EA-Ontology: Ethical Assessment Ontology*

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Abstract

Technological advancements have brought the need to analyse and evaluate the potentially negative impact that technologies might have on individuals, society and the environment. More and more voices are being raised in favour of carefully examining technologies from an ethical perspective at different stages of their development, especially at the early stages. Several methodological approaches have been proposed to ease the analysis and guide involved actors in the assessment process. In this preliminary work, we propose the Ethical Assessment Ontology (EA-Ontology). This ontology models the ethics assessment of emerging technologies according to two relevant approaches in the ethics and technology area, namely, Anticipatory Ethics for Emerging Technologies (ATE) and Assessing Expectations Methodology. Additionally, we propose some specific classes to model a complete ontology with general information about the emerging technology. The EA-Ontology has been developed according to the Linked Open Term methodology and published with WIDOCO. The final aim of this work is to use the proposed model for the annotation of the ethical assessments manually produced by experts in the context of the PROTECT EU project, and others that might be available (such as the use cases produced by the SIENNA project).

Keywords

Ethics Assessment Ontology, Emerging Technologies, Anticipatory Ethics for Emerging Technology, Assessing Expectations, Ethical Issue

1. Introduction

Emerging technologies are technologies in which five attributes are identifiable: (1) they have to be radically novel, and (2) relatively fast growing; (3) they have to be characterised by a certain degree of coherence, and (4) with the potential to exert a considerable impact on the socio-economic domain; and, finally, (5) they have to be in a phase that is still somewhat uncertain and ambiguous [1]. Emerging technologies are commonly analysed at the Research and Development stage (RD). Precisely at this stage, such technologies should also be evaluated as for the ethical issues that could arise from their employment, so that users could better

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prepare for the future, and ethical undesirable consequences could be minimised. [2].

In recent years, the research about ethics in emerging technologies has taken important steps which have led experts in the area to propose several approaches to guide the ethical analysis of emerging technologies.

In the framework of the PROTECT International Training Network [1], our aim is to evaluate and refine methodologies and tools to support privacy and ethics assessment of advanced personalisation technologies. Specifically, our work is focused on providing semantically enhanced tools to support the ethics assessment of emerging personalisation technologies. For that purpose, we have analysed two theoretical approaches to ethical assessment, namely, Philip Brey's Anticipatory Technology Ethics [3] and Lucivero et al. [4] Assessing Expectations, and have merged them in an ontological model, the Ethics Assessment Ontology (EA-Ontology).

The *Anticipatory Ethics for Emerging Technologies* (ATE) methodology was formulated by Philip Brey and is explained in [2]. ATE includes ethical principles, issues, objects of analysis, levels of analysis, and research aims. Moreover, the approach created by Brey is particularly intended to predict the use and the social consequences of future technology, i.e., to technology forecasting. Assessing Expectations is proposed by Federica Lucivero et. al. in [5]. Assessing Expectation is exactly about assessing the plausibility of promises and expectations in a technology. The aim of this approach is to study the feasibility, usability and desirability of the expectations.

In the context of the PROTECT project, these two complementary approaches have been used with the purpose of identifying the potential ethical issues of emerging technologies and performing a forecast analysis of expectations. The internal documents resulting from this work (Personalisation case studies) have been taken as the starting point for the ontology engineering work presented in this paper. Additionally, we have also considered the deliverables resulting from the SIENNA project, specifically D4.4 [6].

Another work we have considered is the AI Risk Ontology (AIRO) [7]. AIRO aims at representing in an interoperable manner risks of harm related to AI systems, in agreement with the requirements of the EU AI Act [8]. However, it does not seem to rely on any methodological approaches to ethical assessment, nor relate ethical issues directly to expectations.

The rest of the paper is structured as follows: Section 2 presents the Ontology Design, describing the Methodology and Ontology Overview. Section 4 concludes our work.

2. Ontology Design

2.1. Methodology

Linked Open Terms (LOT) [9] is the methodology used for the development of the EA-Ontology. LOT defines a basic workflow with four steps:

- Ontological requirements specification: The two methodological approaches presented at the Introduction of this paper define the goal of our ontology and are taken as the basis for its development. Additionally, we consider several case studies produced in the context of European projects, since no real assessments seem to be available.

[1] https://protect-network.eu

Finally, we specified the technical requirements of the ontology (e.g., the use of Chowlk[2] and Widoco[3]).

- Ontology implementation: To develop the ontology, we identify the core concepts, relations and properties that describe the domain. In the work at hand, we have used the notation proposed in the Chowlk tool [10].
- Ontology publication: We use WIDOCO [11], a tool for generating HTML documentation of ontologies. The ontology is evaluated by modeling example use cases from PROTECT and Deliverable 4.4 of the SIENNA project. EA-Ontology is provided in: **https://protect.oeg.fi.upm.es/eaontology/eaontology_widoco/index-en.html** with its documentation.
- Ontology maintenance: In the case of changes of requirements, the ontology will have to be revised as a new version with appropriate documentation of changes.

2.2. Ontology Overview

The main classes and relations in the Ethical Assessment Ontology (EA-Ontology), are illustrated in Figure 1. Only a reduced version has been included here for the sake of readability. For the whole version of the ontology, please see https://protect.oeg.fi.upm.es/eaontology/eaontology_widoco/index-en.html. The green shaded classes are the classes that describe an emerging technology. The orange shaded ones represent the information about ethical issues, and the purple ones represent the information about expectations.

The main classes about Emerging Technology are: (1) Technology, (2) Artifact, (3) Application, with respect to which an emerging technology is ethically evaluated; the (4) "Feature(s)" of the emerging technology, (5) the "Function(s)", (6)User, who is divided into (7)Main User and (8)Secondary User, and (9) the specific "Context Of Use" in which the emerging technology is supposed to be employed.

On the other hand, the core classes in the Ethical Issues part are: (10) Ethical issue, followed by (11) the Likelihood of affectation, (12) Severity of affectation and (13) Overall affectation of the ethical issue; Ethical issues are classified according to a taxonomy that contains 79 ethical issues classified into four categories. The ethical issues taxonomy has been revised in the context of PROTECT according to the ethical principles traditionally recognized in Ethics and in documents such as the Universal Declaration of Human Rights. Even though the four main categories are not illustrated in the figure, they are: Harm and Risk, Right, Well-being and Common Good.

Finally, the classes that describe the Expectations are: (14) Expectation and three subtypes: (15) claims about the characteristics and functioning of the technology, i.e., Technological Feasibility, (16) Social Usability, which includes claims about how the technology will be adopted by the intended users and (17) claims about how the technology will address a social problem or need, that is, Desirability.

Any expectation or claim is based on evidences, understood as the information or data that supports an assertion. The class (18) Evidence has been previously defined in a highly similar

[2]https://chowlk.linkeddata.es
[3]https://dgarijo.github.io/Widoco/doc/tutorial/

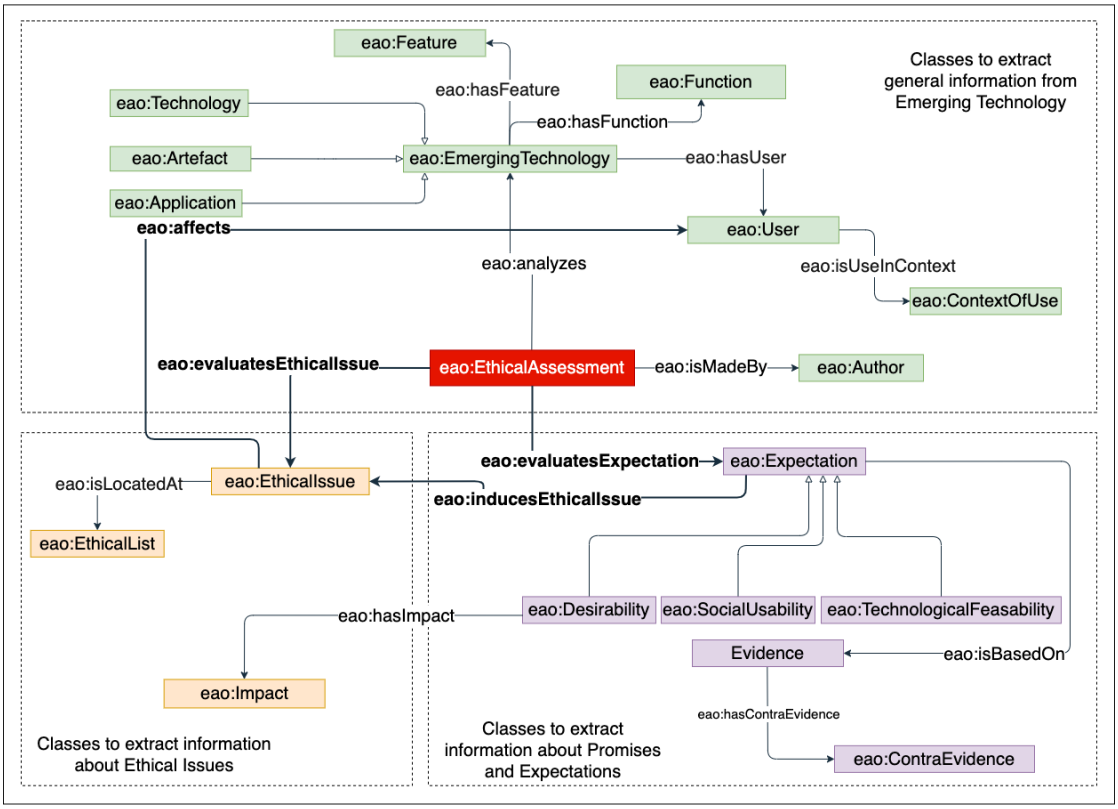

Figure 1: Overview of EA-Ontology's main classes and relations

way in the EBOCA Evidence Ontology [4][12], and, therefore, we decided to import it here. This class allows us to refer to the textual information (paragraphs) in which those expectations are supported, and account for the provenance and authors of the information.

3. Conclusions and Future Work

The ontology described in this paper is a first attempt to model the main aspects involved in the ethical analysis of an emerging technology. EA-Ontology identifies the two key points in that assessment: Expectations and Ethical Issues. Furthermore, the EA-Ontology accounts for the evidence that allowed the ethical expert to make those claims about expectations and ethical issues. In this paper, we illustrate the usefulness of the EA-Ontology with a real use case made by and expert in Ethics.

Our objective is to use this ontology as the groundings to implement a wizard that will assist ethicists and technology developers in assessing emerging technologies. This will also allow to annotate the result of such an assessment and capture data in a queryable semantic format.

[4]https://drugs4covid.github.io/EBOCA-Evidences-Ontology/index.htmlhttp://purl.org/dc/dcmitype/Software

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