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The Cassandra Method: Dystopian Visions as a Basis for Responsible Design †

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Abstract: Innovative technologies often have unforeseen negative consequences on an individual, societal, or environmental level. To minimize these, the Cassandra method aims to foresee such negative effects by systematically investigating dystopian visions. Starting with the activation of a (self-)critical mindset, the next steps are collecting a maximum number of negative effects and assessing their relevance. Finally, the envisioned impairments are used to improve the product concepts in a responsible way. This paper broadly outlines the method, its applications during product development and research, and reports on experiences from an expert workshop.

Keywords: Cassandra method; future scenarios; dystopian visions; product development; technology assessment; responsible design

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1. Introduction

Innovative technologies often come with unforeseen side effects or even detrimental consequences. A smart home full-automation system removing all burdens from the residents to save energy by appropriate heating and water consumption may foster lower responsibility and awareness for sustainable behavior in other contexts. Users of technologies such as TikTok, promoting short attention spans and a quick switch to the next gratification opportunity, may lose the ability to accept boredom or concentrate for longer periods on one topic. The regular use of beauty filters in social media among young people is often accompanied by increasing dissatisfaction with their real selves and an enhanced desire for cosmetic surgery (so-called snapchat dysmorphia [1]). Could we have known better? Naturally, commercial interests may ask us to ignore such possible side effects. However, even with good intentions, from a psychological perspective, the occurrence of such side effects is still expected. Fueled by a great vision and fascinated by technological opportunities, development teams may instead focus on what they wish to see. People generally tend to believe in their favored hypotheses too much (the so-called confirmation bias [2]), and experts in the field may especially show over-optimism with regard to technology assessment and foresight [3].

The Cassandra method aims to counteract such tendencies. In parallel with ethical assessments of research studies by systematic guidelines and questions that must be answered, we try to create a similar mindset when inventing new product concepts by seeing the opportunities but also explicitly looking at worst case scenarios; asking which effects could occur in addition to the primary envisioned product use; identifying the relevant parameters; and refining the features to make the product a worthwhile innovation from all perspectives.

In the following paragraphs, we present our vision of the Cassandra method and its central characteristics and requirements in more detail. We discuss related work from the

fields of technology assessment (TA), human-computer interaction (HCI) and psychology. Based on an expert workshop (N = 12), we introduce a first version of the method and its tool-like representation and discuss possible applications and future research steps.

2. Vision of the Method: Characteristics of Cassandra

2.1. Dystopian View

Based on the above considerations, a first central characteristic of the envisioned Cassandra method is the *dystopian view* and the deliberate focus on negative outcomes. This is meant as a complement to many design and creativity techniques, which instead promote an optimistic mindset and imagination of positive consequences, with some of these, such as classical brainstorming, even explicitly forbidding critiques in the first round. While this can be a valid approach for the phase of idea generation, it can become a problem in later phases of product development. Often, the concept as such is found to be valuable quickly, and the critical questioning rather refers to the technical feasibility or how to make a business case out of it. In addition to such structural aspects, psychological tendencies, such as group think [4], may play a role. As is known from social psychology research, people in a group setting typically fail to recognize risks or deficits and feel pressure to conform and maintain group cohesiveness. Thus, the group members reinforce each other in a biased overly optimistic view. Therefore, mainly positive future scenarios might be discussed within development teams, whereas possible negative effects are left out. In order to fill this gap, Cassandra explicitly looks for the related risks and systematically scans for possible negative developments. Psychologically speaking, one could say that Cassandra aims for the motivational state of a prevention rather than a promotion focus [5]. Note that Cassandra does not aim to make a final decision on whether a technology should be developed or not. In contrast to cost benefit analysis (e.g., [6,7]), it is not about balancing pros and cons or weighing the severity of envisioned benefits and drawbacks. This may follow in a subsequent development step, or, even better, Cassandra may inspire ideas as to how negative side effects could be prevented or alleviated by refining specific product features. However, for the moment of Cassandra, the positive does not play a role.

2.2. Change in Mindset

A second central characteristic of Cassandra is the *change in mindset*. Psychologically seen, self-criticism or looking for negative aspects of an idea or project one sees as somehow belonging to oneself is a challenging task. A long tradition of studies in social psychology has shown that humans have a natural tendency to protect their self-worth, attitudes, and beliefs, and to show a high resistance against potential counterexamples or counterarguments, leading to biases in information searches and perceptions, such as the self-serving bias (e.g., [8], confirmation bias (e.g., [2]), or hindsight bias (e.g., [9]). Moreover, in many daily life situations (and possibly for good reasons), we would rather hear advice to focus on the positive and what works well instead of what could go wrong (which is also the core idea of positive psychology). From a social gratification perspective, and when receiving positive feedback from others, it seems inadvisable to focus on the negative. People who challenge a common view or mention potential risks are often accused of ruining the atmosphere or attempting to destroy a common project. Typically, others want to hear that it will all work. Although philosophers tell us that it actually makes sense to adopt a pessimistic attitude and that we can regard pessimism as a positive condition [10], this is not what is cultivated in everyday life. As stated in blogposts and on popular media, “no one wants to follow a pessimist” [11] and “optimism is the default setting” [12]. Therefore, our brains are not used to searching for negative aspects, much less in our own projects or ideas. However, Cassandra especially asks for this “What if it all went wrong” attitude, in order to prevent design decisions that appear regrettable in hindsight. How to activate this modus of creative self-criticism is also one of the central challenges of Cassandra, because the best methodological structure cannot lead to success if the adequate mindset is lacking. In sum, Cassandra must be understood as a competition for envisioning the most negative

outcomes. Instead of typical risk checklists in other contexts, where it is best to mark "no" to pass the check without any hurdles (e.g., symptom checklists, entry requirements, personal forms, ethical approval), Cassandra assumes that you can only win if you find at least one risk.

2.3. Goals and Requirements

When thinking about Cassandra as a tool, we deem it important that it remains a *lightweight* method, which is neither too complicated, nor too time-consuming. Ideally, Cassandra should be experienced as a welcome guest who brings fun and inspiration, and not as a burden. Instead of fearing how to deal with Cassandra, the method should be seen as a chance, always knowing that every identified risk is an invitation to change or improve features, and contribute to the success of the product.

In addition, we aim for a method with high *flexibility* that is applicable in different phases of product development. First and foremost, we see the application in the concept phase (is this generally is good idea?). Later on, Cassandra could also support in interaction design (is this the best method of interaction?) and re-design (what could be helpful new features?). In addition to being a method for product development, with the aim of preventing unwanted effects and possibly refining product features, Cassandra (or parts of it, as further laid out in the next sections) could also be helpful as a tool in research (a structured analysis of possible effects), post hoc analysis (based on existing problems, what could we have known better), or as a prediction tool (based on trending technologies, what could be possible applications, what could be risks).

3. Related Work: Positioning Cassandra within Existing Methods

Regarding the positioning of Cassandra within existing methods to predict possible futures in the context of product development, one related field is technology assessment (TA). Originally, TA was coined as an approach looking at "the widest possible scope of impacts in society of the introduction of a new technology" with the aim of identifying "an analyzed set of options, alternatives and consequences" [13] and putting an emphasis on "the effects that would normally be unplanned and unanticipated" [14]. However, the term was also picked up by business and industry executives, who instead inverted the perspective and used it to anticipate the effects of the outside world on their own activities, rather than anticipating the effects of their activities on outside factors (also denoted as inverted technology assessment [15]. Overall, the TA landscape consists of a multitude of approaches (for a review see [16]). Among these, Cassandra must be distinguished from methods such as cost-benefit analyses, economic assessments, primarily statistical techniques and mathematical models, or methods within the public decision-making domain, that relate different parties and perspectives with the aim of finding consensus. Although the latter might be relevant at some point in time, Cassandra does not aim to mediate between parties or to find compromise but instead highlights the full range of possible negative effects. However, the Cassandra idea also shares some elements with existing methods such as working with scenarios (e.g., [17,18]), focusing on risks and responsible innovation [19], or the future-oriented focus of a group of techniques relating to newly emerging technologies (e.g., [20]). As critically remarked by Fleischer et al. [21], classical TA is concerned with the outcomes or impacts of a technology at later stages of technology development when societal implications are already visible and can easily be identified and determined. Therefore, they called for a paradigm shift in TA, which is better suited for assessing the (future) consequences of newly emerging technologies, typically related to a number of uncertainties. In line with this, a trend analysis of the TA literature over the years shows an increase in publications referring to emerging technology assessment [16].

In the field of human-computer interaction (HCI) and design, different attempts have been made to deal with future-related uncertainties in different phases of HCI evaluations (for recent overviews see [22,23]), often with a focus on how to visualize possible futures, or what kind of visualizations can support the creative process. For example, the Futures

Wheel [24,25] is a visual brainstorming method, where the center of a wheel represents the factor of interest (e.g., a new technology), and the consequences are visualized as concentric rings around the center, as a form for creative and nonlinear thinking. Building on a similar visual metaphor, the Future Ripples Method [22], aiming to support critical long-term reflection in technology innovation, uses the metaphor of scanning the shore for indicators of change, choosing a pebble representing a 'what if', throwing that pebble into the water, and mapping out its consequences as ripples. Regarding the content dimensions of effects, Cassandra could borrow from existing frameworks of impact analysis, such as the eTA (Ethical Technology Assessment, [26]) checklist, referring to nine ethical aspects of technology (e.g., impact on social contact patterns, privacy, sustainability, or impact on human values), or the STEEPLE framework, looking at social, technological, economic, environmental, political, legal, and ethical factors (e.g., [23,27,28]).

4. Expert Workshop: Inspirations for Cassandra

In an expert workshop with twelve participants from various backgrounds in fields related to technology and product development (e.g., media informatics, psychology, HCI) we discussed the idea of Cassandra and collected ideas for its tool-like representation. More specifically, we explored different techniques for the aforementioned aims, i.e., a lightweight method, activating a dystopian view and mindset of creative criticism, to be applicable in different phases of product development. As a preparation task, each participant reported an example of a technology for which he or she saw negative side effects. Examples ranged from parking sensors, smart home technologies to health trackers, with mentioned negative side effects on different levels, referring to impairments in different areas such as health, privacy needs, social situations and communication, or human skills and competencies (see Table 1 for examples).

Table 1. Examples of technologies mentioned and negative side effects from the expert workshop.

Technology	Level	Impairment	Negative Side Effect
Parking sensors	Individual	Competence	■ Losing the ability to park. You get so used to it that you can no longer see or estimate how much space is left ■ If you drive without it, you wait for the beep, but it does not happen
Smart home	Individual	Privacy	■ Losing autonomy and privacy. If the home reacts to you, you get the feeling that a third person is there ■ This refers to the users/residents but also visitor data
VR, a new world made by AI image generators	Societal	Reality awareness, social interaction	■ A very immersive reality, become addicted to the feeling of being the hero in your own movie ■ Preferring VR to the real world, people are withdrawing from reality and interaction with real people
Smart watch	Individual	Body perception	■ Losing the ability to listen to your body ■ My friend looks at his watch and says "Ah, I'm tired"
Health tracker	Individual	Health, security	■ Fear when you receive certain notifications ■ Taking unnecessary or even harmful actions (without consulting a doctor), e.g., adjusting bedtimes to recommendations, behaving contrary to your own nature
Smart watch	Individual, societal	Communication, social interaction	■ Social conflicts, interrupts the flow of conversation ■ Designed to be impolite: doing something in parallel to a conversation which of course demands more attention than just checking the time
Location sharing (e.g., FindMy, AirTag)	Individual, societal	Privacy	■ Monitoring factor ■ You behave differently if the other person always knows where you are

In sum, the variety of examples shows that many established technologies of everyday use come with negative side effects that are worth examining in more detail, underlining

the general relevance of approaches such as the Cassandra method. In addition, it shows that many of these side effects are subtle and probably not evident when deciding to use the technology. In contrast to more obvious possible effects of technologies (e.g., aggression in computer games fostering aggression in real life), which appear as an evident issue of discussion, more subtle effects are more easily ignored or overlooked. Still, on a broader level, subtle effects (e.g., shorter concentration spans, higher needs for instant gratification, resulting from the regular use of technologies such as TikTok) could have tremendous consequences for a society.

5. Sketching of the Method: Cassandra V1

Based on the above listed goals and requirements, Cassandra as a method may consist of different phases, whereby the collection and assessment phase form the core elements (see Figure 1). The different phases are supported by different prompts and tool-like representations, as further outlined in the following sections. Though we primarily see the method related to envisioning negative effects of technological products and services (e.g., AI-based applications, social media), we mostly use the more general term 'product' to include technical and non-technical products alike. Typically, we assume the method to be applied in a moderated workshop with about three to ten participants and alternating time slots of group discussions and individual work. Individual work, where each participant on his own searches for negative effects, can be useful to maximize the sum of found effects, prevent group think or domination by single participants. Then group discussions can be helpful to consolidate the individual ideas and different viewpoints regarding the severity and probability of effects.

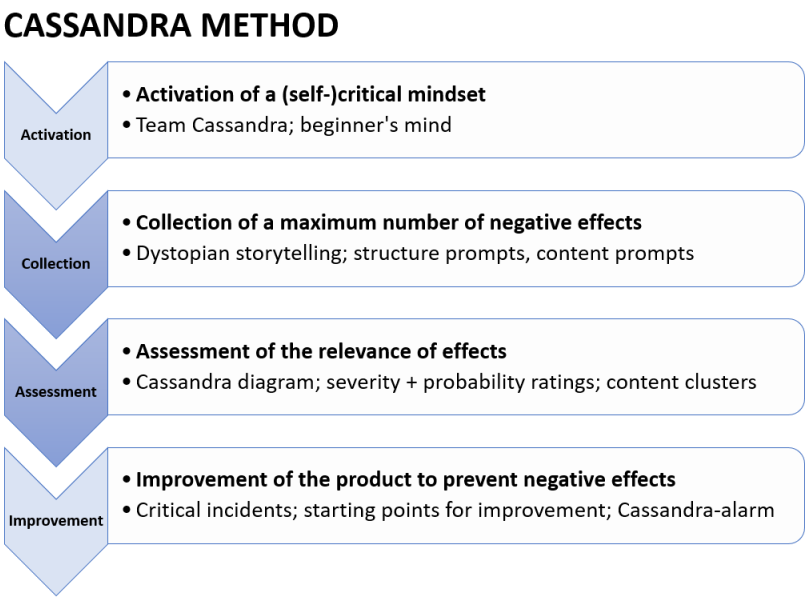


Figure 1. Sketch of the Cassandra method.

5.1. Activation of a (Self-) Critical Mindset

The first phase is dedicated to the activation of the required creative critical mindset. Elements from different philosophies or approaches can be used to achieve this, possibly noted on a visible sign, and serve as a reminder for the whole team during the following phases. One method could be to deliberately switch into another role as the "Cassandra-Team", fulfilling the mission to foresee unhappy future events (an analogy to the Cassandra from Greek mythology). This role assignment is similar to existing approaches for decision-making under uncertainty such as the "devil's advocate" (e.g., [29,30]), where one team member is assigned the role of an intellectual counterplayer with the task of deliberately searching for dissent and blind spots, and challenging the statements of other team members. Considering it as a role one plays for the next few hours might make it easier to

develop criticism and not see it as destructive or feel bad about it. A similar approach is penetration testing (short pen test), which is used to detect the security issues of computer systems (e.g., [31]). A pen test is an authorized simulated attack, whereby the pen testers use the same techniques as "real" enemies, mimicking how most malicious hackers would behave. The identified weaknesses, software flaws, and security vulnerabilities can then be addressed by companies to improve their systems. Another helpful element could be the idea of a "beginner's mind" (so-called shoshin) as promoted in Zen Buddhism. The idea is that with repetition (e.g., while reciting a sutra, eating a meal) people lose their original attentiveness and do not continue with the same mindfulness experienced at the beginning (the first sutra, the first bite). The beginner's mind asks that you go into ventures without preconceptions, as a beginner might, even in familiar situations. As described by Shunryu Suzuki [32] "if your mind is empty, it is always ready for anything; it is open to everything. In the beginner's mind there are many possibilities; in the expert's mind there are few". Thus, for the moment of Cassandra, it could be a task to forget one's "expertise" and what others have formerly said about a technology but think about a technology with a fresh mind and think the unthinkable. Once the Cassandra mindset is established, the team can turn to the collection phase.

5.2. Collection of a Maximum Number of Negative Effects

In the collection phase, the goal is to collect a maximum number of negative effects possibly resulting from the product in question. As described in creativity research [33], creativity can be characterized by different aspects such as fluency (the number of relevant ideas), flexibility (combinations of thus far unconnected categories), and originality (the number of statistically infrequent ideas). To support creative dystopian thinking, there are two kinds of prompts, referring to the structure and content of dystopian storytelling. The structure prompts aim to elicit ideas through inspirational questions and instructions that envision negative effects as part of a scenario or in a certain structure (e.g., effects of increasing severity). The content prompts support thinking in various directions regarding the concrete type of effect through lists of possible (probably non-exhaustive) dimensions, affected persons, and relevant analogies. The following sections describe exemplary prompts and ideas for tool-like representation and application in moderated workshops.

5.2.1. Structure and Content Prompts

Table 2 lists examples of structure and content prompts and related guiding questions and instructions. For instance, applying the perspective of incremental steps to a recent everyday life technology, you could inspect Apple's AirTag. The main function (and advertising message) is that you can use it to easily find things you tend to lose (e.g., your key, your purse), but also to keep up with friends and family. As Apple explains, "items that everyone uses—like an umbrella, a bike, or the family car keys—can be tracked by friends and family" [34]. It is a practical thing in the first place, but how will it affect behavior in the long run? What thoughts could arise? What reaction chains could follow?

First step: "We just bought a big family umbrella and AirTaged it—one shared umbrella for all—a nice idea, also from a sustainability perspective".

Next step: "I have the family umbrella with me, so I shouldn't go to McDonalds (which my wife doesn't like, and she could track me)".

Next step: "Today, I better not take the family umbrella since I want to go to McDonalds" (and get wet).

Next step: "I think I better buy a secret umbrella. Not the best for the environment, but the best for me".

Table 2. Examples of structure and content prompts and related guiding questions and instructions.

Prompts	Guiding Questions/Instructions
Structure prompts	
Archenemy	Imagine your archenemy launches the product on the market—how would you describe it to others to prevent them from buying or using it?
Dictator	Imagine the product was invented by a dictator of a hostile state—what is his goal in establishing such a technology? What malicious purpose could the technology serve?
Conspiracy theorist	Imagine the product was invented with a hidden goal—what could the dark forces actually want to achieve?
Movie script	Integrate the product into a dystopian movie script (e.g., like the dystopian anthology television series *Black Mirror*).
Maximum damage	Imagine how the product could cause maximum damage.
Counterarguments	Name one counterargument for every positive effect.
Group auction	One person starts with naming one negative effect, who bids more?
Retrospective	Starting from the most negative imaginable effect—how did we get there? Which steps and branches were involved on the way to dystopia?
Incremental steps towards dystopia	Inspect possible reaction chains from a systemic point of view, step by step. Starting from the current state, which components are affected by the product? How do changes in these components affect others in the system? What follows in the next step? What could be negative effects in the long run? How could intended effects turn into the opposite? (e.g., people start breeding rats to get the reward for every dead rat that the government established to counteract the rat plague)
Content prompts	
Psychological needs	How could the product impair basic psychological needs such as competence, autonomy, stimulation, relatedness, popularity, security etc.? (e.g., [35])
Levels	What type of negative effect could the product have on different levels, such as individual, societal, or environmental level? What does this mean?
Persons	How does the product affect the person next to me, such as my neighbors, my parents, my partner, children, the elderly, the people in my town, people in other countries etc.?
Learning from history	What are similar products or technologies already on the market? What problems did occur with these?
Negative examples	Think about product failures in the past. What type of fail would be the most imaginable for the product and why?
Losses	What losses known from other products or developments could be relevant here as well? For example, costs of automation, such as losses in meaning, transparency, autonomy, responsibility, competence, reflection etc. (also see [36])

5.2.2. Ideas for Tool-Like Representation and Moderation

Regarding a tool-like representation, the prompts could be represented as cards or as a list, and the moderator guides through the prompts to collect ideas. Within this, the moderator cares for continuous activation and time management, such as a minimum time period for brainstorming based on one prompt, then moving to the next. Importantly, participants are free to collect any kinds of effects. There does not need to be a fixed categorization for one of the prompts, and there is no urge to find effects for every prompt. In addition, the moderator could also introduce additional provocations, like recounting previous experiences or showing results from focus groups.

There are various ways in which the effects could be noted and collected. For example, participants could use post-its, writable magnets, or any other material that supports a flexible arranging and clustering of collected effects (that can be placed on the diagram in the next phase).

5.3. Assessment of the Relevance of Effects

In the assessment phase, the collected effects are roughly rated according to severity and probability and clustered along different dimensions of content. In order to keep it a lightweight method, both kinds of ratings can be on a broad level, and the relative positioning is more important than an exact number for each effect. For example, the severity could be rated as low vs. medium vs. high; the probability could be rated as possible/speculative vs. plausible vs. probable, oriented on the varying levels of uncertainty in the STEEPLE method (see [23]).

5.3.1. Guiding questions

In order to assess the severity of an effect, helpful guiding questions could be

- What is the relevance for different groups of people, the society, or the environment? How many people would experience the effect? How bad would it be?
- Are there transfer effects? Would other skills/areas also suffer?
- Would the effect be relevant in various contexts? (e.g., unlearning how to back into a parking space is a different problem in the countryside than in the city)
- Similarly, guiding questions for assessing the probability of an effect could be
- How often would the effect occur? Each time when using the product? More seldom? Or more often, also independent from product use?
- Is this the first time that the effect would occur? Or are similar effects known from other contexts/products? Can we use prior experiences to assess the probability?

5.3.2. Ideas for tool-like representation and moderation

Regarding the tool-like representation of assessments and relative positioning of effects, one idea is a diagram that is visible for the whole group (e.g., as a large print or sketch on a magnet wall). Figure 2 shows an illustration of the Cassandra diagram and a fictional example. In the diagram, the positioning along the *x*-axis indicates the relative probability of effect and the positioning along the *y*-axis shows broad content clusters. Circles around the effects represent the severity of an effect, with larger circles indicating a greater severity. The ratings for probability and severity could be performed as a group task, where the moderator asks for the group vote, whereby ratings and positioning also could still be changed over the course of the process.

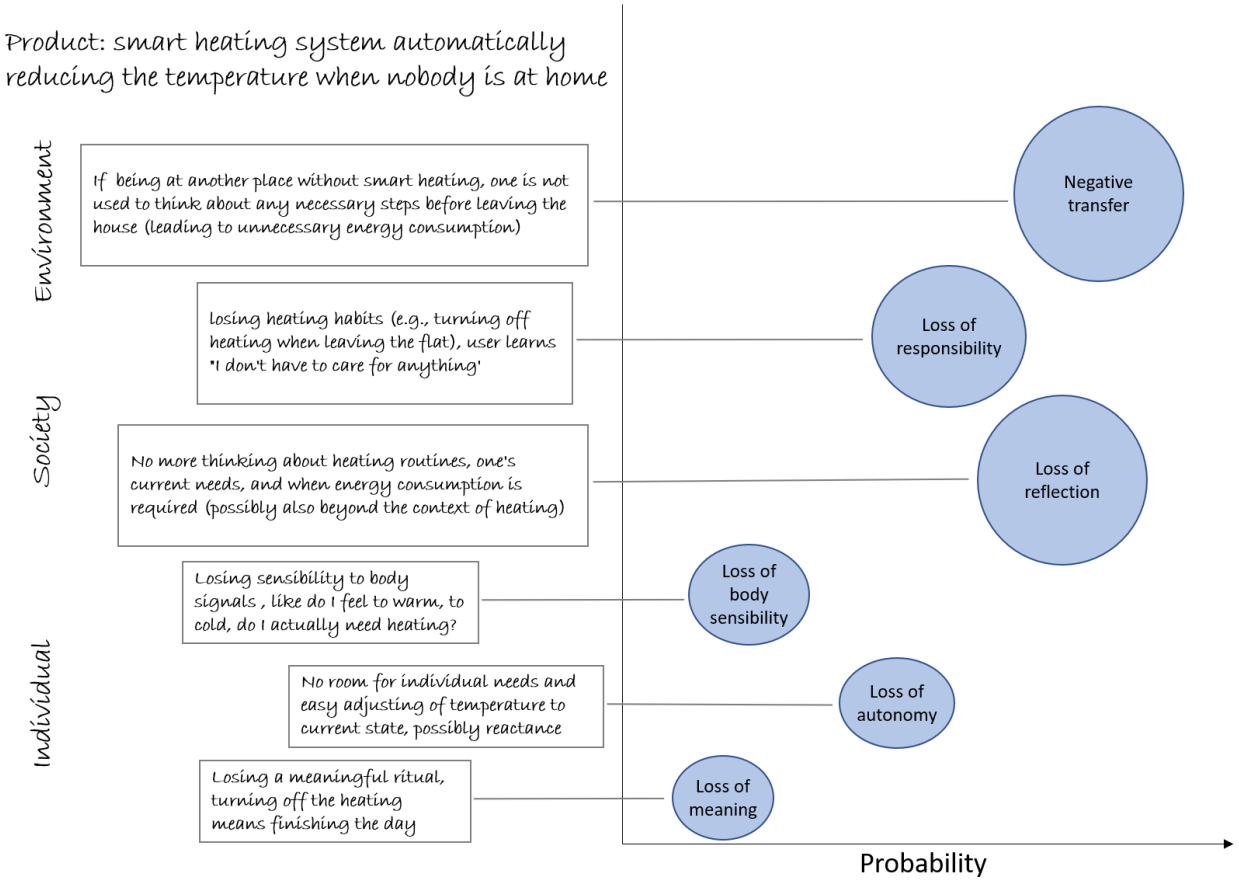


Figure 2. Cassandra diagram of negative effects for the example, a smart heating system that automatically reduces the temperature when nobody is at home, discussed in the expert workshop. *Note*: Circle size represents the severity of effects.

5.4. Improvement of the Product to Prevent Negative Effects

The phase of improvement does not belong to the central part of the Cassandra method and could also be performed in a separate session (and presumably followed by more elaborate steps of product refinement, which must be integrated into the general process of product development). Based on the Cassandra diagram from the collection phase, the following steps may be performed to identify starting points for improvement:

- Picking the negative effects that seem most relevant to consider
    - Discussion of relevance of each effect according to probability and severity;
    - Depending on the sum and variety of effects, the team could define a threshold of relevance to support a quicker or more systematic identification of relevant effects;
    - Marking the relevant effects in the Cassandra diagram.
- Using the negative effects as a basis for refining the product concept
    - Identify the critical incidents (e.g., developments, product features, characteristics) that are relevant for the effect;
    - For each critical incident: imagine how one could change the product to make the negative effect less probable;
    - If there seems to be no way to change it, since it refers to the main function of the technology, this may indicate a case of "Cassandra-alarm" and a reason to reconsider the concept as such.

6. Outlook and Conclusions

In this paper, we have outlined the Cassandra method as a lightweight way to challenge product concepts for possible negative side effects in the process of development and, in a larger context, as a method to predict possible developments related to innovative technologies on an individual and societal level. In contrast to statistical forecasting approaches based on algorithms, aiming for exact forecasts related to possible influencing factors (e.g., how likely it is that a student will pass an exam given the number of attended lecture sessions), Cassandra takes a more qualitative and holistic approach. The focus is not on forecasting exact relationships but rather on noticing that a possible relationship is there, considering a wide range of possibly affected areas beyond the obvious.

In the next steps, we aim to flesh out the materials for a tool-like representation of Cassandra, practicably apply the methods in diverse fields of product development, evaluate the experiences, and possibly refine it. In this vein, we also hope to collaborate with other researchers and practitioners, explore how to adjust the method to diverse requirements, how it can be integrated in existing research and development processes, and how it might be combined with other techniques to best exploit its specific potential.

To conclude, we want to emphasize that Cassandra is meant to be a constructive method. It is not meant as a check to pass, that companies with commercial interests must fear and prefer to ignore, but as an opportunity for improvement, to create products that deliver better experiences and contribute to a worthwhile place to live for all (which is not in conflict with commercial success). When looking at the examples of side effects of existing technologies brought up in the expert workshop, we do not want to imply that all these technologies should not have been developed but that taking a closer look at the possible side effects beforehand might have led to other decisions from particular aspects. For example, one might think that the argument to "unlearn navigation" is not worth mentioning, given the many benefits of a navigation device. However, dispensing with one or the other is not the only option. There may be a way to combine both, and there could be features that retain the security of automated navigation but still support its user's navigation competencies or at least some awareness of the surroundings. However, to invent such a feature, one must first detect the problem. This is the job of Cassandra.

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References

1. Ramphul, K.; Mejias, S.G. Is" Snapchat Dysmorphia" a real issue? *Cureus* **2018**, *10*, e2263. [CrossRef] [PubMed]
2. Klayman, J. Varieties of confirmation bias. *Psychol. Learn. Motiv.* **1995**, *32*, 385–418.
3. Tichy, G. The over-optimism among experts in assessment and foresight. *Forecast. Soc. Change* **2004**, *71*, 341–363.
4. Park, W.W. A review of research on groupthink. *J. Behav. Decis. Mak.* **1990**, *3*, 229–245. [CrossRef]
5. Higgins, E.T. Promotion and prevention: Regulatory focus as a motivational principle. In *Advances in Experimental Social Psychology*; Academic Press: Cambridge, MA, USA, 1998; Volume 30, pp. 1–46.
6. Ordoobadi, S.M.; Mulvaney, N.J. Development of a justification tool for advanced manufacturing technologies: System-wide benefits value analysis. *J. Eng. Technol. Manag.* **2001**, *18*, 157–184. [CrossRef]
7. McGrath, R.G.; MacMillan, I.C. Assessing technology projects using real options reasoning. *Res. Technol. Manag.* **2000**, *43*, 35–49. [CrossRef]
8. Pyszczynski, T.; Greenberg, J.; Holt, K. Maintaining consistency between self-serving beliefs and available data: A bias in information evaluation. *Personal. Soc. Psychol. Bull.* **1985**, *11*, 179–190. [CrossRef]
9. Christensen-Szalanski, J.J.; Willham, C.F. The hindsight bias: A meta-analysis. *Organ. Behav. Hum. Decis. Process.* **1991**, *48*, 147–168. [CrossRef]
10. Sim, S. *Philosophy of Pessimism*; Bell & Bain: Glasgow, UK, 2015.
11. Carlson, B. No One Wants to Follow a Pessimist. 2020. Available online: https://awealthofcommonsense.com/2020/01/no-one-wants-to-follow-a-pessimist/ (accessed on 1 February 2024).
12. Brown, J.M. Optimism as a Default Setting. 2013. Available online: https://thereformedbroker.com/2013/04/28/optimism-as-a-default-setting/ (accessed on 1 February 2024).
13. Coates, J.F. The role of formal models in technology assessment. *Technol. Forecast. Soc. Change* **1976**, *9*, 139–190. [CrossRef]
14. Coates, J.F. A 21st century agenda for technology assessment. *Forecast. Soc. Change* **2001**, *67*, 303–308. [CrossRef]
15. Coates, V.T.; Fabian, T. Technology assessment in industry: A counter productive myth? *Forecast. Soc. Change* **1982**, *22*, 331–341. [CrossRef]
16. Tran, T.A.; Daim, T. A taxonomic review of methods and tools applied in technology assessment. *Technol. Forecast. Soc. Change* **2008**, *75*, 1396–1405. [CrossRef]
17. Banuls, V.A.; Salmeron, J.L. A scenario-based assessment model—SBAM. *Technol. Forecast. Soc. Change* **2007**, *74*, 750–762. [CrossRef]
18. Chen, K.; Jarboe, K.; Wolfe, J. Long-range scenario construction for technology assessment. *Technol. Forecast. Soc. Change* **1981**, *20*, 27–40. [CrossRef]
19. Hellstrom, T. Systemic innovation and risk: Technology assessment and the challenge of responsible innovation. *Technol. Soc.* **2003**, *25*, 369–384. [CrossRef]
20. Coates, J.F.; Coates, V.T. Next stages in technology assessment: Topics and tools. *Forecast. Soc. Change* **2003**, *70*, 187–192. [CrossRef]
21. Fleischer, T.; Decker, M.; Fiedeler, U. Assessing emerging technologies—Methodological challenges and the case of nanotechnologies. *Technol. Forecast. Soc. Change* **2005**, *72*, 1112–1121. [CrossRef]

22. Epp, F.A.; Moesgen, T.; Salovaara, A.; Pouta, E.; Gaziulusoy, I. Reinventing the Wheel: The Future Ripples Method for Activating Anticipatory Capacities in Innovation Teams. In Proceedings of the 2022 ACM Designing Interactive Systems Conference, New York, NY, USA, 13–17 June 2022; pp. 387–399.
23. Moesgen, T.; Salovaara, A.; Epp, F.A.; Sanchez, C. Designing for Uncertain Futures: An Anticipatory Approach. *Interactions* **2023**, *30*, 36–41. [CrossRef]
24. Bengston, D.N. The Futures Wheel: A Method for Exploring the Implications of Social–Ecological Change. *Soc. Nat. Resour.* **2016**, *29*, 374–379. [CrossRef]
25. Glenn, J.C. The Futures Wheel. In *Futures Research Methodology—Version 3*; The Millennium Project: San Anselmo, CA, USA, 2009; p. 19.
26. Palm, E.; Hansson, S.O. The case for ethical technology assessment. *Forecast. Soc. Change* **2006**, *73*, 543–558. [CrossRef]
27. Richter, S.; Szarka, N.; Bezama, A.; Thrän, D. What Drives a Future German Bioeconomy? A Narrative and STEEPLE Analysis for Explorative Characterisation of Scenario Drivers. *Sustainability* **2022**, *14*, 3045. [CrossRef]
28. Schwartz, P. *The Art of the Long View. Planning for the Future in an Uncertain World*; Doubleday: New York, NY, USA, 1991.
29. MacDougall, C.; Baum, F. The devil's advocate: A strategy to avoid groupthink and stimulate discussion in focus groups. *Qual. Health Res.* **1997**, *7*, 532–541. [CrossRef]
30. Schwenk, C.R. Effects of devil's advocacy and dialectical inquiry on decision making: A meta-analysis. *Organ. Behav. Hum. Decis. Process.* **1990**, *47*, 161–176. [CrossRef]
31. Synopsis. Penetration Testing. 2024. Available online: https://www.synopsys.com/glossary/what-is-penetration-testing.html (accessed on 1 February 2024).
32. Suzuki, S. *Zen Mind, Beginner's Mind*; Shambhala Publications: Boulder, CO, USA, 1970.
33. Bi, H.; Mi, S.; Lu, S.; Hu, X. Meta-analysis of interventions and their effectiveness in students' scientific creativity. *Think. Ski. Creat.* **2020**, *38*, 100750. [CrossRef]
34. Apple. AirTag. 2024. Available online: https://www.apple.com/airtag/ (accessed on 1 February 2024).
35. Sheldon, K.M.; Elliot, A.J.; Kim, Y.; Kasser, T. What is satisfying about satisfying events? Testing 10 candidate psychological needs. *J. Personal. Soc. Psychol.* **2001**, *80*, 325. [CrossRef]
36. Diefenbach, S.; Ullrich, D. Responsible Automation. Exploring Potential Losses of Automation from A Psychological Perspective. (Working paper). Department of Psychology, Ludwig-Maximilians-Universität München: Munich, Germany, 2024.

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