# Bringing Ethical Values into Agile Software Engineering

ESE @ ETHICOMP 2024

School of Computer Science

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# Abstract

 In principle, it is well understood how software engineers should behave; codes for ethics and professional conduct collect principles providing related guidance. However, these codes do not translate seamlessly into tangible advice for software engineering routines on development projects, for instance those applying agile principles. Value statements and principles in documents can easily be ignored, e.g., by busy engineers. Conflicts arise in practice, for instance, between public and commercial interests and between stakeholder groups. To improve the situation, we investigate three research questions:

1. How can ethical awareness be stimulated and integrated into agile software practices?

- 2. How can ethical concerns be actively identified and weighted against other requirements?
- 3. How can methods and tools trigger, assist, and validate ethical behavior on agile projects?
- To answer these questions, we propose *Ethical Software Engineering (ESE)* as an active, integrated approach to value-based software engineering advancing the passive, retrieval-based state of the art.
- Here, we report on first method engineering results and outline our plans for future work on ESE.



#### Agenda

Background information and motivation

#### → IEEE Standard 7000

- → Agile practices
- Problems and solutions
- → Ethical Software Engineering overview
- → Story Valuation practice details
- Validation and discussion
- Summary and outlook



# Motivating Example: eCommerce System

- Epic:
  - Add a "Same Day Delivery" capability to an online convenience store that sells groceries etc.
- Stakeholders and their concerns:
  - Shoppers, shop manager/owner, product suppliers, delivery contractors (self-employed); developers
  - Values (business, ethical): convenience, profit, business growth, health, income; quality of life, fairness, ...
- Conflicts:
  - Tough time commitments may please shoppers and stimulate growth, but also stress delivery contractors
  - Core value "care": quality of life for shopper differs from quality of life of delivery staff and store owner
    - Autonomy vs. care (core values); transparency vs. privacy (core values)



Should the epic be implemented? If so, what are the ethical consequences of that?



#### **Background Information and Motivation**



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Extreme Programming	Scrum	Design
Teams	Product Management	Testing
Lean	DevOps	Fundamentals

## The Agile Subway Map

Source: https://www.agilealliance.org/agile101/subway-map-to-agile-practices/

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## **Practical Use Cases and NFRs for Value-Aware Methods**

- Support for the **roles** defined in IEEE Std. 7000:
  - Senior Product Manager, , User Expert, System Expert, Risk Lead, Value Lead
- Integrate into mainstream agile practices
  - See Subway Map and mapping tables



STANDARDS ASSOCIATION

> IEEE Standard Model Process for Addressing Ethical Concerns during System Design

- Critical Success Factors
  - Do not dictate any school of ethics, rather facilitate the elicitation process
  - Make conflicts visible/explicit, support context-specific tradeoff finding; fixed guidelines: (im-)possible?
  - Fit value work into sprints (2-3 week iterations)
  - Find suited level of abstraction/refinement and granularity (system? epic? feature?)



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# Mappings to and from IEEE Standard 7000

Agile Practice	Related Concept in IEEE Std. 7000	Comments
User Story (as Product Backlog Item)	Functional system requirement	see ESE FAQs <sup>7</sup>
Sprint Planning	no direct mapping	parts of all processes executed in each iteration
Definition of Ready	EVRs elicited (Clause 9)	V in INVEST widened
Definition of Done	Design artifacts produced and reviewed (Clause 10)	from Scrum, many templates/criteria
Sprint Review	Verification and validation activities in all processes	Novel practice in ESE: Ethical Review
Retrospective	no direct mapping, contributes to Transparency Management Process	many variation

#### • Not straightforward

- Agile methods usually do not foresee explicit, sequential analysis and design phases
  - Some analysis and design happens tacitly in each sprint/iteration
  - Notion of MVP, arch, spike, sprint 0

User stories as backlog items seem to be
the ideal carrier/anchor point for value-
related analysis and design work

- Analysis = requirements elicitation; design = modeling, coding, ...
- Architecture design methods (e.g. ADD, ATAM) seem to be closer to IEEE Std. 7000

IEEE Std. 7000	Related Agile Practice	Comments
Clause 7: Concept of Operations (ConOps)1 and Context Exploration Process 2	no direct pendant; epics as input	Concepts in HCI/UX community such as personas, Context Diagram in DPR
Clause 8: Ethical Values Elicitation and Prioritization Process	User Stories and related practices (e.g., backlog refinement/grooming)	Novel practice in ESE: Story Valuation
Clause 9: Ethical Requirements Definition Process	User Stories and related practices	Mapping, splitting; estimation/planning games such as planning poker
Clause 10: Ethical Risk-Based Design Process	n/a (implicit, evolutionary/emerging)	Related literature: "Domain-Driven Design" (E. Evans), "Just Enough Architecture" (G. Fairbanks)
Clause 11: Transparency Management Process	no direct mapping	Ethical Review Meeting/Report, in ESE design decision logs from DPR

Source: own presentment (adopted from ESE repository)



From Value-Based Systems Engineering to Ethical Software Engineering (ESE)

### **IEEE 7000 and ESE – Process/Practice Overlay**



**Reference:** "Relationship of processes and stages in IEEE Std 7000" (Figure 1 in "IEEE Standard Model Process for Addressing Ethical Concerns during System Design")

Solution: Ethical Software Engineering (ESE)

# **ESE Building Blocks**



+ indicates enhancement of existing practice

BAU – Business As Usual



#### Story Valuation Technique Goals and Vision First (aka Question-Based Elicitation)



How does the future system (product, service) **make the world a better place**? Which **ethical values** does it promote?





If there were no explicit, external stakeholder goals and business drivers, why is it still a good idea to develop the system?





Which **positive ethical values are degraded** by any realizations of the envisioned functionality? Which **negative values are promoted**? What are the related **elements of risk**?



How do positive and negative values, as well as **benefits and harms**, relate to each other? What is their **relative and/or absolute weight**?



Which **resources** will the system consume, and **can** this **consumption be justified** by the business/user and ethical values that it delivers?





#### Story Valuation Technique *Individual Values First* (aka Catalog-Guided Value Mapping)

Ethical value applicable to system design	Related value	Opposing value	<sup>e</sup> Tab	le source: Annex G of IEEE 7000, <u>https://ieeexplore.ieee</u>	.org/document/9536679
Autonomy	Moral agency, dignity, independence, freedom, liberty, mobility, self-direction, power, self-actualization, ownership	Accountability, responsiveness, recipropaternalism, slavery	sibility, ocity,	Select Core Value	
Care	Accountability to shareholders, investors, suppliers, and other stakeholders; understanding; compassion; love; empathy; protection of the vulnerable; affection; support; friendliness; beneficence; benevolence; generosity; gentleness; helpfulness; kindness; comfort; quality of life; paternalism	Torture, maleficence, persecution, machine capability, logic, object	tivity	2 Illustrate (in Story/Fx	ample)
Control	Human responsibility, governance, usability, portability, logic, sense of accomplishment, moderation	Trust, accountability to stakeholders; imaginati reminding, obedience	) ion,		
Fairness	Responsible position on conflicts of interest, tolerance, justice, balance, equality (legal, gender, minority)	Bias, suspicion, discrimination, arbitrar	riness	<b>3</b> Prioritize	
Inclusiveness	Participation, partnership, solidarity, interdependence, compatibility, accessibility, diversity	Control, bias, detachme	ent		
Innovation	Modifiability, adventure, novelty, excitement, playfulness, diversity, development, learning, curiosity, creativity	Tradition, distraction	Ethical value	Related value	Opposing value
Perfection	Integrity, truth, honesty, achievement, transcendence, universalism, wisdom	Competence, feasibilit over-capacity,	applicable to system design		
Privacy	Respect for confidentiality, intimacy, anonymity	Transparency, inclusiveness, alerting	Sustainability	ustainability Respect for environment and natural habitat, efficiency, maintainability, operability, supportability, reliability, durability, resilience, forgiveness, robustness, redundancy, reusability, re-configurability, simplicity, economy, renewability Cost (extra wastefulne	
Respect	Politeness, courtesy, respect for environment	Self-esteem, maleficer			
	confidentiality, respect for norms, reputation		Transparency	Openness, cleanliness, explicability, explainability, access to data. auditability	Privacy, bribery, corruption
0	0		Trust	Predictability, dependability, veracity	Control
* ~	Xalue Concerns of	<u> </u>	NOTE-Opposir	g values can be positive or negative.	
Λ Υ Υ	Stakeholders?	) 옷 ㅈ			

Story Valuation Technique User Requirements First (aka Story-Driven Value Jam)

### **User Story as Source of Values and Value Requirements**



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#### Ethical Software Engineering (ESE)

# Notation (1/3): Overview (Templates Partially Validated)

- IEEE Std. 7000 Value Register, comprising multiple value clusters
  - ESE does not mandate a certain format; overview figures and comparison tables can be well suited. But ESE still suggests three novel formats (note that these deviate from the examples in the standard):
    - Value Epic, Value Weighting, Value Narrative, see later slide
- Ethical Value Requirements (EVRs):
  - Extended user story format, see later slide
- Value-Based System Requirements (VBSRs):
  - VBSRs may adopt the Quality Attribute Scenario (QAS) table format from the SEI
    - Stimulus, source, environment, artifact, response, response measure
  - Alternative: structured sentence resembling those used to record Architectural Decision Records (ADRs)



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#### **Ethical Software Engineering (ESE)**

# Notation (2/3): Value Register Entries (3 Templates)

As a [stakeholder role/group], I value [core value], as demonstrated in: - a realization of [related level - a reduction of [opposing level This value cluster has [H, M, L]	1 values] 1 values]. priority for me.	Value Epic	کی Any favorite? Anything missing?
Value Weighting	In the context of SOI [Name], stakeholder [Role/Group] values [Value 1] more than [Value 2] expecting benefits such as running the risk of harms such as		more than [Value 2]
When the SOI executes [epic user stakeholders expect it to promot possibly degrading or prohibitin with the following externally of	r story/use case te, protect or cr ng [values] oservable and/or	NN], reate [values], internally auditable behav	Value Narrative



# Notation (3/3): Extended User Story Template for "EVRs"

EVR-nn: As a [role] I want to [action/feature] so that [benefit] is achieved and that [positive values a, b, c] are [created/supported/promoted/protected], and that [negative values a, b, c] are [discouraged/reduced/violated], accepting that [positive values x, y, z] are [discouraged/reduced/violated], accepting that [negative values x, y, z]\* are [created/supported/promoted/protected].



Does this method design element meet the design goals stated earlier? How will the agile community react to it/receive it? Is this template faithful to/still compliant with IEEE 7000?



#### Ethical Software Engineering (ESE)

# **ESE Validation and Initial Adoption/Reception**

• General feedback on readability, applicability, and usefulness was positive

#### • Experiences:

- Scope/level: epic better suited than single feature story
- *Timing:* not necessarily on each sprint (or sprints only); what about upfront product vision work?
- *Techniques:* VT 2 appreciated most, followed by VT 1
  - Participant not yet familiar with IEEE Std. 7000
- Challenges and risks identified and partially addressed already:
  - Scalability
  - Time management
  - Dealing with conflicting stakeholder interests
  - Visualization challenges
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#### **Summary and Outlook**

# **Take-Away Messages**

- It is possible and beneficial to combine the standard with agile practices
- More validation required, see instructions in experimentation folder in ESE repo:
  - <u>https://github.com/ethical-se/ese-practices/tree/main/experimentation</u>
- Open issues:
  - Notations, visualization of Value Register and Value Requirements and designs addressing them
  - Scalability and change management:
    - Many stakeholders, many opinions and beliefs; many system features
    - Many values, many conflicts
  - Effort management, acceptance (incentives?)
  - Support for conflict resolution and tradeoff management



#### **Summary and Outlook**

# **More Information**

- **ESE repository** (open access/source, public):
  - <u>https://github.com/ethical-se/ese-practices</u>
- IEEE Std. 7000
  - Much more than a process specification!
- Academic papers
  - E.g., by Sarah Spiekermann et al.
- My personal blog <u>«The Concerned Architect»</u>
  - Technical writing advice
  - Architectural decision making and capturing
  - Softeware services, cloud-native traits
  - Misc ramblings
  - Future work: posts on ESE



IEEE Standard Model Process for Addressing Ethical Concerns during System Design

Olaf Zimmermann (ZIO)

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# The Concerned Architect (ZIO's Blog)

*Why is this blog called "The Concerned Architect"?* Software architects<sup>1</sup> (hopefully) address functional and non-functional stakeholder *concerns.*<sup>2</sup>



Thank you very much for your attention – feedback appreciated!

Q&A





#### **Ethical Software Engineering (ESE)**



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# **Practice Synopses**

Practice	Description	Comments
Story Valuation	As a responsible software engineer, I want to craft working software that delivers value to users and other stakeholders while not harming any individuals, society and/or the planet. I also want to identify goal conflicts so that adequate tradeoffs can be found.	Entry point
Definition of Ready	See Agile Alliance glossary	Extended existing concept
Definition of Done	See Agile Alliance glossary	Extended existing concept
Ethical Review	An Ethical Review Report captures the results from an ethical values- enhanced (or -centric) sprint/project Ethical Review Meeting. It may include mere meeting notes and/or an assessment with follow up actions (aka recommendations and findings).	Frequency may vary
Value Retrospective	As a team of agile practitioners, we want to reflect periodically whether we are doing the rights things and whether we are doing things right. There always is room and opportunity for improvement. Being concerned about ethics values, we want to improve our value-based engineering practices continuously.	Requires strong moderation

