Reporting Ethics Considerations in Software Engineering Publications

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Abstract—Ethical guidelines of software engineering journals require authors to provide statements related to the conflict of interest and the process of obtaining consent (if human subjects are involved). The objective of this study is to review the reporting of the ethical considerations in Empirical Software Engineering - An International Journal. The results indicate that two out of seven studies reported some ethical information however, not explicitly. The ethical discussions were focussed on anonymity and confidentiality. Ethical aspects such as competence, comprehensibility and vulnerability of the subjects were not discussed in any of the papers reviewed in this study. It is important to not only state that consent was obtained however, the procedure of obtaining consent should be reported to improve the accountability and trust.

I. INTRODUCTION

Research ethics is a concern for researchers, sponsors and subjects [1]. Unethical approaches by researchers towards the subjects might lead to loss of their trust [2]. Unethical research might result in loss of funding [1], industry-academia collaboration, access to subjects or other resources [1]. In addition, ethical issues in relation to authorship might hamper the rapport between the researchers. Sponsors could impact the research ethics by imposing rules for participation. For example, making it mandatory or influencing the subjects to participate in the study.

Ethical issues are also a concern for the subjects and the organizations. The subjects involved in the research study should understand the consequences of participation in terms of potential harm. Harm could be any form of dismissal, for example, loss of employment [1] or loss of reputation [2]. In addition, every potential subject/participant must be aware of the purpose and procedure of the research, potential conflict of interest, benefit for them and provide their consent before participation only if the information is understandable to them. In special cases obtaining consent could be exempted, for example, if the data is publically available then the risk of causing harm to the subjects is minimized [1]. However, it depends on the what conclusions are drawn from the publicly available data.

In software engineering research and practice the evaluation of human aspects such as performance is becoming a common practice to determine the project success and outcomes [3] and [4]. Research involving human subjects or collection of the data that could be linked to identification of a subject requires ethical protection and consent [2].

Singer and Norman [1] identified four aspects of ethical considerations applicable to empirical software engineering as follows: informed consent, scientific value, beneficence (human and/or organization) and confidentiality. Three out of four (informed consent, beneficence and confidentiality) of the ethical aspects are directly linked to the participation of the subjects. Consent could impact the scientific value depending on how the subjects are selected and involved in the research study. The discussions in this report are limited to the subject's impact on scientific values.

Discussing ethical considerations and procedure to comply with ethical standards in medical research contributes to improved accountability and trust of subjects and world at large [5]. Editors in software engineering journals require discussions on the compliance with ethical standards when submitting a paper to their journals. It is important that such discussions are not limited to templated statement stating that consent was obtained rather elaborated on the procedure of how consent was obtained [5]. In this report, research articles in Empirical Software Engineering - An International Journal are reviewed for reporting of ethical considerations.

In Section II, the ethical considerations that should be addressed in software engineering publications are mentioned. The procedure for reviewing the articles for reporting of ethical considerations is described in Section III and the results are mentioned and discussed in Sections IV and V. Finally, the report is concluded by discussing the possible objections and advantages of reporting ethical considerations in Section VI. The primary studies reviewed in this paper are mentioned in Section VII.

II. WHAT ETHICAL CONSIDERATIONS SHOULD BE ADDRESSED IN SCIENTIFIC PUBLICATIONS?

Ethical issues applicable to empirical software engineering are discussed in a study [1]. Mainly four ethical aspects are discussed as follows:

1) Informed consent - Full informed consent of the participant is important. It can be obtained by making sure the following aspects are communicated:
   - Disclose the purpose of the study, research approach, who will access the raw data and for what

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purpose, risks to the subjects, anticipated benefits for the subjects and statement offering to answer subject's questions.
- Ensure that the participants comprehend the information provided in the consent form.
- Identify the vulnerability of the participants to ensure that there is no undue influence and exploitation.
- Inform the importance of voluntariness.
- Inform the right to terminate participation.

2) Scientific value - It is evaluated in terms of importance of the research topic and the rigor of the research procedure. However, as mentioned in the introduction the discussions in this report are limited to the subject's impact on the scientific value.
3) Beneficence (human) - Maximizing the benefits to the society and the subjects and minimize the harm (risk-benefit ratio).
4) Beneficence (organization) - Minimizing the harm to an organization when uncovering issues and challenges in a company.
5) Confidentiality - It includes anonymity and confidentiality of the data. Anonymity involves not collecting any data that can identify or trace an individual or an organization. Confidentiality is referred to protection of the raw data and only publishing the aggregated results that cannot be traced to an individual or an organization.

The informed consent form should include information about beneficence and confidentiality as they are related to each other and it is important to obtain consent on the procedure of ensuring beneficence and confidentiality.

III. PROCEDURE FOR REVIEWING THE REPORTING OF ETHICAL CONSIDERATIONS IN EMPIRICAL SOFTWARE ENGINEERING - AN INTERNATIONAL JOURNAL

The selection of the journal was based on the its empirical nature and that the journal's ethical guidelines state the following -
Authors should include the following statements (if applicable) in a separate section entitled Compliance with Ethical Standards when submitting a paper:
- *Disclosure of potential conflicts of interest*
- *Research involving Human Participants and/or Animals*
- *Informed consent*

The guidelines explicitly state that ethical considerations should be reported as a separate section. Therefore, the papers published in this journal in the year 2017 (issues 1 and 2) and 2016 (issues 4, 5 and 6) were reviewed. The review was based on the reporting of the informed consent, scientific value, beneficence and confidentiality (defined in Section II). Note that the aim is to review the reporting of the ethical considerations and not to determine if the research was ethical or unethical.

Inclusion and exclusion criteria: The sampling of the papers was based on the papers that employ human subjects or

TABLE I
DATA EXTRACTION TO REVIEW REPORTING OF CONSENT

Informed consent
Disclosure
Q1. Was the purpose of the research communicated?
Q2. Was the procedure of the research communicated?
Q3. Were the risks to the subjects communicated?
Q4. Were the anticipated benefits for the subjects communicated?
Q5. Is the statement to offer answering subject's questions included?
Comprehension
Q6. Was subject's comprehensibility discussed?
Competence
Q7. Were the subject's competence and vulnerability reported?
Voluntariness
Q8. Was the importance of voluntariness discussed?
Right to terminate
Q9. Was the right to termination communicated?
Scientific value
Q10. Was the importance of the research topic reported?
Q11. Was the rigor of the research procedure reported?
Beneficence (human)
Q12. Was risk/benefit ratio reported?
Beneficence (organization)
Q13. Were attempts to minimize the harm when uncovering problematic processes in a company reported?
Confidentiality
Q14. Was the procedure to anonymize the subjects reported?
Q15. Was the procedure to protect confidentiality of the subjects reported?

that involve collection of the information that can lead to the identification of an individual or an organization. The papers that did not need consent were excluded. Examples of the excluded papers are methodological papers, systematic literature reviews, solution proposals, studies that collect information that is publicly available (data from open source) and studies that do not involve human subjects or authors themselves are subjects. The following details were extracted from the papers -

1) Research methods - The research methods used by the authors are extracted. If more than one research methods are used, then only those methods that involve human subjects and require consent from the subjects are included in the review process. In a blind survey where the identification of the respondent is not traceable may be exempted from obtaining consent [1].
2) Type of data collected - Details on what data is collected in the study is extracted.
3) Subjects involved - The subjects participating in the study are identified.
4) How the authors obtained informed consent? - The procedure of how the consent was obtained is extracted (Table I is used to answer this question).

IV. REVIEW RESULTS

In total, 54 papers were screened from volume 22 issue one and two and volume 21 issue four, five and six. The inclusion and exclusion criteria mentioned in Section III were applied on the papers. In total, seven papers were included and the data was extracted. The references to the papers are provided in Section VII.

TABLE II
DATA EXTRACTION RESULTS

ID	Research Method	Type of data collected from subjects	Subjects involved	Consent reported? *
P1	Case study	Procedure of how programmers do change impact analysis, name of the organization and the years of experience	Students and employees	Yes
P2	Experiment	Years of experience, the skills of the subjects and evaluation outcome (done by subjects)	Students and employees	No
P3	Case study	Inspection time and number of defects	Organization	No
P4	Experiment	*Independent variables* - domain familiarities, creativity, experience, educational background. *Dependent variables* - Raw number of ideas, average number of relevant ideas, average number of innovative ideas.	Students and employees	Yes
P5	Case study	Non-work related messages including personal life messages	Offshore and onsite employees	No
P6	Experiment	Time, Total Number of Errors, Ease of Learning	Students	No
P7	Case study	Extraversion, Agreeableness, Intellect/Imagination, Emotional Stability and Conscientiousness	Students and employees	No
* - The details of the data extraction w.r.t. to the consent are discussed in Sections IV-A and IV-B.				

Sensitive information for example, the performance, skills and capabilities of the subjects are collected as mentioned in third column in Table II, it is clear that consent should be obtained from the subjects. As seen in Table II, two out of seven studies reported consent information. However, it must be noted that the consent information was not reported in the paper itself rather in a link provided in both papers. The details of each paper with respect to the procedure of how consent was obtained will be discussed starting with the papers (P1 and P4) that have reported the consent of the subjects. The papers that reported the consent information are discussed in Section IV-A and the papers that did not discuss any ethical considerations are discussed in Section IV-B.

A. Papers discussing ethical considerations

Two papers that discuss consent information of their subjects are described as follows -

- **P1 -** The link provided in P1 was a link to the repository that could be used for reproducing the research. It was not explicitly mentioned that the link also provides consent information. On exploring the different files in the repository the consent form was found, interestingly, the consent form file was named as user study instructions. Given the way the link was referred in the paper and the repository was organized it can be said that finding the consent form was not easy. As mentioned in Table II, the information on how the developers do change impact analysis is evaluated. The procedure of obtaining consent is reviewed based on the review questions in Table I.

Some of the details were clearly mentioned in the consent form such as the purpose (Q1) and procedure (Q2) of the research, statement offering to answer subject's questions (Q5), importance of voluntariness (Q8) and right to termination (Q9). The importance of the research topic (Q10) and the rigor of the research process (Q11) were also stated clearly. Case study

guidelines were followed. The subjects were not the actual developers. However, this limitation was discussed and mitigated by providing the information subjects needed.

Risks to the subjects (Q3) is communicated by stating that there is no harm. However, it is not clear how there is no harm to the subjects which has further implications on other ethical aspects as discussed in the following paragraph. The benefit for the subjects (Q4) was not communicated. Benefit to the research community in terms of contribution to the knowledge area was discussed. However, benefit to the subjects except for monetory benefit was not discussed. Remuneration $45 per hour was provided as a monetory benefit.

The lack of information of risks and benefit has further impact on comprehensibility (Q6) and risk/benefit ratio (Q12). The author of P1 asked if the information is understandable in the consent form however, if the information is brief then it makes it difficult to ensure that the subjects have a good understanding of the research study. The results indicated that the subjects do the change impact analysis after fixing the bugs rather than before fixing the bug as recommended by the literature. Such results might have an impact on the reputation of the subjects. The risk of linking the results to the participants is not discussed. It is specially a concern since the number of participants are only nine. Witnessing the researcher and subjects interaction can easily identify the subjects [1]. In particular, this is true as the number of subjects are few and too diversified. Out of nine subjects, four were PHD students from two universities, two subjects were from industry, one from each company. The identities of three other subjects were withheld due to privacy. It was not reported why the identity was withheld for some subjects and not for the others who could be identified easily due to the small

number of subjects from diversified organizations. The risk of identifying the subjects in relation to the benefit for the subjects were not discussed and reported in the paper. The beneficence in regards to the organization (Q13) is not applicable in this study.

The anonymity (Q14) and confidentiality (Q15) is also not achieved. The anonymity for all subjects was not consistent. Some were anonymized while the other subject's identity could be traced through the data reported in the paper (see Table II - Name of the organization and the years of experience). It was not clear why the procedure was not consistent. The data from the subjects is presented without aggregation. This impacts the confidentiality of the subjects as it can be linked to the subjects. Also, given the sample size was small, aggregation does not help in protecting the confidentiality.

Finally, the competence and vulnerability (Q7) of the subjects were not discussed. It is important to determine as the subjects (students and employees) are vulnerable to exploitation (students by the teachers and employees by managers).

In conclusion, even though P1 reports (somehow in a hidden manner) the procedure of obtaining consent from subjects, it still lacks reporting of several crucial aspects such as anonymity, confidentiality and risk/benefit ratio which are important. This emphasises the need to not only report ethical considerations as part of a mandatory process but also rigorously address the ethical considerations.

- **P4 -** The details of the ethical consideration were not reported in the paper. However, a link was provided to the details of the study procedure. The procedure of approaching the subjects was mentioned in the link also the subjects were assured that the clearance from the ethical board was obtained. All the review questions in Table I except for comprehensibility (Q6) and competence and vulnerability (Q7) were covered in the consent form used by the authors in P4. Similar to P1, risks to the subjects (Q3) is communicated by stating that there is no harm. Unlike, P1 there was no reason to suspect this as the anonymity and confidentiality was clearly stated in the consent form as follow: *Once the data are logged, each name will be replaced by a unique number in the data and the relationship between the number and the name will not be recorded. Then the original data will be shredded.*

The aggregated results were presented hence, it was not linked to the raw data as the sample size is not too small. Also the details about who will access the raw data and for what purpose was communicated to the

subjects. The following was mentioned in the consent form: *The information will be kept in a locked desk in the principal investigator's office, and in password-protected computer accounts. Paper records will be confidentially shredded after one month. Anonymized electronic data will be kept indefinitely.* Benefit to the subject (Q12) was discussed as follows: *You may benefit from being exposed to new techniques in requirements elicitation that you will be able to use effectively in your professional career.* Remuneration of $30 for the approximate 90 minutes was provided to the subjects.

As mentioned earlier the students' competence and vulnerability to exploitation is not discussed and the process of ensuring the comprehensibility of the subjects is not discussed. Overall, P4 scored the highest coverage of the review questions in Table I in comparison to the other papers reviewed in this report.

B. Papers not discussing any ethical considerations

The following discussions are related to papers (P2, P3, P5, P6 and P7) that did not report ethical considerations is any form.

- **P2 -** None of the ethics concerns related to the subjects were discussed in P2. The subjects included six students (master and Ph.D. students) and four practitioners from a company. The university name and the company name were not anonymized. In addition, the company mentioned was also the sponsor of the study which emphasises the need to ensure that the subjects were not exploited by the management. The years of experience and the skills of the subjects were reported as mentioned in Table II. It was clear that the subjects could be identified due to the small number of subjects. The technique discussed in the paper was evaluated and as the subjects were not under evaluation the potential harm to the subjects is minimized. However, since the subjects include students and employees both that are identified as vulnerable subjects in software engineering, obtaining consent becomes necessary. It must be ensured that the subjects are protected from any harm. Coercing employees to participate as research subjects can result in collection of invalid data [1]. In this case, the data collected from the subjects was used to evaluate effectiveness of the solution. If it is not ensured that subjects provide valid data under no undue influence, the evaluation results might provide wrong information. Thereby making it difficult to prove the scientific value of the research study.
- **P3 -** In P3 the subjects were anonymized. However, sensitive data of the organization in terms of defects were reported. The company's name was anonymized and the results were aggregated. More than 150 projects were evaluated over a period for four years hence, the aggregated results could not be linked to an individual or a project. However, the consent from the company is

necessary to make sure that the participating organization is aware that the harm to the organization is minimized or eliminated.

- **P5 -** In P5 personal data which is non-work related was collected. It is not clear how the subjects were ensured that there is no harm for them as it was not reported. The risks of exploiting personal information should be mentioned.
- **P6 and P7 -** Students' data was collected by teachers in P6 and P7. There is no reporting of how the consent was obtained. The authors of P7 recognize the threat that the students might give answers that the teachers expect them to. However, it was discussed as a validity threat rather than an ethical issue. Ensuring the vulnerable subjects that there is no harm, risk or exploitation is an ethical process that should be addressed.

V. Discussions

Based on the review process it is clear the ethics discussions are focussed on anonymity and confidentiality. The ethics aspects reported in [1] are beyond anonymity and confidentiality. Even when subjects are anonymized and their confidentiality is protected it is important to obtain their consent to ensure that the subjects are informed about the study, are aware of any potential harm in terms of loss of reputation, loss of employment (employees) or receiving lower grades (students). It is important to ensure that the subjects do not feel exploited and comprehend all the information provided to them.

The recommendation to improve comprehensibility have been suggested in medical research. Recommendations are made to use plain language [1] and [5], provide consent form in the subject's preferred language [6] and discuss between the researchers and subjects to improve comprehensibility [5]. Students and employees are used as subjects to evaluate project or individual outcomes. Hence, they are important subjects and cannot be eliminated as vulnerable subjects are sometimes eliminated in medicine research [7]. However, the power of researchers, management and sponsor should be minimized if cannot be eliminated. Researchers should access the ability of the subjects to provide informed consent [8].

VI. Conclusion and Future work

Possible objections of reporting ethical considerations - The reporting of ethical considerations may seem like providing a templated statement stating that the consent was obtained. In addition, some researchers might regard it as superficial and pro forma. P1 would fall under this category. Hence, merely stating consent was obtained is not enough, a detailed procedure of how the consent was achieved should be described either in the report or an external link containing the information should be provided in the paper with correct referencing. Providing an external link will also mitigate the problem of space constraints in publications. This solution to the problem is well described by Franklin and Rosenstein [8] - *"A slightly longer article should be a price worth paying for enhanced accountability"*. The details in Table I could be used as a template to describe the procedure of obtaining consent.

Advantages of reporting ethical considerations -

- The practice of reporting of ethical considerations will encourage researchers to critical think about the applicable ethical issues and address them in the study design.
- Reporting innovating ideas to address ethical considerations will help other researchers to utilize them in their study.
- Consciously thinking about ethical considerations will help in eliminating any unethical accusations. Reporting of ethical considerations will improve accountability and trust in the research study.

Future work - The future work will be focussed on identifying additional and upto date ethical aspects that are relavent to the pervasive data collection methods in software engineering.

The review procedure will be extended to cover more issues from several software engineering journals to understand the state-of-practice of reporting ethical considerations. Future work is planned to find if the lack of reporting of the ethical aspects is stemming from the researchers not being aware of these aspects, being aware but not implementing them in practice or implementing and not reporting?

Guidelines on how to report ethical considerations in software engineering research is also planned as future work. Another planned future work is to provide recommendations on how to ensure that the research is ethical. For example, appropriate way of ensuring that the participants in vulnerable positions (students, employees) are not exploited by the managers/teachers/sponsors.

VII. Primary Studies

P1 - Jiang, Siyuan, Collin McMillan, and Raul Santelices. "Do Programmers do Change Impact Analysis in Debugging? "Empirical Software Engineering 22.2 (2017): 631-669.

P2 - Mkaouer, Mohamed Wiem, et al. "A robust multi-objective approach to balance severity and importance of refactoring opportunities." Empirical Software Engineering 22.2 (2017): 894-927

P3 - Vitharana, Padmal. "Defect propagation at the project-level: results and a post-hoc analysis on inspection efficiency." Empirical Software Engineering 22.1 (2017): 57-79.

P4 - Niknafs, Ali, and Daniel Berry. "The impact of domain knowledge on the effectiveness of requirements engineering activities." Empirical Software Engineering 22.1 (2017): 80-133.

P5 - Wang, Yi, and David Redmiles. "Cheap talk, cooperation, and trust in global software engineering." Empirical Software Engineering 21.6 (2016): 2233-2267.

P6 - Li, Xiang, Chetan Mutha, and Carol S. Smidts. "An automated software reliability prediction system for safety critical software." Empirical Software Engineering 21.6 (2016): 2413-2455.

P7 - Kosti, Makrina Viola, Robert Feldt, and Lefteris Angelis. "Archetypal personalities of software engineers and their work preferences: a new perspective for empirical studies." Empirical Software Engineering 21.4 (2016): 1509-1532.

REFERENCES

[1] J. Singer and N. G. Vinson, "Ethical issues in empirical studies of software engineering," *IEEE Transactions on Software Engineering*, vol. 28, no. 12, pp. 1171–1180, 2002.

[2] J. E. Sieber, "Protecting research subjects, employees and researchers: Implications for software engineering," *Empirical Software Engineering*, vol. 6, no. 4, pp. 329–341, 2001.

[3] L. Bao, J. Li, Z. Xing, X. Wang, X. Xia, and B. Zhou, "Extracting and analyzing time-series hci data from screen-captured task videos," *Empirical Software Engineering*, vol. 22, no. 1, pp. 134–174, 2017.

[4] R. Harper, C. Bird, T. Zimmermann, and B. Murphy, "Dwelling in software: Aspects of the felt-life of engineers in large software projects," in *ECSCW 2013: Proceedings of the 13th European Conference on Computer Supported Cooperative Work, 21-25 September 2013, Paphos, Cyprus*. Springer, 2013, pp. 163–180.

[5] M. Jefford and R. Moore, "Improvement of informed consent and the quality of consent documents," *The lancet oncology*, vol. 9, no. 5, pp. 485–493, 2008.

[6] R. L. Sudore, C. S. Landefeld, B. A. Williams, D. E. Barnes, K. Lindquist, and D. Schillinger, "Use of a modified informed consent process among vulnerable patients: a descriptive study," *Journal of general internal medicine*, vol. 21, no. 8, pp. 867–873, 2006.

[7] A. E. Shamoo and D. B. Resnik, "Strategies to minimize risks and exploitation in phase one trials on healthy subjects," *The American Journal of Bioethics*, vol. 6, no. 3, pp. W1–W13, 2006.

[8] F. G. Miller and D. L. Rosenstein, "Reporting of ethical issues in publications of medical research," *The Lancet*, vol. 360, no. 9342, pp. 1326–1328, 2002.