National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Making Innovation Safe. By Design.
Explore safety, uncertainty & design

Introduction

Here you will find exercises that will help you explore safety issues. We encourage you to adjust the exercises to your own project, class, or circumstances. You can select the exercises that fit your needs best. If you want to know more about the challenge behind Safe-by-Design, you can watch the animation or lecture.

Which types of safety issues are there in your field?

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As the animation showed, safety issues can have a tangible origin, stem from persistent uncertainty, and be grounded in different perceptions of safety.

For your own field of study, find at least two real world examples of each type of safety issue and explain why this is an example of this type.

Then, if they are examples from the past, write down how this safety issue was addressed. If safety issues are not yet resolved, write down how you would address them.

If you find it difficult to find examples in your own project or in the literature, try to interview someone with a lot of experience, like a professor.

Discussion

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In groups, discuss one of the following statements. If you find your group to be in agreement, appoint a (couple of) 'devil's advocates' to bring up the arguments that outsiders to your group could use to challenge your group's position.

- Safety issues that have a tangible origin / stem from persistent uncertainty / are based on different perceptions of safety* are the most important type of safety issue and we should focus our attention mainly on this type at the expense of the other types.
- It is best not to try to identify and address safety issues, as you will become accountable for them.
- It is short-sighted of a company to pay more attention to return on investment than to potential safety issues.
- Addressing all safety issues is too great a burden for companies in a competitive economy so the government should regulate safety of products on the market instead.

* Choose one, or divide the three types across people/ groups who will debate each other.
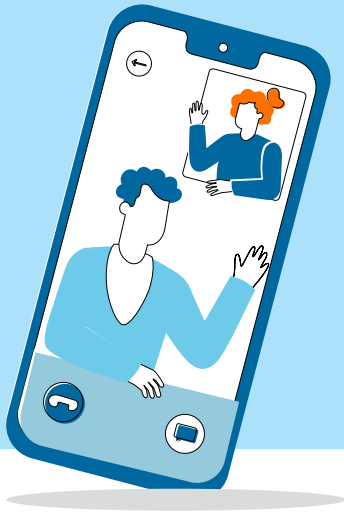
Uncertainties and stages of R&D

FOR 👤 OR 👥👥👥 | 🕐 30+ MIN | ✏️ OR 🌐 | abc ALL LEVELS

You are working in the R&D department of a firm that specialises in printers for offices. Since the rising popularity of remote working, the demand for office printers has fallen. You need to develop a new product if your firm is to survive. Fortunately, you and your colleagues are working on several new products. For one, you are exploring the potential of a device that pharmacists can use to compound and print tailor-made medicinal band-aids (i.e. band-aids that deliver a dose of medicine – such as opioids, contraceptives, or other actives – through the skin, for people who have trouble swallowing or remembering to take pills). You want the band-aids to be gentle to the skin, adhesive yet easy to remove, water resistant, give the medicine off in a controlled pace, and be safe. You aim to sell the new printer to pharmacies.

To start, you will make a mind map of safety issues and ways to deal with them. Brainstorm about safety issues you will face while developing this device. You can use your expertise from your own field, but try to look broader as well:

- Think about the stages of research and innovation, manufacture, (re-)use, end-of-life of your product, as well as the substances, processes, and products involved, or anything else that seems relevant.
- The aim is to think of as many potential areas or clusters of uncertainty rather than to be super specific, e.g. write down 'no allergic reaction to adhesive' rather than 'no allergic reaction to x, y, z'.

Mind map the safety issues that arise in the different stages of the life cycle. Can you distinguish safety issues that have a tangible origin, stem from persistent uncertainty, or are grounded in different perceptions of safety?

Then, think about strategies to eliminate, reduce or deal with the uncertainties. Include these in your mind map.

Finally, what do you see as your professional responsibility in dealing with safety issues? Explain your answer.

Case study the Vessel

Before you start working on this exercise[i], watch this short video about the Vessel and look at the image on the cover of this brochure.

The grand opening

It is March 2019 and the Vessel in New York opens to the public. Like the Eiffel tower, the Vessel in New York is an interactive, architectural sculpture. Although designer Thomas Heatherwick had kept the design a secret as long as possible, the structure that has cost more than US $150 million was already debated during construction. One reason was the design itself: the 50 meter high Vessel consists (only) of many stairs and platforms that New Yorkers and tourists can climb and use to look out over the city. Heatherwick is known for his grand and sculptural designs. Stuart Wood, a member of Heatherwick's team, said: 'Bringing bold designs back to public spaces, that's what this project is fundamentally about. [...] If you think about it, that's something that the best cities in the world do. [...] That is, create three-dimensional objects that bring people together in ways that otherwise wouldn't be happening.'[ii] A second reason for debates about the Vessel was its location. The Vessel is part a of the development project Hudson Yards. Hudson Yards will house over 100,000 residents and include businesses and stores, there is no fire station either in Hudson Yards or close by. Despite the debates, the team behind the Vessel see their building as a gift to the city, which residents and tourists can visit free of charge and where they can meet each other. Wood: 'Over time its use will evolve in ways we can't even imagine right now. [...] In this way, we're giving the structure to the city and allowing them to define it.'

First, read the textbox 'The grand opening'. Then, identify and write down all safety issues with a tangible origin, stemming from persistent uncertainty, and grounded in different perceptions of safety you can think of.

Then, map or list the design chain for the Vessel by breaking the development down into the innovation stages. Add all the actors, their role, as well as their main views on safety. Do the views on safety in this project align with Safe-by-Design? Why (not)?

Tragedy and response

Since the Vessel opened in March 2019, many visitors have climbed the stair and looked out over the city. Then, the following sequence of events unfolded:
February 2020: First suicide. Officials ask that the railings at the Vessel be raised, but the owners choose to add guards trained in suicide prevention instead.
December 2020: Second suicide.
January 2021: Third suicide, after which the Vessel temporarily closed to consider how to make it safer. All suicide victims were between 19 and 24 years of age. Charlotta Thodelius, an expert on how built design influences injuries in young people, said that young people 'commit a different type of suicide from adults. They are spontaneous and act very impulsively. They might not actually want to die, they just want something to stop. It might be something that has been going on for a while, but it can also be something that, as adults, we might find quite trivial.'[iii] The built design can be a factor in such an impulse, like railings that can be easily climbed.

safety protocol training
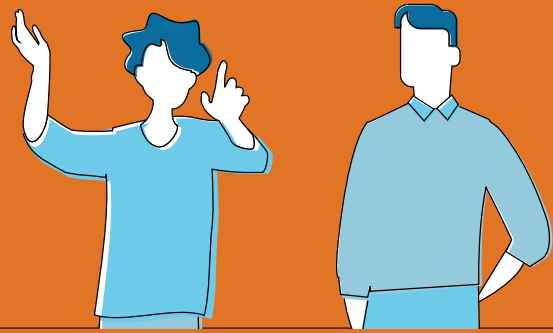
May 2021: The Vessel reopened with the following, new safety measures: increased security, a buddy system, mental health resources signage, and – after the first hour of every day – there will now be a fee of $10 to enter the Vessel.

July 2021: Fourth suicide. The victim is 14 years old. The Vessel closed again and is still closed (April 2022)

Next, read the textbox 'Tragedy and response'. Did you include the possibility of suicides, and, if so, as which type of safety issue did you classify them? If not, how should they be classified?

In their response, the owners of the Vessel focused on redesigning the possibilities of how visitors interact with the building. Explain why Safe-by-Design covers how we can interact with a design. How could applying the ideas behind Safe-by-Design (or Safe-by-Redesign) have led to a different response?

By contrast: By-Design!
The Vessel is not the first building where young people have jumped off high railings, platforms or balconies. New York University's Bobst Library saw two students commit suicide by jumping off the balconies in the atrium, after which screens were attached to the railings. When a third student committed suicide by climbing around the barriers, the university had seemingly ethereal, metal wire screens installed. The screens were intended to prevent further suicides as well as designed to fit in, or even enhance, the building.

Read the textbox 'By contrast: By-Design!' It is difficult to imagine every possibility, scenario and safety aspect from the start of a design or innovation process. It is always possible that people can find unforeseen ways to interact with or use the design or innovation and some of these ways may be unsafe. In the case of the Bobst Library, the response was to install safety measures. These were integrated as part of the (re-)design, changing the vision of the original architect. It is sometimes said that good art needs to be dangerous and that we should not alter (or censor) art. Doing so would negatively impact art. About innovation, it is sometimes said that you should not burden researchers or designers with demands like Safe-by-Design as doing so would harm progress.

Does Safe-by-Design, in your view, limit of stifle progress in general?

What lessons for Safe-by-Design from this example of an unforeseen way people interacted with a design can be applied in your own field of study or work?

i Based on Mafi, N. (2019). 'The Vessel in Hudson Yards Has Finally Opened to the Public', Architectural Digest; Wachs, A. (2021). 'I Knew the Vessel Was Going to Have a Suicide Problem Years Before it Was Built', Curbed; Wong, A. & Gold, M. (2021). 'Fourth Suicide at the Vessel Leads to Calls for Higher Barriers', the New York Times; Blackmore, W. (2021). 'After a Third Suicide, the Vessel at Hudson Yards Closes Indefinitely', Curbed; Brandon, E.M. (2021). 'Learning from the Vessel: Designing cities to prevent suicide', Fast Company; Levenson, E. (2021). 'After latest suicide the Vessel in New York City's Hudson Yards ponders its future', CNN.
ii Quotes from 'The grand opening' taken from Mafi (2021).
iii Quote from 'Tragedy and response' taken from Wachs (2021).
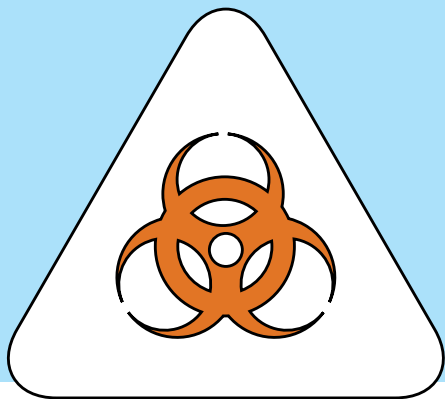
SciFi your research part III: Unforeseen plot turns

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This exercise builds on the SciFi story premise you developed in the exercise SciFi your research part I: Setting the scene and the world with its characters, institutions and science system you developed in the exercise *SciFi your research part II: Building a world.*

To make a story interesting and convincing, it needs conflict. Conflict is what literally or figuratively forces the main character to take action. Conflict sets the chain of events in the story in motion and also keeps the action going. In SciFi, the conflict often originates in the science and technology.

The plot of a story can be structured using the following elements to make it captivating:
- Inciting event – something happens to sets the story in motion.
- Complication and conflict – an interesting story has twists and turns that keep you interested and there is some form of conflict the characters have to deal with.
- Turning point – the first half of the story works towards this point and tells how the main characters become involved in the story. At the turning point, the main characters start to take matters into their own hands and, often, the pace of the story picks up as it works (with some more complication and conflict) towards the:
- Resolution – the problem is solved, the war is won, the world is saved, etc. and they live on. Happily ever after is optional.

Keep in mind that, in science fiction, the human reaction to the presented technological future makes the story interesting.[iv]
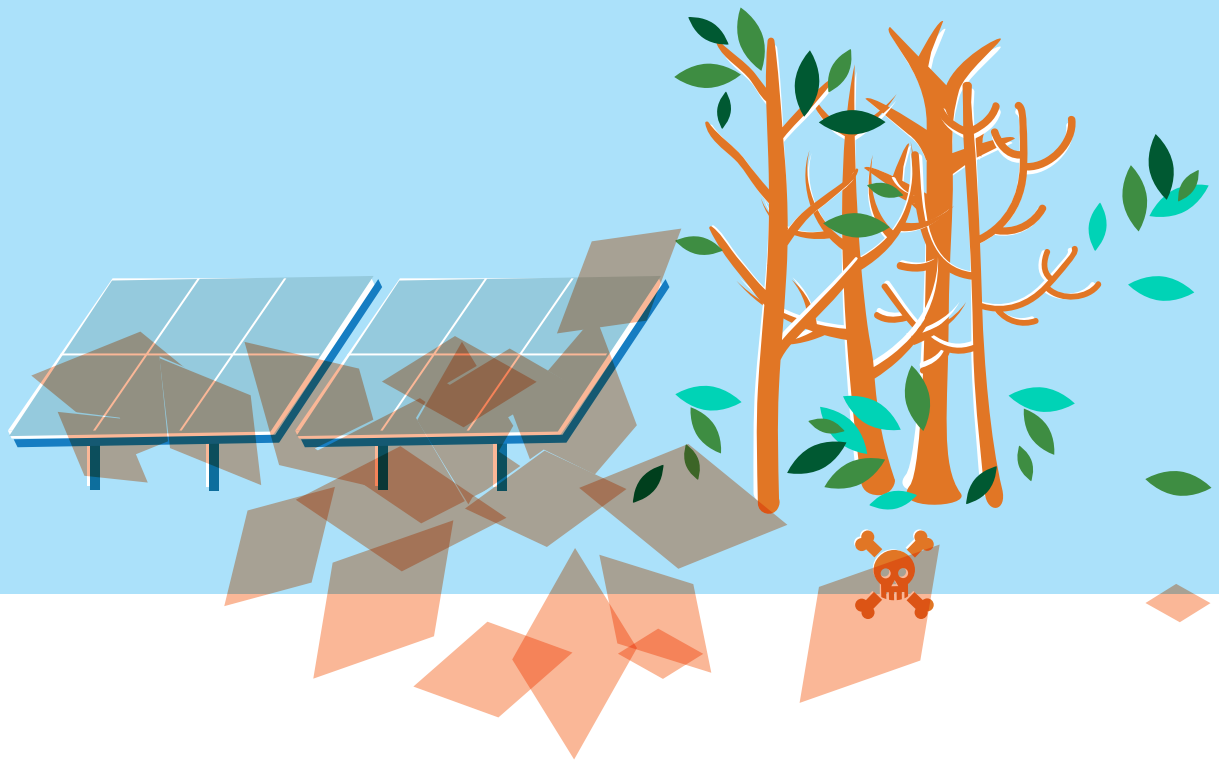
Now go back to your story premise and world. Brainstorm a couple of uncertainties (risk, scenario uncertainty, ignorance, indeterminacy, and/or normative ambiguity) *related to the science and technology* in your premise and world. Use one (or more) in your premise to build conflict, and thus action and suspense. Which uncertainties are most likely to occur? Which are least likely? Which will only have mild consequences? Which can have devasting consequences? How will characters in your story (the hero and associates, but also opponents) think and act? Remember, captivating stories have twists and turns, and the main character has to face hurdles before the main problem is tackled.

Prompts to help you start brainstorming:

- What are the direct harms or dangers of the science and technology your SciFi story is based on?
- What are the indirect harms or dangers?
- Are there any cascading effects?
- What if some very dangerous substance that is being studied accidentally leaks from the laboratory?
- What if the technology-to-save-the-world turns out to also cause a fatal flaw for bees, people who carry a specific gene, or the internet?
- What if your life-saving solution to a global crisis can only be manufactured in a process that leads to large-scale environmental damage?
- What if there is some doubt about the effectiveness of an intervention?
- What if the main character and her ally get into a moral conflict over how far they can go?

Finally, now that you have explore the science fiction of your present-day field of study or research or innovation, do you think exploring scenarios can help to consider the mid-to-long-term effects of present day research, and the safety issues in particular? Why (not)?

iv Based on Van der Lande (ed.) (2013). De Schrijfbijbel; NaNo Prep 101 | NaNoWriMo.

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