



A Roadmap for Ethics- Aware Software Engineering

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Abstract

- ▶ In today's world, the software is highly intertwined with our lives, and it possesses an increasing ability to act and influence us. Besides the renowned example of self-driving cars and their potential harmfulness, more mundane software such as social networks can introduce bias, break privacy preferences, lead to digital addiction, etc.
- ▶ Additionally, the software engineering (SE) process itself is highly affected by ethical issues, such as diversity and business ethics. This paper introduces ethics-aware SE, a version of SE that defines a roadmap that illustrates the necessary steps for the SE research and practice community in order to fully realize ethics-aware SE.

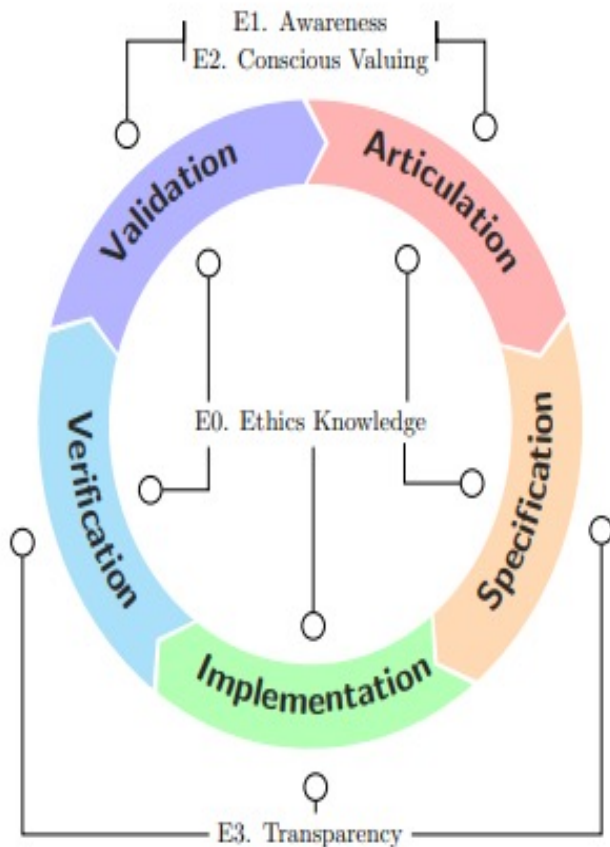
Introduction

- ▶ We know that humans are the centerpiece of most software engineering (SE) phases, including requirements elicitation and specification, development, verification and validation, maintenance and evolution. Moreover, software projects and products arise to fulfill stakeholders' needs and wishes, and the resulting systems are utilized (directly or indirectly) by human users.
- ▶ In this paper, we introduce ethics-aware SE, the ethics-aware version of SE that fosters the elicitation and analysis of stakeholders' values and their inclusion both in the socio-technical process through which software is built, and in the resulting software product.
- ▶ We present ethics-aware SE by means of an analytical framework, which assists stakeholders in analyzing ethical issues in terms of the subject (software artifact or SE process), the ethics value to be preserved (diversity, privacy, autonomy, eco-sustainability, discrimination, etc.), and the object that is threatened when compliance with the value is not ensured (user, developer, etc.).

Population targeted

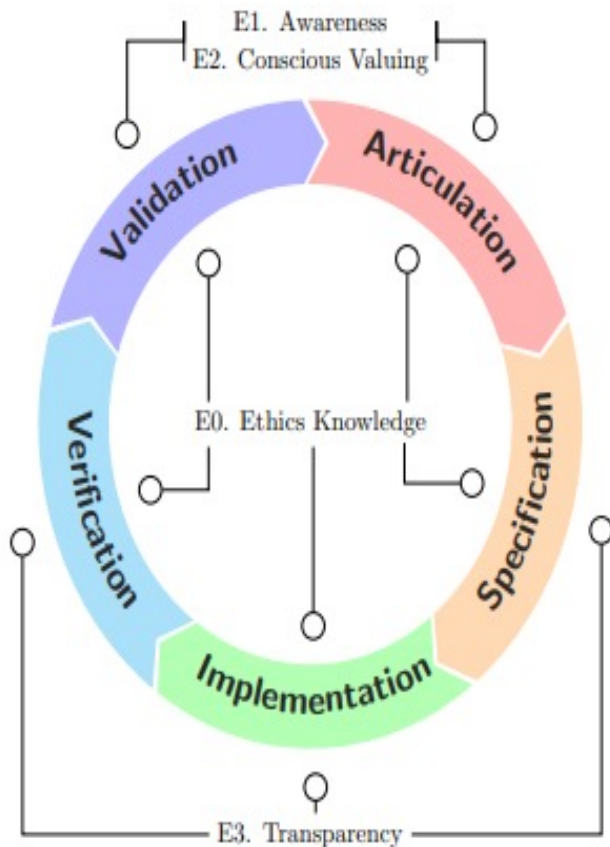
- ▶ Targeted Users:
 - ❑ Stake Holders.
 - ❑ Software Professionals.
 - ❑ Users.
- ▶ A code of conduct is a set of guidelines for its intended audience. In the case of SE, a code of conduct for software engineers is a set of rules for the software professionals to follow. However, many other stakeholders are involved in the development, release, and usage of software including customers, software development organizations, and users. There is therefore a need for tools and methods to reflect, implement, and validate the ethical values of these parties, who are not disciplined by the existing code of conducts.

The Ethics-Aware SE Method



- ▶ Figure illustrates the high-level method for ethics-aware SE. The method is agnostic of specific development paradigms; its activities can be embedded in any method including agile, waterfall, iterative, and V-model.
- ▶ Five distinct phases of the method are shown in a cycle which indicates that being ethics-aware is not a one-shot activity, but rather requires continuous effort as long as the software artifact is being built, maintained, and used.
- ▶ Figure also lists four distinct enablers of being ethics-aware in software engineering practices (E0–E3).

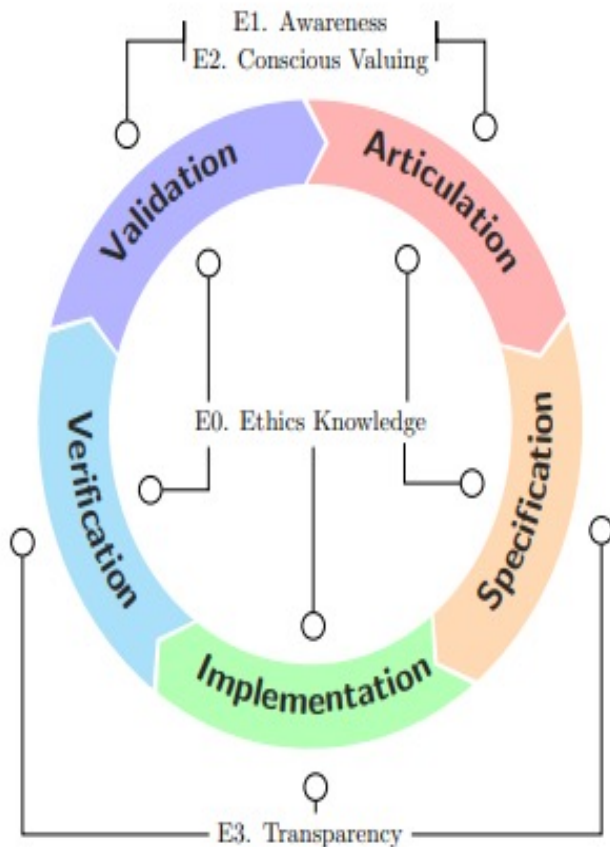
The Ethics-Aware SE Method



► Articulation

- ❑ This activity involves eliciting, modeling, and analyzing ethics values, what we call ethics requirements for software artifacts and their development processes.
- ❑ However, the voices of SE professionals also need to be heard to ensure the harmony between them and the organizations they work for, as well as the products they build. Similarly, software organizations should declare their ethics values to ensure that their processes and products are aligned with their values in the subsequent activities. Articulation can be included in the traditional requirements engineering activities for software stakeholders.

The Ethics-Aware SE Method



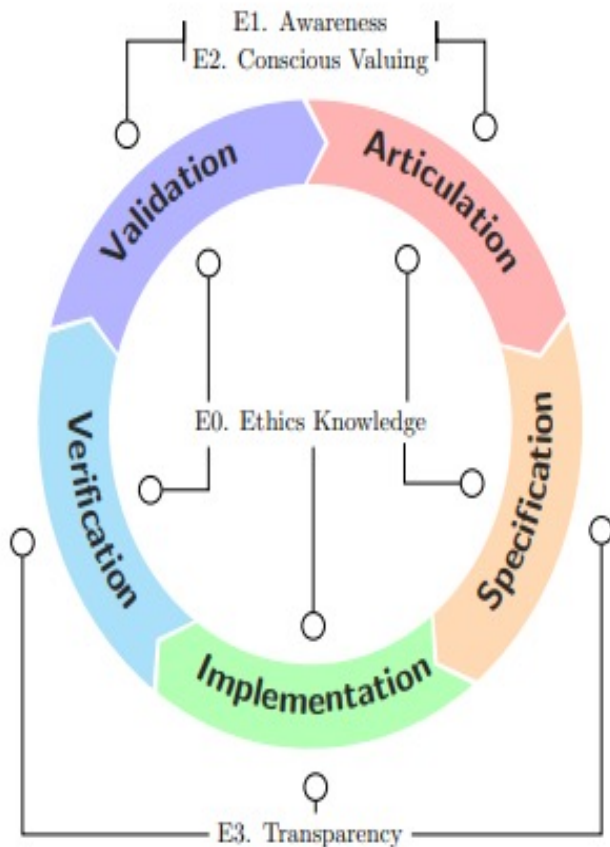
► Specification

This activity fills the gap between the ethics requirements and the corresponding functional and quality requirements on software artifacts and processes.

► Implementation

From the ethics-aware software engineering perspective, the implementation activity not only refers to writing code and documents for software products, but also building software development processes based on the ethics specification.

The Ethics-Aware SE Method



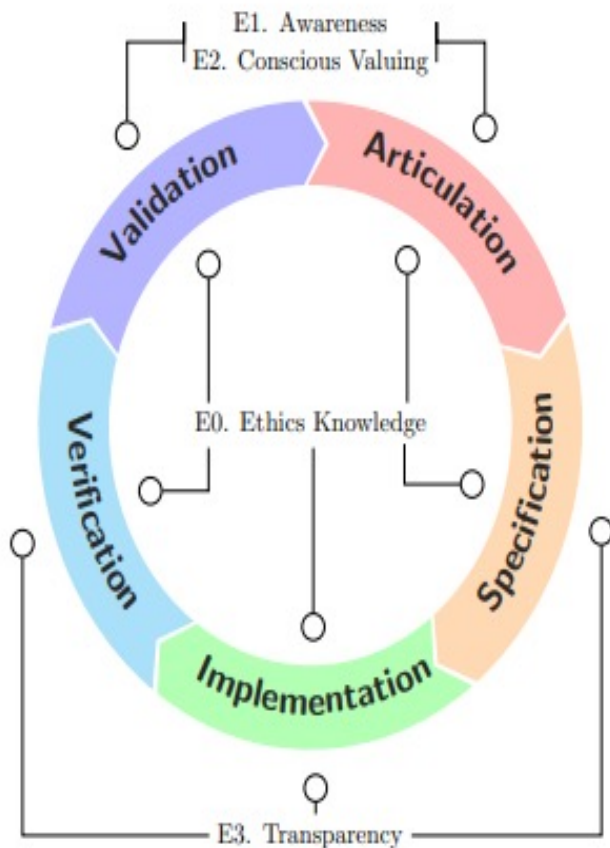
► Verification

These activities involve both the software artifact and the software development processes and require organizations to put in place appropriate means to continuously check that the software is being built according to the ethics specification.

► Validation

These activities check whether the software artifact and the development processes the ethics requirements imposed by the stakeholders at the beginning of the process.

The Ethics-Aware SE Method



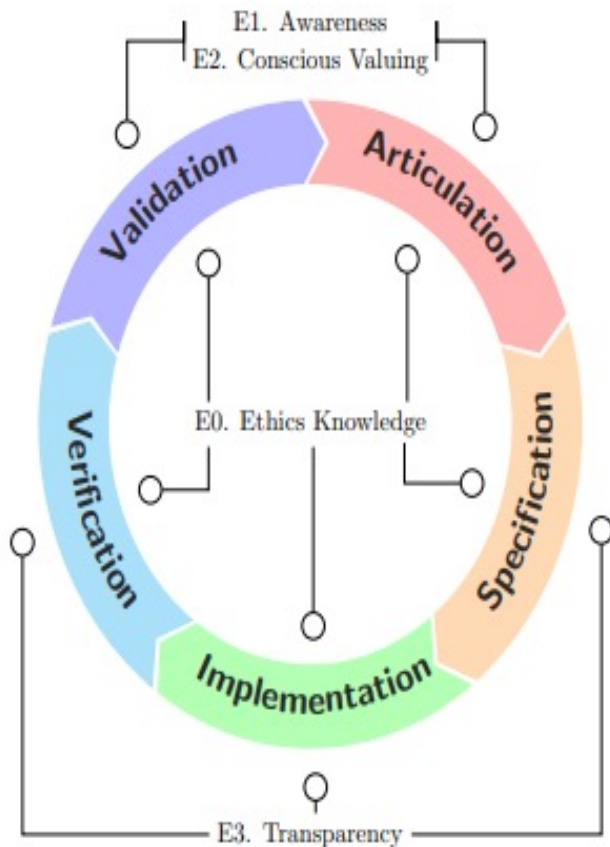
► E0: Ethics knowledge

First and foremost, this is required for each step involved in the method. Users, professionals, and organizations should know about ethical issues related to SE to decide whether they care about these issues, and what is their desired “right” behavior for each issue.

► E1: Awareness

All stakeholders must be aware of the ethical issues and their consequences within the realm of SE. Issues are discussed and treated only when there is a wide awareness about them.

The Ethics-Aware SE Method



► E2: Conscious valuing

Awareness alone is not enough. The stakeholders must develop a conscious value for issue in discussion. If a certain issue, such as accountability of the software engineers for algorithmic bias does not have a value for the public, they will not articulate their requirements for the issue for they do not care about it.

► E3: Transparency

In order to ensure that the behavior of the artifact as well as software development processes follow the specification, transparency is key. Software development processes and the behavior of the artifact must be transparent so that they can be validated against the ethics requirements.

Research questions

- ▶ What are the relevant ethics issues for software engineering?
- ▶ Which visual notations can help capture ethics requirements?
- ▶ Which techniques can help trace ethics requirements?
- ▶ How can we validate software against ethics requirements?

Strengths and Weaknesses

► Strengths

- ❑ Major ethics issues in software engineering are discussed clearly in this paper.
- ❑ The flexibility of embedding the ethics-aware SE method in any software engineering process including agile, waterfall, iterative, and V-model.

► Weaknesses

- ❑ The four enablers (E0, E1, E2, E3) can be explained more clearly by mentioning the exact areas where this enablers has importance in software engineering processes.
- ❑ Lack of explanation on how we can embed this ethics-aware SE method into the currently ongoing software engineering system.

Major Findings

- ▶ Major ethics issues in software engineering.
- ▶ The Principle of Harmony.
- ▶ The Ethics-Aware SE Method.

Conclusion

- ▶ In this paper, The authors have proposed an ethics framework for the SE discipline. The framework aims to capture and analyze ethics requirements to achieve ethical harmony that is reflected in software artifacts and development processes.
- ▶ The aim is to provide an umbrella ethics framework that educates end users as well professionals on ethics, and that provides alternative solutions based on their individual and organizational values as well as their requirements. The goal is not to declare right and wrong behavior ourselves, but rather to create awareness on the existence of ethics issues and possible behaviors that respect ethics requirements of stakeholders involved in building and using software.



Thank You