientists to reflect on and respond to such considerations as they do their work. Viewed through the lens of structuration theory, this modulation is akin to what Giddens (1984) called **reflexive monitoring**, a process where "actors not only monitor continuously the flow of their activities and expect others to do the same for their own; they also routinely monitor aspects, social and physical, of the contexts in which they move" (p. 5).

A structuration-focused analysis suggests that Policy and Practices judging criteria may be perceived as structural contradictions. On one hand, the competition's purpose is to "design to build biological systems and operate them in living cells" in a highly compressed time period. On the other hand, to win a gold medal, teams must engage social questions, describe how they addressed those questions, and evaluate that approach in relation to their scientific projects.

Perceived contradictions can facilitate positive change and generate new knowledge by prompting conflict that is centered around the "fault lines" of governance (Giddens, 1984; Canary, 2010). Accordingly, this study investigates how iGEM participants navigate perceived contradictions, paying special attention to **where "fault lines" are drawn to indicate what is technical vs. social, responsible vs. irresponsible, acceptable vs. unacceptable, and why**. Research questions include:

- What do iGEM participants say when they talk about Policy and Practices?
- How does iGEM discourse organize societal concerns in relation to technological concerns?
- What types of governance can be inferred from the fault lines that participants draw?

iGEM Policy and Practices graphic

Midstream research for upstream insights

This project draws on the methodology of midstream modulation, which was developed by Fisher et al. (2006) as a means of encouraging scientists and engineers in the laboratory to recognize and reflect on the contexts of their decision-making, and ultimately to apply this increased reflexivity in order to improve decision processes and products. While midstream modulation seeks to enable technical researchers to engage more effectively with the structures and incentive systems in which they are working, the current study seeks to capture the insights of researchers as a way of evaluating, and potentially modifying, governance structures. To do so, it draws on Giddens' (1984) premise that the interplay between macro-level structures and individual agency is empirically observable in day-to-day communicative interaction.

Methods

After IRB approval was secured, data collection proceeded in multiple stages. The first stage involved searching team websites to identify which iGEM teams included a "Policy and Practices" aspect in the projects they submitted for judging, as required for gold medal consideration. (Teams competing in the competition's high school division were excluded because their average age is under 18). In the second stage, I participated in the iGEM competition and obtained informed consent to observe project presentations and conduct brief interviews with team members and their advisors, as well as competition judges and attendees. In the next stage, data will be coded using NVivo qualitative data analysis software according to the constant comparative method (Glaser, 1978). **Preliminary insights will be discussed at the Workshop on Research Agendas in the Societal Aspects of Synthetic Biology.**
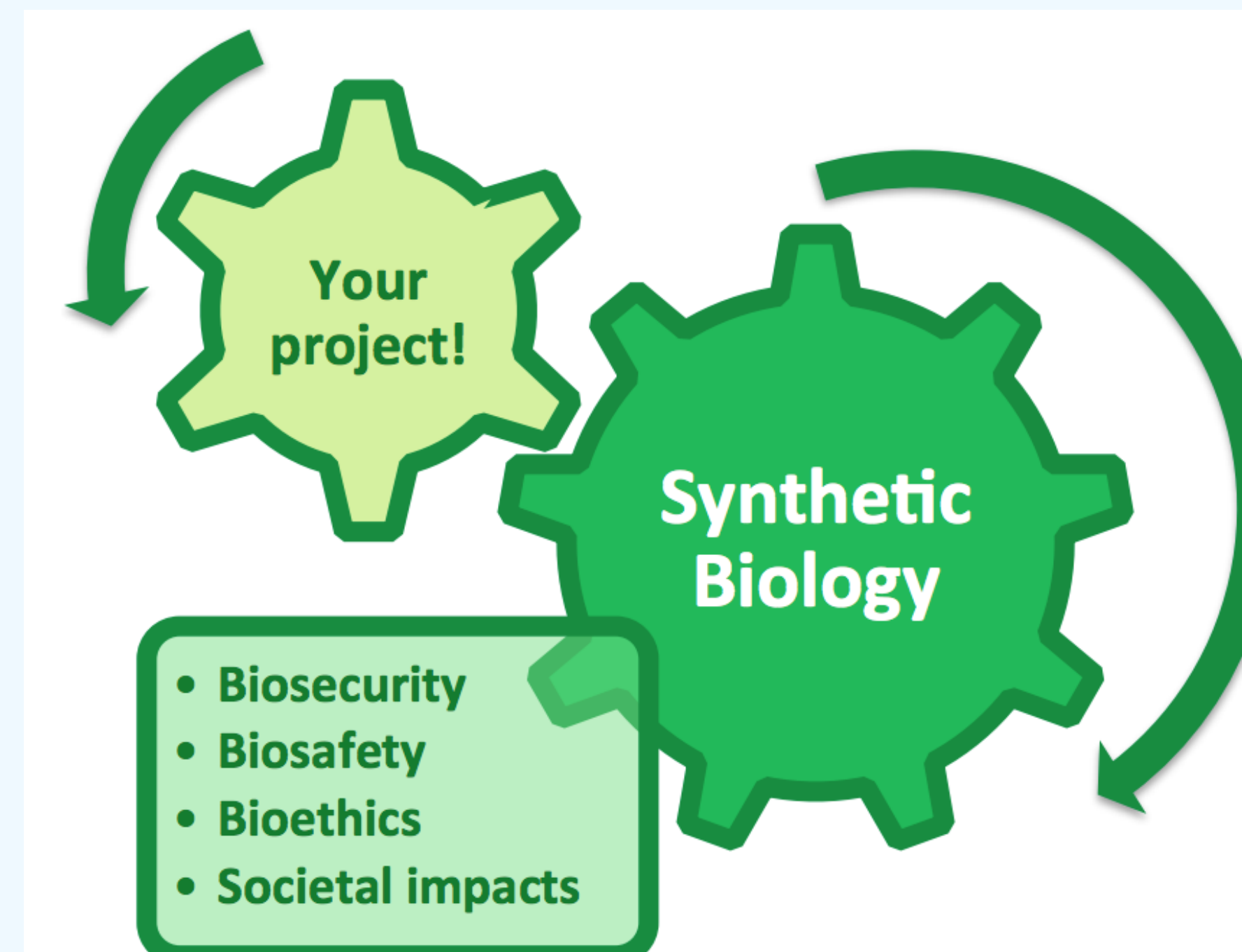
Why study iGEM?

- Studying early-career researchers can yield insights into the messages and incentives they receive from their mentors, who play a powerful role in shaping perceptions about what types of conduct are acceptable and responsible (Anderson et al., 2007). This type of research can also yield incentives into how organizational cultures and structural incentives affect individual behavior.
- iGEM participants possess significant technical competency but may not have developed the "tunnel vision" of expert bias (Chhibber et al., 1992).
- Identifying unintended consequences in existing policies can contribute to adaptive governance (Lee & Petts, 2013).

Graphic by the 2013 Valencia Biocampus iGEM team

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