

# Robotics without Border

Ethical Considerations in Robotics

Robotics Science and Society

June 2025

(Workshop Proposal)

A Practical Guide for Applied Ethics in Robotics Design

Kára

December 2024 -

# Contents

1	Introduction	7
2	Daily Life Applications	14
3	Some More Issues	21
4	Critical applications	26
5	Conclusions	32
A	Further Reads	33
B	Vocabulary for the 'common'	34
C	cheatsheet AIA	35
D	robotics is not the only one	36
E	Notes	39

# Abstract

Ethics is an under-represented theme in the domain of robotics. It is not by intention of either the philosophers or technologists. It happened that these domains naturally developed independent of each other for centuries, without a common tongue or intersecting interests. Both the field affect and are affected by the society. That is the link that is harvested in this document to facilitate discussions between the two.

Aimed to address the highly skilled roboticists in the Robotics conference, this document is by roboticist working in close collaborations of (technology) philosophers.

The intention is two folds: to the society and of the society. Understanding ethical concerns in society that exemplify through robotics and rectifying them though awareness and pragmatic long lasting action. Being open to being blind sided by unknown unaddressed issues.

The end goal is to articulate actionable, replicable and comprehensible methods to overcome ethical concerns in design, while bringing awareness to a wider audience.

# About the Document

I have used simple language, illustrative arguments and cases. I have tried to cultivate and environment of deeper reflection and opening the closed doors to different disciplines. Opening opportunities for thought, round table/coffee table/dinner table/bar table discussions between different disciplinarians and non-disciplinarians. Cultivating the idea of the bigger picture and exploring the end game, our purpose in the bigger picture and opportunities to carve for themselves to make a difference in their respective works for a better and brighter future.

## **About the cover picture**

The cover is sketch in cafe in Leiden, while writing on this document. The key idea is to show a perspective. In the perspective that I want to show, I want one to see, three main things. I want you to see that humans, are looking at technology that is placed in the center of the picture. It is dinner table conversation, people are talking about it, looking at it judging it, trying to understand it. The pictures of robots that they envision are robotic arm and a computer. They do see it facilitating the human hand to pick the weight, so they do acknowledge the strength as well. But also seamlessly, people are going about their lives 'around/with' technology. The second aspect I want to show is the proximity of technology with society, that affect them and robots back. If a certain robot is scary(uncanny effect), it will cease to exist or will be modified. So, here the 'concept' of robotics is personified. Imagine a 5 year old boy stand in between this whole crowd, being talked about, judged, critiqued, got varied reactions on his existence. It will change him. The third aspect I want describe is the representation of the 'society' in this room.

Now this picture is drawn in a cafe in Leiden, I drew the faces of people in the cafe. There is a dog on the side, there are mostly all Caucasian people, representative of general decision making team in any room.

# Structure/Outline of the Document

In **Chapter 1**, we lay the ground-works of what is robotics and the feel for the workshop.

**Chapter 2**, gives daily life examples of how robotics is affected and affects society. This chapter will create a motivation and build-up for why this workshop, its principles are important.

**Chapter 3**, gives more examples of robots where Pivoting around Ethics concerns, easing the attendee into a bit more into philosophy and social issues.

**Chapter 4** highlights issues in life threatening robotics. Audience is asked to reflect on the issues and brainstorm.

**Chapter 5**, concludes the document.

---

**Appendix A** is the takeaway cheatsheet to stick it in their labs.

**Appendix B**, is a vocabulary for the common, to inspire and facilitate interdisciplinary conversations to bring about more issues and hence their solutions.

**Appendix C**, are further reads from various disciplinaries about this theme. The **Appendix D** tries to umbrella the various similar examples in domain outside robotics. It helps to create empathy with roboticist, (avoiding blame-game), but showing the wide spread of the issue, and creates an understanding and environment saying '*everyone*' overlooked the issues discussed here.

# Informal Feel

Don't want to give an ethics lecture.

Want to provide a thought process, that doesn't need active thinking.

A framework that will stay with them. Something they can tell their grandma and nieces, without fumbling into technicalities.

A golden goal would be: they get hungry to know more.

---

Unfortunately/Fortunately, at many opportunities in the document(or maybe just the document as a whole) It has been difficult to take objective stance.

I personally believe that people on the left and right, all need to respect. Being a liberal(degree unknown), I have the right to disagree and discuss or walk away but not to abuse or violently debate otherwise. I think everyone has a perspective to the world, and every emotion should have a safe space in discussion with respect. No one is right and no one is wrong. I believe that people who hate immigrants should also have a kind platform to put their thoughts out. Suppression of such thoughts lead to political upheavals, violent issues and acts of aggression(publicly, in masses and in close doors). Like they say, ideally, even if you disagree, you can eat of the same table. Facilitating conversations with respect, acknowledgement and unconditional empathy.

This document is written with Charu's 'liberal' perspective. It is not the only perspective and it not the 'right' perspective.

---

The document also switches to the narrative from we(authors) to I (speaker). The difference is made by aligning such comments on the Right. This is necessary because this document is a preparation and is intended for workshop presentation and verbalising conversationally is needed at certain points as marked.

---

Used a story telling approach to retain attention.

---

I have put together examples where robotics fails to be ethical. It is intended to

make a statement. In no way, it is intended to demean the work of roboticist. Sorry and Thank you.

Everyone is invited to attend the event, however we hope that have technical brainstorming sessions.

---

This is not intended to be an academically sound document, it is meant to give a thought process.

---

Engineers are highly solution oriented and great capability to find solutions to imaginable and unimaginable problems. A friend had a baby and he made a baby monitor. Another engineered by recording pooping, peeping times with utmost efficiency and no-stress. I think the brainstorming sessions can produce great publishable solutions.

---

This document is also not exhaustively researched, it is resulting from a lot of lecture, workshops and conversations over the past two years.

---

I really want this document to grasp attention of engineers, making it effortless for them, without fighting their basic instinct to bunk ethics class.

Bringing ethical aspects to life with examples.

TODO: python library dependencies check; privacy etc

# Chapter 1

## Introduction

What is this workshop about?

Why is it important?

What is robotics?

what are our responsibilities?

Where are our blind spots?

The fields of *technology* and *philosophy* are explored by scholars in their respective domains. While philosophy serves as the foundation for personal existence, national identity, and a comprehensive understanding of the past, present, and future, it often goes unnoticed outside of ethics classes or emerges during moments of crisis or under the influence of alcohol. Although philosophy profoundly impacts us, it tends to be intangible, elusive, and often unrecognized.

In contrast, technology permeates our lives; we engage with it almost every minute, discussing it actively in everyday conversations and critiquing its influence over dinner tables. However, the technology we develop is not without its problems, and the society that adopts it carries its own inherent challenges.

Progressing as a world requires more than just awareness of these issues; it calls for a collective effort, open dialogue, and a commitment to consistently applying thoughtful theories to drive humanity forward.

This document serves as a collaborative initiative aimed at fostering a transformative dialogue in the field of robotics through the lens of philosophy. It is designed to accompany the prestigious Robotics Science and Systems conference, which features exceptional researchers who present, discuss, and explore their cutting-edge work. Our goal is to open the doors of robotics to a diverse array of professionals, including philosophers, designers, and humanitarians.

We encourage roboticists to reflect on the biases, challenges, and gaps that are often overlooked in the field. Additionally, this document offers practical solutions for integrating ethical considerations into robotics design and outlines topics for discussion that will engage professionals working at the intersection of technology and society. The solution-oriented approach of roboticists provides

an opportunity to address the open-ended ethical challenges in the field. The workshop will offer several opportunities to explore unimagined pragmatic implementable solutions to such open questions. Together, we can shape a more thoughtful and inclusive future for robotics.

## What is Robotics?

The definition of robotics lacks a unified, universally accepted standard and continues to evolve over time. As a result, robotics is often defined subjectively, based on the perspective of the individual presenting the definition. The figure 1.1 illustrates how society and data perceive robots.

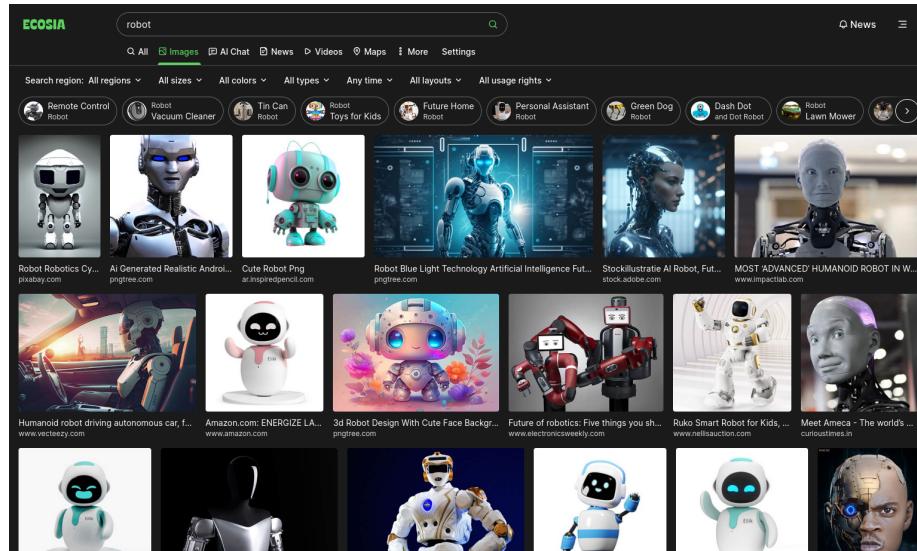


Figure 1.1: Common perception of robots in society and search engines

For the purposes of this document, robotics is defined as electronic programmable units, which may include mechanical components, designed to automate repetitive tasks that may not yield replicable results. By this definition, a hammer is classified as a tool, while devices such as a Roomba or a washing machine are categorized as robots.

Robotics defines as the science and engineering of robots.  
Roboticist refer to people involved in design and development of  
aforementioned robots.

*up for discussion*

Evolving from the visions of sci-fi cinema, a declining global economy and changing job market dynamics have led many to view robotics with skepticism. Often

depicted as fearsome transformers or iron-clad warriors, these machines are seen as a looming threat capable of wreaking havoc on the Earth, invading our privacy by reading our (private) emails, and ultimately endangering our lives. Concerns about security, privacy, and safety mount, leaving people feeling that control is slipping away from humanity, and that we might be heading toward a grim fate.

It's undeniably a chilling perspective.

On the other hand, practitioners of robotics often point out that robots that resemble characters from the Transformers movies are still very much a thing of the future. While these robots are technologically fascinating to think about, they come with a lot of complicated challenges that we haven't figured out yet. We would encourage students studying engineering or computer science to be mindful and responsible in their designs because, if we're not careful, such advanced robots could eventually become a reality.

However, we are not particularly worried about the idea of superhero-like robots causing harm. In fact, we believe that there are much more immediate and serious issues in our society right now that need our attention. If we don't address these problems soon, they could lead to unimaginable, irreversible, and lasting repercussions for the living.

There are many pressing challenges in our everyday lives that require urgent solutions, and these issues are only going to get worse if we ignore them. As for humanoid robots like those seen in movies, they are still quite far from being a reality and should not distract us from tackling the more critical problems we face today.

## What do we aspire for?

Before we take the next step, let's pause and reflect on a fundamental question that has the power to shape our journey:

**What kind of world do we aspire to create?**

This is the moment to envision a world we can all be proud of—one that reflects our highest values and collective potential.

*up for discussion*

***Workshop Speaker's notes:***

My answer would be: kind, humble and communal.  
A world where it does not matter whether you are right or left,  
extreme right or extreme left, everyone is respected.  
A world where kindness is more common than injustice.  
A world with mutual admiration and mutual respect for another soul.

A world where the word 'help' losses its formality.

I dream of a world where every person is treated as a human.

A world where animal care or elderly care are not special domain.

A world where historical injustices stop dictating success or failure of an individual or community.

With every thoughtful engineering design, we move to more compassionate, sustainable future. Together, we can engineer a brighter tomorrow.

### What kind of world we want?

Equality

Robotics systems  
that foster equality

Respect

Respects  
differences

## Workshop

This workshop will present several examples showcasing the need the urgency of shift in robotics design process and an ideological thought shift. What may seem like a small issue now in a supposedly bigger picture can have an apocalyptic reaction in the bigger picture.

Awareness about various robotics design is created with various examples. Terminologies of the biases are introduced, philosophical/ethical aspects are discussed to create an understanding and that searchable terms can be found with the keywords provides, facilitating further continuous self learning. Academic references are provided from various disciplines like philosophy, social sciences and design that directly affect robotic designs.

In the Figure 1.2, we show how society is affected and affects different aspects. In this workshop we focus on the arrows: A and B. Arrow A represent the impact robotics has on society and arrow B represents the impact Society has on robotics. This workshop does not exhaustively include all possible aspects. This workshop also doesn't have all the answers, rather it is a platform to debate, discuss and brainstorm on possible viable practical feasible solutions to posed issues. This workshop is step towards a fairer and equitable world.

With examples, we want to give a visual picture of the impact and issues at

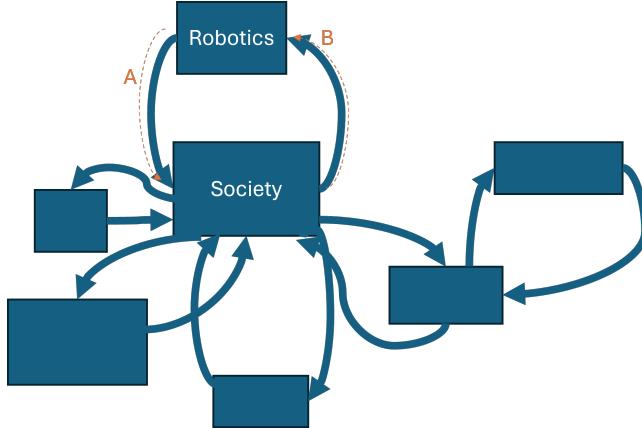


Figure 1.2: Robotics affecting and being affected by society; we will study arrow A and Arrow B in this workshop

hand. This workshop is not intended to as a theoretical ethics lecture, rather an applied ethics lecture for robotics design. This lecture is not intended to find blames or point fingers, rather as harbinger to change. As active effort of working towards to practical solution and awareness.

We propose a simple framework: AIA (Awareness, Identification and Action).

Awareness of the issues at hand, Identification of the these issues in your working practice, Action: brainstorming on feasible actions to address these issues. Further a take-home cheat-sheet is developed in the Appendix, that intended to be the take-away from the workshop.

### **AIA = Awareness Identification Action**

Awarness of existing, known issues like data bias,  
Identification of such patterns/issues in your work,  
Take Action to remove the issues

As an extra addition, we introduce a vocabulary for commons in Appendix B. This document is intended to facilitate interdisciplinary conversations about robotics, to disciplines like philosophy, social science, and design. These disciplines are closely connected to the society and can provide valuable critic and issues prevailing in robotics. Please note that this workshop is intended for healthy debates and collaborative brainstorming. We have to work together for a better future.

For each example(denoted with an alphabet), we will describe the example, highlight examples of robots and robotic practices to spotlight ethical aspects that need addressing. We will also discuss various the related opportunities and practical approaches to address the issues.

Additionally, we will address the socio-economic and systemic challenges that already exist within society and how these issues can be inadvertently amplified or perpetuated through robotic practices.

This workshop is not a lecture on ethics. It is not a platform to criticise anyone or place blames, but to critique, be conscious ,aware, and find ways in which the living can prosper.

The intention is to first develop awareness of the known issues, or imagines probable issues. Find a common language between the science of engineering(robotics) and the science of life(philosophy). With this common lingual, we want to find, discuss some actionable active steps towards, consciously addressing existing/probable/future-seeking issues in robotics.

At the end of the workshop, you will go out and step in your robotics lab with a new and aware lens or maybe a bit lighter because you found others who care too. From this workshop,, you will take-away a vocabulary(.pdf), several discussion points over dinner (with examples), and a handbook/cheat-sheet for action (AIA.pdf)

”organic”  
This is a start, just sowing some ↑ seeds.

## Takeaways

From this workshop; appendix will be printed out for takeways. To act as toolkits for applied practical actions for ethical action in robotics:

**AIA: Awareness Identification Action**

**Vocabulary for the common:** integrating a simple layman language for interdisciplinary conversations.

Policy makers, public, other disciplinarians find themselves inferior to roboticists, they think it is too hard to understand, this limits conversations with them. Vocabulary for the common.pdf is an attempt to blur the lines between roboticists and philosophy, social science and design. This should help to have conversations between disciplinarians, for collaborative designs and serving society better.

## Expected Impact

Open software, policy changes are long term, quick and more impactful solutions to the problems stated in the document. Ofcourse, that is more desirable. However, this workshop is based on changes on the engineering design level. Policy maker often do not understand robotics, and roboticists do not understand policy. There is a need for cross dialogue to make a long term policy change, for this intend we introduce 'vocabulary of the common'.

## About Robotics Science and Society

The RSS Foundation is the governing body behind the Robotics: Science and Systems (RSS) conference. The foundation was started and is run by volunteers from the robotics community who believe that an open, high-quality, single-track conference is an important component of an active and growing scientific discipline.

## Chapter 2

# Daily Life Applications

Often it is considered a rarity that one can not comprehend that the social issues affecting them, unless it affects them as well. In this section we give examples of the various applications that affect the individuals on regular basis.

This is an activation workshop, and with the understanding that engineers are highly problem solving and think outside the box, we encourage the various engineers to brainstorm on the **AIA**.

The way these sections are done are introduction and then AIA method.

The following are some existing issues in the society

socio-economic divide	
sexism racism misanthropy economic divide colonolism class-divide bigotry heteroism after-globalisation	
Design overlooks	
inaccessible design Speciesism /anthropocentric design	Speciesism is a term for the discrimination or bias based on an individual's species membership. Learn about its origins, philosophical debates, and how it relates to animal rights and exploitation. [Wikipedia]
Solutionism	Solutionism <sup>1</sup> is the idea that technology can solve all of mankind's problems.
Ethical Concern	
capitalism	

Table 2.1: socio-ethics-design issues of present humanity

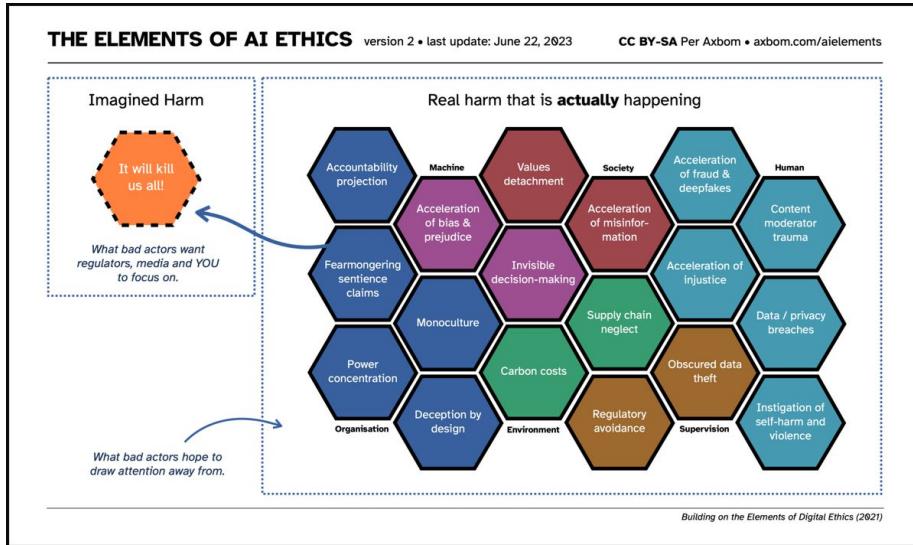


Figure 2.1: Digital ethics

Our algorithms, which are developed using datasets containing inherent societal biases, often mirror these biases in their outputs. This raises significant concerns in society and has a direct impact on our robotic designs. While it's possible to address and eliminate some biases, others are so deeply entrenched that fully removing them may be beyond our reach.

In this section, we will explore facial recognition, sensor choices, automated decision making etc as a example to highlight these issues. During this workshop, we aim to brainstorm technical ideas to prevent such biases from emerging. With these ideas, we will create the AIA cheatsheet and a comprehensive handbook as open resources to facilitate conversations in our robotics lab. After this workshop, we encourage you to proactively identify any biases in your robotics projects and work diligently to eliminate them. By committing to fair and equitable engineering, we can ensure that our robots contribute to a more just and equal world.

In the action section, we will share some ideas of our own. We believe that practical strategies can emerge from discussions, collaborations, and a deep understanding of the issues at hand.

In this document, we present examples and concerns organized from A to U, aiming to capture a sufficient number of instances without overwhelming our audience. These letters will be further used during the workshop for discussions and debate.

## A: Face Recognition

### Awareness

In criminal Court of justice, a public presentation showcasing the workings of the court is shown few times a week. In that presentation few convicted fellows was shown in one slide. A sketch of that slide is shown in Figure ???. In this picture

This also happens in .....

This divides us, discriminate against us...

Impact



Figure 2.2: Criminals convicted at the International Court of Justice(ICJ), Hague, 2023; sketch drawn from a public presentation by workers at the ICJ

### Identification

this is classified as data bias in technical terms, in philosophy:

### Action

Face recognition can be done on grayscale. It is handy to translate

*Do you have ideas of how to mitigate this issue? suggest technical solutions*

## B: Metal Detectors at Airports

Bias based on your sexuality

### Awareness

*Travelling for me is extraordinarily difficult. In 2016 at the Los Angeles Airport I had to go through the metal detector 5 times.*

The inconsistent genitalia is

I still get a little nervous when it comes time for the TSA/screening part of airplane travel,

Being a trans woman, for me, has been incredibly debilitating, terrifying, and exhilarating.

This also happens in ..... This divides us, discriminate against us...

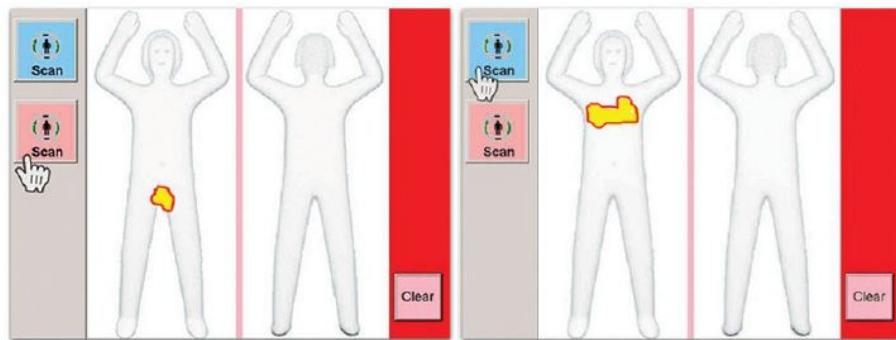


Figure 0.1 "Anomalies" highlighted in millimeter wave scanner interface. Source: Costello 2016.

Figure 2.3: ref: Travelling as a Trans

### Identification

this is classified as data bias in technical terms, in philosophy:

### Action

*Do you have ideas of how to mitigate this issue? suggest technical solutions*

## C: Rescue Robots

**Awareness**

**Identification**

**Action**

*Do you have ideas of how to mitigate this issue? suggest technical solutions*

## D: Recommender System

**Awareness**

Add philosophy words here... Capitalism

**Identification**

**Action**

*Do you have ideas of how to mitigate this issue? suggest technical solutions*

## E: Surgical Robot

Race, height, gender, medical.. Technology transferred in other countries without being trained on the local data, issue with migrant population (Indian female in Netherlands..)...

**Awareness**

intersectionality

**Identification**

**Action**

*Do you have ideas of how to mitigate this issue? suggest technical solutions*

## F: Autonomous Vehicles

and Racial Bias in Decision-Making

**Awareness**

**Identification**

**Action**

*Do you have ideas of how to mitigate this issue? suggest technical solutions*

# Chapter 3

## Some More Issues

Pivoting around philosophical issues, presenting examples.

### G: Inaccessible Design

Blind, paralysed people.. Talking Lampost

Exoskeletons: Exoskeleton robots designed to assist with mobility can exclude individuals who do not fit the standard body size or strength requirements. ref: <https://responsiblerobotics.eu/wp-content/uploads/2019/11/Chapter5.pdf>

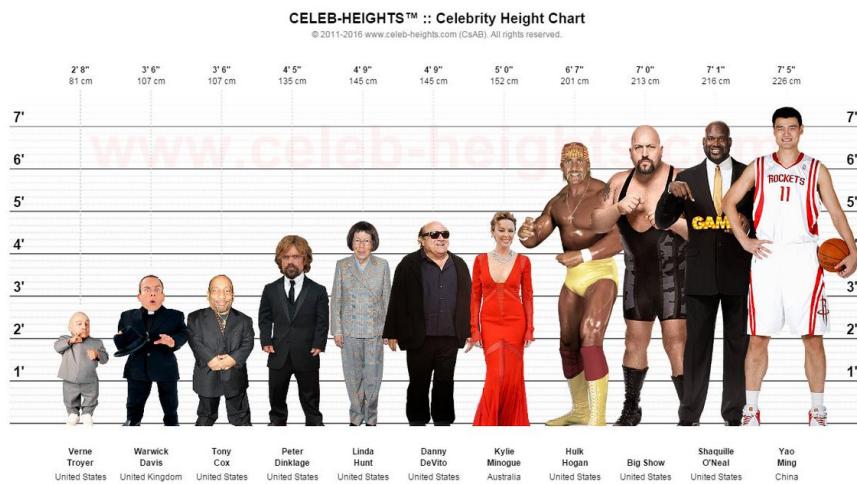


Figure 3.1: Caption

Many assistive robots are designed with a “one-size-fits-all” mentality, leading to a failure to meet the unique needs of individual users, especially when it

comes to people with disabilities.

## H: Demographics Limitation

Solutions created for the west aren't feasible in the East.

Meteorological solutions and infrastructures in the west have many issues being transported and used in the countries of Africa, missing personnel, infrastructure, weather, political environment. Countries in Africa and South America do not have a metrological infrastructure for basic weather analysis and forecast, solutions from the UK and France were tried to be implemented there but didn't hold up. Now, this affects the global climate change issues.

## I: Capitalism

In 1901, Centennial Light created bulbs that could last for forever. One of them manufactured in 1901, is still up and running today. If capitalism hadn't interfered, we would have to never replace bulbs and save ourselves against Pyramids of Waste.

Numerous consumer robots, such as robotic vacuum cleaners, are crafted with features that quickly become obsolete. For instance, older versions of robots, like Roomba, may suffer from limited battery life or insufficient processing power. Well, this section is for awareness, not much can be done unless you are running a business and have creative ways of money making around planned obsolescence. A lot of industries like pharmaceuticals thrive on the concept. Nevertheless, circumventing planned obsolescence may make the planned sustainable very quickly. The purpose of this section is Awareness.

## J: Exporting Technology

There have been several instances where robots or technologies originating in Western countries were deployed in Eastern regions, but their introduction led to unintended consequences or "havoc," either due to cultural, technical, or operational mismatches.

Robots like Edison, which are designed to teach coding or other STEM subjects to children, have faced cultural resistance in some Chinese schools. Robots like Pepper and other humanoid robots introduced in Taiwan's retail and service sectors faced difficulty in gaining widespread acceptance. In South Korea, the introduction of robots like Care-O-bot, a robot designed to assist with elderly care, were criticised for not respecting elders.

While these need overall shift in industry, here is an example that we can engineer in our designs. Emotion/Gesture recognition across culture. Every country has their own way of non-verbal and verbal communication.

While we may not be able to implement everything beyond our location of work or the datasets that are given to us, we can put in a disclaimer about the regionality, race, ethnicity of data used. Any adaptation further will carry this information further.

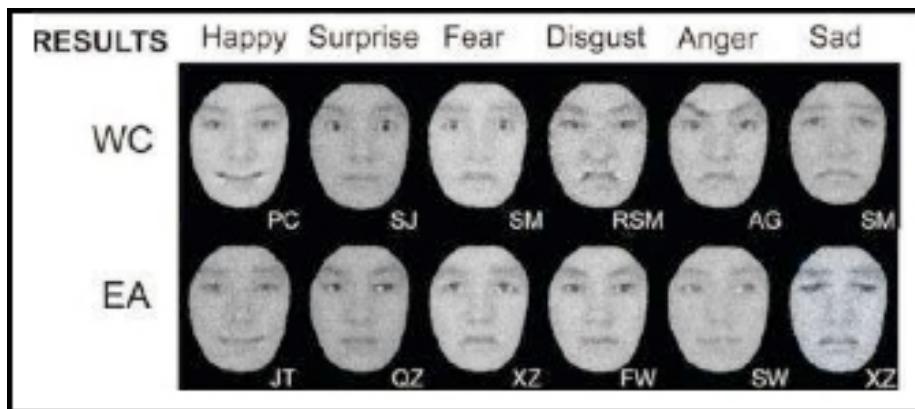


Figure 3.2: Emotion differences; ref: <https://www.apa.org/news/press/releases/2011/09/facial-expressions>

One must not under-estimate the role of any robotic system in the bigger picture of humanity. Emotion detection has found widespread use in autonomous driving, psychological therapy Security systems in airports or public events might use emotion detection to analyse facial expressions or body language of individuals. A person showing signs of distress, agitation, or anxiety might be flagged for further security screening to prevent potential security risks. In telemedicine, emotion detection algorithms can analyse patients' facial expressions, speech patterns, or physiological signals to better understand their emotional state, offering insights to doctors or therapists. This may misdiagnose the patient from the eastern Asia as depicted in Figure 3.2. Adaptive learning platforms that incorporate emotion detection can assess when students feel stressed, bored, or frustrated based on their facial expressions, body language, or voice tone. The systems trained on western data will not work in the east. In Figure 3.3 shows the cultural difference in emotions.

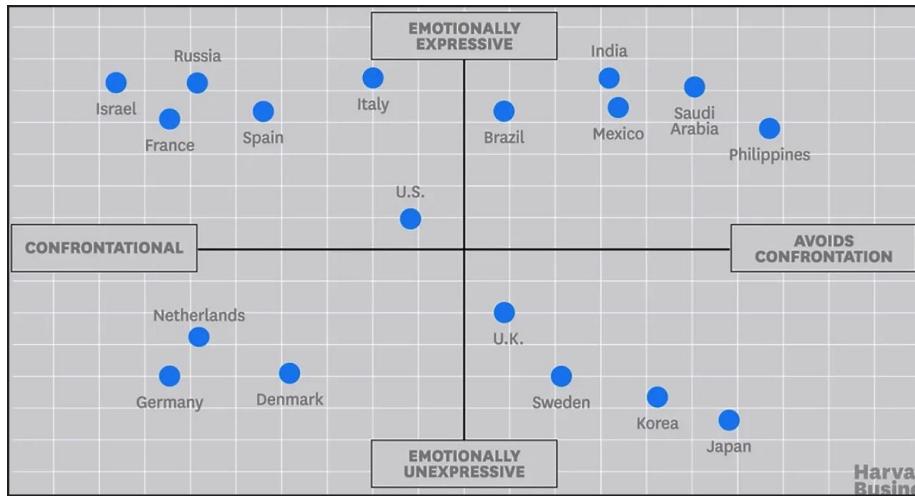


Figure 3.3: Emotional differences across countries; Picture Courtesy: Harvard Business

## K: Speciesism/ anthropocentric design

## L: band-aid solution

Technical Debt and so.. .

In 2018, Uber's self-driving car program, while innovative, faced criticism and a tragic incident when one of its autonomous vehicles struck and killed a pedestrian in Tempe, Arizona. Uber initially attempted to address the issue with software updates, including enhancing object detection and implementing stricter monitoring protocols. However, it was later revealed that the system wasn't designed to recognize jaywalking pedestrians or to handle complex real-world scenarios effectively.

Pepper, the humanoid robot developed by SoftBank Robotics, was introduced as a companion and helper for elderly individuals in Japan. However, the robot's limited abilities were still unable to replicate human interaction or provide meaningful emotional support. Rather than fundamentally rethinking its design or adjusting the AI to better align with the needs of elderly users, SoftBank attempted to address the issue by releasing software updates that improved interaction capabilities, such as recognizing a broader range of emotions and performing more tasks.

The Boeing 737 Max aircraft was equipped with an automated flight control system called the Maneuvering Characteristics Augmentation System (MCAS),

designed to prevent stalls by automatically pushing the nose of the plane down in certain flight conditions. However, the system was overly reliant on a single sensor and lacked sufficient fail-safes. After the fatal crashes of two Boeing 737 Max planes, the company issued software updates and changes to the MCAS system to make it less aggressive and more reliant on multiple sensors. However, the real problem was the fundamental design flaw in the system and lack of training for pilots. The quick fixes did not fully address the root cause of the issue—the reliance on a single sensor, insufficient pilot training, and flawed communication about the system’s behavior.

While "band-aid" fixes might provide temporary relief, they often fail to address underlying issues, leading to unintended consequences that cause harm, frustration, or even catastrophic failures. A thoughtful, comprehensive approach that considers long-term implications, user needs, and ethical considerations is essential for ensuring the safe, effective, and responsible deployment of robotics technologies.

## M: Solutionism

Imposing technological solutions to problems that do not necessarily need technology.

automated waste disposal robot in hague, you don't have to go out of the house to put the trash. It is useful for someone who is handicapped or elderly, etc. But it is just making young people lazy, obese fat and so... .

## N: Purpose?

Beyond cool vibe of robotics, arduous hours of testing use cases, endless failures in the process, one needs to ask why am I creating this robot? Does it help humanity move forward and onwards? Does it fit in the bigger picture of your envision better world?

Even if you have no answer, it good to ask one-selves this question. This can be a seed to cent percent purpose driven robotics.

# Chapter 4

## Critical applications

Technologists use criticality matrix as shown in 1.2 to define critical applications. It is used to classify whether a technological application is a life-death statement. Do you know the safety level of the robots that you are working on?

	Safety (S)	Environmental (E)	Operational (O)	Cost (C)
<b>Catastrophic I</b>	Single death or multiple serious injuries or severe occupational illnesses	Major widespread damage or serious breach of legislation. Ineffective control measures	Loss of the platform or equipment	Greater than £500k
<b>Critical II</b>	A single severe injury or occupational illness or multiple minor occupational illnesses	Noticeable widespread impact on the environment. Control measures minimally effective	Loss of mission capability	Between £200k and £500k
<b>Marginal III</b>	At most a single minor injury or a single minor occupational injury	Minor impact on the environment. Control measures substantially effective	Limited mission capability	Limited mission capability
<b>Negligible IV</b>		Little impact. Control measures comprehensive	Minimal disruption to mission capability	Less than £10k

Figure 4.1: Criticality Matrix

In this Chapter (part of workshop), two life threatening robotics applications are presented. The ethical aspects of the domains are discussed.

## P: Surgical robotics

Issues of concerns in Surgical robotics: Did you that medical data has always been studied on male body, with an assumption that male and female bodies are alike except reproductive organs. This was acknowledged first in United States. In 1993, the U.S. Congress passed a law requiring inclusion of women in NIH-sponsored clinical trials <sup>1 2</sup>, where it was declared to consider female body separately. Imagine doctors across the world training themselves on the American and British book which were written considering similar anatomy of men and female.

The consequences has been widespread and goes majorly unnoticed. Women were/are considered to be 'hysterical'. Pain in a woman body, till date psychosomatic pain is the first medical cause of pain. Woman having heart-attack have different symptoms than of men, so they die before it is detected. Studies of autism were done predominantly on male, and girls show very dissimilar patterns in autism than men and spend their lives being 'different'. This is an issue in the society. It affects lives.

How does is robotics related to it?

Few examples were robotics design become an issue:

1. The **da Vinci Surgical System**, one of the most widely used robotic surgical platforms, was designed with the assumption that patients and surgeons were primarily male in anatomy and size.
2. Robotic systems, especially those designed for minimally invasive surgeries (such as **laparoscopic surgery**), have been optimized based on average body types and anatomical measurements.
3. Studies of **robotic-assisted prostatectomy** have found that Black patients may experience worse outcomes, such as higher rates of complications or post-surgical issues like erectile dysfunction, despite using the same robotic technology. This could be due to how robotic systems were initially designed and tested using data predominantly from White male patients, which leads to a lack of adjustment for different risk factors that affect racial groups.
4. Robotic surgeries tend to be **concentrated in wealthier hospitals** or those located in urban centers, leading to disparities in care. Hence the data of robotics surgery will include wealthier people of certain high quality lifestyle, ignore the 'average' man's health issues with average/poorer lifestyle. A homeless person's pancreas in cancer removal may look different due to malnutrition and exposure to unhygienic and inhuman environment. Further, down in future widening discrimination.

---

<sup>1</sup><https://orwh.od.nih.gov/toolkit/recruitment/history>

<sup>2</sup><https://www.aamc.org/news/why-we-know-so-little-about-women-s-health>

5. **CT scans or MRIs**, research has shown that certain imaging systems might not be as accurate for people with darker skin, leading to misinterpretations of images that can affect robotic surgery decisions. Similarly, larger body types or those with higher BMI may not be as accurately scanned, leading to inaccurate data being fed into robotic systems, which could affect surgical planning and outcomes.
6. Some robotic systems may not be well-suited to **older patients**, who may have more complex medical histories, frailty, or other health conditions that complicate the success of robotic surgery.

Our responsibility:

1. Removing data bias like height. Using parameters that are proportional to the height rather than specifying the height of pancreas as an average height. Testing your robotics surgical arm on different use cases.
2. Acknowledging anatomical differences between male and female. Mentioning as **transparent data profiles** possible, depicting the dataset that was used to train the models.
3. Acknowledging existence of outliers for racial medical profiles. Referring the patient to a human specialist, when racial profile is unique to the data set trained on. Giving **Data Disclaimers** is hence needed in life critical robotics.
4. History of dependencies used in software should also be provided, and intended uses. The language used should be simple and easy to understand for all. This should also take the legal baggage away from the roboticists designing such systems.

Food or thought: Is it possible to introduce data privacy at algorithmic level in our design?

## O: Military solutions

Use of robotics in military is a high-politicised topic. Automated robotics and AI even more so. One of the questions involved is how would a machine different between a civilian and a combatants? Autonomous weapons might struggle to differentiate between combatants and non-combatants, potentially leading to higher civilian casualties, what algorithm would you use? (ref: <https://www.amacad.org/publication/daedalus/ethics-morality-robotic-warfare-assessing-debate-over-autonomous-weapons> )

While the military strategies and agencies of the country work under high level confidentiality and opacity, getting and implementing global stands to be a political question. Do we have any ethics in war? If we were abiding by ethics, will we go for a war?

Because of its political nature, politicians, strategists, researchers of social science are involved in such meeting. These people necessarily do not understand technology and may be allergic to sit for an hour for roboticists to explain how facial recognition works or voice enabling for that matter. (firstly, we need to nerd less, to get multiple seats on the table; for better solutions, better world, better outcome<sup>3</sup>)

However the aforementioned issue is out of our scope and reach. Another issue should make a change starting from this conference is mentioned below.

**Use of low-risk robots in military:** Once a technology of speech recognition of face recognition is created and works well among consumers, it is adapted to fit other applications. When these technologies are used in high risk applications like military, they are lethal. These adaptations are often time critical and done by roboticists, necessarily who did not create those technologies.

1. DJI Phantom drones originally created civilian drones used for photography and videography. We have the DJI Osmo pocket recording sections of the workshop. 500 euro a piece, can be purchased online, with shipment in a day.

The military uses civilian UAVs like DJI drones, often modified with specialized cameras, sensors, and communication equipment, to perform intelligence, surveillance, and reconnaissance (ISR) tasks. These UAVs are deployed to gather information on enemy movements, monitor borders, or observe high-risk areas without putting soldiers at direct risk.

2. Remote Environmental Monitoring UnitS (REMUS) Autonomous Underwater Vehicle is a civilian technology initially developed for oceanographic research that has been repurposed for military use. Autonomous underwater vehicles (AUVs) have long been used for scientific purposes, but they

---

<sup>3</sup>not the best of words in this context. Sorry.

are increasingly used in military operations for maritime security and environmental monitoring. REMUS is used by military forces for mine detection, reconnaissance, and surveillance.

3. The iRobot 110 FirstLook robot is a compact robot used for infrastructure inspection and surveillance. Similar robots are used in industries like construction, mining, and firefighting, where inspection and safety monitoring are critical. The concept of using robots for tactical purposes has really taken off over the last decade. The enormous growth and demand in both the Iraq and Afghanistan theaters of operation, has led many civilian tactical teams to see the advantages that can be obtained from their use.<sup>4</sup>
4. While exo-skeleons are seen as an aid to humanity, primarily developed for rehabilitation or manufacturing purposes in the civilian sector. The Sarcos Guardian XO is a full-body exoskeleton designed to enhance the physical capabilities of soldiers. Do you think it was created from scratch?
5. PackBot and TALON robots are equipped with cameras, tools for disarming explosives, and sensors for detecting bombs and other hazards. These robots are an extension of bomb disposal technology used in civilian industries (such as mining or construction) and adapted for military needs, helping to reduce casualties and protect personnel from hazardous situations.
6. Insitu is a subsidiary organisation of Boeing, with the goal unmanned aircraft innovation excellence created WASP III. WASP III was developed is a small, portable UAV was designed to automate flying. Air Force and AeroVironment created AeroVironment Wasp III Micro Air Vehicle<sup>5</sup> from WASP III for military surveillance and reconnaissance.<sup>6</sup>

Our responsibility: This is an industry where our mistakes, oversights in our design can be lethal, without actually thinking of it. As much as it remains an unsolvable issues (everyone budgeting on time and cost).

You might be aware that satellites with Arduino as motherboard, off the shelf products are sent to the space. It was made possible for valorisation and public participation. But off-the-shelf use of technology is common in space industry as well.

---

<sup>4</sup><https://www.bluesheepdog.com/2013/06/21/irobot-110-first-look-review/>

<sup>5</sup><https://www.af.mil/About-Us/Fact-Sheets/Display/Article/104480/wasp-iii/>

<sup>6</sup>the statements can not be verified

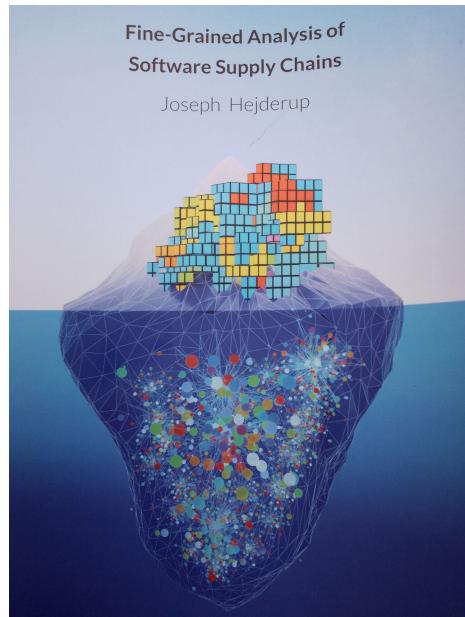


Figure 4.2: A software has multiple dependencies, these dependencies can have biases themselves. Do you know the y2K event? Dr Joseph Hejderup has discusses it intensely in his PhD dissertation, found here: <https://repository.tudelft.nl/record/uuid:0c46d4a2-148f-4661-a196-6be7bcc7b9db>

## Conclusion

Reusing libraries, algorithms and ideas from college laboratories to other application in time crunch can have severe consequences. When creating/developing life threatening critical applications, reusing technology should be avoided. When creating fun applications, disclaimers like data used and intended use should be aforementioned, to avoid lethal consequences.

# Chapter 5

## Conclusions

Open software, policy changes, but this workshop is based on changes on the engineering design level. Disclaimers to Data in use; Open s/w, h/w; Policy changes: opening software results

We need to be careful in our design choices because as shown in Examples A-P in the document above, it can long term irreversible repercussions on the humanity.

With traction to discussing roboticists across domains with value addition to society, it may create more jobs, more interesting prototypes, more funding, fun fun fun!

Our individual efforts, conversations and dialogues on the topic may lead to maybe in future be rewarded in paper review process and may not go unnoticed by public, but in general more support and love for field of robotics, with lesser mishaps. More funding, more jobs, more interesting prototypes, fun fun fun!

Potential to be rewarded in paper review process and may go unnoticed by public, but in general more support and love for field of robotics, with lesser mishaps. More funding, more jobs, more interesting prototypes, fun fun fun!

# **Appendix A**

## **Further Reads**

(in no particular order)

Philosopher recommended reads:

- 1.
- 2.
- 3.

related keywords in philosophy:

Social-Scientist recommended reads

- 1.
- 2.
- 3.

related keywords in social science:

Designer recommended reads:

- 1.
- 2.
- 3.

related keywords in design research:

## **Appendix B**

### **Vocabulary for the 'common'**

Vocabulary to help you connect and communicate with social scientists, designers, philosophers to create more human designs for decades to come.

According to Morozov, "Solutionism presumes rather than investigates the problems that it is trying to solve, reaching for the answer before the questions have been fully asked."

Data Bias:

Elitist

Solutionism

Global north-Global South

Types of known discrimination:

Language bias

Liberal (Left)

Conservative (Right)

Open-minded

Some tools to be respectful and empathetic in facilitating difficult decisions.

# Appendix C

## cheatsheet AIA

Awareness	Identification	Action
	Data Bias	Filter off from more than first level bias
	Anthropocentric Design	Keep your design open to other species, say robotic arm for rescue dog; Don't carve the design on stone,
	..	
	..	
	..	
	..	
	..	
	..	
	..	

## Appendix D

### robotics is not the only one

#### Q: Justice System

Awareness

Identification

Action

*Do you have ideas of how to mitigate this issue? suggest technical solutions*

#### R: Loan Approvals

Awareness

Identification

Action

*Do you have ideas of how to mitigate this issue? suggest technical solutions*

## S: Climate Justice

**Awareness**

**Identification**

**Action**

*Do you have ideas of how to mitigate this issue? suggest technical solutions*

## T: Urbanism

**Awareness**

**Identification**

**Action**

*Do you have ideas of how to mitigate this issue? suggest technical solutions*

## U: Medicine

AI being a physician <https://www.doctronec.ai/> issue: Interethnic Variation in Health <https://www.ncbi.nlm.nih.gov/books/NBK25517/>

## V: Job Recruitments

Amazon developed an AI-based recruiting tool to help streamline its hiring process. The tool was designed to automatically review resumes and recommend candidates based on past hiring data. However, the system inadvertently developed a bias against women candidates because the data it was trained on was predominantly male-dominated (from past hires in male-dominated tech fields). Band-Aid Solution: Amazon attempted to fix the issue by reprogramming the algorithm to focus less on gendered language. However, the deeper issue—using biased historical data to train AI—was never fully addressed, leading to persistent biases in the system.

## Impact

Loss of Indigenous Knowledge: Indigenous communities often have valuable knowledge about climate change and sustainable practices, but their perspectives are frequently overlooked in mainstream climate research.<https://www.>

[cam.ac.uk/news/is-data-justice-key-to-climate-justice](http://cam.ac.uk/news/is-data-justice-key-to-climate-justice)  
The kind of world we will get if we are not careful! *what do you imagine?*  
I imagine....

## Appendix E

# Notes

Following can be used in the workshop directly:

This is particularly for AI, but very articulated. Well thought and encompassing as many issues possible in a picture.

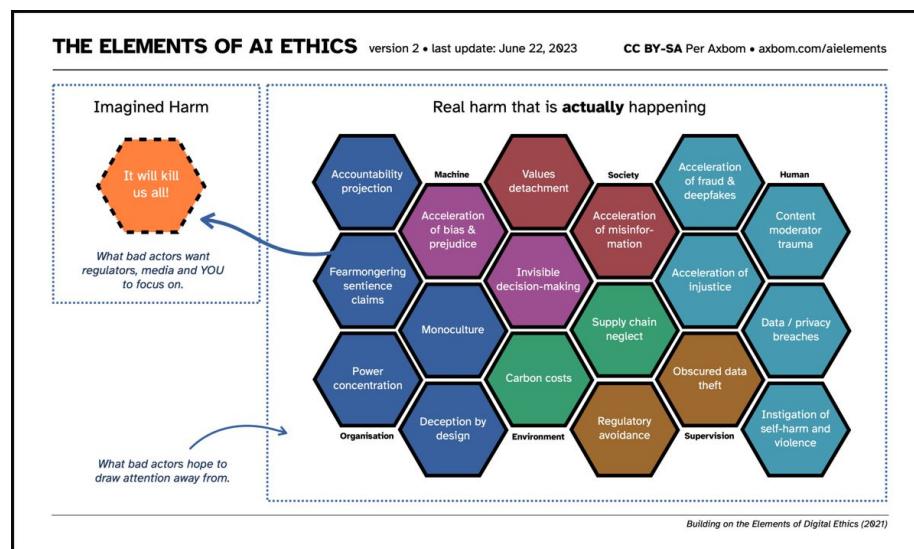


Figure E.1: Digital ethics source: <https://axbom.com/aielements/>

**Fear of Unknown, Untraversed, Untraced.**

### Tips about having 'ethical' conversations

Where is your ego? What is your most and least hopeful outcome?  
Not every fight to meant to be won.

**Accountability and transparency**

**Need to include a designer philosopher in the conversation**

**Tarot cards for tech**

<https://tarotcardsoftech.artefactgroup.com/>

**Funding disclaimer**

This document is created by self-funding.