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Never Mind the Codes of Conduct. DARE You to Tackle Ethics in Software Development for eHealth

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Abstract. Currently, there are no adequate methods for dealing with changes in the healthcare system brought about by electronic health applications (eHealth) or the associated ethical implications in practice. This can be attributed to the lack of comprehensive interdisciplinary approaches that could support teams in integrating ethical considerations into the agile software development process. To close this gap, the DARE approach has been developed and tested in interdisciplinary collaborative research. The DARE method is a modular system designed to improve the development of ethically sound software in a deliberative, agile, and responsive manner.

Keywords. eHealth, Software Development, Applied Ethics, Agile, DARE

1. Introduction

The ongoing "digital revolution" [1] is causing major transformations within social structures that are in some ways comparable to those brought about by industrialization in the 19th century. With the introduction of digital technologies into many areas of life (in areas such as enhanced safety in transport, greater participation for people with disabilities or in improved care), profound changes are taking place for both people and society.

Progress in the electronic health (eHealth) sector is not only ensuring that medical care is more personalized for patients, more efficient and accessible to more people, but it also brings about fundamental changes on a society-wide scale [2]. However, the nature and extent of this change and its moral implications have been so far insufficiently recorded and reflected, especially in the area of technological progress: in software development [3]. One reason for this may be that the situation is rather confusing, particularly concerning eHealth. After all, various fields of applied ethics overlap here,

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insofar as data ethics, medical ethics, business ethics and technology assessment are all at stake.

One way to counter these disruptive changes is to incorporate ethical considerations already into the software development process of eHealth applications. Agile development approaches are especially suited because of their iterative nature. To date, two alternative approaches have been adopted in particular: first, the introduction of (ethical) guidelines into software engineering, which provide catalogues of ethical principles that are important in the software development process, and second, the development of frameworks that are designed to contribute to the development of ethically sound software.

1.1. Integrating Ethics in eHealth-Development: Existing Methods and Approaches

Codes of conduct and ethical guidelines for software engineering are now available in large numbers. Approximately 91 publicly accessible guidelines have been established in Europe alone, particularly for the application and use of algorithmic systems [4]. In terms of substance, the various guidelines show major parallels with one another, as they are based on central principles such as transparency, non-maleficence, responsibility, justice & fairness, privacy, benevolence and solidarity [5].

Another established alternative for integrating ethics into software development are frameworks. At the moment, 4 frameworks are at the center of interest, especially with regard to AI development: The »Responsible Design-Process-Framework« [6], the »Ethics Canvas« [7], the »ECCOLA«-method [8], and the »EDAP« scheme [9] all of them having a main focus on artificial intelligence and its ethical implications.

1.2. There are Methods, aren't there? – Weaknesses

For both, frameworks and guidelines alike, the main difficulty remains in the translation of the abstract academically oriented principles into practical application (i.e. real-world decision-making situations). [9, 10].

Further points of criticism can be raised regarding individual frameworks [10]. While the first three frameworks listed above focus primarily on the area of conceptual »As-Is« analysis and fail to disclose the normative presuppositions within the decision-making process, the EDAP scheme improves on this as it also focuses on the development process. However, it is not intuitively understandable and applicable in practice for software developers due to its complex philosophical terminology and academic provenance.

Since eHealth application development ideally involves interdisciplinary teams consisting of, e.g., nurses, doctors, researchers and software developers, additional difficulties arise: *(1)* Firstly, there is a multitude of approaches, methods and frameworks in the various disciplines that are not necessarily compatible with each other. *(2)* Secondly, even if there is compatibility, it is not always clear how the interaction between the disciplines can be designed at the interfaces. And finally *(3)* it is impossible or at least too time-consuming for developers to select the "right" methods and frameworks from the multitude, which, in case of doubt, would allow an ethically justified decision.

2. Methods

The DARE approach was developed in joint interdisciplinary research between implementation sciences, nursing sciences, software engineering and ethics. In the accompaniment of a multi-year eHealth project, elements from existing procedures and frameworks (ECCOLA, Ethics Canvas, Moral Case Deliberation [11]) were taken up, further developed and adapted for the use case of agile software development.

The resulting method was tested in a 3-day-workshop with designers and software developers and thereafter optimized for usability and comprehensibility. Subsequently, initial pilot tests with agile teams as part of software projects (n=7) at Augsburg University of Applied Sciences were conducted and further feedback implemented.

3. Results

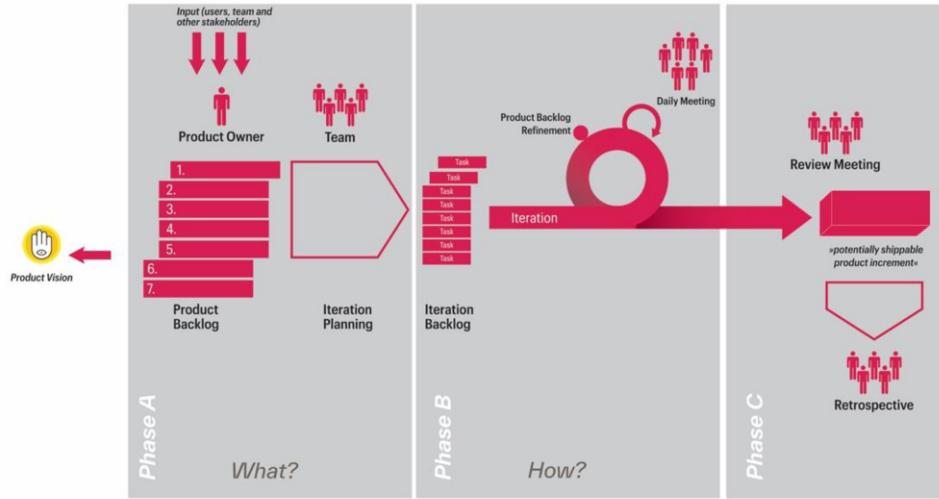

Figure 1. The DARE-method can be implemented in agile development processes without disrupting familiar procedures. In particular, it can be integrated into phases A, B, and C. The overarching »As-Is«-analysis takes primarily place in phase A, providing valuable information collected on the canvas that is important for implementation in the sprints. In phase C, the results are subsequently evaluated in order to make any necessary adjustments for the next iteration.

With the DARE-Method, we have developed a modular system that aims to avoid precisely these problems. I.e. in a **D**eliberative, **A**gile and **R**esponsive way, **E**thics are integrated into development processes.

Its advantages can be seen in 5 core aspects: *(1)* DARE helps to bridge the gap between principles and practice by guiding the team through a transparent process of descriptive »As-Is«-analysis and by explicating the normative premises in the practical syllogism of evaluation. *(2)* Secondly, the method is responsive inasmuch as it can be easily adapted to different team and project sizes and requirements. Furthermore *(3)*, its application is not specifically tailored to AI projects (even if AI applications can be addressed) and can therefore be used for a broader range of applications in eHealth. The implementation of the method *(4)* does not need big upfront steps. The set and its

application are *(5)* easy to understand and adapted to the context of agile development in terms of terminology and internal structure. It is a ready-to-use set that is tailored to fit the idea of the *Informative Workspace,* which is crucial for agile methods like »XP«, »Scrum«, »Crystal«, or »Lean Software« [12-14]

The DARE-Method & Set includes:

- Big **whiteboard-canvas** for display in the workspace; this canvas-grid is primarily used for »As-is«-analysis (*phase A*; **Figure 1)** and records important descriptive facts about the context, stakeholders and product vision as well as central values and communicates them to the team;
- **Guiding questions** (descriptive and prescriptive) tailored for »As-is«- as well as »To-be«-Analyses, conducted at all *phases A–C* (cf. **Figure 1)**;
- Set of **flash-cards with main ethical principles**; the cards explicate 9 different »middle principles« derived from several fields of applied ethics which are important for ethically informed decision-making with regard to the development, implementation and use of eHealth applications. They are mainly introduced in *phase A* and accompany the iterative development process through all *phases A–C* in order to make the normative premise visible;
- Set of »**Ethical Estimation Poker**«-Cards; these cards are used as a part of the prescriptive analysis to prioritize identified ethical principles. In line with the deliberative practice of a process-ethical approach [15, 16], evaluation standards are developed in a consensus-oriented manner;
- Colored dots (green, red, yellow) to mark certain aspects of the »As-is« analysis in the grid according to traffic light coding. In this way, both critical and/or unproblematic topics are highlighted for the development team and can be recognized at a glance;
- DARE-Manual.

The DARE-Method can be excellently integrated into agile development without disrupting familiar processes, principles, and events in several phases of the iterative process (see **Figure 1)**.

The DARE-Method differs from existing procedures by explicitly conducting both a descriptive "is analysis" and a prescriptive "ought analysis," formulating the otherwise implicitly assumed normative premises and applicable principles. In this way, ethically informed evaluations can be made, and specific recommendations for action can be developed without falling into the gap between theoretical principles and practice.

4. Discussion

Although the DARE-Method seems to be a promising procedure for integrating ethics in agile development, there are some limitations, one has to consider: We are pursuing a pragmatic approach here, which is primarily intended to contribute to practicable solutions in specific use cases. However, this also implies possible potential drawbacks. For example, it is entirely possible that important aspects may be overlooked or not sufficiently considered by the participants in the course of the process.

Especially at phase A (see **Figure 1)**, when the comprehensive »As-is«-analysis of the descriptive level is carried out, the team (or in scrum: particularly the Product Owner) bears a great deal of responsibility, as it is important to collect all the important aspects

and information that should be included in a comprehensive assessment. This burden may need to be countered by special training that can impart the necessary know-how and provide confidence in decision-making.

5. Conclusions

The use of this novel method in initial tests has proven that it is perfectly suitable for use in student software projects. But still, further tests are needed to prove the actual feasibility of the method for everyday development work. Although some tests have already been carried out in individual software projects and eHealth sub-projects, there is still a lack of end-to-end support for an eHealth project from the outset.

In order to be able to integrate ethical reflection into the development of eHealth projects in the long term, not only a functioning method that has proven itself in practice is needed, but probably also a sensitization of the developers working on such projects. This could be achieved through customized workshops and through appropriate adjustments in the training of software developers.

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