

The trek towards sustainability - truth, tale, or transition?



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Birgit Penzenstadler

- Associate Prof, Software Engineering for Sustainability
- CV: Phd@TUM -> UCI -> LB State (& LUT) -> Chalmers|GU
- Research:
 - Sustainability Design (www.sustainabilitydesign.org) since 2010
10 years RE4SuSy workshop series 2012-2021
 - Wellbeing & Resilience studies (www.twinkleflip.com) since 2020
- Education Projects:
 - SE4GD (<https://se4gd.lutsoftware.com>)
 - EUGAIN (<https://eugain.eu>)

Outline: {Tale, Truth, Transition}*

- Tale: Where the misconceptions are.
- Truth: Where we getting it right.
- Transition: What the way forward may look like.

Disclaimers:

1. I will probably say thing you don't like.
2. I won't give you tools for software architecture.

Tale. „I just do what my customer asks.“



- Likely answer by student
- Version of practitioner
- Translates to
"I am not responsible"

Truth. Responsible for impact.

“Every line of code represents
a moral and ethical implication.”

– Grady Booch

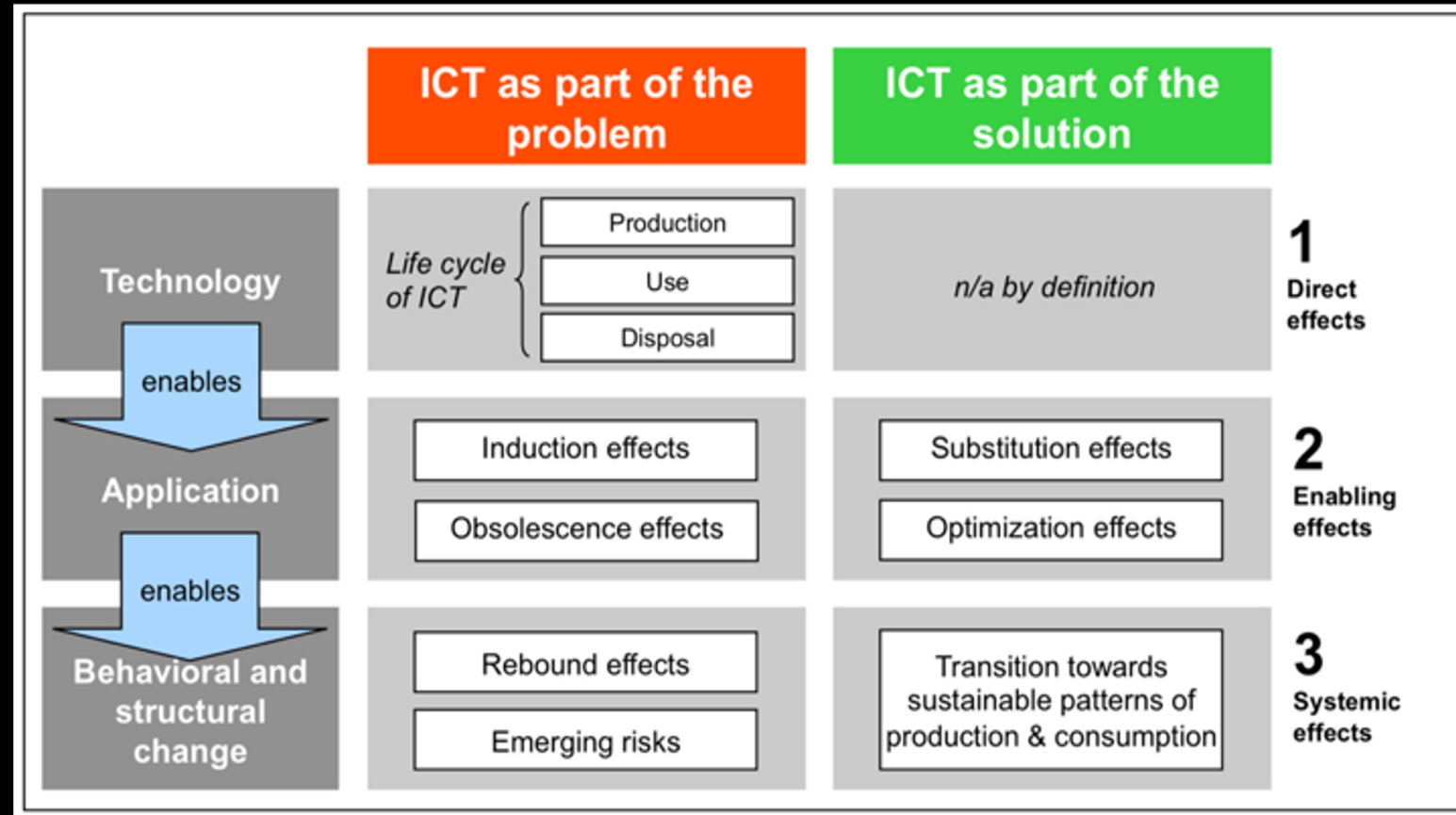


- We embed our values into the systems we design.
- SE has responsibility for systems we put out.
- There is more to it than Green IT.

Who knows sustainability impacts?



Environmental impacts.



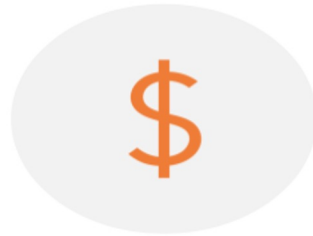
Hilty, Lorenz M., and Bernard Aebischer, "ICT for sustainability: An emerging research field." *ICT Innovations for Sustainability*. Springer, Cham, 2015. 3-36.

Is „environmental“ everything?

DESIGN OF AIRBNB - ENVISIONED BENEFITS



MARKETPLACE TO
RENT YOUR HOUSE



MORE AVAILABILITY
OF CHEAPER,
SHORT-TERM RENTAL
OPTIONS



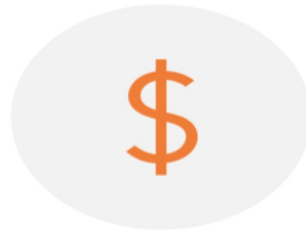
LOCAL
ACCOMMODATION

Things foreseen at design time. Anything missing?

THINGS GONE WRONG - WE DIDN'T SEE THIS COMING



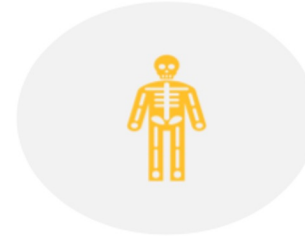
NEW YORK:
HOMEOWNERS CAN
EARN 55% MORE
THAN THE MEDIAN
LONG-TERM RENTAL



ESTIMATED: AIRBNB
REMOVED 7,000 -
13,000 UNITS OF
HOUSING IN NY
→ INCREASE OF 1.4%
IN THE MEDIAN
LONG-TERM RENT



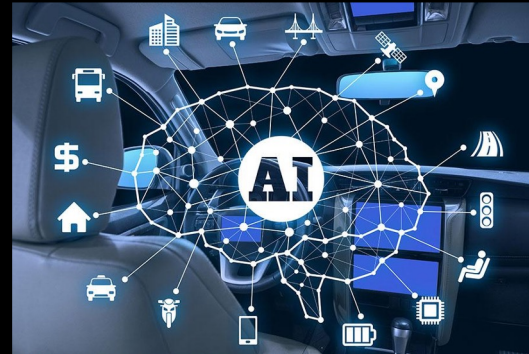
72% OF POPULATION IN
NEIGHBOURHOODS AT
HIGHEST RISK OF
AIRBNB-INDUCED
GENTRIFICATION ARE
NON-WHITE
→ INCREASING RACE
SEPARATION



D.Wachsmuth and A. Weisler. Airbnb and the rent gap: Gentrification through the sharing economy. *Environment and Planning A: Economy and Space*, 50(6):1147-1170, 2018.

Economic and social impacts.
Anything else?

Have you noticed impacts?



- Making sense of the world
(Misinformation, fake news)
- Attention and cognition
(Loss of crucial abilities)
- Physical and mental health
(Stress, loneliness, addiction)
- Social relationships
(Less empathy, more confusion)
- Politics and elections
(Propaganda, distortion)
- Systemic oppression
(Amplification of sexism, racism)
- The next generations
(Developmental delays, suicide)

Social & individual impacts

Center for
Humane
Technology



Transition.



KARLSKRONA MANIFESTO FOR SUSTAINABILITY DESIGN

https://www.youtube.com/watch?v=kcr8acz_q-Y

Introduction

Version 1.0, May 2015

As software practitioners and researchers, we are part of the group of people who design the software systems that run our world. Our work has made us increasingly aware of the impact of these systems and the responsibility that comes with our role, at a time when information and communication technologies are shaping the future. We struggle to reconcile the needs of our planet Earth and its societies with the work we do. We have come to understand the importance of sustainability and

There is a perception that sustainability is a distinct discipline of research and practice with a few defined connections to software.

Whereas sustainability is a pervasive concern that translates into discipline-specific questions in each area it applies.

There is a perception that sustainability is a problem that can be solved, and that our aim is to find the 'one thing' that will save the world.

Whereas it is a 'wicked problem' - a dilemma to respond to intelligently and learn in the process of doing so; a challenge to be addressed, not a problem to be solved.

There is a perception that there is a tradeoff to be made between present needs and future needs, and hence that sustainability requires sacrifices in the present for the sake of future generations.

Whereas it is possible to prosper on this planet while simultaneously improving the prospects for prosperity of future generations.

There is a tendency to focus on the immediate impacts of any new technology, in terms of its functionality and how it is used.

Whereas the following orders of effects have to be distinguished: *Direct, first order effects* are the immediate opportunities and effects created by the physical existence of software technology and the processes involved in its design and production. *Indirect, second order effects* are the opportunities and effects arising from the application and usage of software. *Systemic, third order effects*, finally, are the effects and opportunities that are caused by wide-scale use of software systems over time.

There is a tendency to overly discount the future. The far future is discounted so much that it is considered for free (or worthless). Discount rates mean that long-term impacts matter far less than current costs and benefits.

Whereas the consequences of our actions play out over multiple timescales, and the cumulative impacts may be irreversible.

There is a tendency to think that taking small steps towards sustainability is sufficient, appropriate, and acceptable.

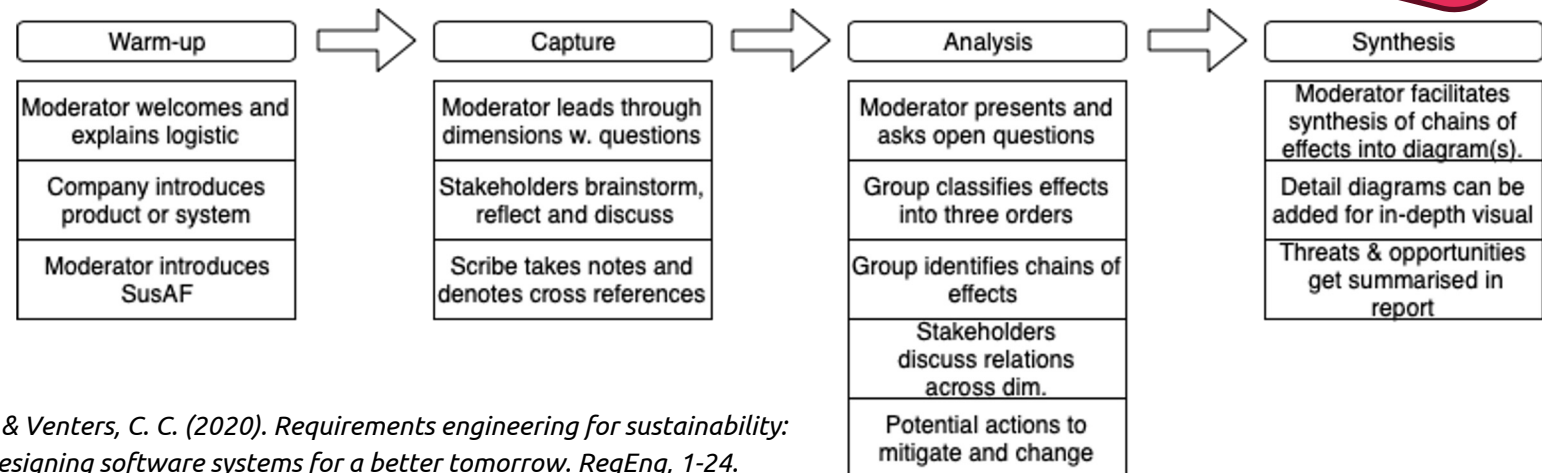
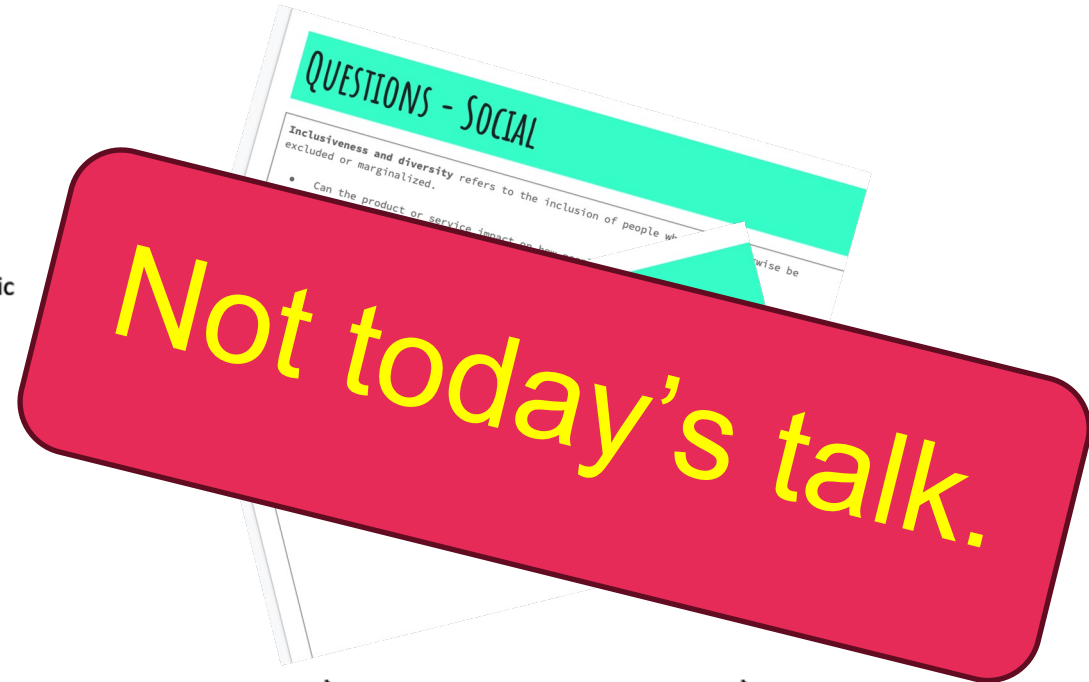
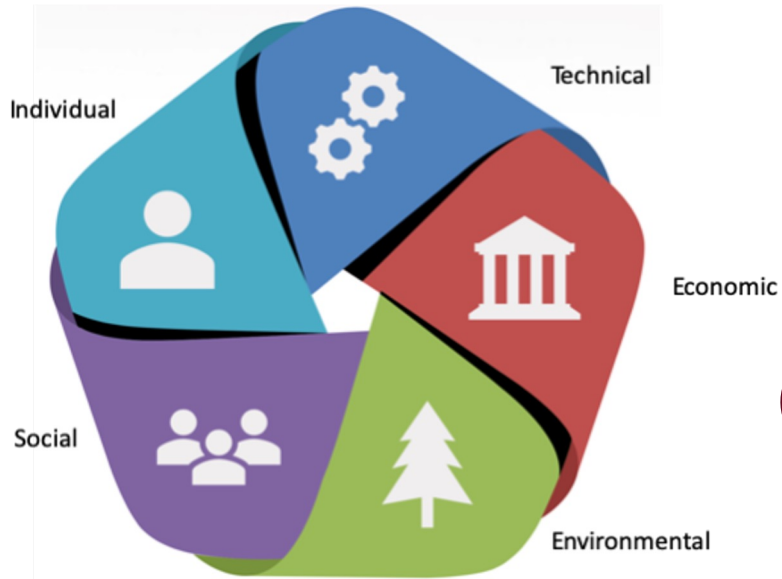
Whereas incremental approaches can end up reinforcing existing behaviours and lure us into a false sense of security. However, current society is so far from sustainability that deeper transformative changes are needed.

There is a tendency to treat sustainability as a desirable quality of the

Not today's talk.

<http://www.sustainabilitydesign.org>

Tool. How to find them (all)? SusAF.



Duboc, L., Penzenstadler, B., ... & Venters, C. C. (2020). Requirements engineering for sustainability: an awareness framework for designing software systems for a better tomorrow. *ReqEng*, 1-24.

But does it work? Yes. (2016-2021)

- Higher Ed
- Practice

- Online version in Miro <https://youtu.be/7snzpBEsYMI>
- Workbook 6.0 on Zenodo <https://zenodo.org/record/7342575>

Not today's talk.
(Check QR code.)



Leticia Duboc, Stefanie Betz, Christoph Becker, Steve Easterbrook, Sedef Akinli Kocak, Ruzanna Chitchyan, Ola Leifler, Jari Porras, Norbert Seyff, Colin C. Venters



Truth. Why isn't everyone doing this?



" Our whole economy is based on

Planned Obsolescence...

We make good products, we induce people to buy them, and then next year we deliberately introduce something that will make those products old fashioned, out of date, obsolete.



We do this for the soundest reason... to Make Money!"

— Brooks Stevens,
Industrial Designer. 1958



*Brought to you by the
Post-Landfill Action Network*



"NEVER DOUBT THAT A SMALL GROUP OF
THOUGHTFUL, COMMITTED
CITIZENS CAN CHANGE THE WORLD;

INDEED,
IT'S THE ONLY THING THAT EVER HAS."

— MARGARET MEAD

(cultural anthropologist and writer, 1901-78)

Penzenstadler, Birgit, et al. "Safety, security, now sustainability: The nonfunctional requirement for the 21st century." IEEE software 31.3 (2014): 40-47.

Transition.

Some of the “thoughtful committed citizens”:

- Sustainability in Software Architecture

- Systematic Review [Koziolek, 2011]
- Systematic mapping study [Andrikopoulos et al, 2022]
- Sustainability Assessment Framework [Lago et al, since 2018-ish]
→ Keynote ECSA 2022



- Sustainable software engineering

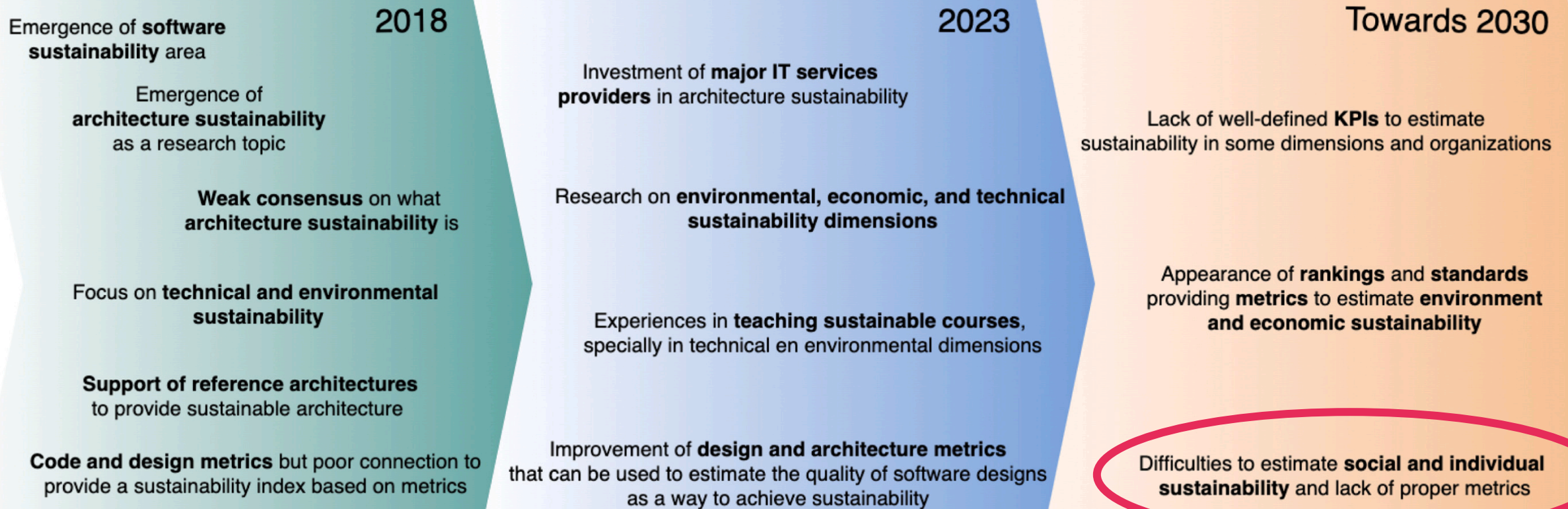
- Systematic Review SiSE [Penzenstadler et al 2012]
- Systematic mapping study SE4S [Penzenstadler et al 2014]
- “Reflections on advances in research and practice”
[Venters et al., 2023]



Truth. The status quo of „Sustainable Software Engineering“



Colin C. Venters



How are the software developers doing?



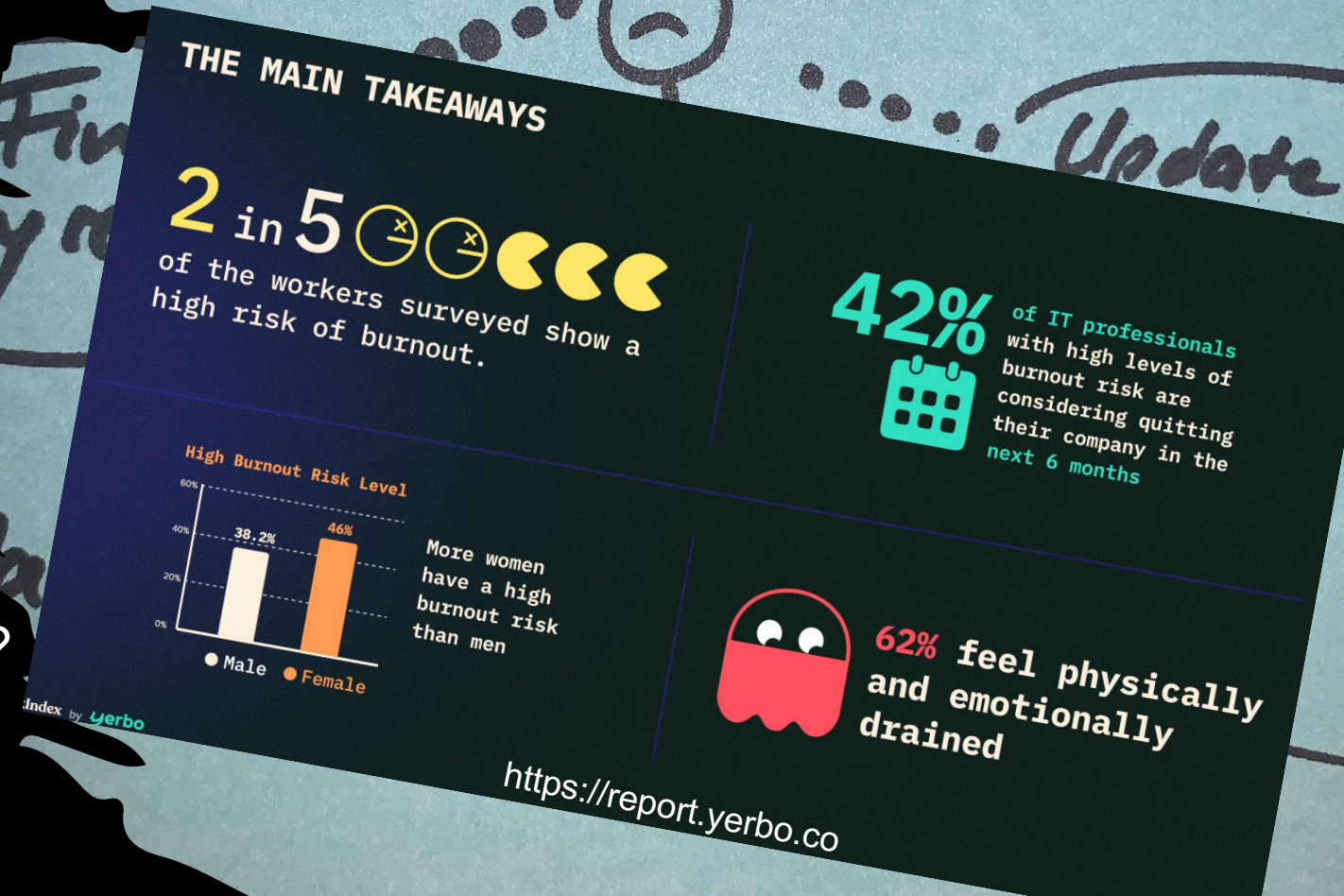
Complex & many tasks,
Challenging environments,
Demanding work places.

Plus everything going on in life & the world...

- Physical & mental health
- Work changes & online fatigue, burnout

→ Best decisions & designs under stress?

→ Wellbeing & resilience are precursors for developing software for sustainability



Tool. Neuroplasticity practice for indiv. sustainability

Over a couple months breathwork intervention, what are the participants' shifts in:

1. Mindful attention awareness
2. Personal well-being
 - a) Positive and neg. experiences
 - b) Psychol. well-being
 - c) Positive thinking
3. Perceived productivity
4. Self efficacy
5. Daily perceptions
6. Engagement

Not today's talk.
[Deep breath.]



Thank you!
Cristy Martinez Montes
Richard Torkar
Juliet Norton
Leticia Duboc
Francisco Gomes



Qualitative
analysis



Statistics
wizardry



Asking all the
right questions



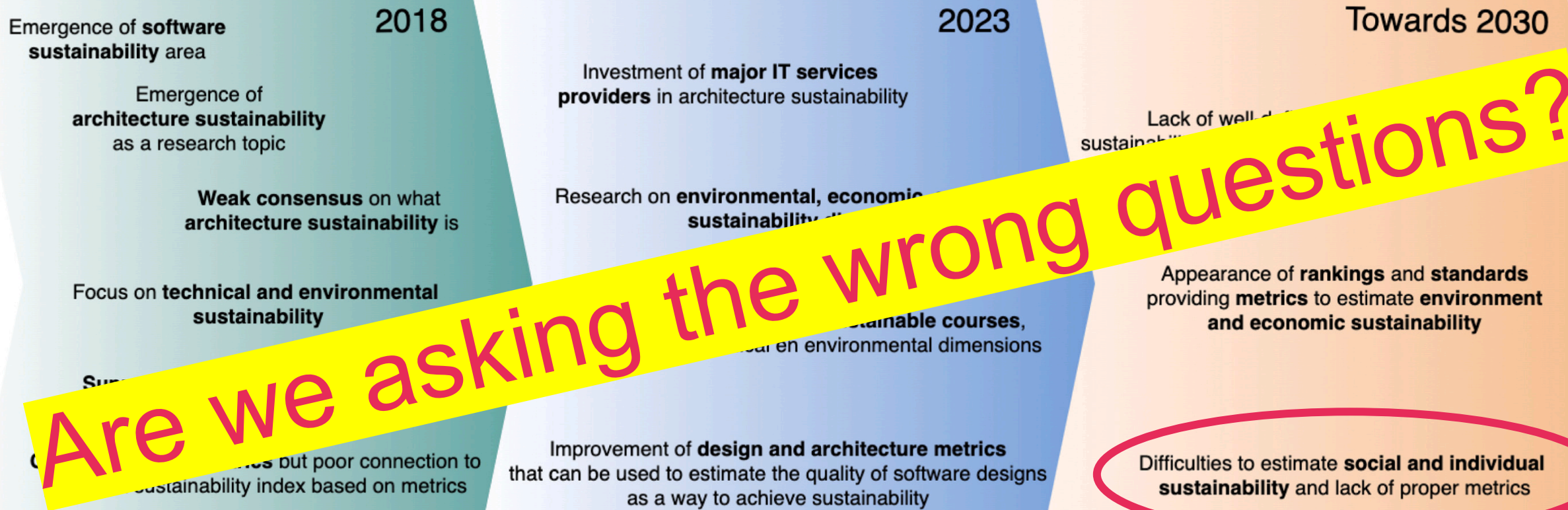
Consistent Support and
Showing up



Truth. The status quo of „Sustainable Software Engineering“



Colin C. Venters



Software Engineering Research

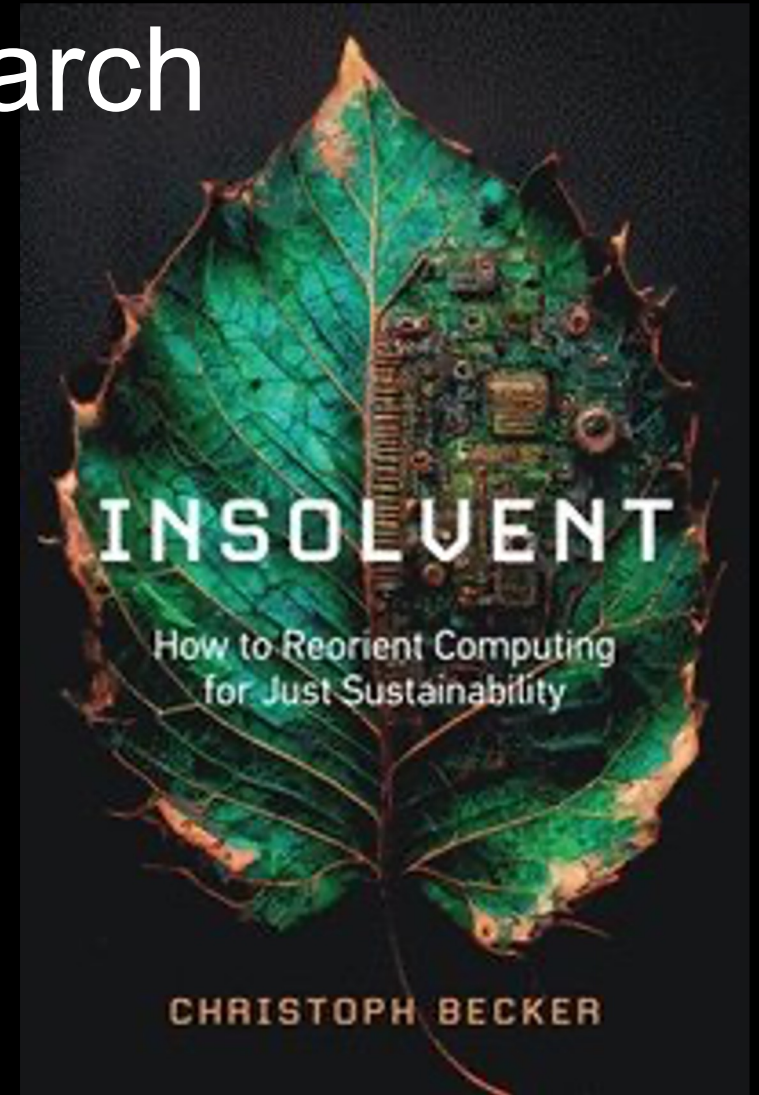
1. Identify problem/question.
2. Propose solution.

Is this the best way to help?

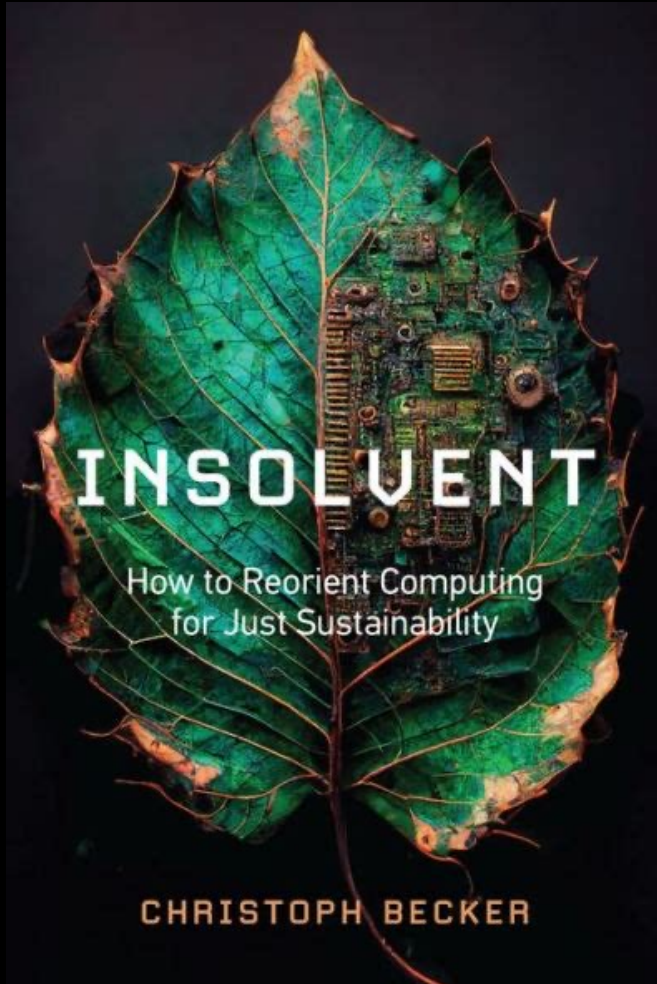
„Devil’s dictionary of computing“

Problem, n. Something that can be
fixed or solved.

Insolvent,
p.13, 198



Tale. Sustainability can be „solved“



Common sustainability pitfalls:
- characterizing it as "problem"
- little better: "wicked problem"

→ Still... "fixing" mode

Why is this harmful?



Christoph Becker

Tool. Engineering „Fixing“ Mode

COMPUTATIONAL THINKING

DECOMPOSITION

Breaking big problems into smaller, easier to manage problems



PATTERN RECOGNITION

Analyze & look for a repeating sequence



Remove parts of a problem that are unnecessary and make one solution work for multiple problems

ABSTRACTION

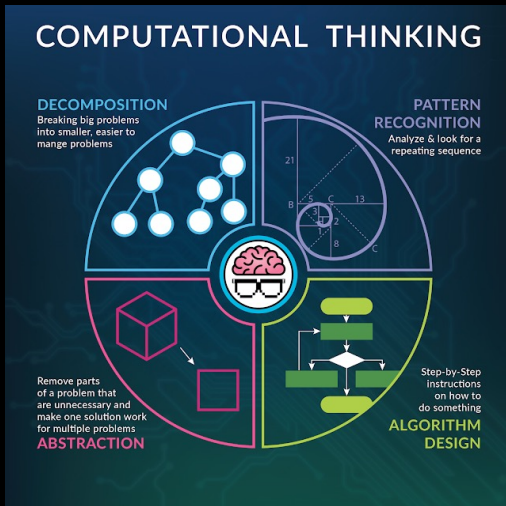


Step-by-Step instructions on how to do something

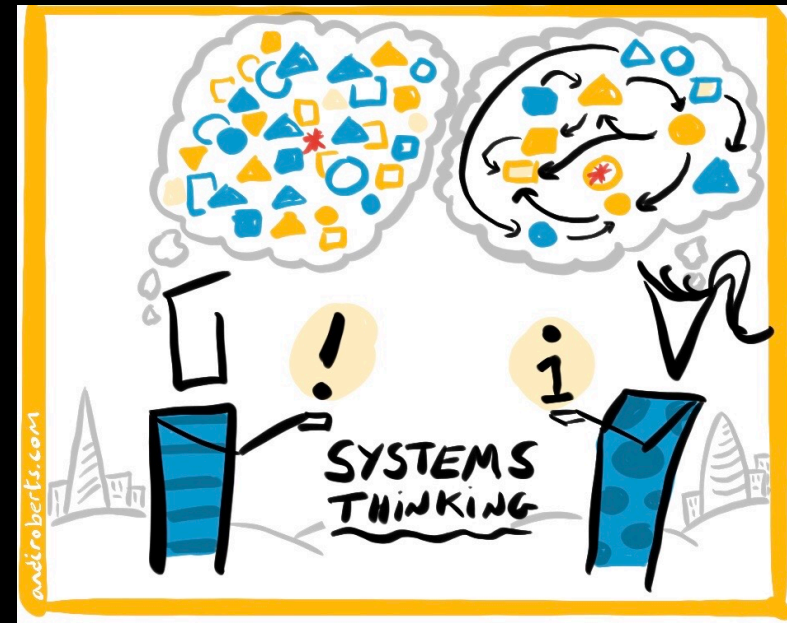
ALGORITHM DESIGN



Tale. We can fix everything with this 😊



With a good hammer in hand, everything starts looking like a nail.



“From Computational Thinking to Systems Thinking: A conceptual toolkit for sustainability computing”
Steve Easterbrook. <https://www.cs.toronto.edu/~sme/papers/2014/Easterbrook-ICT4S-2014.pdf>



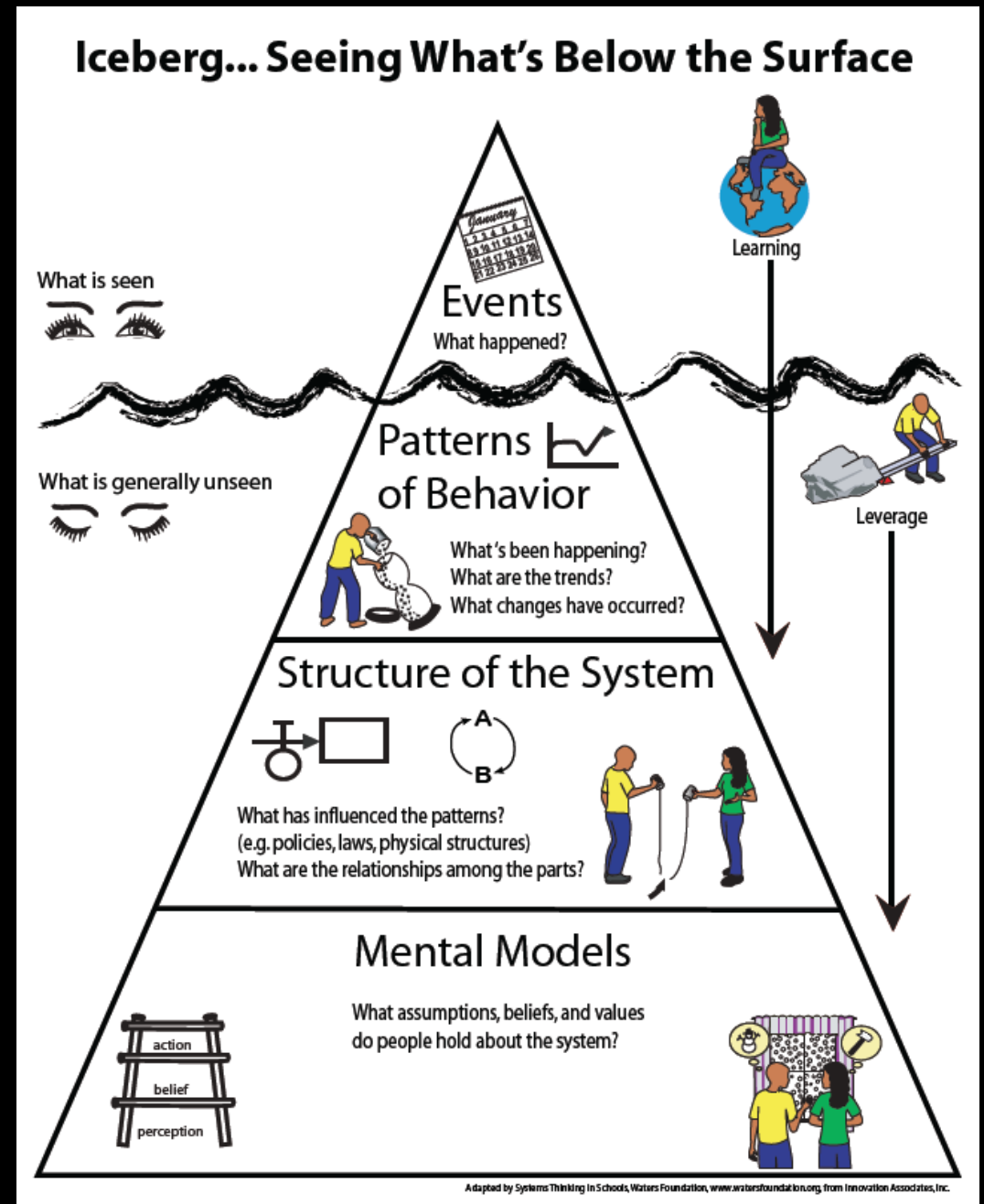
Transition. Systems Thinking.

Include in SE Education

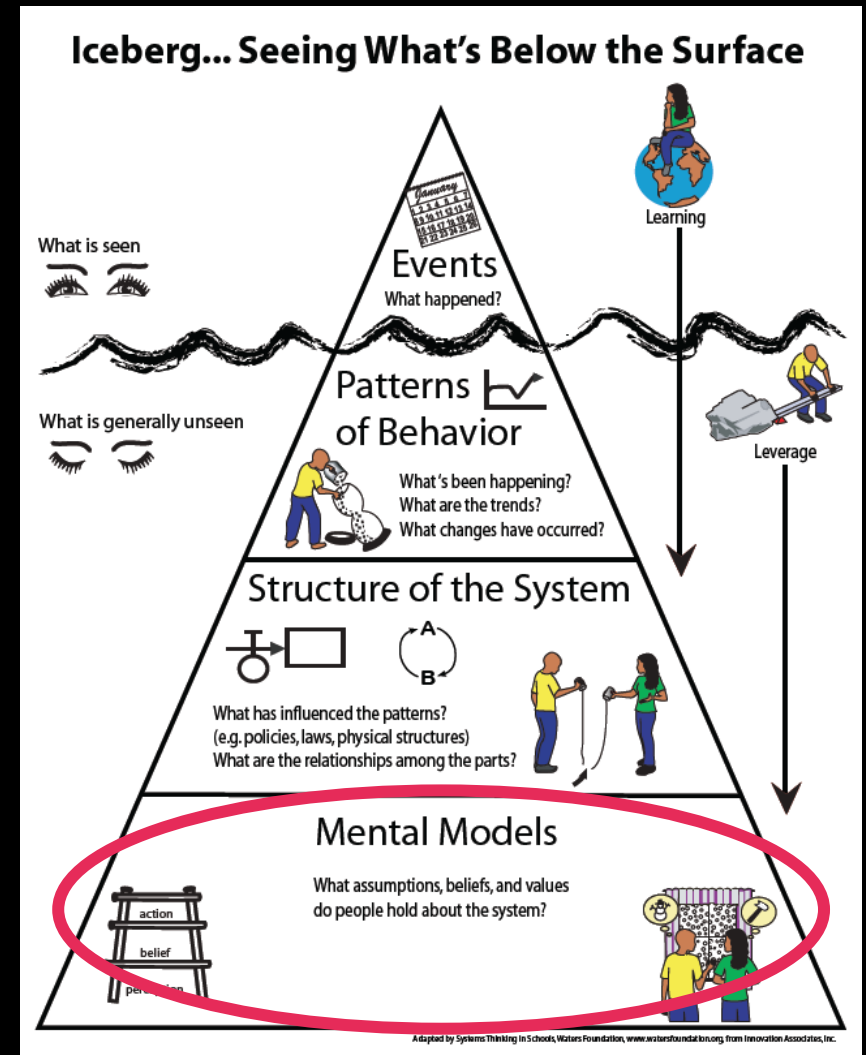
→ Complementary perspective

→ Give students tools to think wider

→ Enable practitioners to embrace

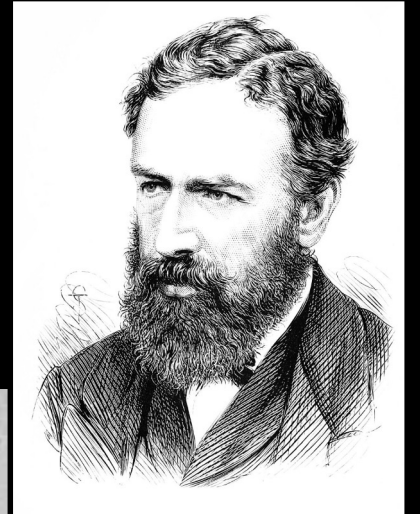
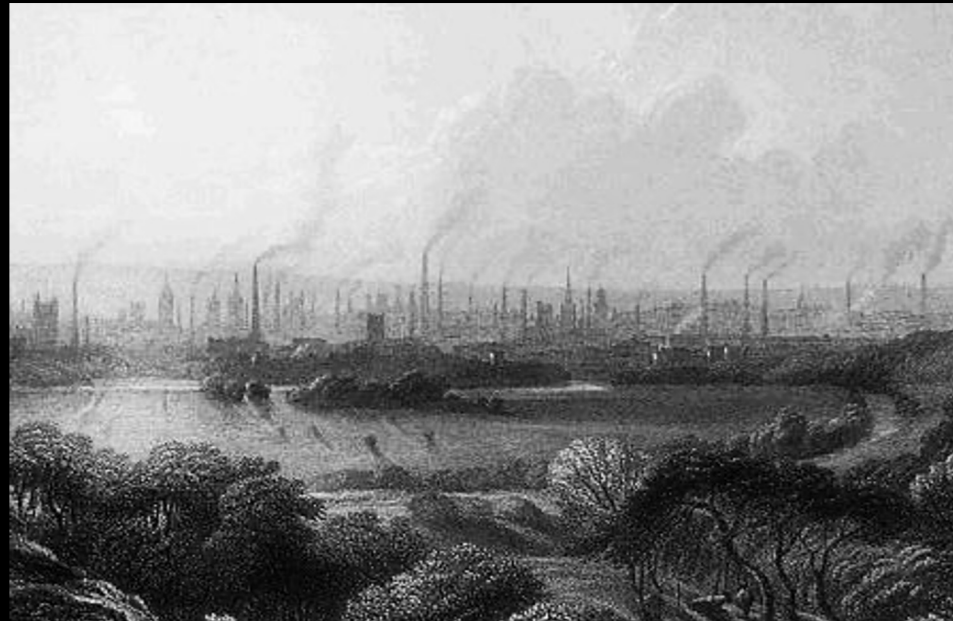


Ok, so if we include systems thinking into engineering from here onwards, we are done?



Tale. Efficiency is good, right? To save energy.

Improved technology allowed coal to fuel the Industrial Revolution, greatly increasing the consumption of coal.
- Jevons Paradox.

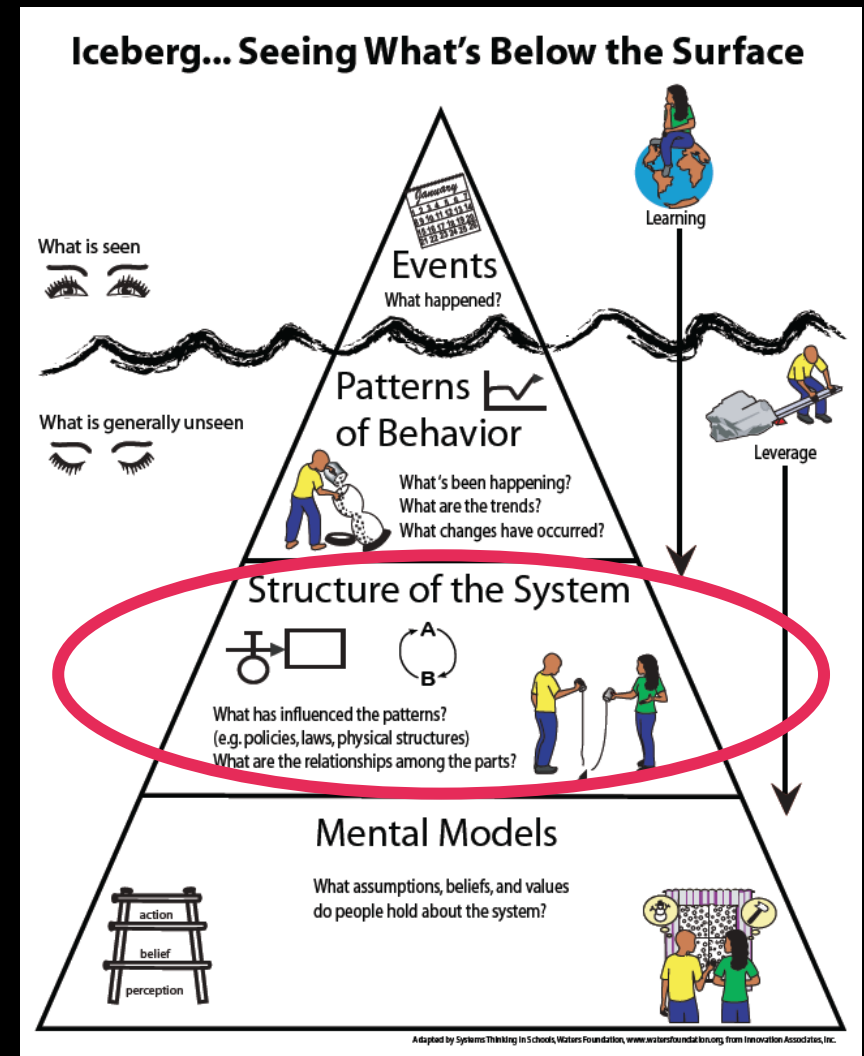


William Stanley Jevons,
after whom effect is named

Coal-burning
factories
in 19th-century
Manchester, England.

Ok, mental model overhaul, then we are done?

Once we “catch” all our beliefs in operation, then...



Tale. Technology has brought us so far!



Stefania Milan, Professor of Critical Data Studies at the University of Amsterdam

Yes, and ... also into other trouble:

1. Conjecturing the “standard human”
2. Flawed categorizations and biased datasets
3. Designing for the wealthy
4. Colonial thinking → use everything as resource

Colonial?

Truth. Neo-colonialism, what's that?

Neo-colonialism

Practice of using globalization, capitalism & cultural imperialism to influence a developing country in lieu of direct military control (imperialism) or indirect political control (hegemony)



Tool. Positionality statement.

A central concept in **feminist theory** that describes

- how a **person's perspective** is situated within society and
- how that affects their **worldviews**, perspectives and **social position**,
- to provide more clarity on the **perspective** from which **knowledge is being produced**.

"Feminist" means to advocate women's rights on the basis of equality of the sexes.

"For feminist decolonial scholars, our positionality is the embodied pivot from which our knowledge-making materialises."

Yvonne Te Ruki-Rangi-o-Tangaroa Underhill-Sem,
Cook Island and Niuean New Zealand scholar (2020)



Tool. Positionality statement.



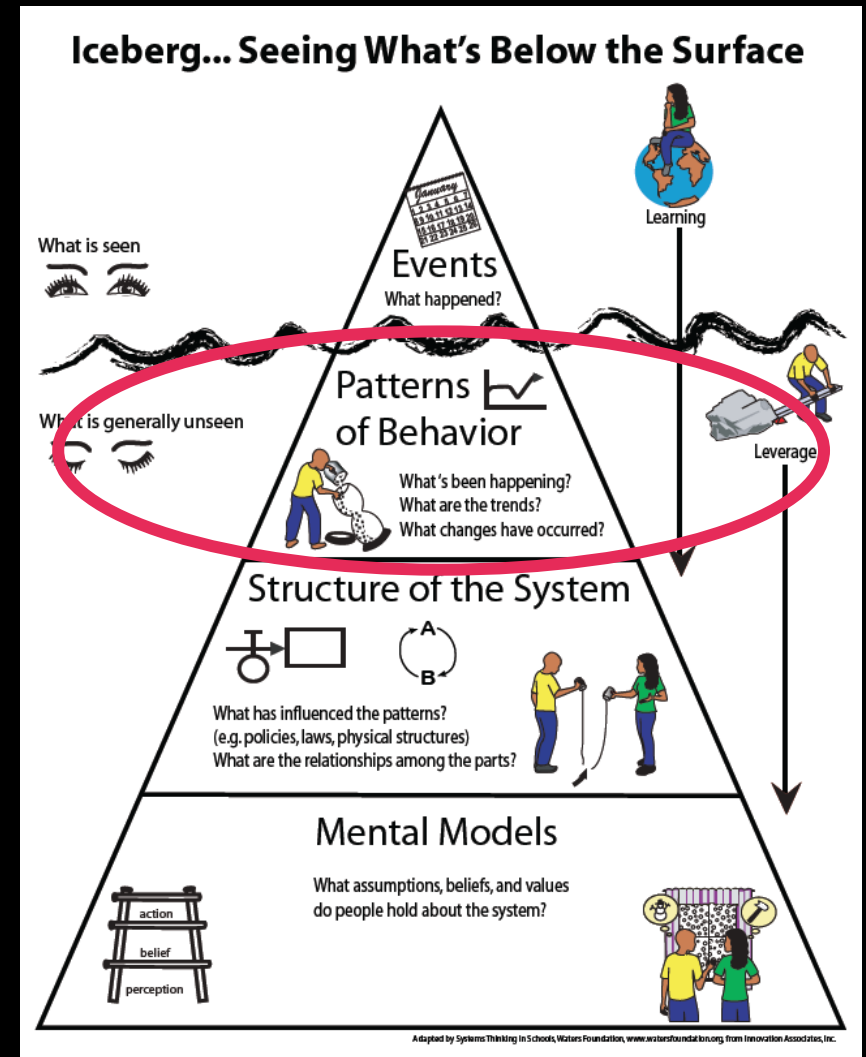
Me: Born 1981, white woman of European descent.
German upbringing and ancestry.
Privileged in education, associate professor.
Software engineering, sustainability, wellbeing.
Lived on four continents, visited many countries.
Yoga teacher and embodied mindfulness coach.

Reviewer 2: This has no place in a research article.
Research is objective and measurable.

Me: Well... other disciplines (e.g. HCI) consider it important.
Let's make it a standard in SE as well.

Ok, structure led us back to more mental models...

What happens on the third layer?



Truth. Techno-solutionism debunked.



Techno-solutionism: Naïve belief that any problem can be solved by applying a *magic technology box* and that the application of technology will change society for the better.



Computational thinking: quantify, track, gamify.

Trouble: Ethics, civic behaviour.

Truth. That's only sceptics, right? Nope.



Katharine Jarmul, Principal Data Scientist at Thoughtworks Germany

“I am interested in ethical and secure machine learning in real-world production systems. I am passionate about automating data workflows and distributed data setups and have many opinions about data security and privacy.”



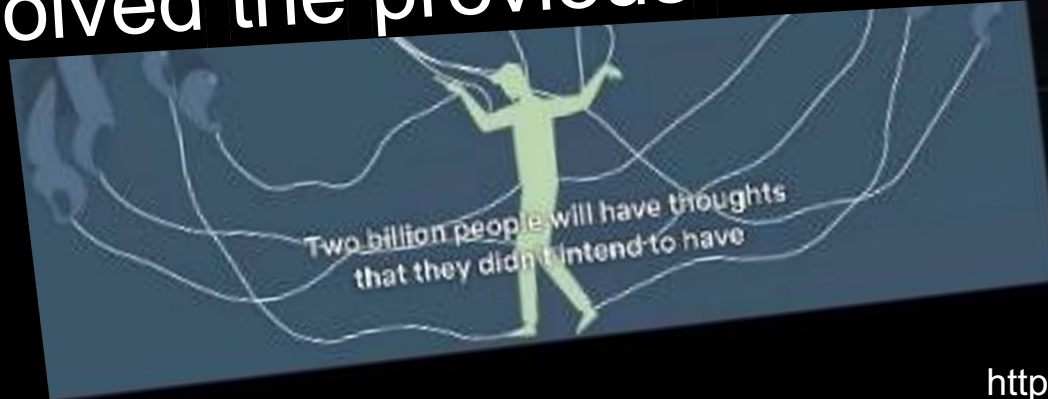
Techno-solutionism treats technological advancement as inherently good. AI & Machine learning simply put a layer of abstraction on it. Same story.

Truth. AI dilemma. What's that?

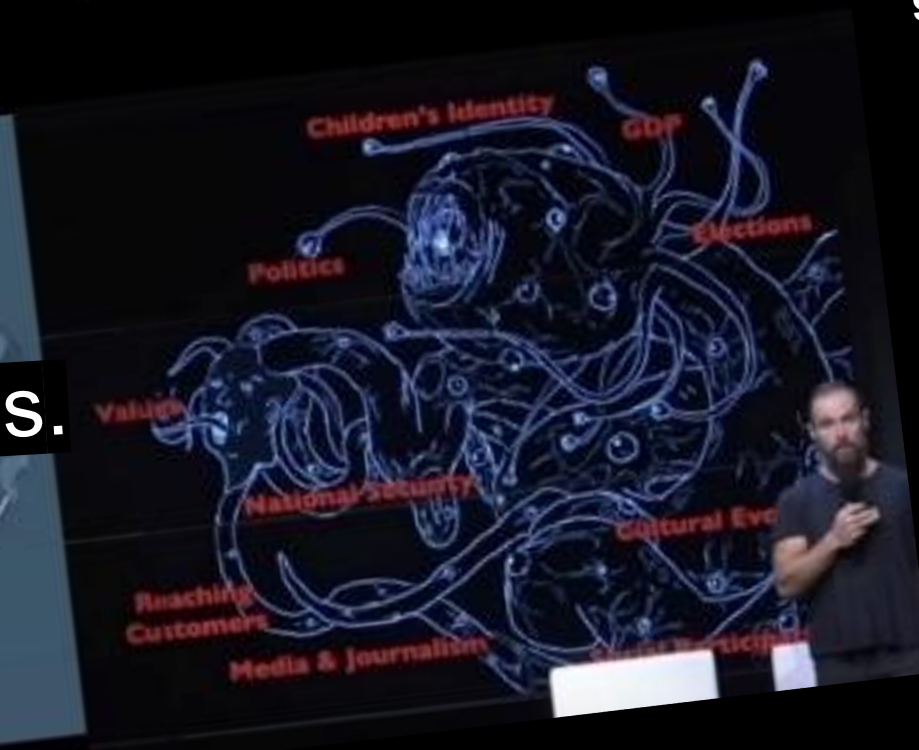
Tristan Harris
Aza Raskin
9th March 2023

Social Dilemma

New technology raises
new class of responsibility.
We haven't even remotely
solved the previous troubles.




A.I. Dilemma



<https://m.youtube.com/watch?v=xoVJKj8lcNQ>

Are we completely doomed? No. Never.

Transition: Let's get imaginative again.



“WHAT IF we wasted a lot less energy and generated most of what we do use from renewable sources?

WHAT IF we made refugees feel welcome and supported in their newly adopted homelands?

WHAT IF we measured the economy with metrics other than how much bigger it is from one year to the next?

WHAT IF we could think about car-free cities, no prisons, a more equal distribution of wealth?

WHAT IF we revived our collective imagination, and asked **WHAT IF** in great abundance starting now?"

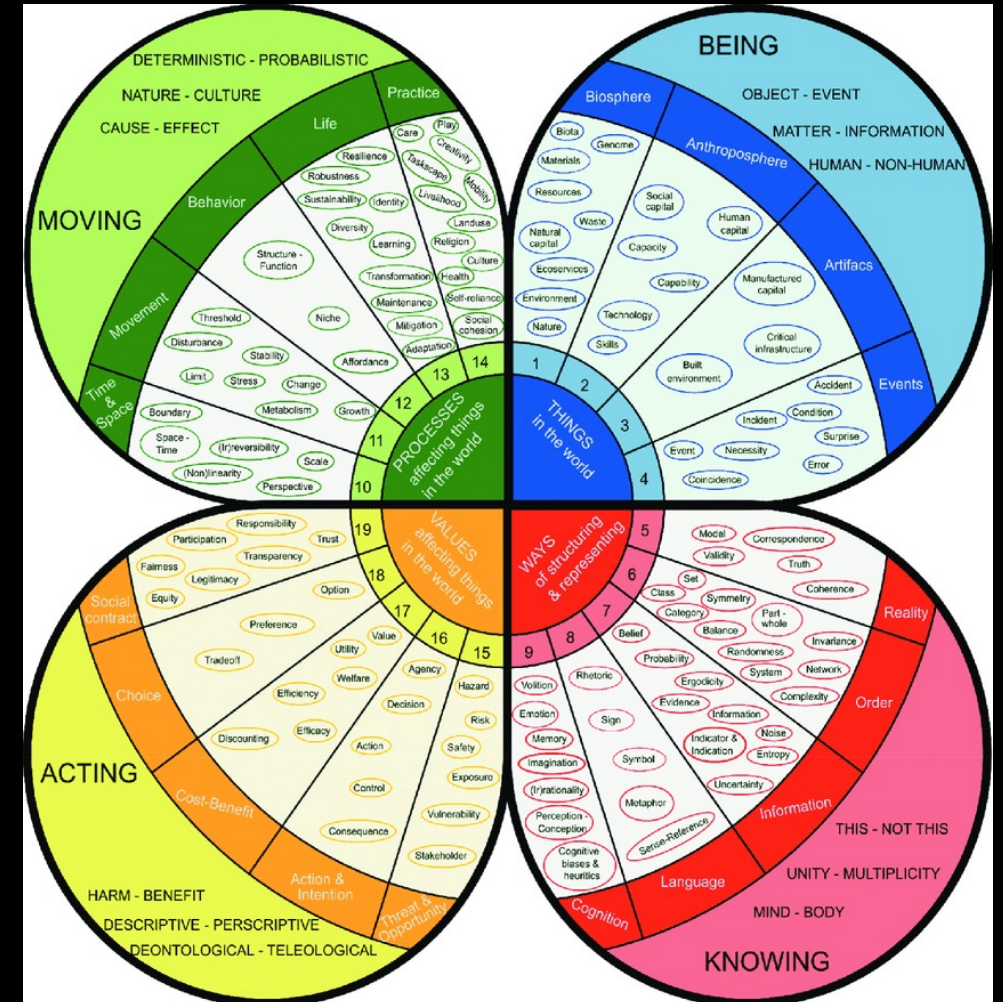
—**ROB HOPKINS**

Transition. Sustainability as pathway.

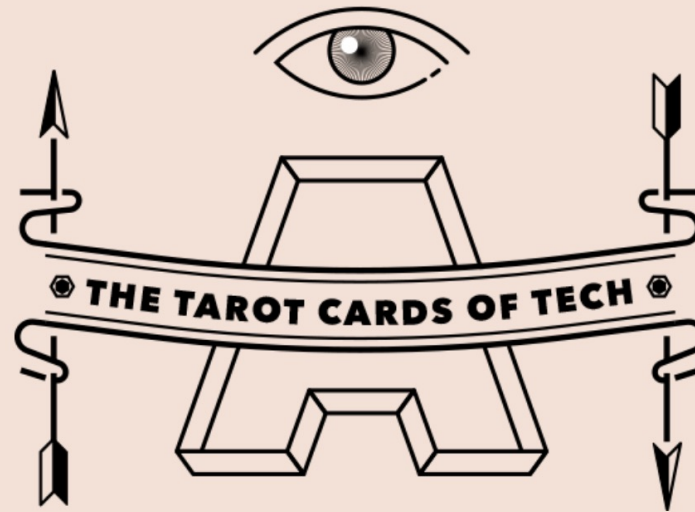
Samuel Mann:
Visualizing Sustainability

790 different models to
visualize sustainability

→ pick your favorite



Tool. Tarot Cards of Technology



From feeds full of fake news to smartphone addiction, we are all waking up to the unintended consequences of technology. We think it's time to ditch the Silicon Valley mantra, "Move fast and break things" for a new approach: Slow down and ask the right questions.



The Tarot Cards of Tech are a set of provocations designed to help creators more fully consider the impact of technology. They'll not only help you foresee unintended consequences—they can also reveal opportunities for creating positive change. To begin, simply click below—and see how the cards fall for you.

Tool. Tarot Cards of Technology



Tool. PGT – Post-growth toolkit



Summary: Truth, Tale, Transition



Truth: Neo-colonialism & AI dilemma

Tale: The false promise of techno-solutionism

Transition: From what is to what if

Neo-colonialism
Practice of using globalization, capitalism & cultural imperialism to influence a developing country (imperialism) or indirect political control (hegemony)

TRACK
Staff+ Engineer Path

SESSION
Unraveling Techno-Solutionism: How I fell out of love with "Ethical" Machine Learning

Katharine Jarmul
Principal Data Scientist @Thoughtworks



NOV 30 - DE 1

60% of the entire web content is in English. **10%** only of the world's population speaks English.

Digital Colonization with the Internet

- 1 The language of the Internet is majorly English while only a handful of the population speak and understand it.
- 2 The Internet seems to be available for everyone, but is controlled by a few major corporations, overshadowing other businesses.
- 3 A deficiency in resource optimization for the Internet leads to the domination of the technologically developed countries over the under-developed ones.

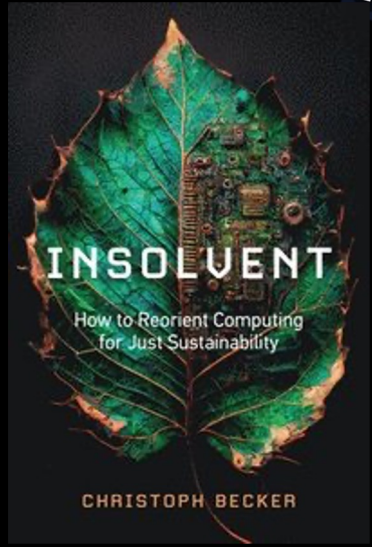
The Trump administration analyzed nearly **50 MILLION** Facebook users to underpin the results into the 2016 election campaign.

Statistics say **\$4.84** is the net worth of every Facebook user in advertisements per year.

Resisting Digital Colonization

Checks on the extraction of the online data with reinvented knowledge among the people and professionals using the Internet, will help nip this governance in the bud.

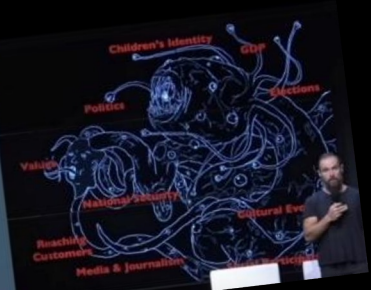
Governments and major technical corporations, on an international scale, must work together to come up with collective ways to curb the existing form of colonization present across the world.



INSOLVENT
How to Reorient Computing for Just Sustainability

CHRISTOPH BECKER

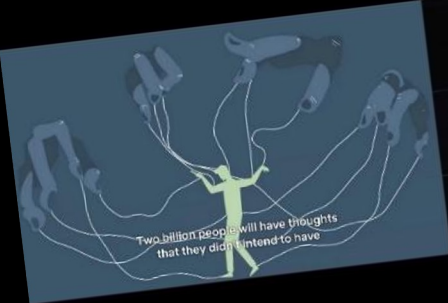
A.I. Dilemma




Children's Identity
Politics
Education
Valuable
National Identity
Reaching Customers
Media & Journalism
Cultural Eye

Two billion people will have thoughts that they didn't intend to have

Social Dilemma



Two billion people will have thoughts that they didn't intend to have



FROM WHAT IS TO WHAT IF
UNLEASHING THE POWER OF IMAGINATION TO CREATE THE FUTURE WE WANT

WHAT IF we wasted a lot less energy and generated most of what we do use from renewable sources?
WHAT IF we made refugees feel welcome and supported in their newly adopted homelands?
WHAT IF we measured the economy with metrics other than how much bigger it is from one year to the next?
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WHAT IF we revived our collective imagination, and asked **WHAT IF** in great abundance starting now?"

—ROB HOPKINS

Resources & Future



Summary: Truth, Tale, Transition

Truth: Neo-colonialism & AI dilemma
Tale: The false promise of techno-solutionism
Transition: From what is to what if

- Christoph Becker „Insolvent“, MIT Press 2023
- TEDx talk: <https://youtu.be/04JkvbF4I9A>
- Sustainability awareness framework SusAF
 - REJ article: 10.1007/s00766-020-00336-y
 - Workbook: <https://zenodo.org/record/7342575>
- Wellbeing
 - EMSE Article: <http://arxiv.org/abs/2109.07285>
 - Tiktok: <https://vm.tiktok.com/ZMRsb9826/>
 - Website: <https://www.twinkleflip.com/rise-2-flow/>
- **Current Questions**
 - How to correlate sustainability, resilience, and wellbeing?
 - Who's responsible for organizational/cultural change?



Lorenz Hilty, Samuel Mann, Cristy Martinez Montes, Richard Torkar, Juliet Norton, Francisco Gomes, Leticia Duboc, Stefanie Betz, Christoph Becker, Steve Easterbrook, Sedef Akinli Kocak, Ruzanna Chitchyan, Ola Leifler, Jari Porras, Norbert Seyff, Colin C. Venters

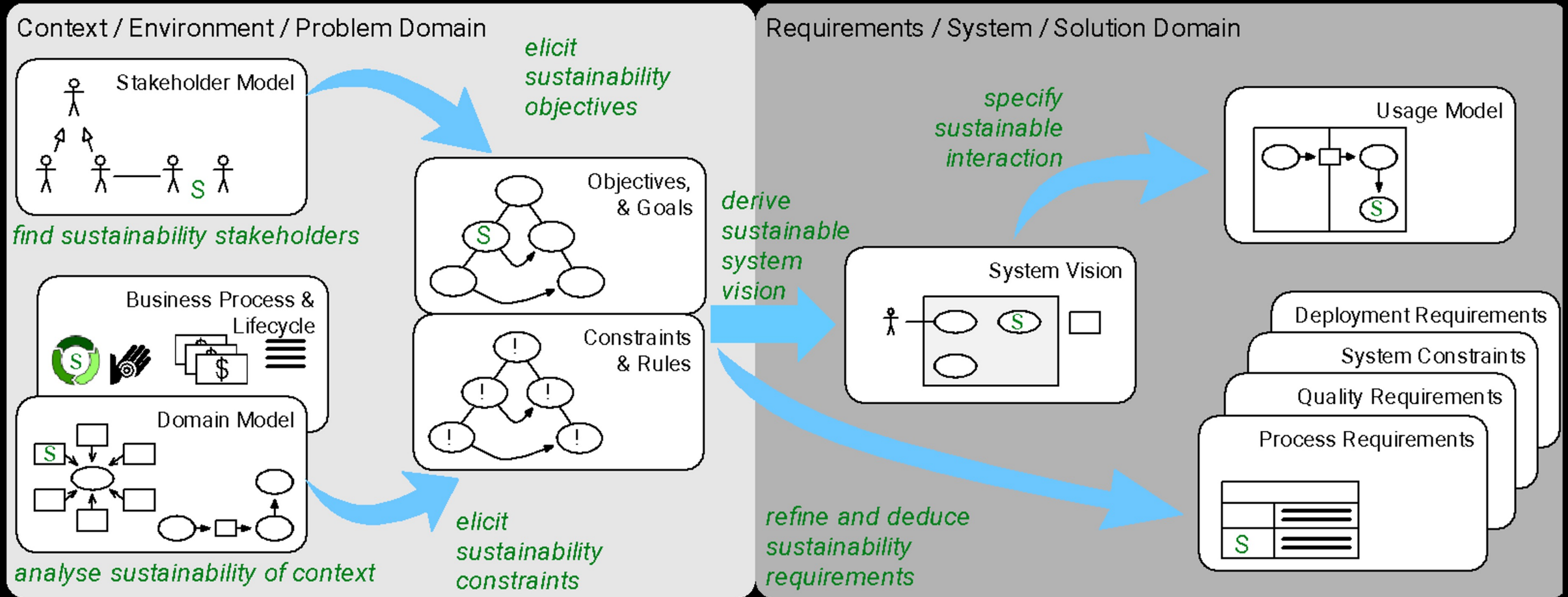
Birgit Penzenstadler
Chalmers Univ. of Tech.
Lappeenranta Univ. of Tech.
birgitp@chalmers.se

@twinkleflip

Wait a moment... how to do that in RE?

- How do you integrate sustainability into RE?
- What are the artifacts we develop for that?
- We don't want to have yet more documentation...

Artifact-based RE4Sustainability



From there...

- Derive the specific requirements as you usually document
- With sustainability goals integrated