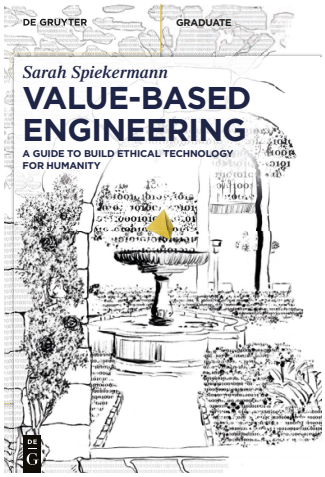
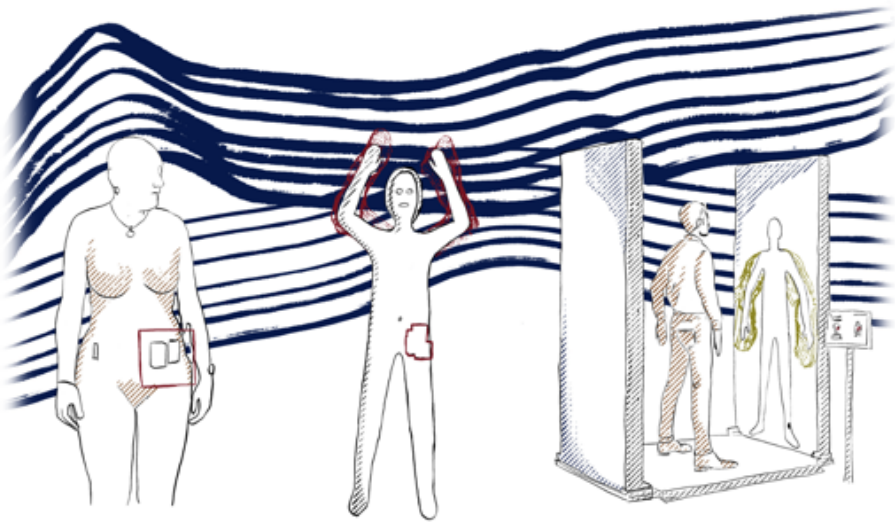
The 10 Principles of Value-based Engineering



Spiekermannn, Sarah. "The 10 Principles of Value-based Engineering". In Value-based Engineering – A guide to build ethical technology for humanity. Berlin: deGruyter. forthcoming in Jan 2023.

In the aftermath of the September 11th terrorist attacks on the New York twin towers most countries decided to ramp up security technologies and in this vain airports worldwide started to install full-body scanners to screen passengers for weaponry or explosive materials before boarding a plane. The goal was to foster airport security and flight safety. Several scanner alternatives came to market and it soon became clear that this technology could considerably harm passenger privacy by exposing people's intimate bodily details. For a short while it seemed as if there was a tradeoff to make between privacy and security. It turned out, though, that scanners built with privacy by design could resolve the issue. Presenting passengers as stick figures or schemata on security screens allows them to be scanned for security reasons without exposing their figure or genitals. A privacy sensitive technology version was born, which we now often use when traveling through airports. For the company (L3) that offered the privacy friendly scanner a significant competitive advantage was created. At some point I calculated that L3 could probably make over a billion euros in European turnover alone if two scanners were bought from them by every European airport (Spiekermann, 2012).



However, have you ever been through such hands-up scanners yourself? Asked to raise your hands like a criminal? Legs apart, hands up? How did that feel? A value analysis would show that the bodily posture we have learned to associate with criminal conviction induces a negative feeling-state in us; a feeling of shameful unease. Being just ordinary passengers, people feel as if they were suspected criminals being forced into a surrender position. The negative value of a default distrust is created, a perception of loss of dignity as well as discomfort. And these value breaches give rise to such negative feelings that the privacy sensitive design of the scanners alone has simply not been enough to make the market; at least not in Europe. In fact, at least one European competitor grasped the opportunity to come up with a third solution, which offers passengers the possibility to keep their hands down. This is now a much more agreeable outcome for passengers, and scrolling through many European airports in 2021 it seems as if airport procurement was increasingly embracing this solution.

The airport scanner example has various takeaways:

- First, it shows that the value-based engineering of products can have tangible economic consequences, creating an important competitive advantage for those who envision and respect ethical consequences of their system design.
- Secondly, it shows that values, which initially appear to be in an insurmountable trade-off, such as privacy and security in this case, can be overcome through good technology design.
- Third, it shows that values such as privacy and security, which have been well documented as tech-policy issues today, are not the end of the story when it comes to human-centric and socially acceptable technology. More values play a role depending on the respective context (here: trust, dignity, comfort).

Note that when I just said value-based "engineering" of products can have tangible economic consequences, I used the term "engineering." This is because providing ethically

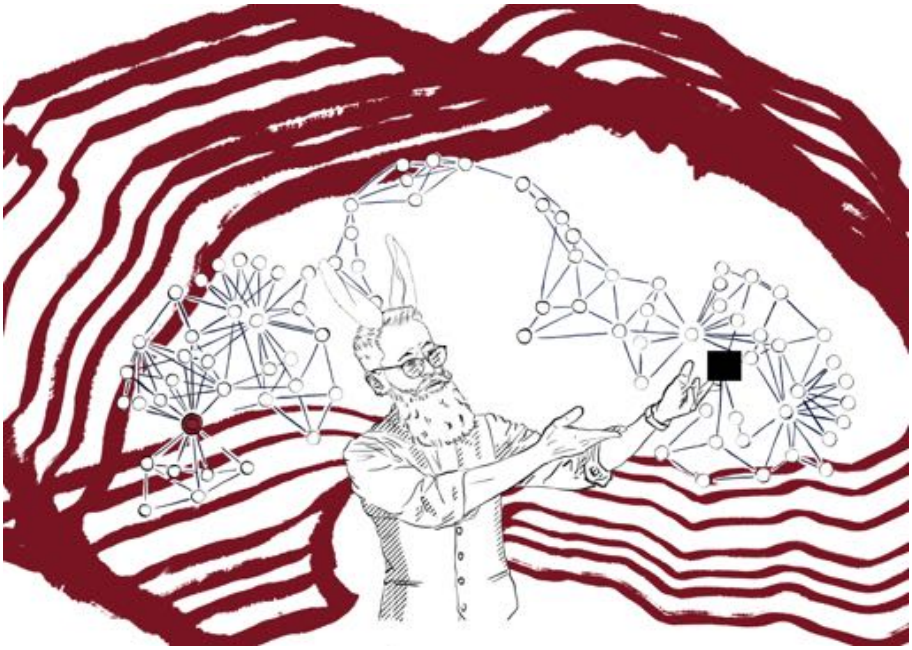
aligned security scanners is not just a "design" issue. It is also a technical and organizational engineering challenge. Even though the designer's sketch of a hands-down stick-figure-scanner is already a stroke of genius when compared to an exposing-nude-scanner, it is not enough to build and operate good technology. What is also required is that the machine respects privacy in the background, works safely when being used and is dependable so that trust can be put into its security scans. This again means that the technical engineering of the scanners must be reliably done in such a way that it lives up to these expectations. Who would be satisfied with a privacy-friendly screen image at the airport itself when at the same time the full resolution nude picture version was being sold by airports to personal data markets? Who would find it reasonable to use these scanners if they did not do their job of truly detecting terrorists? And who would want to be forced to use scanners that impact one's health due to radiation? These rhetorical questions show that the technical backend operations, data flows, organizational policies, operational testing and risk assessments are all required to make airport scanners work and to support their deployment from an ethical perspective. This goes far beyond design issues.[i]

Of course, one might wonder whether all these values—privacy, dignity, reliability, health––are not stating the obvious. Do we passengers not take for granted that airport scanners and their operators work in a way that is reliable, safe, secure, and privacy-friendly? Unfortunately, at this point in the machine age people's natural expectations of tech providers' respect for such obvious human values are often disappointed. In 2015, for instance, the news platform *Politico* reported that the US Transport Security Association failed to find fake explosives and weapons in 96% of covert tests of the scanners (Scholtes, 2015). So even the most essential functional value of this public system, its reliability and the ensuing security of passengers, was not supplied.

The takeaway is that values end up being borne by systems only when there is a rigorous engineering process. Value-based Engineering provides for such processes. Value-based Engineering, which is now in large parts standardized in the IEEE 7000™ Model Process for Ethical System Design, provides a structured and transparent method to ensure that organizations are aware of the full value-spectrum impacting their stakeholders and to then translate this into organizational processes as well as technical roadmaps (IEEE, 2021a).

Value-based Engineering is not bowling alone

Value-based Engineering is not a stand-alone practice that on organization alone can easily achieve. To provide IT services today hardly any provider is an isolated greenfield entity any more. IT systems often bring in a history. They are highly networked, if not interwoven with external web services. In Value-based Engineering, as in many IT standards, we recognize that there is one "System-of-Interest" (SOI), but that this is embedded in a larger "System-of-Systems" (SOS). And if an organization wants to respect values and ensure ethical conduct in a modern system, then this is only possible by choosing the right partners.



A simple example of an SOI is a webshop. A webshop will need to offer a digital payment function to its customers, but it is likely to not have the competency to handle all the payment transactions itself in addition to its core business of selling a good selection of products. Therefore, webshops typically delegate the handling of payments to a specialized credit card service (like Mastercard or VISA). An interface is created between the webshop and the digital payment service and when a sale is agreed, the relevant purchase information is handed over from the webshop to the credit card service to do the billing and money collection. This is a very fine way for every system operator in the digital supply chain to concentrate on its own core competencies and to realize economies of scale in its own operations.

That said, what happens if a webshop provider—let's call him Peter—found out that all his customers' personal data, what they bought, at what price, at what volume, at what frequency, where they live, etc. would not only be used once by his credit card transaction partner to do the billing for him for a fee, but would continue to be used by the company for its own benefit? In a 2017 report on Corporate Surveillance in Everyday Life, Vienna activist Wolfie Christl reported how the company VISA, for example, "provided data on 14 billion purchase transactions to the data broker Oracle and combined it with demographic, financial, and other data in order to help companies better categorize and target consumers in the digital world" (p. 23 in (Christl, 2017). Would Peter the webshop provider care if he learned that his credit card partner engaged in a similar data sharing practice? IF Peter wanted his webshop to protect the privacy of his customers, then yes, he probably would care. Just imagine Peter trading stuff like intimate toys or esoteric gadgets that none of his own customers would want to be associated with. Peter would want to know for sure what his credit card partner is doing with his customers' data trails.

This is exactly where Value-based Engineering comes in. Unlike most other approaches to ethical or value sensitive system design it always asks the question of ecosystem responsibility. An organization that wants to claim that it has built its system in line with its

customers' values or with ethical principles in mind will always be at risk of disappointing if it does not ensure that all its relevant partners are toeing the line. Therefore, the 1st principle of Value-based Engineering is Ecosystem Responsibility: "Value-based Engineering organizations embrace responsibility for their technical ecosystem. They abstain from partnerships or external services over which they have no control and which they cannot access."

Principle 1:
Ecosystem Responsibility

Value-based Engineering checks on AI service coupling

Value-based Engineering with IEEE 7000™ is not the first approach to recognize the importance of ecosystem responsibility. Important ISO standards such as ISO/IEC 29101 (ISO/IEC, 2018), ISO/IEC/IEEE 15288 (ISO, 2015) or the European Data Protection Regulation (EU Parliament and the Councial, 2016) have recognized how important ecosystem control is, for instance for privacy reasons. It is vital to not only look at the data processed in one's own controlled IT environment, but to look at the data exchange with other partners and what they are doing with the data.

Yet those who think that data protection is the only value relevant in a responsible ecosystem are mistaken. Many values are at stake when partners do not act in concert. Take the value of transparency. A system-of-interest provider might need to know how an interconnecting AI service calculates its results before integrating these in her own service. If an external AI component is a black box and unable to explain how it achieves its calculations, then a responsible organization cannot integrate it in its own operations. Working value-based and with an ethical responsibility, the organization would have to forgo the partnership.

Let's clarify this issue with an example that I witnessed myself in a university context. The goal of the university's admission office was to automate the processing of motivation letters of student applicants. It got thousands of motivation letters each year. So having those read and scrutinized by an AI seemed attractive. The university's AI project fed all its application letters from a single year into an external text-analysis-AI, run by one of the world's leading AI providers. This external AI service returned a score on the level of motivation demonstrated by the student applicant in his or her motivation letter. Furthermore, it returned a calculation of the presumed personality of that student alongside the so-called "Big Five" personality traits. When I spoke to the project lead (who I acknowledge was still a student at that time), he had no clear idea of the algorithm design or logic employed by the external AI service provider. So, he knew almost nothing about how this external service would calculate the scores (motivation, personality dimensions, etc.) The only thing he found out after some research was that the external AI was trained on Twitter data. As a result, the AI's training data was from a completely different context than the one needed to evaluate student applications and therefore the decontextualized student scores were probably no more than senseless noise. No process was in place to evaluate whether the external AI scores would make any sense in the student application context. To my knowledge, the idea to use the external AI has fortunately been abandoned. The example shows how important it is for an ethical organization like a university to know the exact details of its AI-partner operations. Only in this way can it exercise ecosystem responsibility. A responsible player would cease further co-operation with the AI provider or alternatively, in line with IEEE 7000™ (IEEE, 2021a), it would explore whether there is leeway to

- co-operate with the AI provider on algorithm design,
- co-determine the selection process of the training data,
- jointly ensure the quality of the data used in the AI system,
- control the evolution of the AI's logic, and

- investigate whether sufficient transparency of the AI's conclusion is given.

If any of this is not ensured, then Value-based Engineering organizations would forgo the partnership and any further investment. This is a core principle: "Value-based Engineering organizations actively consider not investing in a system if there are ethical grounds for such renunciation."

Principle 2:
Willingness to Renounce Investment

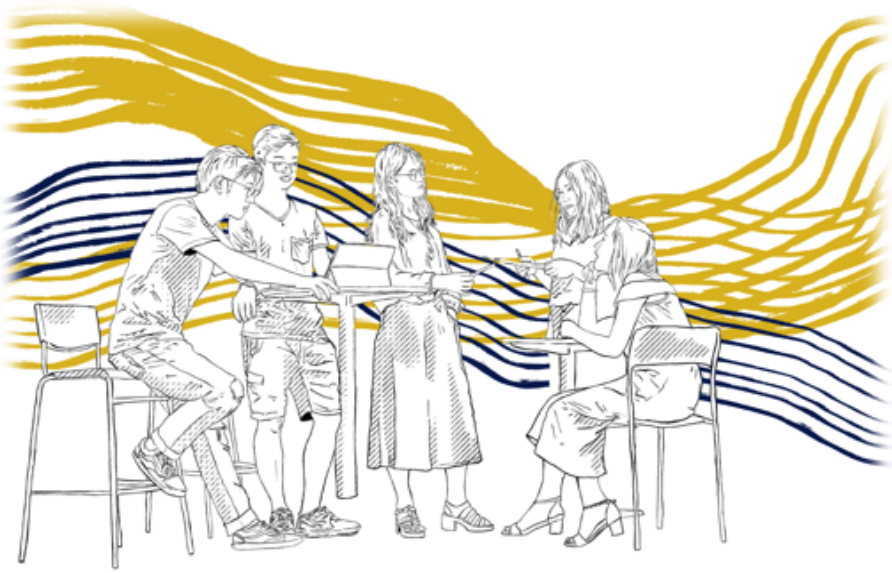
Value-based Engineering is about an open and honest stakeholder dialogue

The example of the university admission system brings a third principle to the front that is essential for Value-based Engineering and IEEE 7000™: the inclusion of stakeholders. How do you think students perceive a university (or a company?) when they learn that their diligently written motivation letters are only read by an AI system? How does it feel to know that your own care and motivation is scrutinized in this way by a non-living void of neutrality? Students in this university case are the direct stakeholders and Value-based Engineering with IEEE 7000™ recommends asking them. Would students like their motivation letters to be received in this way? What values are borne by such a practice? Neutrality? Efficiency? Absence of care? Or, in contrast, justice? And an expectation of fair unbiased application treatment? The list of potential negative and positive values shows that analyzing students' letters with an AI is an ethical challenge. There are diverging views and hopes. Furthermore,

the view of the indirect stakeholders, such as in this case the ministry of education, the dean's admission office and the professors facing the students admitted in this way, also plays a role.

Many organizations are still shying away from such an honest weighing of external stakeholder views in a critical dialogue. They feel uneasy about dealing with critical voices that may undermine their freedom to make their own choices. [ii] But the intuition to fear critical voices is a clear indication of ethical ambiguity. When innovation teams feel uneasy to openly and honestly discuss their system ideas with critical stakeholders it should be a warning sign to themselves that they might have something to hide. Value-based Engineering with IEEE 7000™ resolves this negative tension. No business in the service of customers should feel uneasy about its practices. Uneasiness is like a snake eating up the motivation of all parties involved in a project. Therefore, the third principle of Value-based Engineering organizations is to envision and plan their systems in honest and open cooperation with an extended group of direct and indirect stakeholder representatives, including critical ones.

Principle 3: Stakeholder Inclusiveness



Value-based Engineering uses moral philosophies and respects spiritual/ religious traditions to elicit values

Understanding the wide spectrum of thoughts and reactions of stakeholders to one's own system idea or early concept of operations is extremely valuable in anticipating all kinds of value breaches as well as positive value potentials. In three case studies we conducted at Vienna University of Economics and Business we found that conventional product

roadmapping (that is often today's starting point for programming sprints in agile system development and that often comes out of function-focused technology planning (Albright & Kappel, 2003)), sees few human and social values impacted. Some, like privacy and security, have in recent times tended to be on system developers' radar (see left bar in the graph), but our Institute's research shows that normally no more than four to seven values are covered in technology roadmaps. In contrast, when having people engage in value-based thinking with the help of ethical frameworks their creativity around potential value impacts explodes (Bednar & Spiekermann, 2021b). In our research lab's context, at least, each study participant identified on average between 16 to 19 positive or negative values per technology case.

Furthermore, we have found that reflecting on values helps with seeing the potentially adverse effects of a system's deployment. Our Institute's research across three case studies suggests that innovators building technology roadmaps with a function-driven mindset, or what I have called "pure-will innovation" processes, end up discerning almost no negatives to a project. In contrast, innovators working with the ethical frameworks used in Value-based Engineering and IEEE 7000™ identify on average 10 negative value risks per person involved in the project (Bednar & Spiekermann, 2021b). That said, the kind of value elicitation we engage in in Value-based Engineering and IEEE 7000™ is not just asking for any kind of stakeholder preference. It is not a simple brainstorming exercise. Value elicitation in our approach is guided by three established ethical frameworks and by the spiritual/religious traditions stakeholders might have. Our fourth principle says: "Value-based Engineering organizations use moral philosophies for value elicitation"

Principle 4: Use Moral Philosophies for Value Elicitation

The three established ethical frameworks used to elicit values for Value-based Engineering and in compliance with IEEE 7000™ are Utilitarianism, Virtue Ethics and Duty Ethics (in the very order given here). First, we anticipate the harms and benefits that could result for the direct and indirect stakeholders if the system was ubiquitously deployed. This is the utilitarian perspective, which provides for a very broad perspective on any consequences the system might have. Second, the virtue effects on human users are questioned. Virtues describe the habitual character quality of a person that makes her or him a good and moral community member and decision-maker. Or, in simpler terms, one could say a virtue is "the positive value of human conduct" (p.24 in (IEEE, 2021a)). Examples are humbleness, moderation, kindness, attentiveness, reliability, etc. These person values are often undermined by timely IT systems, and it is a particular concern of Value-based Engineering that systems should strengthen human virtues rather than undermine them. It is important to anticipate the long-term character effects of an IT system, imagining what would happen if the system were used at scale. And thirdly the question is asked of whether there are any duty-ethical principles touched upon by the IT system and potentially already seen by utilitarian or virtue-ethical reflection that are of such universal importance that they should be treated with particular care in the system's future design.

Committing to Value-based Engineering means to commit at the very least to these three ethical frameworks of moral philosophy. This is not only because these three ethical frameworks are the most established ones (covered probably in every ethics class in the Western world), but also because our research has shown that these three philosophies are complementary in their ability to unveil values (Bednar & Spiekermann, 2021a). The general utilitarianism we use in Value-based Engineering allows us to zoom out and see a future system-of-interest and its wider societal implications from a bird's-eye perspective. Virtue ethics allows us to specifically unveil culturally grown expectations on human long-term conduct. And duty ethics allows us to pull out a stakeholder's personal "maxims," which they want to see respected in a system for higher reasons. Different cultures have different expectations and views on what is good conduct, and they also have different maxims and higher reasons for wanting a system to be in a certain way. To ensure a respect for local and

regional traditions it is therefore important to conduct a virtue ethical and duty ethical reflection.

Finally, many regions of the world still have strong spiritual traditions, in which certain values might be cherished that are foreign to a Western style of thinking and that might not be uncoverable by following utilitarianism, virtue ethics or duty ethics. Therefore, IEEE 7000™ recommends questioning whether a region of system deployment has such a tradition, and if so, to discuss the long-term value impact of a system against the background of that tradition.

Note that I have been saying that we use the philosophical frameworks to reflect on the "long-term" value implications of a system that is imagined to be "ubiquitously deployed" or used "at scale." This practice of envisioning a system's effects at scale is also embraced by Value Sensitive Design (B. Friedman & D. Hendry, 2012). The long-term and ubiquitous perspective is vital. Our Institute's research suggests that imagining a system to be deployed at scale or to be a future monopoly makes people think more carefully about the system's potential value implications than if this assumption was not made (Winkler, 2021). Many negative value potentials only materialize when a system has a large number of users or a dominant market position.

Value-based Engineering is context sensitive instead of promoting lists

Assuming a dominant market position for a service and analyzing its value impact against this economic background is only one pillar of value elicitation. The second pillar is the bottom-up, unbiased, context-driven and ideally physical exploration of the value space. By "unbiased" I mean that Value-based Engineering recommends not using existing value lists or principles for the initial value exploration phase.

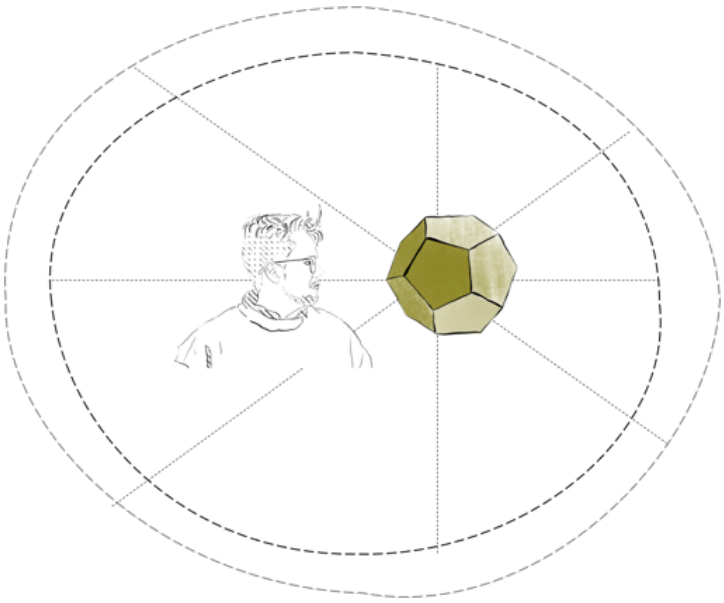
In recent years, many such lists have been published by leading institutions around the world, emphasizing values such as justice, privacy, equality, transparency, etc. (Jobin, Ienca, & Vayena, 2019). These principle lists show that organizations around the world have made a commitment to embrace more values and ethics in their IT systems, and I would be the last person to criticize this effort. However, I have seen various IT projects in the field where the innovation teams and engineers tried to fit the logic of the value lists to a specific technology context and this simply did not work. Take the values of privacy or well-being in the EU's Assessment List for Trustworthy AI (HLEG of the EU Commission, 2020). I have seen a grand military project trying to use the ALTAI list and look out for privacy and well-being issues in their military system but having a hard time finding any, because in the battle context on a military jet, privacy and well-being are simply not what the pilot is concerned about. In another project I saw how the innovation team was primed to embrace privacy so much that they were not open to seeing the true concerns of retail customers, which was about tangible help and convenience; two values not included in any AI value list of the 84 most well-known (Jobin et al., 2019). In line with other value scholars I have therefore come to the conclusion that the use of value principle lists for value-based engineering is

counterproductive, at least in the initial value exploration phase (Le Dantec, Poole, & Wyche, 2009) (Spiekermann, 2021).

Value issues are also so rich in each technology case that value lists are but the small tip of a project's real iceberg of potential issues and opportunities. In the various case studies we did at Vienna University of Economics and Business we always identified more than 10 value clusters, each one of them being again composed of multiple instrumental value qualities. In a trial with a Vienna telemedicine platform, for instance, 93 values were directly or indirectly mentioned by stakeholders, which formed 13 core value clusters. In another project with UNICEF we identified 10 value clusters based on 56 values originally named by stakeholders. All of these values are deeply contextually bound to the system itself and to the locus where it will be deployed.

Taken together it should not surprise that the 5th principle of Value-based Engineering is that innovation teams should strive to deeply understand the context of their systems' deployment and anticipate its effects.

Principle 5:
Context Sensitivity



Coming back to value principles lists, the question arises what they are good for. I would say that value principle lists should be regarded as key hygiene factors to watch out for when building any kind of system. Consider once more the EU's ALTAI List. The list says that humans should have control over AI systems (agency). Systems should be safe. Data flows should be protected and secure (privacy and security). Algorithms' skewedness towards certain outcomes, such as discrimination of black people (lack of fairness), should be made transparent and false judgments of course avoided. All in all, algorithms should hopefully be in the service of social and environmental well-being. Isn't it fair to say that IF such qualities

were not in place, then the system itself would actually be so suboptimal at its very operational core that it would be hard to operate, sell and maintain in the long-run? Who would be willing to bear responsibility and run the operational risk of a system today where these qualities are not ensured (provided that they play a role in the context of the system at hand)?

This is why I say these listed value principle lists should be seen as hygiene factors for all systems put into a market. The details of how to create human agency, safety, privacy, transparency, fairness and environmental care must be part of *any* system engineers' education. They do not make a system particularly "ethical" or "valuable." They make a system good enough to stay in the market at reasonable operational, legal and human cost. Therefore, they are just the beginning of what I understand by Value-based Engineering.

Value-based Engineering ensures a Respect for Regional Laws and International Agreements

The legal and operational costs of a system bring me to another principle important for Value-based Engineering: Tech companies wanting to act globally should also be thinking more locally. They should be ready to limit their economies of scale to some extent in order to cater more seriously to regional interests.

The first 25 years of digitization between the mid 1990s and today saw the roll-out of some almost hegemonial "winner-take-all" platforms, hardware and software systems. Only a few global market regions that wanted to maintain their local control over digitization, such as China and Russia, succeeded in building their own regional monopolies or oligopolies. In general one could say that those who made the Western world's digital market created law with their code. They determined how people would use the Internet and corporate services. Winner-companies created hegemonic defaults of how things are digitally done today in the Western world; defaults, however, that are primarily designed to secure the winners' own profit margins (Transatlantic Reflection Group, 2021).

As we are still living in a neoliberal capitalist society where anything goes and shareholder value trumps all, there seems to be nothing wrong with this winner-takes-all situation. Companies have a right to be successful! Any realistic company listed on the stock-exchange today will think about how it can maximize its economies of scale and will seek homogeneity in its processes in order to minimize process cost. Therefore, regional laws such as the EU's Data Protection Regulation or other human rights agreements are not particularly welcomed by tech companies, seeing that they undermine their business models and imply re-investments into an infrastructure that has already matured. Reshaping their systems and business models makes them vulnerable vis-à-vis more flexible and younger competitors who might be able to better comply with laws at lower cost. So only depending on the nature and rigor of felt legal sanctions do tech companies currently rethink and restructure their data processing operations. The dilemma they are in is that *if* social and human-friendly, moral or regional value structures are not considered from the start of a system's conception, then it is very hard and costly to bold them on later in a system's life cycle. Sometimes legislation can even imply running separate data processing units in a region just

to comply with that region's legal expectations. Large tech companies are hence in a cost dilemma. They underestimated the ethical implications of their systems and business models when they first conceived them and now they need to decide whether they continue to spend their money on lawyers to fend off customer and NGO complaints (that were never foreseen in the business plan) or whether they truly embrace a new form of better engineering, which I call Value-based Engineering. Both strategies cost money.

The 6th principle of Value-based Engineering recommends that organizations should pro-actively and wholeheartedly respect the ethical principles embedded in the spirit of laws and signed agreements. They should embrace the fact that many of their target markets are big enough to deserve the regional laws' respect. They should not prioritize only their own continent's system values over and above their local customers' expectations. And certainly, they should not prioritize profit over service quality.

Principle 6: Respect for Regional Laws and International Agreements

Value-based Engineering requires top-Management Engagement and seeks healthy profit

To not prioritize profit over a service's value quality still seems a bold statement to make in times where shareholder value continues to outweigh all else in practice. As of 2021 a large

segment of professors at business schools or top-executive consultants are still full of theory heralding profit maximization as the main goal of business. "The business of business is business" is a famous claim of the now deceased Milton Friedmann (1912–2006), who also claimed that the sole social responsibility of a company should be to increase profits as long as one does not break the law.

In line with a wide range of critiques, Value-based Engineering scholars would not consider Friedman a role-model thinker for the times ahead.[iii] As seen throughout history, cultural and economic perspectives are constantly changing. While greed was still sexy in the early 2000s (German: "*Geiz ist geil*"), this has gradually changed in the past 20 years, particularly so after the financial market crash in 2008. Since then more sustainable and value-based thinking is on the rise, slowly but steadily replacing the old economy of greed. Famous strategists like Michael Porter have been foreseeing that "the purpose of the corporation must be redefined as creating shared value, not just profit per se. This will drive the next wave of innovation and productivity growth in the global economy … learning how to create shared value is our best chance to legitimize business again"(Porter & Kramer, 2011).

Management Scholar
Michael Porter

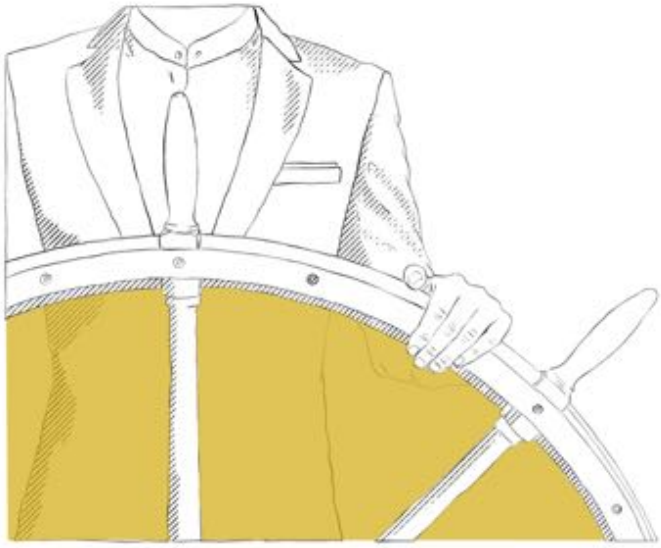
Against the background of this new economic undercurrent, corporate executives who enter leadership positions are now observed more closely. Those who are found to be too greedy or using tricks to maximize profit at the expense of society don't get away with this behavior any more. They are increasingly put on personal trial for their behavior. Social networks, investigative journalism, whistleblowers and NGOs expose misconduct. A single mistake can lead to a degree of opprobrium unknown up to the early 2000s. In times of ever flatter organizational hierarchies, top executives cannot any longer hide behind a high position that would legitimize false behavior; or at least it has become a dangerous strategy to do so. More and more executives are facing legal sentencing and even jail, regardless of their former career or engagement for their company. As a result, corporate leaders are facing the necessity of developing an old aristocratic skill: they need to work on themselves and their personalities to become virtuous leaders. As the wise Japanese thinker Ikujiro Nonaka wrote: "[Corporate] judgments must be guided by the individual's values and ethics. Without a foundation of values, executives can't decide what is good or bad"(Ikujiro Nonaka & Takeuchi, 2011). <quote disappear> And he went on to say that "In conventional economics, the ultimate goal of any company is to maximize profit. But in the knowledge

society, a corporate vision has to transcend such an objective and be based on an absolute value that goes beyond financial matrices."

Management Scholar & Philosopher Ikujiro Nonaka, © SSP & MT CC BY-ND 4.0

Value-based Engineering helps executives and corporate leaders to understand what that value could be, which helps them to transcend profit-oriented thinking. The method, in line with the IEEE 7000™ standard, gives them guidance on how to prioritize the many values that stakeholders mention in response to the operational concept of a new product. They are guided towards considering their own value maxims—what they deem personally to be of universal importance from an ethical perspective. Against this background the 7th principle of Value-based Engineering reads as follows: "Corporate leaders engage in introspection and support only those core values as future system principles that they would want to become universal and are therefore willing to publicly and personally endorse."

Principle 7: Leadership Engagement



Note, however, one important boundary in this argumentation for value-driven leadership: Value-based Engineering is not against making profit per se. To speak with the words of the former CEO of German Rail, Heinz Dürr, it is about making *a healthy* profit. A healthy profit is one signaling that a company is in a sustainable state, able to successfully maintain its business mission while paying reasonable wages to a large enough number of employees for which the company has a duty of care.

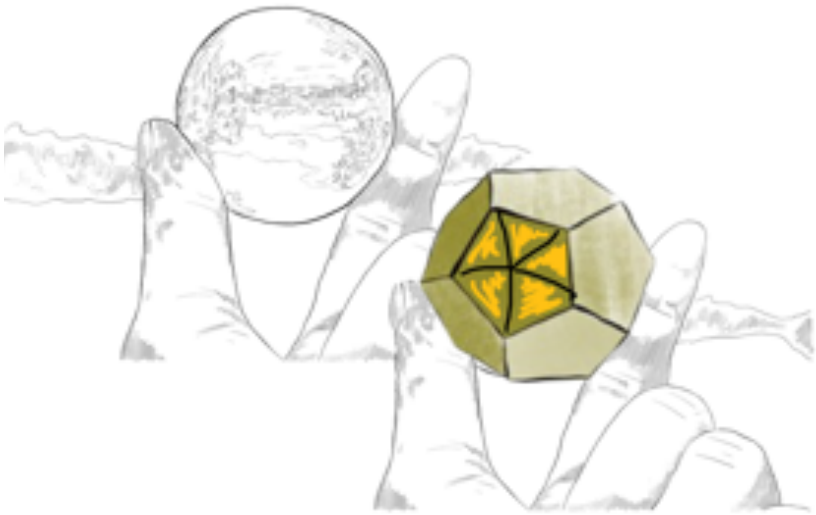
Transparency of the Value Mission

Once corporate leaders and their innovation teams commit to healthy profits in the service of human and social value, they will have no problem to make this mission public. They will not hesitate to demonstrate their thinking and arguments; indeed, they will be eager to share it with their employees and with the world to motivate the people who work for them and the customers who buy from them. Value-based Engineering therefore encourages innovators to publish an Ethical Policy Statement, which summarizes the core values that an enterprise prioritizes for a product or service.

Such an Ethical Policy Statement is not to be confounded with a marketing slogan or a list of Corporate Social Responsibility commitments. You may recall that I earlier explained that Value-based innovation teams run stakeholder groups through an ethical elicitation process, which is focused on a concrete product or service. Value-based Engineering is not a remote strategic exercise, such as many CSR activities are today bemourned to be. It is also not about a marketing message that is bolted on to a product by a PR agency after the product has been built. Instead, Value-based Engineering focuses on the concrete concept(s) of operation for tangible products and services in the early stages of their making. Ethical and value-based thinking is not a general corporate view or a PR promise, but rather concrete thinking that enters the product roadmap, the agile development sprints or the developers' list of system goals very early on.

Ethical Policy Statements can then summarize the higher and intrinsic core values that have inspired the system development goals. And it is the path from these core value principles down to the system requirement practice that should be documented in a separate file that the IEEE 7000™ standard calls an "Ethical Value Register." These two artifacts of value history, the Ethical Policy Statement and the Value Register, help companies to structure, remember and share what they work for. Against this background the 8th principle of Value-based Engineering is about the transparency of the value mission, endorsed in these two documents.

Principle 8:
Transparency of the Value Mission



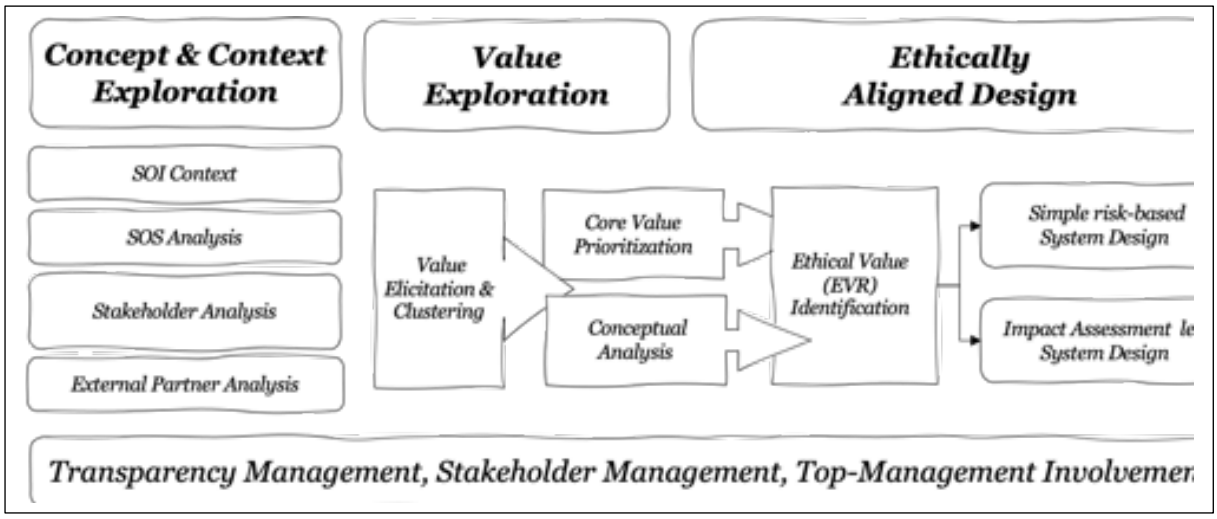
Value-based Engineering offers a path to value creation

The Ethical Value Register contains what I just referred to as a "path from higher intrinsic core values to system development goals." It is the transparency tool that is also standardized for information management in IEEE 7000™ (IEEE, 2021a). But what does the path to value creation look like and how is it pursued concretely?

Most companies that build technology today and operate with professional maturity are following processes or work flows that they have either defined for themselves or adopted from industry standards. Value-based Engineering is equally process driven and it has been one goal of the 7000 standardization effort to understand how its processes can be aligned with activities that are prescribed by widely used process frameworks, such as ISO 15288 (ISO, 2015) or other established life cycle models (ISO/IEC/IEEE, 2017; Spiekermann, 2016). Established process frameworks outline how systems should be engineered step by step. It is defined what goes into processes as inputs and comes out of them as outputs and/or outcomes. They show what actors are involved in what roles and what activities and tasks

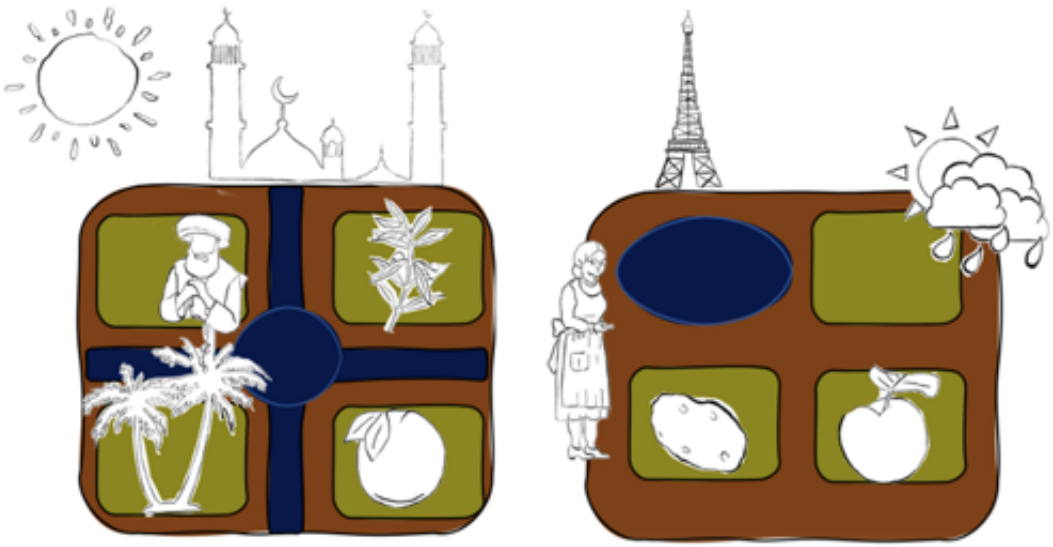
are completed. Value-based Engineering is not only an equally detailed and thereby reliable and repeatable method, but it is designed to be accommodable with such established corporate practices.

That said, Value-based Engineering still has its own blocks of work, activities and tasks. In fact, the path to value creation can be summarized with the help of three grand process blocks: a block of concept and context exploration work, a block for the ethical exploration and value prioritization and a third block of activities where the ethically aligned design of an SOI is created. In this latter part of work core values of a system are translated into practical system of interest (SOI) requirements.[iv] These process blocks and processes can be run through in an iterative, repetitive and interlinked way.



Concept and Context Exploration

Before a Value-based engineering project can start, a number of activities and tasks need to be completed in preparation. Most importantly, an understanding of the SOI's initial set-up, its context and its likely ethical challenges associated with legal, social and environmental feasibility must be gained. An organization will need to graphically depict the components of the SOI in a concept of operation; for instance, by using box diagrams, contextual diagrams, high-level UML sequence diagrams, etc. Stakeholders are identified and studied in terms of their expectations on the system. Data flows and ethically relevant system boundaries are analyzed as well as the control the organization has over its envisioned external partners.



Ethical Exploration

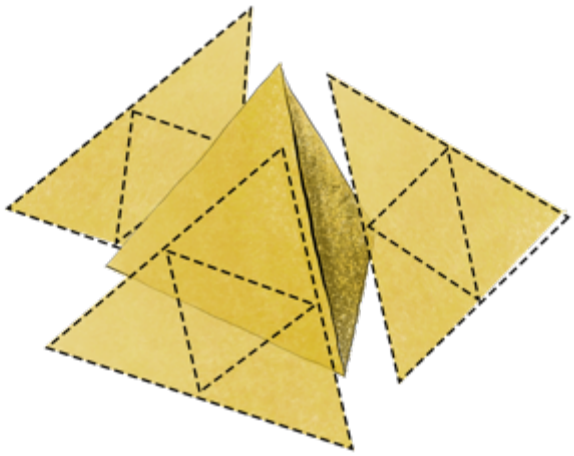
Once this preparation is completed and an innovation team with stakeholder representatives has been appointed, the organization building the SOI can start with the ethical exploration. Through value exploration positive and negative values relevant for a SOI are identified and prioritized. The deployment of the system needs to be envisioned at scale. The harms and benefits that could result for a broad set of direct and indirect stakeholders if the system were ubiquitously deployed (utilitarian perspective) are anticipated during this phase. The virtue effects on human users are questioned (virtue-ethical perspective). And the question is asked of whether there are any duty-ethical principles touched upon by the system that should be treated with care in the system's future design (duty-ethical perspective). Together with a potentially regional ethical framework, these ethical perspectives support the identification of the core value clusters that need fostering or protection in the SOI.

Organizations then engage their top management to prioritize these core values, each of which is conceptually built up by value qualities relevant in the SOI.[v] Prioritization is not profit-driven. Instead, core value priorities are informed by the comparison of alternative core value missions that may be supported by the SOI. Prioritization is supported by existing ethical frameworks, such as human rights agreements, existing regional legislations as well as corporate social responsibility (CSR) commitments already made. Value priorities should mirror the respect the organization has for people, society and the environment. Top management should play a vital role in this value prioritization activity.

A vital part of the ethical exploration is to understand the core values prioritized in depth. Stakeholders in their bottom-up and context-sensitive dialogues are more or less able to express in what respect they find certain values important. But they usually do not have the knowledge or bird's-eye perspective to really understand the conceptual details of a value. Take the example of privacy. Stakeholders may state that they are concerned about the

security of their data and want to control the further use of their personal data for secondary purposes. A Value-based Engineering project will need to respect such concerns. But if the project goes ahead and prioritizes privacy as a system's core value, then it will also need to go beyond what stakeholders saw and said. In addition, they will need to query what privacy experts would want to see in a system that is later marketed as being particularly privacy-friendly. Through the conceptual value analysis (or call it "expert-view") on a value, additional value qualities come into play, which a normal stakeholder or project team member would not have seen or mentioned. In the privacy case, for instance, legal issues such as data portability, privacy by design, etc. might be identified as relevant.[vi] For this reason, Value-based Engineering teams engage in a conceptual analysis of their prioritized core values. They need to—as principle 9 states—understand their core values in depth.

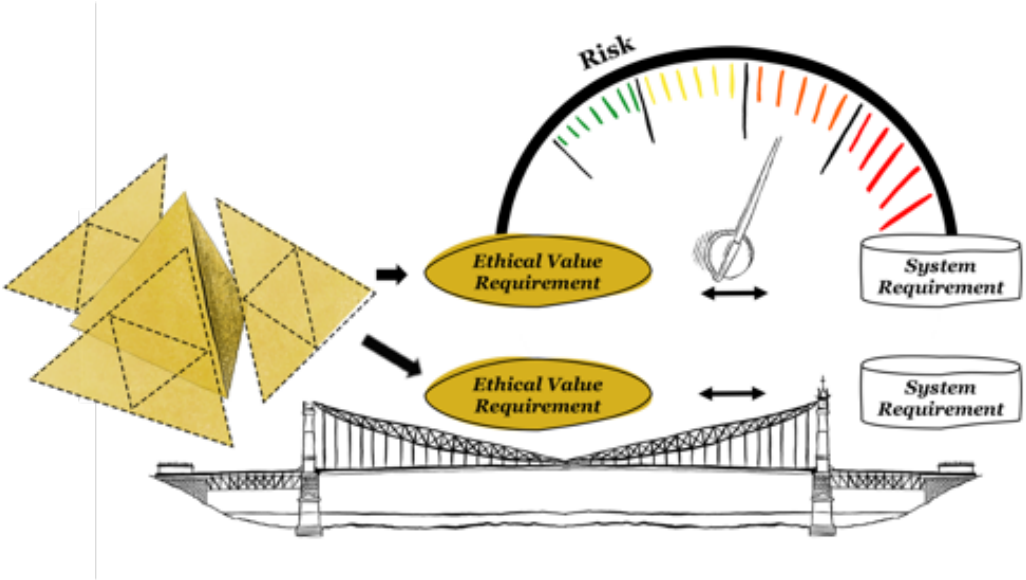
Principle 9:
Understanding Values in Depth



An Ethically aligned Design is Risk-based

Once core values are prioritized and analyzed, their alignment with system requirements can start. All sets of prioritized core values with value qualities are first translated into so-called "Ethical Value Requirements" (EVRs), which are qualitative descriptions of what should be done to actualize a value quality. These EVRs are then translated into system requirements. Principle 10 of Value-based Engineering requires organizations to do this translation with the help of a risk rationale.

Principle 10:
Using Risk-Analysis for System Requirements Elicitation



Normally, EVR translation into system requirements is done with a simple risk-based approach; that is, with the help of a threat-control analysis. The threat-control analysis scrutinizes each EVR to see how it could be undermined or "attacked." In other words it is being asked whether there is a threat that the EVR might not be reached. Then, in a second step, it is considered how a potential undermining of an EVR could be mitigated. Mitigation implies concrete technical measures taken or system policies in place. Expectations of partners are clarified as well as partners' operational restrictions and service levels. In short: One or more organizational and technical system requirements are identified for each EVR. The technical system requirements are then integrated into the organization's existing functional product roadmap, which is managed by the technical development units bringing the system up and running.

Risk Assessment-based Design

Sometimes core values and their value qualities may be of particularly high importance for an organization investing in a system. For example, privacy and security are values of the highest importance for banking systems; or reliability and transparency may be particularly important values for financial trading systems. Likewise, ensuring patient health and safety is crucial for any medical or body-attached system. Value-based Engineering (unlike IEEE 7000™) recommends that organizations analyze where particularly high value-expectations or liabilities are associated with a system-of-interest. And if there are such "high-risk" values, then the organization should embrace not only a simple threat-control-based risk design, but engage in a proper impact assessment-based system design. Impact assessment-based design is also a "risk-based" system design approach, but it is much more rigorous than a

simple threat-control analysis (see, for example, the NIST standard for system security (NIST, 2013)).

Ethically Aligned Design needs iterations and adjustment

Finally, it is well known that new products and services are regularly put to unexpected uses. In most cases, once an SOI is deployed it is not used in full alignment with the intentions of the engineers. Negative as well as positive value effects appear where nobody expected them. Think of the Facebook "like" button as an example that was introduced by the social network with the good intention of giving users the possibility to provide their peers with positive feedback. Only in the aftermath did it become clear that this like button can breed addiction to the service—as well as an unexpected amount of envy on the platform (Krasnova, Widjaja, Buxmann, Wenninger, & Benbasat, 2015). When a system causes such unexpected value harms, then a Value-based Engineering process foresees an iteration. A value like the avoidance of envy is inserted as a new system priority. This priority is then conceptually analyzed and EVRs are identified, triggering system requirements that mitigate the unexpected value harm. Organizations should therefore constantly monitor the market's value reactions to the system and then be ready to adjust their system design accordingly.[vii]

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[i] I am of course aware that I am using the word "Design" here ambiguously. There is a design-phase in a technical engineer's system development life cycle. This is not what graphic designers, architects, artists, etc. would understand by the term, though. They understand "design" probably as an accumulation of concretized ideas and sketches, while an engineer would understand by "design" a much more detailed machine model (such as a UML activity diagram or a process model).

[ii] Important in such a difficult value-tense decision space is to maintain an inner stance of what Evagrius Ponticus (345–399) would have called "Apatheia"; that is to not feel tempted to be drawn to one side from the very start, but to listen and try to understand what a valuable path can be in this context, honestly weighing the views.

[iii] The Friedman doctrine is still discussed among many businesses still pursuing its guidance in practice. However, even conservative media have started to turn away from it. The Economist said in 2016 that a focus on short-term shareholder value has become "a license for bad conduct, including skimping on investment, exorbitant pay, high leverage, silly takeovers, accounting shenanigans and a craze for share buy-backs, which are running at $600 billion a year in America".[7] In 2019, influential business groups such as the World Economic Forum and the Business Roundtable updated their mission statement, leaving behind the Friedman doctrine in favor of "stakeholder capitalism"[20] (at least on paper if not in widespread practice[21]).

[iv] Note that I speak of three "blocks" here. I could also talk about three "stages" or "phases" of system engineering. However, I avoid these terms, because system engineering was for a long time dominated by a sequential "system development life cycle" thinking, such as the waterfall model, which is now perceived as too rigid and cumbersome for technology projects. Instead, highly iterative and agile forms of system analysis, design and implementation have become the industry norm, which go away from the kind of sequence thinking that is signaled by words like "stages" or "phases."

[v] Note that value qualities are called "value demonstrators" in IEEE 7000™. For more detail on value qualities and their ontological role in the value phenomenon see my lecture on "What values are."

[vi] Note that the term "Conceptual Analysis" has been recognized as important by Value Sensitive Design scholars like Batya Friedman (Friedman & Kahn, 2003), who has promoted and used this analysis for a long time.

[vii] This last process of validation, monitoring and iteration is not well elaborated on in IEEE 7000™. Here, Value-based Engineering clearly diverges from the standard provided guidance on risk-based design for highly sensitive systems.