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Moral Imagination for Engineering Teams: The Technomoral Scenario

Abstract:

"Moral imagination" is the capacity to register that one's perspective on a decision-making situation is limited, and to imagine alternative perspectives that reveal new considerations or approaches. We have developed a Moral Imagination approach that aims to drive a culture of responsible innovation, ethical awareness, deliberation, decision-making, and commitment in organizations developing new technologies. We here present a case study that illustrates one key aspect of our approach – the technomoral scenario – as we have applied it in our work with product and engineering teams. Technomoral scenarios are fictional narratives that raise ethical issues surrounding the interaction between emerging technologies and society. Through facilitated role-playing and discussion, participants are prompted to examine their own intentions, articulate justifications for actions, and consider the impact of decisions on various stakeholders. This process helps developers to re-envision their choices and responsibilities, ultimately contributing to a culture of responsible innovation.

Agenda:

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Background

"Moral imagination" is the capacity to register that one's perspective on a decision-making situation is limited, and to imagine alternative perspectives that reveal new considerations or approaches.[1] At Google, we have developed a Moral Imagination approach that aims to drive a culture of responsible innovation, ethical awareness, deliberation, decision-making, and commitment in organizations developing new technologies. This case study illustrates the application of one key component of our "Moral Imagination" approach – the technomoral scenario – as we have applied it in our work with product and engineering teams.[2]

A techno-moral scenario is a story about a possible future in which ethical issues emerge in the interaction between a novel technology and society.[3] Scenarios are not predictions about the future. Rather, they are designed to elicit reflection amongst technology developers about their own work. The use of a story about a fictional technology allows developers to gain distance from their work, enabling them to see their context, technology, and perspectives anew. At their core, techno-moral scenarios aim to focus a group's attention on key ethical considerations that they face through collectively imagining, and complicating, the consequences of their intentions, and creatively imagining how the consequences of their decisions impact different stakeholders, including those they may not have considered. To achieve these aims and create an effective learning environment, expert facilitators guide participants through the techno-moral scenario.

In practice, a facilitator reads the scenario out loud, and then introduces a role playing conversation with various stakeholder perspectives in the fictional world of the scenario. This helps participants understand the limitations of their own perspectives and the value of gaining diverse points of view by encouraging participants to interrogate their own intentions and rehearse articulating justifications for action. A subsequent discussion allows participants to share learnings amongst the group and prompt deliberate information seeking to underpin subsequent ethical decision-making. In this respect, technomoral scenarios are an important tool for helping developers re-envision their choice landscape and practical responsibilities.

Exercise Overview

The techno-moral scenario below has been designed to simulate a discussion that could arise at a real world tech company. This particular scenario is not meant to reflect any real world technology development of which we are currently aware, but rather to evoke an ethical landscape comparable to what technology developers may confront today. So, as you read it, imagine you are part of a team of developers in the US or Europe setting off to work on a groundbreaking technology, striving to develop it for socially beneficial ends, as well as for profit. The exercise has five steps:

1. Introduce the exercise
2. Read the scenario out loud
3. Assign participant roles and let them prepare for a mock public hearing
4. Conduct the mock public hearing
5. Discuss reflections from the exercise

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[1] Werhane, Patricia Hogue. Moral imagination and management decision-making. Oxford University Press, USA, 1999.

[2] See Lange, B., Keeling, G., McCroskery, A. et al. Engaging engineering teams through moral imagination: a bottom-up approach for responsible innovation and ethical culture change in technology companies. AI Ethics (2023). https://doi.org/10.1007/s43681-023-00381-7.

[3] Swierstra, Tsjalling, Dirk Stemerding, and Marianne Boenink. "Exploring techno-moral change: the case of the obesitypill." Evaluating New Technologies: Methodological Problems for the Ethical Assessment of Technology Developments. (2009): 119-138.

A facilitator should guide participants through the sequence and to enable robust and productive conversation throughout. The following sections present the materials and instructions for each step.

Introduce the Exercise

Instructions: The facilitator describes the overall sequence and aims of the exercise:

- *Recognize and articulate ethically important factors*

- *Recognize the nature and limitations of one's own perspective*

- *Recognize the value of information-seeking from a wide variety of stakeholders in ethical deliberation*

Read the Scenario

Instructions: The facilitator reads the scenario out loud while withholding any ethical judgement on the material or the perspectives described therein. The idea is to convey the scenario so that participants can fully imagine it. A visual aid (e.g. a slide deck or a printed copy of the scenario) can be a helpful reference for participants.

The Scenario: Intentional Rain

The year is 2034.

"We've done it!," shouted the CEO of Intentional Rain Research, based in Dublin. She uncorked champagne as a rain cloud moved away from the green Iberian Peninsula toward the parched regions of the continent Abudantia. Now that their atmospheric pressure manipulators were fully operational, the years of drought that had plagued Abudantia would at last come to an end. Global leaders lauded the historic achievement and celebrated the international research collaboration between Intentional Rain and the United Nations (UN).

North Abuntian countries like Dryland had been pleading with the United Nations for ongoing assistance for wildfires and droughts, which displaced thousands and decimated their primary industry: agriculture.

Sophisticated atmospheric models responded to the challenge. The aim was to simulate the interplay of temperature, humidity, pressure, and wind patterns. These models ran on supercomputers capable of millions of calculations per second. The models, trained on petabytes of historical and real-time weather data, were constantly refined through machine learning processes. The complexity of the Earth's atmospheric system, with its chaotic nature and countless variables, demanded immense computational power to optimize the world's weather system for agriculture. It needed to identify optimal pressure manipulation points that would nudge rain clouds towards their intended destinations.

While the UN and international aid organizations responded directly by bringing in as much water as their logistics and funding would allow, they also invested in promising research efforts in partnership with companies and leading universities. Finally their investments were paying off. By manipulating atmospheric pressure zones around the globe, Intentional Rain was finally able to influence cloud movements and bring ongoing relief and restoration to regions like Beeland.

As rain poured down, the world joined Dryland in celebrating this historic success. In its communications, the UN-Intentional Rain partnership was careful to focus on the benefits of the affected areas, rather than highlighting the unique power it possessed to manipulate this precious natural resource. But the power of this development was implicit as pundits discussed publicly what it could mean for all the world's future, and who should control it.

Six weeks after the launch, the international press raised multiple alarms coming from inside the affected region:

- The drenching rains in the targeted region swept away topsoil, lowering the average yield per acre in Dryland.
- The area immediately southeast of the targeted region saw a steep decrease in rainfall.
- In a neighbouring country called Beeland, farmers noted a large decline in the honeybee population, which adversely affected their harvest and nature's ability to pollinate their fields.

The Intentional Rain Research Partnership struggled to comprehend the causes of these issues, working hard on understanding how it works and what went wrong. They knew they had two complex systems here: global weather and a huge machine learning model. And while they investigated both, the controversy quickly became heated.

Farmers in Beeland organized a public letter of protest to the United Nations and Intentional Rain, calling for an immediate stop of the project in light of its detrimental effects on their local harvest. This was seized upon first by local and then national politicians in Beeland, calling into question the authority by which the UN-subsidized project has begun to shape weather. The politicians accused Intentional Rain and the UN of playing "Weather Politics".

The controversy was documented by journalists across the globe:

- "We. Do. Not. Consent." Says Beeland president at emergency hearing. - The Daily Nation
- "The global climate crisis is existential. We must take risks or else our mutual destruction is assured!" — TOP Scientist
- Weather Politics by Deep-Pocketed Research Labs: Who gets to control the weather? - Science Weekly
- "Technology ascends the global throne… because it can." — New York Chronicle

Stakeholder Roles

Instructions: Individually or in groups, participants pick a stakeholder role from the list below and reflect on the considerations they imagine would be salient from the point of view of those stakeholders. Prepare a short opening statement for the mock public hearing, along with questions for the other groups. Note that running the exercise with different combinations of stakeholder groups can result in different ethical considerations appearing more or less important.

Beeland Farmers' Association: Your role as a representative of the Beelandian Farmers' Association is to represent the interests of Beelandian farmers. You might consider emphasizing the negative impact that the Intentional Rain system has had on the farming industry, and pressing political actors to take steps to remedy the harm done by Intentional Rain. You might also advise political organizations on how to engage with farmers in general in future to prevent the intentional rain system from negatively impacting their businesses.

Environmental Activists: Your role as an environmental activist is to highlight the impact of climate change on Dryland and the planet more broadly. You might consider assessing the choices and commitments of other stakeholders from the point of view of values such as sustainability and biodiversity, and also advocating for plausible ways in which decision-makers can better account for the environment in their decisions moving forward.

Journalists: Your role as journalists is to hold decision-makers accountable to the public by asking critical questions. You might consider pressing Intentional Rain on why they chose one course of action over alternatives or how they might seek to rectify the situation that they have created. Who did Intentional Rain consult with as they made product decisions? You might also press political actors on what steps they intend

to take to remedy the damage caused by Intentional Rain's system or to put questions to those impacted by Intentional Rain's actions to better enable Intentional Rain and politicians to understand their lived experiences.

Intentional Rain Engineers: Your role as Intentional Rain engineers is to account for Intentional Rain's choices in developing the system in response to questions from journalists, politicians, and other stakeholders. You might consider emphasizing the ethical considerations that the company counted for in deploying the Intentional Rain system alongside the trade-offs that Intentional Rain encountered and how those trade-offs were resolved. You might also consider the steps that they could take to remedy the negative impacts of the technology and how the company will identify and work with stakeholders to prevent these kinds of negative impacts in the future.

United Nations Spokesperson: Your role as the UN spokesperson is to reflect critically on the UN's decisions that led to the backing of the Intentional Rain project and suggest how the UN might better approach decisions around high-impact environmental technologies in future.

Mock Public Hearing

Instructions: Once statements have been prepared, the facilitator can open the mock public hearing with a brief statement to set the scene and an invitation to one group to share their point of view on the situation. The facilitator can also provide transitions between roles to ensure a balance of perspectives throughout the exercise, and follow up questions in order to ensure a robust conversation.

Discussion

Instructions: The aim of this section is for the participants to reflect on the conversation that ensued about the technomoral scenario. In particular, participants should articulate issues and tensions that emerged that are relevant for making technical and governance decisions. The facilitator can document the conversation and work with the group to dive more deeply into each emerging topic.

Here is a set of questions that are often useful to drive this discussion. Of course not every question will be relevant to the discussion the participants just had. Therefore, we are also providing some underlying motivation for each question, so that facilitators can judge for themselves which questions to use, whether questions should be adjusted for the context, or whether formulating a different question would be more helpful.

1. What were some salient moments in this conversation? Why were they significant?

During the conversation, some participants might have focused on particular issues or positions. By taking a step back and considering the larger picture they remind themselves of how the exercise unfolded. By articulating which moments stood out, participants focus the ensuing discussion.

2. What mattered most to each stakeholder? How did each stakeholder's values, interests, and needs differ?

This question aims to reflect on the ethical values and stakeholder interests that appeared in the conversation. Moderators can use this moment to ask whether participants did justice to the needs and interests of their persona, or whether others would have raised different points and questions.

3. To what extent did stakeholders have shared objectives? To what extent did the values and interests conflict?

Reflecting on stakeholders' values is key for a diligent ethical analysis when introducing new technologies; in particular, as many who are impacted by technologies lack access to and are not represented in the discussions

that shape the course of those technologies. It typically takes some time for participants to think through these questions, so moderators should be patient and suggest some tensions they themselves had noticed. However, when the first few have been mentioned, all participants will have something to contribute.

4. Thinking practically, what should each stakeholder do to resolve the current situation? Are they obliged to act in particular ways? If so, why?

Participants will think through how to resolve (or not resolve) some issues, which actions are required, and on which grounds. This question pushes participants to think about responsibilities and their sources. Most likely, value tensions and unresolved issues will remain. It's important to understand why they remain unresolved.

Expert Analysis

Note: Please refer to this section after conducting the full exercise. Facilitators may look at this analysis prior to ensure better facilitation.

Some relevant areas that this exercise should/could have touched on:

- **Power asymmetry, consent, and legitimacy:** Technological solutions to societal-scale problems can materially impact broad stakeholder groups. In this case, the atmospheric pressure manipulators impacted the peoples of both Dryland and Beeland, without political or democratic oversight nor participation, besides the United Nations research support. The fact that these stakeholders were not involved in the conception and development of the atmospheric pressure manipulators is problematic. When powerful actors such as Intentional Rain Research address societal-scale problems, their understanding of the problems and how to solve them are laden with potentially uninformed assumptions. In this case, Intentional Rain Research made assumptions about how drought negatively impacts the people of Dryland and Beeland, and how their atmospheric pressure manipulators would benefit these stakeholders. Involving stakeholders in both the conception and development of new technologies contributes to the legitimacy of the technological solution. Not only does it afford stakeholders the opportunity to give informed consent or refusal to the proposed technological solution, but also brings the unique perspectives of the stakeholders to bear on the developers' understanding of the problem and whether and how the proposed solution will remedy that problem.

- **Societal benefit, complex systems, and unintended consequences:** Development of new technologies is often motivated by perceived societal benefit. In this case, Intentional Rain Research developed atmospheric pressure manipulators as a technological solution to drought in Northern Abuntia. Technological interventions on complex systems such as the weather can nevertheless have unintended consequences. Two unintended effects of the atmospheric pressure manipulators were the decline in the honeybee population in Beeland and the sweeping away of topsoil in Dryland leading to reduced crop yield. Hence it is important to ask prior to deploying a technological solution what assurances are in place to guarantee that the technology will solve the problem as intended; and to anticipate and safeguard against possible unintended consequences. This may require phased deployment of the technology in which the technology is initially deployed at small scale and only scaled up once the developers have an evidence-based picture of the potential negative consequences of deploying the technology at a larger scale.

- **Power concentration:** New technologies can afford significant power to developers. In this case, the atmospheric pressure manipulators empowered Intentional Rain Research to influence global weather patterns. Concentration of power creates the potential for developers to misuse the technology to serve their own interests and also to use the technology in ways that negatively impact particular groups of stakeholders (whether or not those negative impacts are intended). When developing technological solutions to societal-scale problems it is important to assess what new power relationships are created by the technology. For example, the dependency of the people of Dryland and Beeland on Intentional Rain Research for crop yields and ultimately their livelihoods. Reflecting on these power relationships can suggest alternative models of deploying technologies so

that affected stakeholders are not dependent on powerful actors that may have divergent or only partially aligned interests with the relevant stakeholders.

Further Reading Recommendations

- Werhane, Patricia Hogue. Moral imagination and management decision-making. Oxford University Press, USA, 1999.
- Lange, B., Keeling, G., McCroskery, A. et al. Engaging engineering teams through moral imagination: a bottom-up approach for responsible innovation and ethical culture change in technology companies. AI Ethics (2023). https://doi.org/10.1007/s43681-023-00381-7.

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