Mapping Responsible Innovation
A First Principles Approach

North Carolina State University
Genetic Engineering & Society Center iGEM Team

http://2014.igem.org/Team:GES_NCSU_Raleigh_NC
Outline

I. Purpose & motivation
II. Concept map
III. Evaluation tool
IV. Our beta testers
V. Preliminary results
VI. Contributions, future directions
Team Diversity

- Communication
- Computer Science
- Entomology
- Forestry & Environmental Resources
- Genetics
- Public Administration
- Public Policy
What does it mean to act responsibly with respect to emerging technologies?
Responsible Research and Innovation

“Transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and social desirability” of products and the social processes that surround them.

(von Schomberg, 2011, p. 9)
Allow definition to evolve in collaborative way

Develop tool to articulate and compare values
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Concept Mapping Approach

- Expert elicitation
  - Within the group
  - Outside feedback
- Initial focus: genetically modified plants

Source: larrytinnerman.com
Initial Values

*Responsibility may include...*

- Fostering economic benefits & employment
- Securing legitimacy & public trust
- Meeting regulatory requirements
- Considering intellectual property and ownership
- Advancing ethics & social equity
- Promoting environmental health
- Addressing social system impacts
- Promoting entrepreneurship & innovation
- Improving quality of life
- Protecting biodiversity
- Addressing cultural impacts
- Protecting human health
Concept Mapping Approach

- Expert elicitation within the group
- Literature review
- Visualize concepts through map

Source: larrytinnerman.com
Initial Values

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• Addressing cultural impacts
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Strengths

- Collaborative
- Feedback
- Discussion
- Adaptable
- Reactive
- Versatile
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Evaluation Tool

• Two questions
  • How much effort is being given to each principle
  • How important is each principle
• For each principle there is a set of statements, users score each value statement on a 1-5 Likert

- Secure Public Trust and Legitimacy
  - Product developers should avoid controversy
  - Product developers should invest in community outreach
  - Product developers should cultivate customer loyalty
## Results Page

<table>
<thead>
<tr>
<th>Value Name</th>
<th>Your effort/importance</th>
<th>Average at</th>
<th>Global average</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsible Release of a Genetically Modified Organism</td>
<td>4/4</td>
<td>3.75/4.75</td>
<td>4.09/0.09</td>
<td>View the full concept map</td>
</tr>
<tr>
<td>Advance Innovation and Entrepreneurship</td>
<td>3/4</td>
<td>4.0/4</td>
<td>4.05/0.55</td>
<td></td>
</tr>
<tr>
<td>Secure Public Trust and Legitimacy</td>
<td>None/None</td>
<td>4.0/4.0</td>
<td>4.05/0.55</td>
<td></td>
</tr>
<tr>
<td>Promote Biodiversity</td>
<td>None/None</td>
<td>3.0/4.0</td>
<td>4.05/0.55</td>
<td></td>
</tr>
<tr>
<td>Products should benefit certain segments of society.</td>
<td>3/4</td>
<td>2.75/4.0</td>
<td>4.0/4.0</td>
<td></td>
</tr>
<tr>
<td>Products should create as many or more jobs than they eliminate.</td>
<td>2/4</td>
<td>2.25/3.75</td>
<td>4.0/4.0</td>
<td></td>
</tr>
<tr>
<td>Products should offer the greatest good for the greatest number of people.</td>
<td>3/5</td>
<td>3.0/4.0</td>
<td>4.0/4.0</td>
<td></td>
</tr>
<tr>
<td>Products should directly benefit customers.</td>
<td>5/5</td>
<td>3.66/6.0</td>
<td>4.0/4.0</td>
<td></td>
</tr>
<tr>
<td>Products should generate income for their developers.</td>
<td>2/1</td>
<td>2.6/3.0</td>
<td>4.0/4.0</td>
<td></td>
</tr>
<tr>
<td>Products should generate profit for shareholders.</td>
<td>2/5</td>
<td>2.0/3.0</td>
<td>4.0/4.0</td>
<td></td>
</tr>
</tbody>
</table>

### Statements Column

- **User’s input score**
- **Average score for affiliation**
- **Global Average Score**
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Our Beta Testers: The Glowing Plant
Learning Through Conversations

Glowing Plant team and other “beta testers”

• provided focus
• suggested principles
• tested tool
• identified tensions & challenges
Why Is This Valuable? To Whom?

Deliberative inquiry:
a social learning and reasoning process in which people air and explain differing views and knowledge claims

(Burgess et al., 2007)
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Data Collection

• At iGEM, we have used our web app to conduct an IRB-approved study on the values people rely on to define responsibility
• Members of our team have been standing by our poster and helping visitors fill out the evaluation tool
Data Collection

• The tool contains 25 values, scaled from 1 to 5 on both effort and importance, for a total of 50 questions
  • 28 respondents
  • 33/50 questions answered on average
  • Values with most responses
    • Effort: Products should benefit certain segments of society.
    • Effort: Products should offer the greatest good for the greatest number of people.
Effort: Products should benefit certain segments of society.
Effort: Products should offer the greatest good for the greatest number of people.
With More Data...

- We can make stronger claims about how these values interact with one another
- Our concept map will evolve over time to incorporate more values as our users suggest them
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Major Contributions

The foundations of an interactive concept map

Value quantifying evaluation tool

User friendly web application
Future Directions

- Seek grant to develop version 2.0
- Integrate concept map and evaluation app into a single tool
- Develop more principles and relationships for the C-Map
- Initiate more conversations about values with more stakeholders
- Make the evaluation tool more user friendly for non-experts
- Develop better ways to measure values
Thank You!

North Carolina State University
- Dr. Jennifer Kuzma
- Dr. David Berube

The University of Michigan
- Dr. Andrew Maynard

The Glowing Plant
- Antony Evans

iGEM Competitors & Judges
- Thanks for your feedback, and for taking our survey!

Kopenlab Festival
- organizers
- attendees

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