

# Value-based Engineering with IEEE 7000™

Dr. Sarah Spiekermann,

IEEE 7000™ Launch, Vienna, Nov 16<sup>th</sup>, 2021

When the IEEE “P7000” Project started in 2016 the world was full of doomsday-calls for AI ethics.



# Many value-principle listings have been put forth since 2016...a path 7000 did not take.



Over 80 value lists accumulated...

- EU Commission's ALTAI list
- OECD list
- Microsoft, IBM and other corporates
- IEEE 7010 list catalogue
- ...

# The IEEE 7000™ pioneers thought differently!



Chair, Ali Hessami, Ph.D  
London, UK



Annette Reilly Ph.D.  
Washington DC, USA



Gisele Waters Ph.D.  
Austin, Texas, USA



Ruth Lewis  
Melbourne, Australia



Rob Schaaf  
New York, USA



Vice Chair,  
Prof. Sarah Spiekermann  
Vienna, Austria



Lewis Gray, Ph.D  
Washington DC, USA



Lee Barford, Ph.D  
Silicon Valley, USA



Zviko Murahwi  
Nairobi, Africa



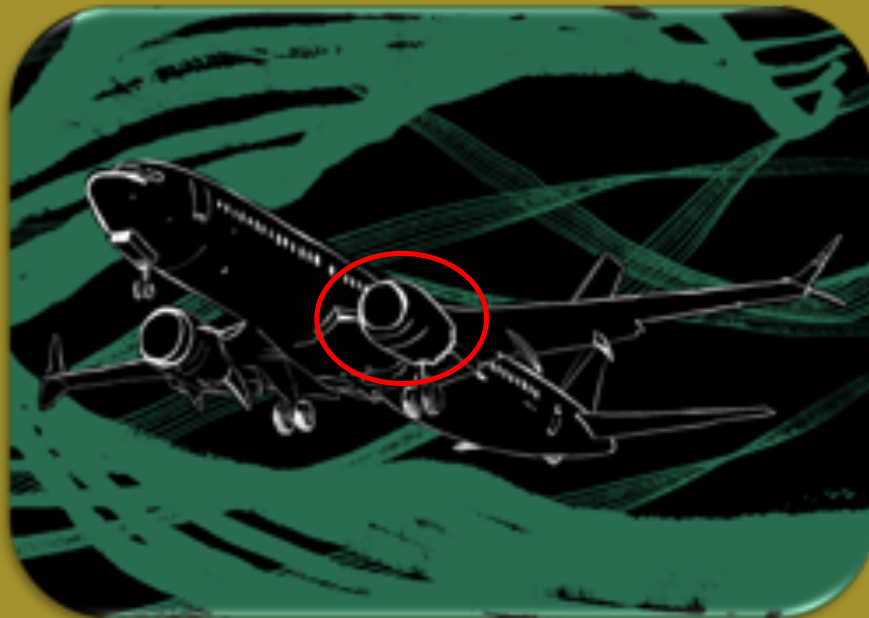
Jake Metcalf,  
Silicon Valley, USA





## Challenge 1 Software Quality

non-transparent predictive analytics  
leads to wrong decisions by machines,  
unfair treatment of human actors and  
nonsensical system behavior due to  
wrong categorizations



## Challenge 2 Hardware Quality

Products are built to just function instead of being really good and reliable  
Innovations mentality of "problem fixing".

### Challenge 3 Business Models

Monetary value is pursued without any regard for human dignity or human rights

- Participation in the data economy
- It is all about cost minimization instead of quality
- A derogatory image of humans as suboptimal beings that have to be 'developed' or 'manipulated' through technology shows a lucrative trend (e.g., humans are "predictably irrational" or characterized by "mental inertia")

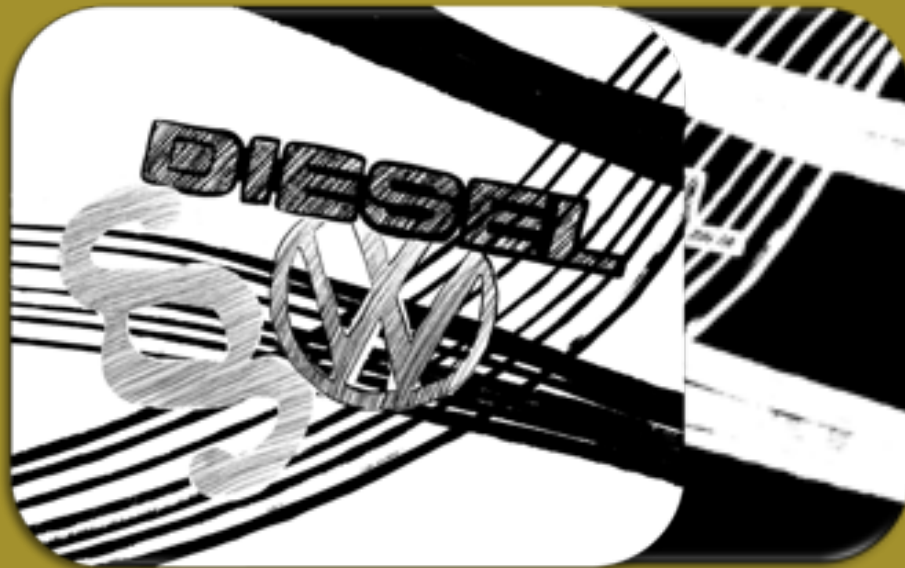




## Challenge 4 Complexity

Uncontrolled system-of-systems  
partners share opaque data and  
services





## Challenge 5 Corporate Culture

- Priority of profit instead of values
- Support of intransparency
- No time for diligence
- No room for conscientiousness



## Challenge 6 Sustainability

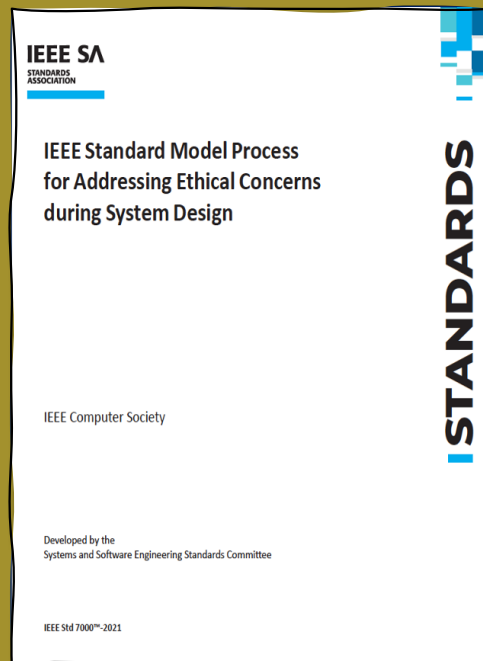
- Enormous energy costs are required to build and operate digital infrastructure, but this is ignored
- Resource availability of components is overestimated
- Potential global conflicts over dwindling resources are not seen



## Challenge 7 „Degrading Humanity“

Addiction and dependence on digital services leads to a change in social behavior, learning and thinking skills in children and adults.

# The 7000 standard embodies a path to better system design, anticipating impacts and addressing them IN the product or service.

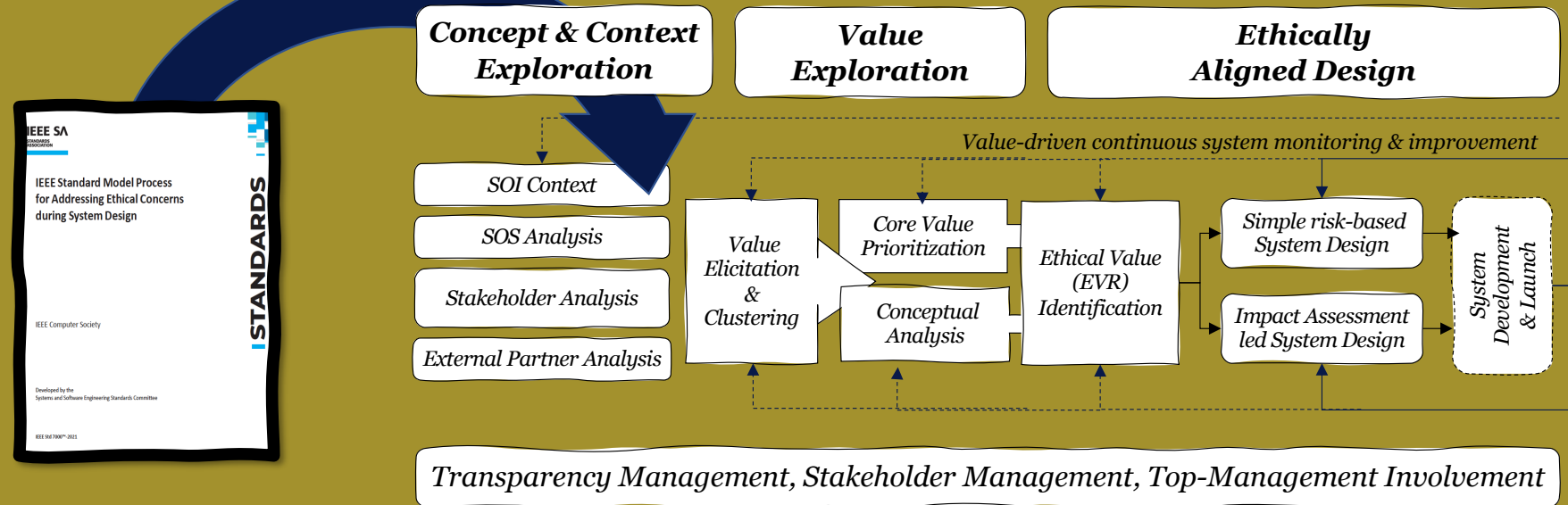


- IEEE 7000™ gives organization's IT departments clear guidance on how to build 'valuable' technology in awareness of ethical issues.
- IT's value issues are seen and addressed early on in the innovation process. Risk of building technology degrading humanity is greatly reduced.
- Value-based Engineering with IEEE 7000™ helps innovation teams to build social and human-friendly IT narratives departing from science fiction and transhumanism.
- IEEE 7000™ is challenging organizations to find AI-partners that give them access and sufficient control over their service.
- IEEE 7000™ can help companies to comply with the EU AI Regulation.
- IEEE 7000™ can help investors make better investment decisions.



# How does VBE relate to IEEE 7000™?

*VBE is a tested way to implement IEEE 7000™*



# VBE with IEEE 7000™ has 3 phases.

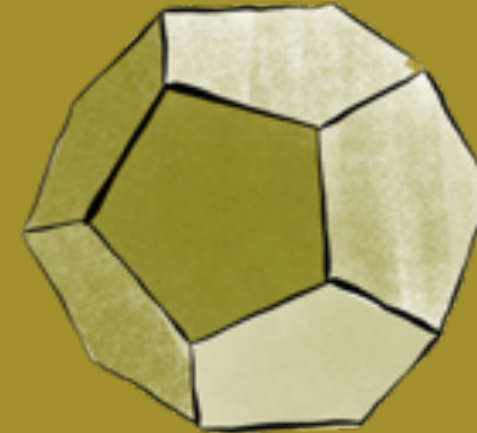
Preparing the  
Grounds



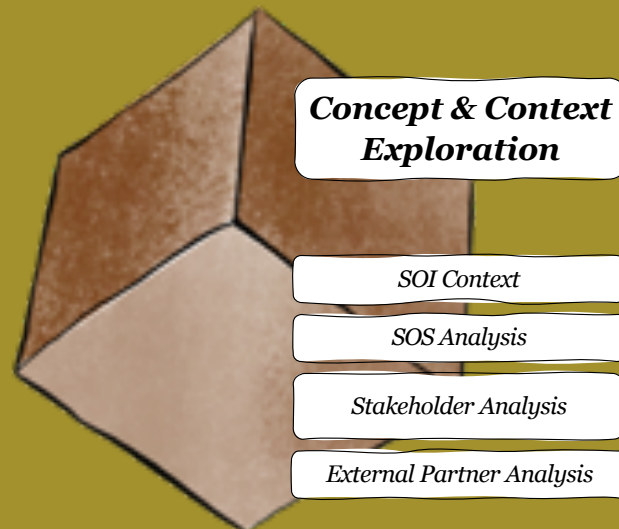
Eliciting relevant  
Values



Deriving value-based  
System Requirements



VBE's 1st phase tries to understand the reality out there.



- IEEE 7000™ starts with a SOI, not *needs*!
- The real-world deployment space is explored
- Contextual diagrams visualize data flows to analyze SOI boundaries and vulnerabilities
- The SOS partners need to be scrutinized; especially potential AI components
- Relevant direct and indirect stakeholders are identified in their various roles

SOI = System of Interest  
SOS = System of Systems

So far the epitome of modern thinking is to design the world as we deem fit.



Dr. Sarah Spiekermann



7-12 year olds...



Dr. Sarah Spiekermann

### Pipi Langstrumpf

*„I'm making the world,  
widdle widdle wid,  
how i like it...“*

*„Ich mach' mir die Welt  
Widdewidde wie sie mir gefällt  
...“*

12-18 years old ...



Dr. Sarah Spiekermann

With over 3 million patents a year awaiting commercialization, we continue designing.

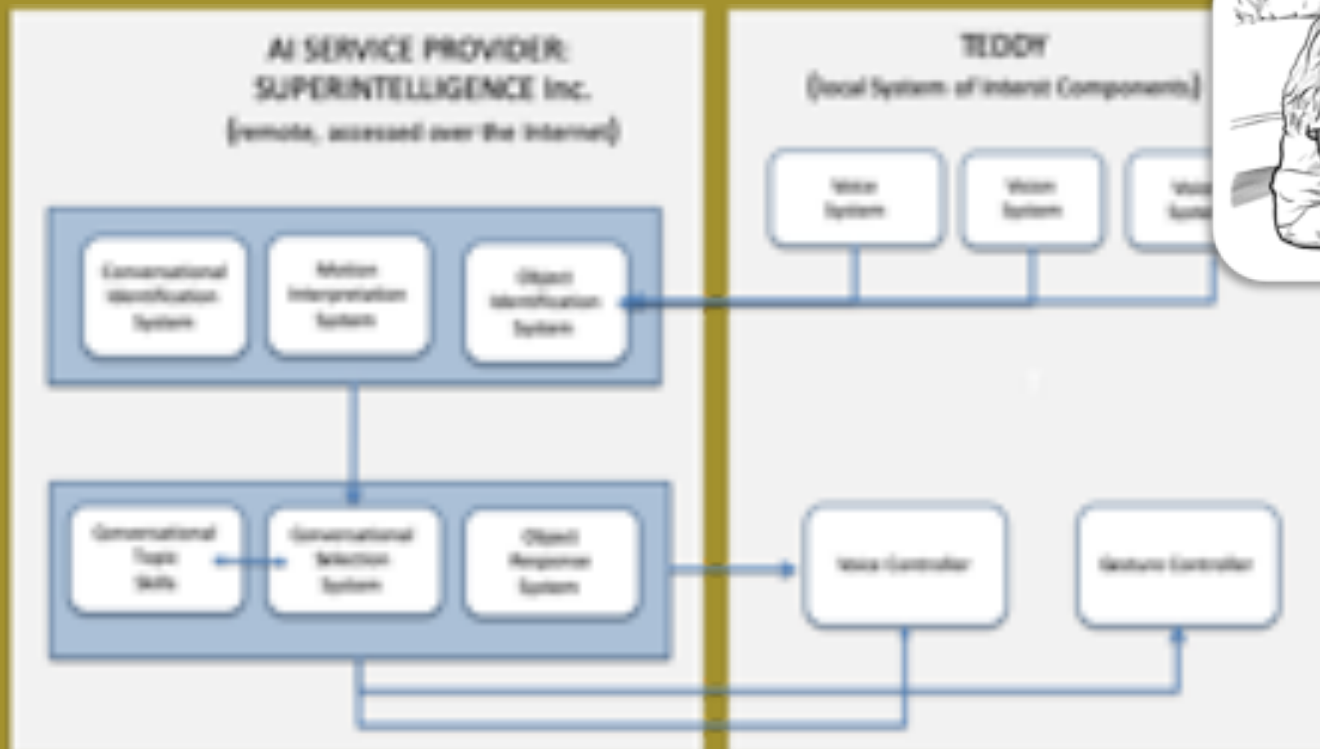


If Louis XIV had known VBE, his garden would have looked differently...





IEEE 7000™ also starts with a concept of operations...

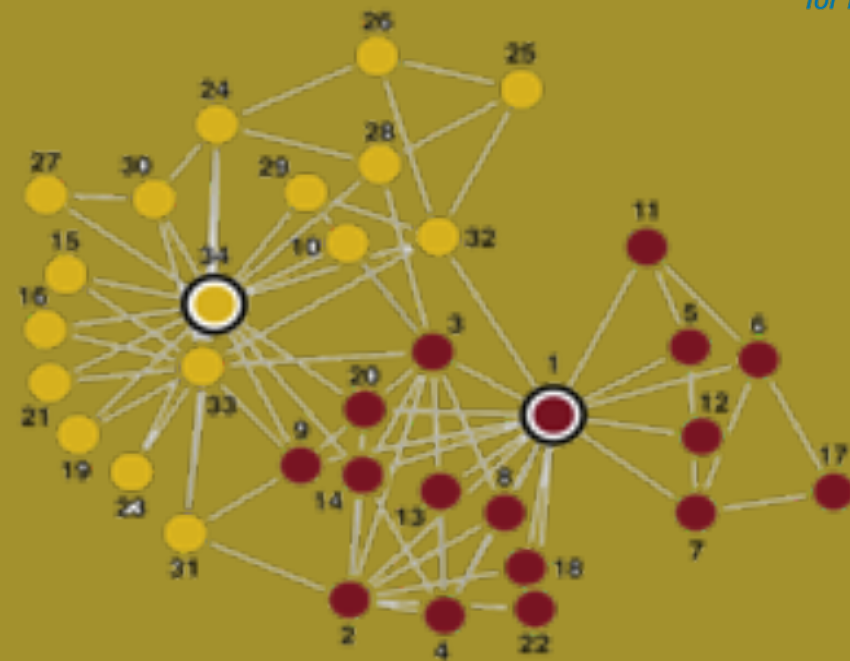


Today's architectures are extremely distributed and data is like water: If you don't control it, you lose it.



## Partner scrutiny ...

- The normative part of IEEE 7000™ requires organizations to only line up with partners who are willing to *give access* to their systems.
- Acknowledged or directed form of partnership are recommended (see ISO 15288).



# AI component selection

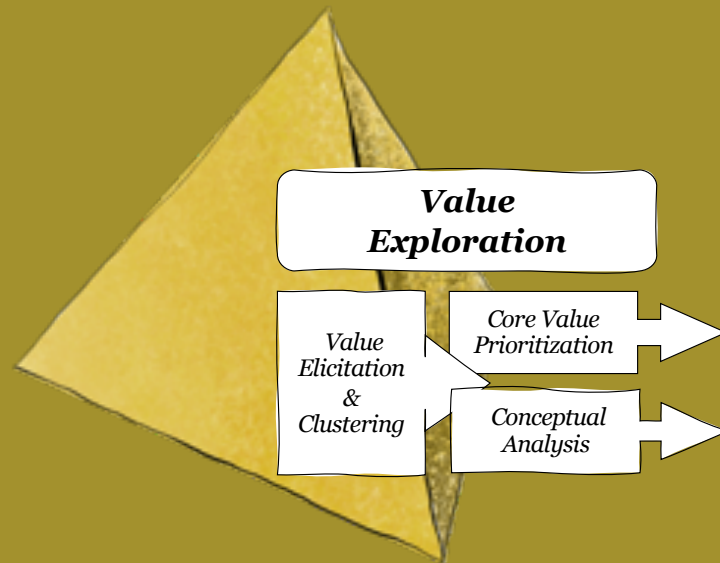


For an external AI service to be integrable into a “good” system, the IEEE 7000™ standard outlines that the necessary control over an AI system should only be presumed where there is

“control over the following:

- The quality of the data used in the AI system;
- The selection processes feeding the AI;
- The algorithm design;
- The evolution of the AI’s logic; and
- The best available techniques (BATs) for a sufficient level of transparency of how the AI is learning and reaching its conclusions.”

VBE's 2nd phase explores and analyzes the value space by going into „philosophical mode“.



- VBE & IEEE 7000™ wonder what value qualities a technology might contribute to a context & what value qualities might be destroyed
- VBE & IEEE 7000™ have a 'value ontology'
- The approach uses multiple moral philosophies to elicit relevant values & is sensitive to locality
- Values are not traded-off, but ranked
- Prioritized values are conceptually analyzed



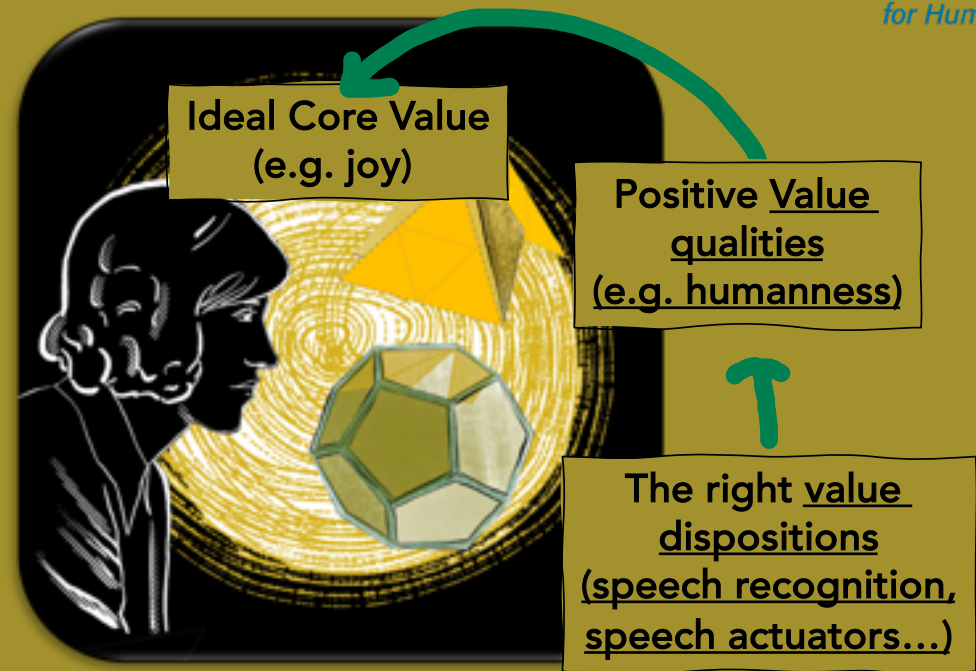
# How can we use technology for advancing, enriching, beautifying humanity?



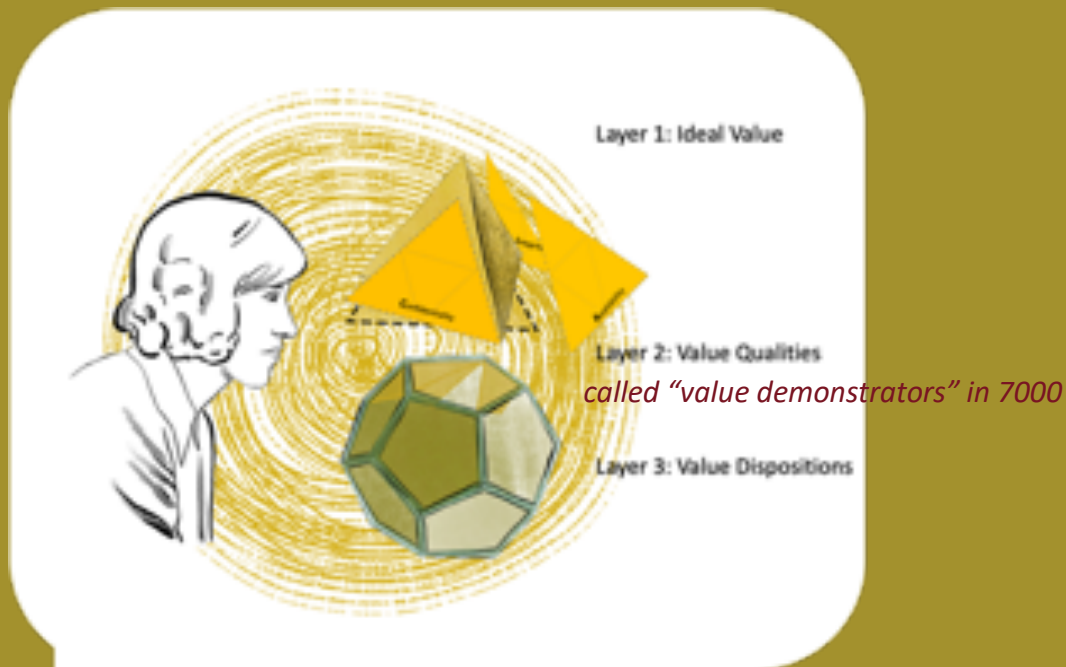
VBE: Values contributing to the ‘good’ are analyzed.



Objects' value dispositions enable positive value qualities, actualizing ideal core values in our relationship with things.



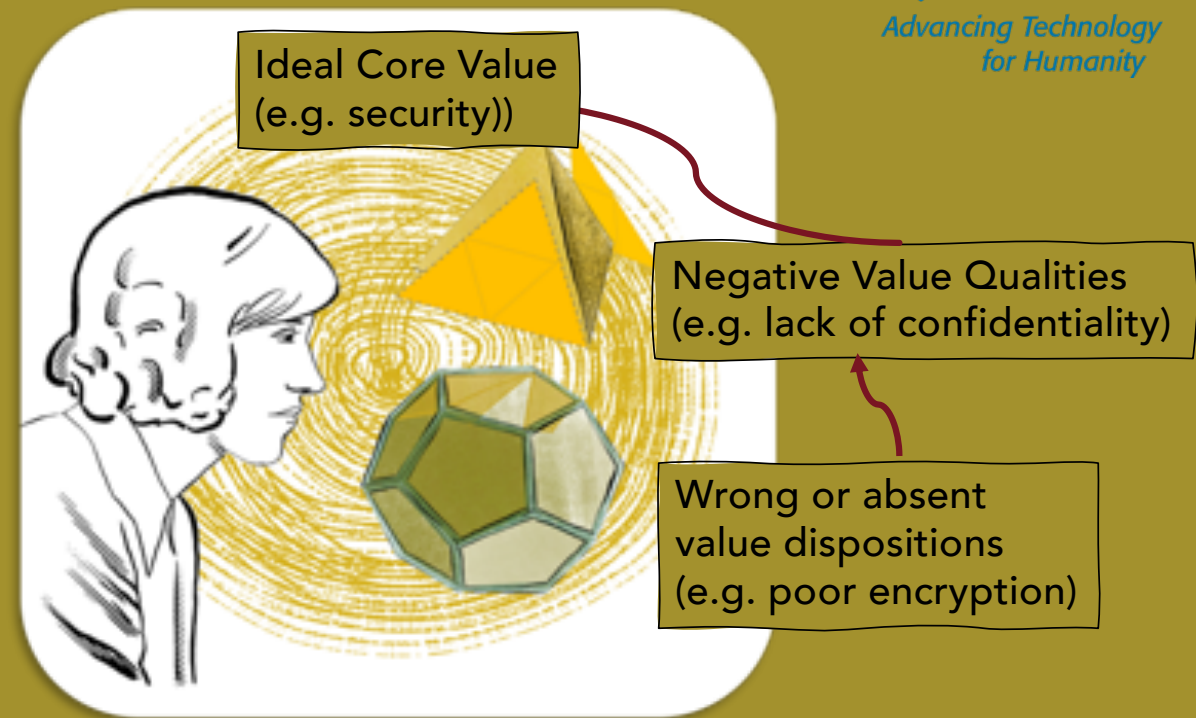
IEEE 7000™ has a built-in value ontology taken from Scheler's Material Value Ethics.



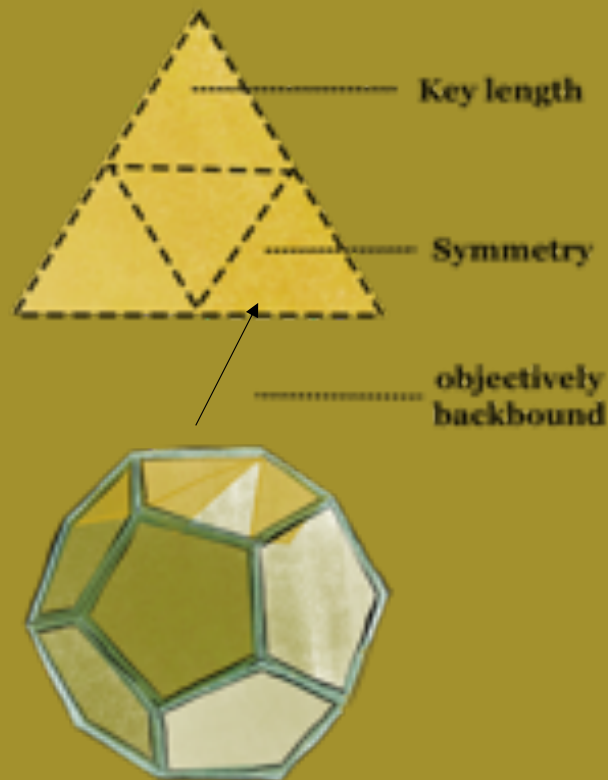
*Max Scheler (1921)*



# Negative value qualities can undermine core values.

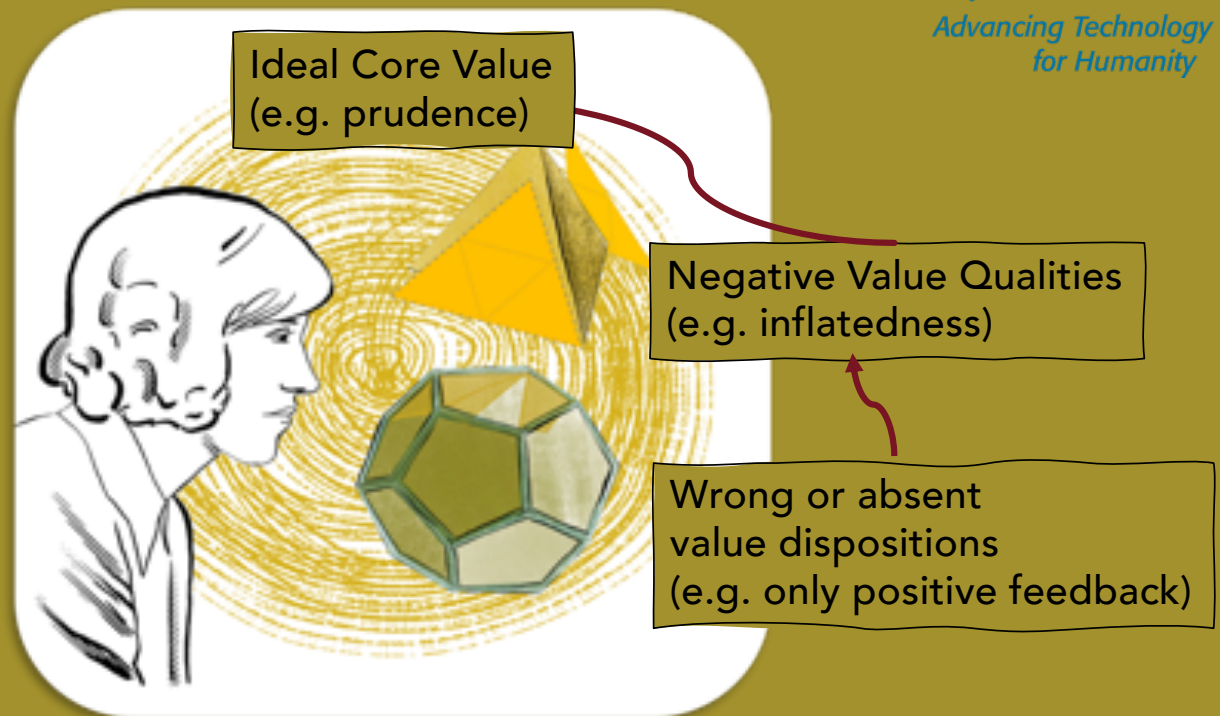


Engineers responsibility is to build appropriate value dispositions into systems.





A factor often underestimated is the negative value qualities fostered by systems in people.



At the moment our poorly build systems foster hate, envy and e-personalities.



This is why a central building block of value elicitation is the use of virtue ethics.



### Core virtue ethical question in VBE with IEEE 7000:

What are the negative implications of the system for the character and/or personality of direct and indirect stakeholders—that is, which virtue harms or vices could result if the system was implemented **at scale**?

In addition to virtue ethics, VBE with IEEE 7000™ uses Utilitarianism and Duty Ethics for guidance.



**Utilitarianism**

**Virtue Ethics**

**Duty Ethics**



Dr. Sarah Spiekermann

In addition to virtue ethics, VBE with IEEE 7000™ uses Utilitarianism and Duty Ethics for guidance.



**Utilitarianism**

**Virtue Ethics**

**Duty Ethics**



**Utilitarianism:**

What human, social, economic, or other values are affected, positively or negatively, by the SOI?

**Duty Ethics:**

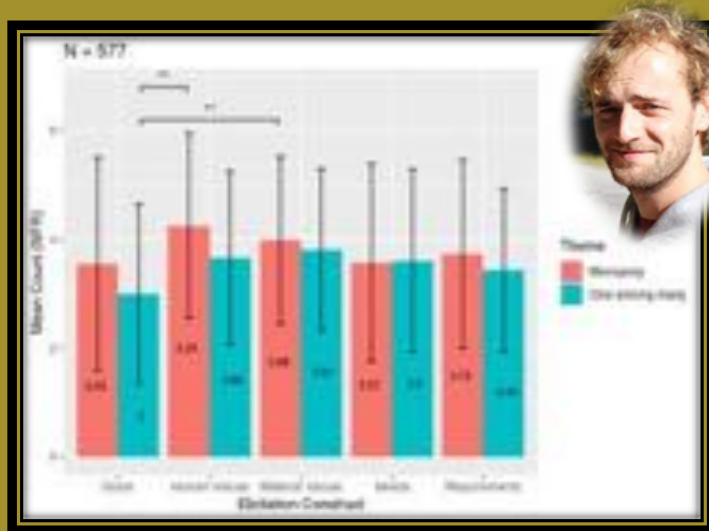
What personal maxims or value priorities does the project team see affected by the service that the project team members believe are so important that they want to preserve them in society?



Dr. Sarah Spiekermann

Our research shows that SOIs expected to become monopolies can sensitize for additional non-functional requirements.

Does the choice of construct and market power influence the number of non-functional requirements seen?

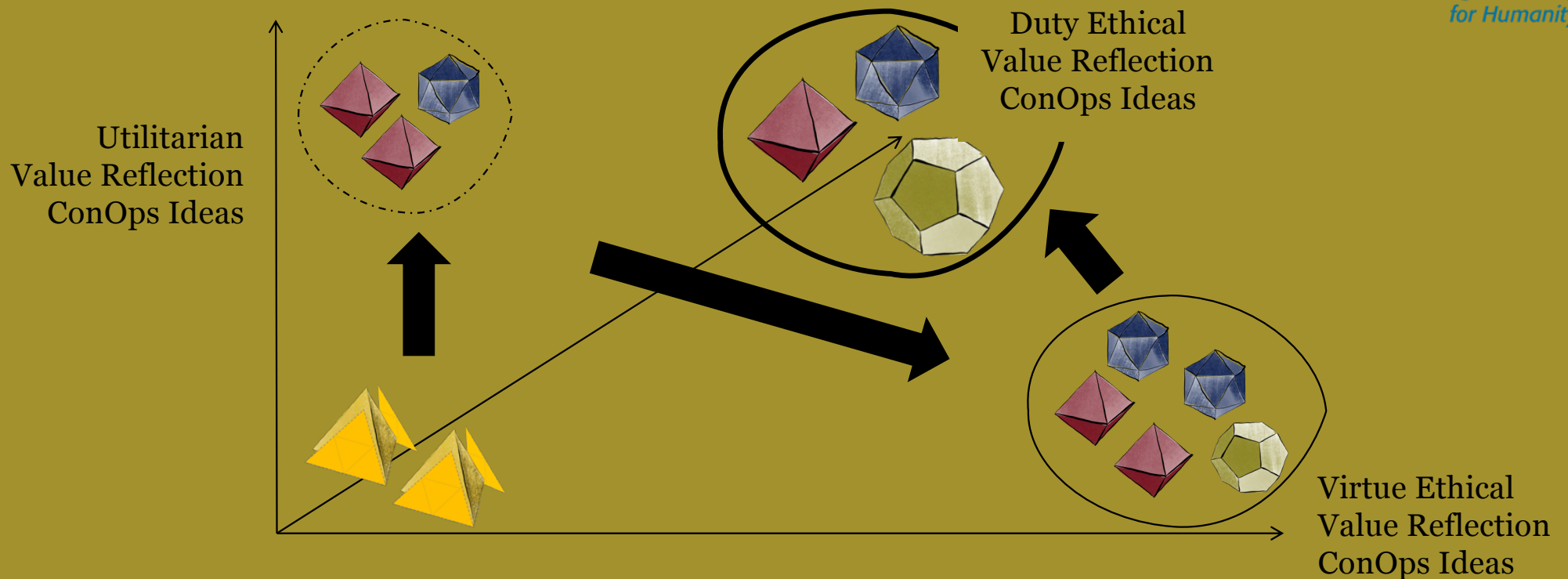


Source: Till Winkler, Ph.D Thesis

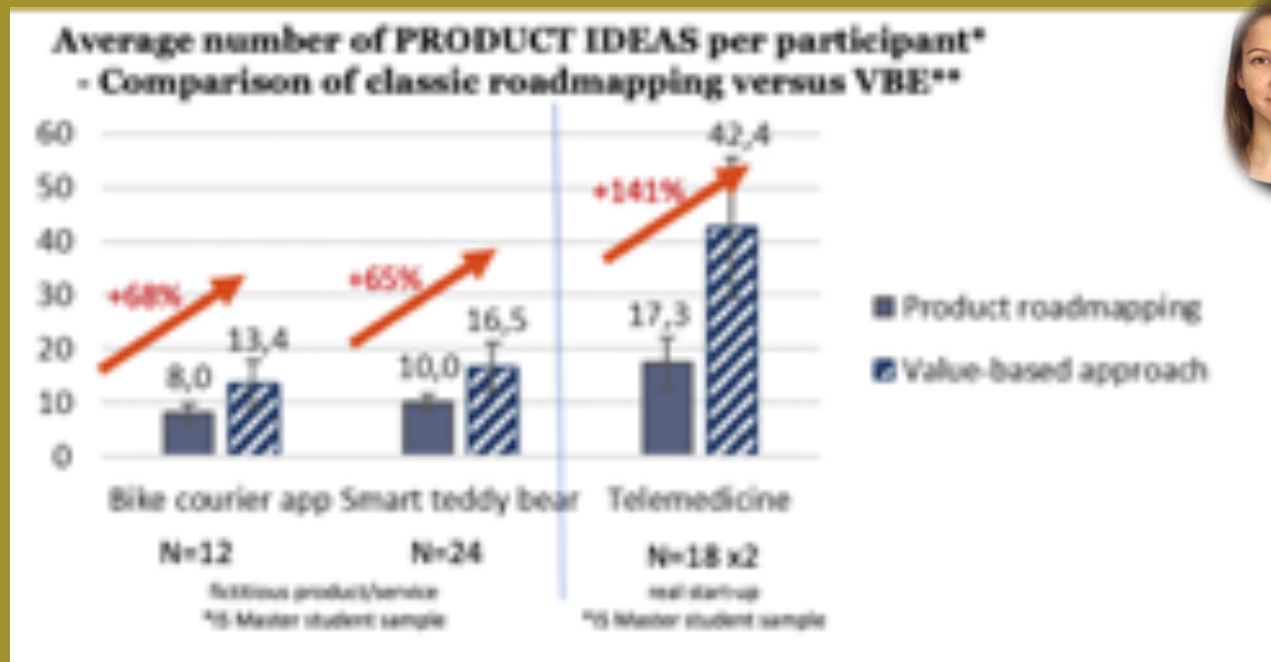
- It makes a difference whether one asks for "needs", "values" or "goals" for requirements engineering
- asking for values will lead to more nuanced non-functional requirements elicitation.
- There is a (non-significant) trend that a "monopoly assumption" (system scale assumption) leads to a slightly more fruitful elicitation of non-functional requirements



The ConOps gain continuous shape as ethical reflections are made.



Using VBE/IEEE 7000™ participants\* generate significantly more product ideas in response to moral challenges than in preparing a classical product roadmap.



\*\*© Bednar, K., & Spiekermann, S. (2021). On the power of ethics: How value-based thinking fosters creative and sustainable IT innovation; Working Paper: <https://epub.wu.ac.at/7841/>

5 generations of WU students were involved in various case studies.



WU Master Class in Innovation Mgt.



UNICEF Yoma Stakeholders



Our case studies show that depending on the number of participants\* involved hundreds of value qualities can play a role for a system, which are cleaned and clustered.

## Number of value ideas mentioned

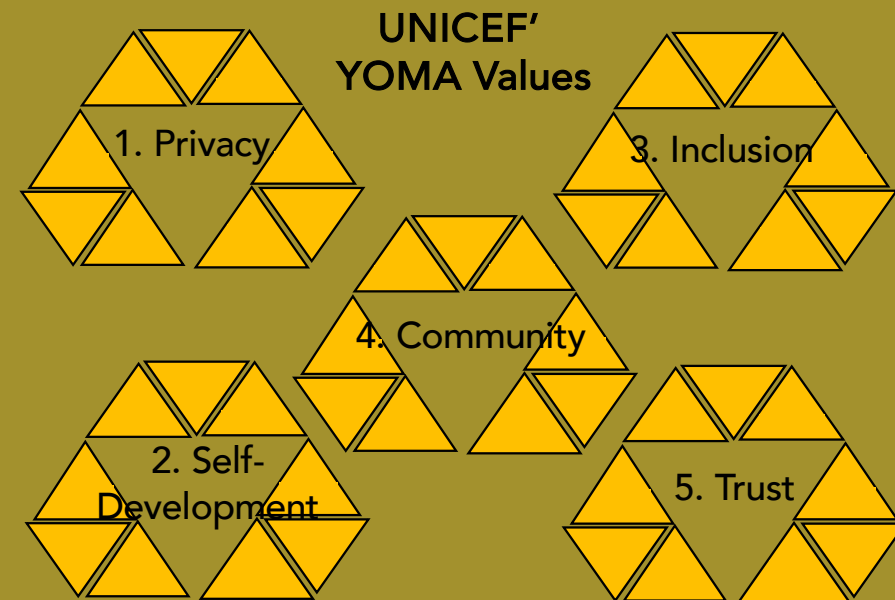
1. Digital Toy\* : 534
2. Foodora Delivery\*: 263
3. Telemedicine (TM) Case\*\*: 467



## 4. UNICEF Case : 56 Value/Qualities

*\*40 + students treated the case in a lab context; TM being a real company*

## Value Cluster Development

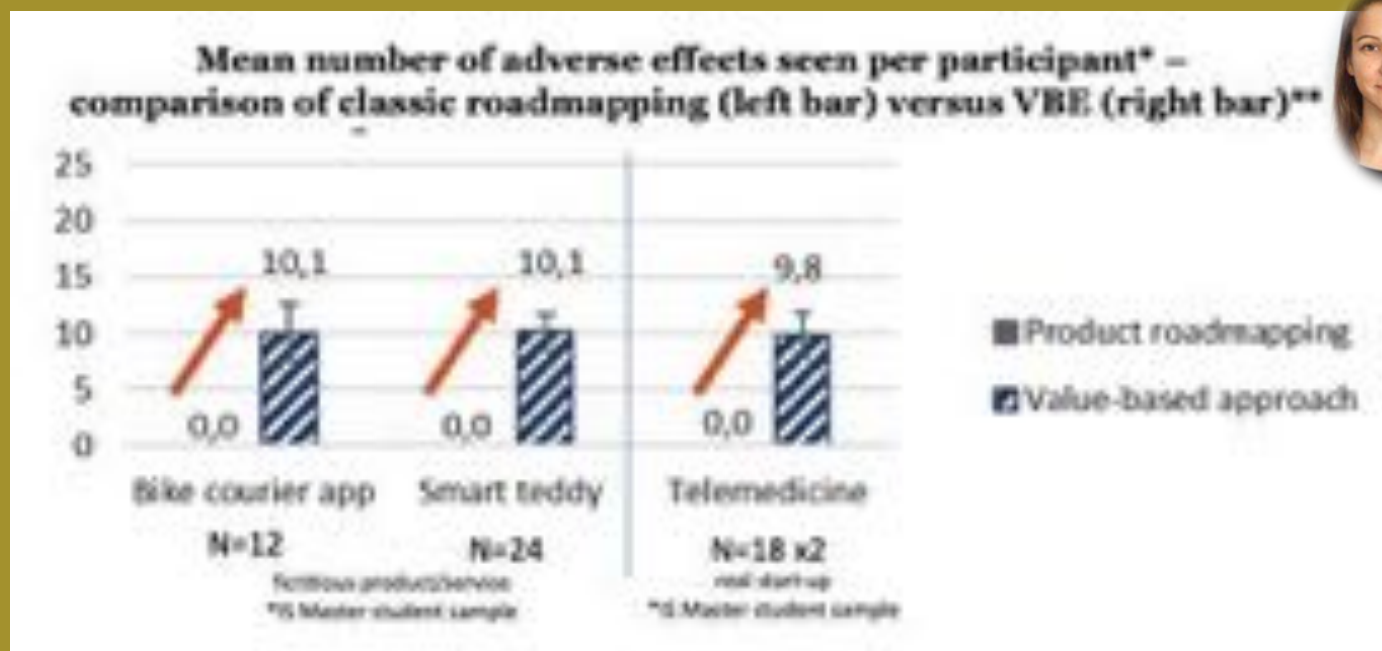


Using VBE/IEEE 7000 participants\* saw significantly more value potentials involved in a new product than in preparing a classical product roadmap.



\*\*© Bednar, K., & Spiekermann, S. (2021). On the power of ethics: How value-based thinking fosters creative and sustainable IT innovation; Working Paper: <https://epub.wu.ac.at/7841>

# Current product roadmapping practices can easily overlook negative technology effects.

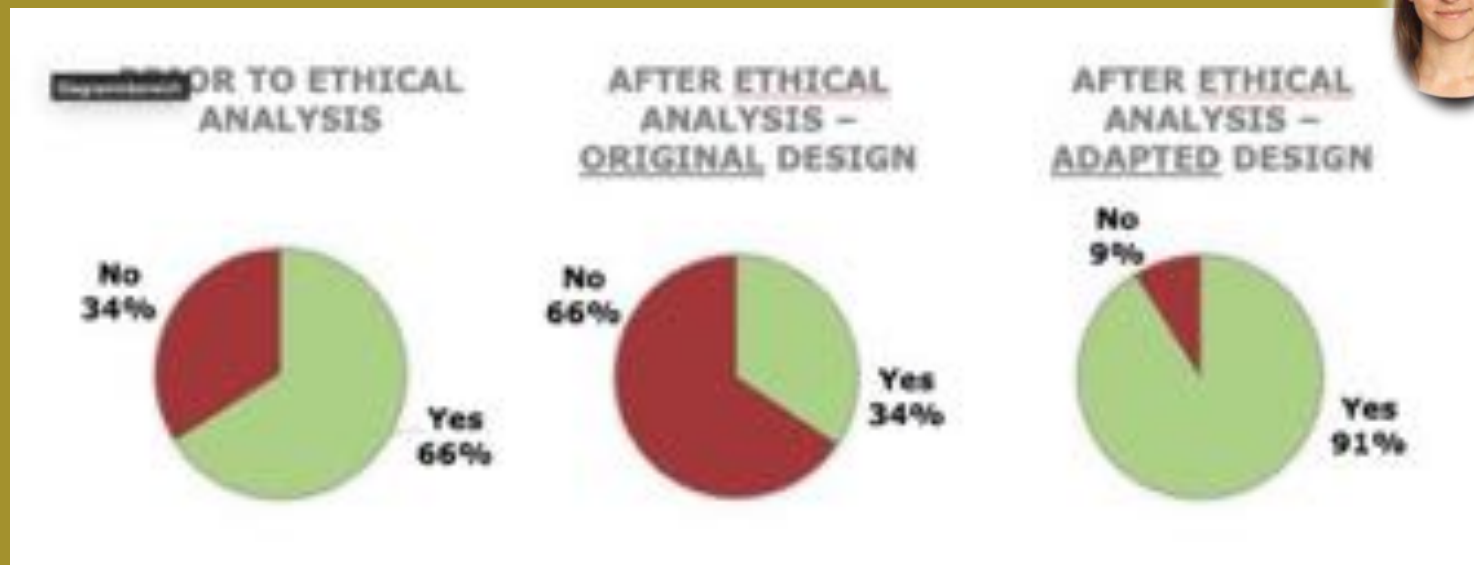


\*\*© Bednar, K., & Spiekermann, S. (2021). On the power of ethics: How value-based thinking fosters creative and sustainable IT innovation; Working Paper: <https://bach.wu-wien.ac.at/d/research/results/ris/export/97385/>.



# Ethical Analysis is making investment decisions more rational. Example: Digital Toy

**Would you invest in an AI-integrating toy?**  
(N=32 IS Master student sample)





# Yoma went from an AI-driven talent calculation machine to a community platform for mutual and local support of African youth

Before (very first idea November 2019):  
**AI focus**

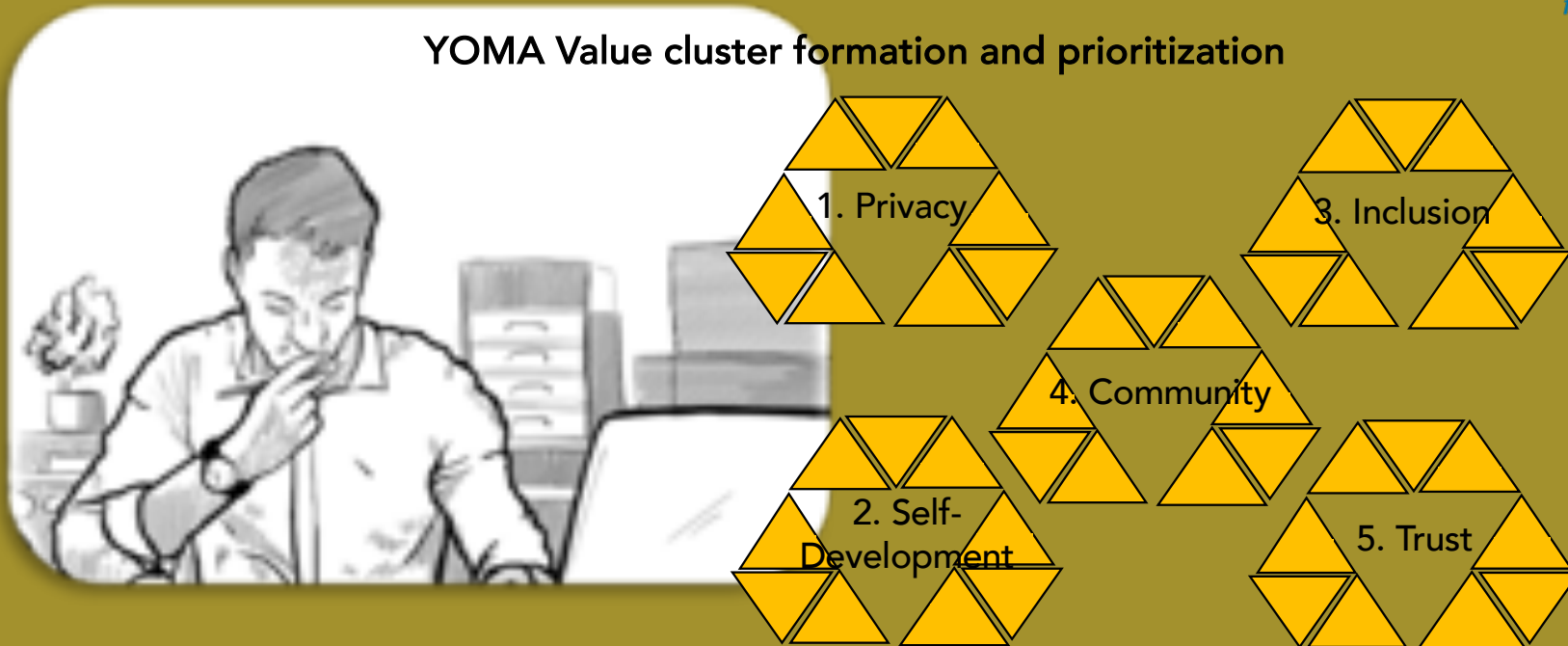
- Young peoples' data is combined and aggregated to calculate individuals' 'talent scores' with an AI engine hosted in Germany
- Young people are represented through its AI-based talent score and homogenized, comparable profiles are created
- All data providers can pull talent scores from young people.
- "Diamonds in the rough" are contacted to be channeled into innovation hubs to support African business

After (summer 2021):  
**Bottom-up Youth support**

- Youth gets richest possible self-presentation opportunity and no talent score is calculated, but young people can participate in local challenges and education and can build up a CV (**self-development**)
- Young people have maximum **privacy and control** over CV data (using a self-sovereign identity framework)
- Only those can get access to the young people who the young people want to be in touch with
- "Diamonds in the rough" become mentors for other young people to provide **local community support** AND can respond to African businesses if they want

A new professional is identified in IEEE 7000™:  
A Value Lead who analyzes the value structure.

YOMA Value cluster formation and prioritization



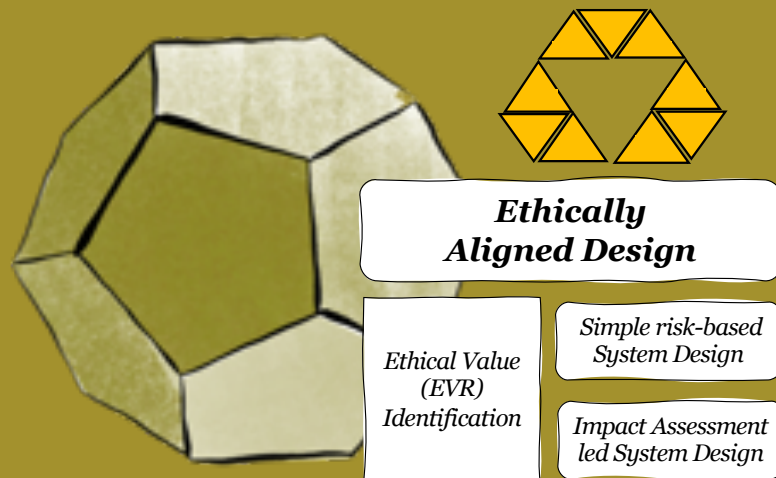
Values are prioritized. Here regional laws, agreements, CSR principles come in.



Value leads help companies understand the conceptual details of each prioritized value cluster.



VBE's 3rd phase generates system requirements for prioritized value clusters from each value cluster.



- Prioritized value clusters are analyzed as to their ethical value (quality) requirements (EVRs)
- EVRs are subject to a threat-control analysis
- Core values of highest risk are made subject to impact assessment led system design
- Traceability and transparency is created in a Value Register following a numbering scheme.

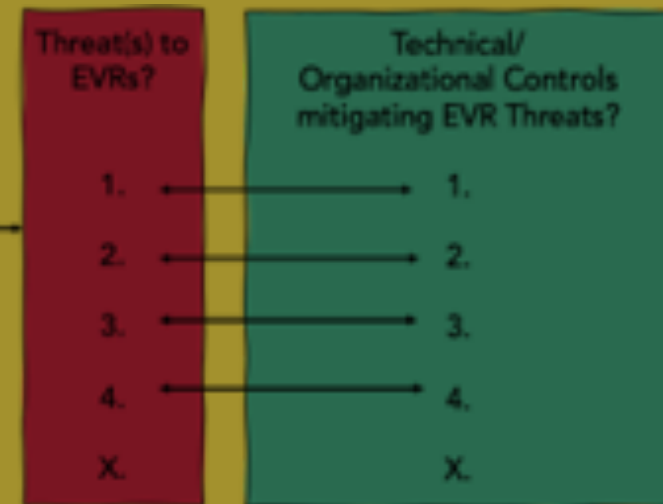


# IEEE 7000™ goes "from principles to practice" with the help of EVRs and a risk-based design.

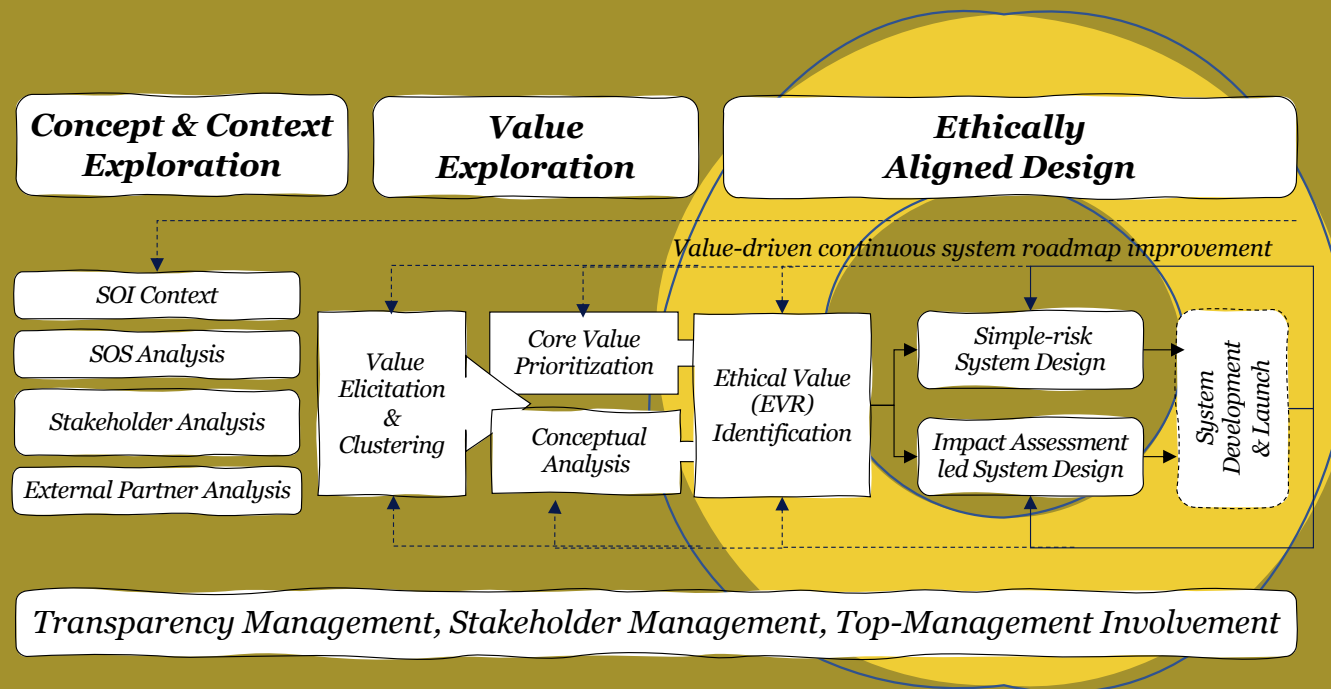
## Value Principles



## Practice: Risk Logic identifies System Requirements



System requirements can be the start for agile sprints or other forms of iterative development.



Here is what the YOMA CTO said after the project

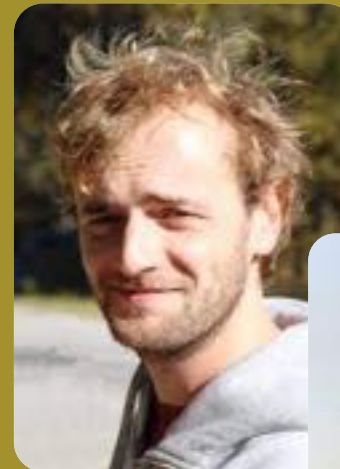
In 2020/2021 Value-based Engineering with  
IEEE 7000™ was tested with UNICEF's Yoma



# A great thanks to the VBE team @ the Institute!



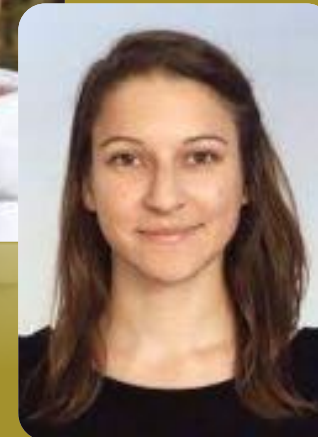
Art & Illustration:  
Marie-Therese Sekwenz



Advocatus Diaboli:  
Till Winkler



Chief Evangelist:  
Sarah Spiekermann



Case Study Analyst:  
Kathrin Bednar

# More information on IEEE 7000 site & VBE portal!

<https://www.wu.ac.at/value-based-engineering>

## Value-based Engineering with IEEE 7000

Value-based Engineering (VBE) is a research project aimed at extending the traditional engineering design process by integrating ethical concerns into the design process. The project is led by Prof. Dr. Sarah Spiekermann and Prof. Dr. Ingrid Isenhardt. The project is funded by the Austrian Research Promotion Agency (FFG) and the Vienna University of Economics and Business (WU). The project is part of the 'Value-based Engineering' research program.

## IEEE 7000™-2021 Standard

Addressing Ethical Concerns During Systems Design

**IEEE 7000™-2021**  
Integrating ethical and functional requirements to mitigate risk and increase innovation in systems engineering design and development

**An Unintended Risk in Engineering Design: Ignoring the Values of Your Users**  
Building risk is a key concern for any organization. But focusing only on physical risks can create a false sense of an end-user experience of what you build. Artificial intelligence systems will change many products and services today and driven by algorithms. Hidden risks are that they will slowly affect their data, identity, and values. Beyond the best intentions of a manufacturer, without having a methodology to analyze and track how an end-user interacts a product, service or system, a design process will compromise the values of its users. Responsible innovation for algorithms requires a value-oriented methodology that complements traditional systems engineering. This is what IEEE 7000-2021 provides.

IEEE 7000-2021 Standard Access Options	
View for Free in the IEEE Reading Room	Purchase the IEEE 7000 Standard
IEEE Xplore	IEEE SA STANDARDS STORE

<https://engagestandards.ieee.org/ieee-7000-2021-for-systems-design-ethical-concerns.html>

# Value-based Engineering/IEEE 7000<sup>TM</sup> Training?

If you are interested to receive information on a 4-day intensive training @WU Executive Academy, please leave a note or card.