

State of the Practice for Sustainability as an Explicit Objective

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Abstract. Sustainability in its various facets has become an important aspect of engineering software. However, we have only few guidelines on how to incorporate sustainability as an overall objective from the very beginning of software systems development.

In previous work, we provide a discussion on including sustainability during requirements engineering and while taking software product management decisions. To gather further information about the state of practice, we propose this questionnaire to investigate more real life examples from the experience of the survey participants.

These data points will facilitate insights on the state of practice and allow us to improve the description of a systematic guidance. Both makes incorporating sustainability easier to apply for requirements engineers.

Keywords: Sustainability, value-based software engineering, requirements engineering, decision-making, software product management

1 Background & Motivation

Over the last decades, sustainability research has emerged as an interdisciplinary area; knowledge about how to achieve sustainable development has grown, while political action towards the goal is still in its infancy [2].

Sustainability must be discussed with reference to a concrete system in order to be meaningful—such as an ecological system, a human network, or even a specific software system. Furthermore, sustainability has a number of different aspects, inter alia an economic, social, and environmental perspective [1,6]. The fact that when humankind talks about sustainability, we usually refer to the objective of maintaining our own well-being over an extended period of time, means that even an explicit focus on environmental sustainability will necessarily entail some social and some economic considerations. Therefore, within the scope of our research, we target environmental sustainability as major aspect, but this can only be achieved if we consider overall sustainability as main objective. For IT or software systems, sustainability can be understood in two ways:

- Green *in* IT: Any IT system can be modified (“greened”) in such a way that it (a) consumes less energy, (b) is manufactured using sustainably produced hardware components, (c) is developed using a sustainable development process, and (d) uses renewable energy sources. The scope is the software system as status quo technical system independent of the specific purpose of the system. This is also denoted as Green IT and a well-known example are green data centers.
- Green *through* IT: On top of Green *in* IT, the scope can be extended to take into account the system purpose. This means considering different types of solutions for making our lives more sustainable, for example software systems that support saving resources (carbon foot print trackers, smart home applications, energy-saving apps), sharing resources (car sharing, tool sharing, server sharing), and informing systems (educational systems on climate change, water pollution, biodiversity, environmental hazards).

Both of these understandings yet have to be explored in a more systematic way by requirements engineering as well as by software engineering in general. Software Engineering for Sustainability³ [3,5] has developed as a current focus of research due to sustainability being advocated as major objective for behavior change on a global scale.

2 Surrounding Research & Study Plan

The online questionnaire “Sustainability in Value-based Software Engineering” was created on the basis of previous work presented at the International Workshop on Software Product Management at REFSQ 2013. In that paper, we discussed the importance of incorporating the different aspects of sustainability into product management decisions [4].

In addition to the discussion at the workshop, we prepared the online questionnaire belonging to this proposal. As it triggered only 23 responses after advertisement at the workshop and informal advertising in the personal network of the presenting author at the conference, we want to conduct a second round in a separate data set to retrieve more responses that allow for statistic significance.

The study is expected to gather further information about the state of practice. We propose this questionnaire to investigate more real life examples from the experience of the survey participants.

These data points will facilitate insights on the state of practice and allow us to improve the description of a systematic guidance. Consequently, the plans on the continuation of the study after REFSQ14 are (1) to make the results available to participants and research community, (2) to enrich the description of how to incorporate sustainability into software decisions with concrete examples, and (3) to fine-tune our guidance.

³ <http://se4s.ics.uci.edu/>

2.1 Goal & Hypothesis

Our goal is to get an insight into the rating of importance and the state of practice of including the different aspects of sustainability in the community as well as to gather experiences from practice in dealing with sustainability issues.

Our hypothesis is that the values representing the aspects will be rated with a higher importance than their current consideration will be rated. Furthermore, we expect that at least half of the participants call recall various situations of their personal experience in software development where these values might have been considered.

2.2 Benefits

The data points will facilitate insights on the state of practice and allow to improve the description of a systematic guidance. Both makes incorporating sustainability easier to apply for the requirements engineering community. The analysis will be shared with the participants and reported to the research community. Furthermore, the result data of the study will be made available to the community.

2.3 Subjects

The only prerequisite for being a subject is having developed software at some point during the subject's career, independent of the size of the system. We are interested in the whole range of experiences and backgrounds—persons who are currently requirements engineers, persons who have requirements engineering experience, or it could even be software engineers in general (including requirements engineers as well as receivers of requirements down the line).

The benefits to the subjects of participating in the study are (1) a reflection on how they personally incorporate sustainability into their current decision making, (2) an insight on how their peers incorporate it when the results are analyzed, and (3) improved guidance with enhanced examples on how to incorporate sustainability aspects into decision making when the guide is reworked.

To motivate participation, the first author will advertise throughout the conference in person and hand out little paper slips with the QR code and URL of the questionnaire. Apart from convincing potential participants in personal conversation, we will also hand out little give-aways and sweets to create a playful version of a favor to call in. This simple psychological tweak does not always work but has helped in the experience of the authors.

2.4 Development and Planned Analysis

We follow the standard procedures for questionnaires according to the literature. The questionnaire was prepared in draft iterations that were reviewed internally (by all authors) and externally (by researchers not involved in the project). The questionnaire will be available online from the start day of the conference to the

end of the following month (7th April - 31st of May 2014), so that participants can fill it in either directly at the conference or in the weeks to follow. The data will be gathered by the tool Unipark Questback (<http://www.unipark.info>) and analyzed in June '14. We will consolidate the data of closed and open questions and visualize the results in appropriate ways.

3 The Questionnaire

This questionnaire (print version attached) evaluates a list of value aspects that should be taken into consideration for incorporating sustainability while taking software product management decisions. In the given context, these 'management decisions' are all decisions that relate to whether a requirement will or will not be considered during product development. It is an approach to using a catalog of value aspects for product management decisions for the purpose of supporting different aspects of sustainability during software system development.

We would like participants to rate the importance of given value aspects for human, social, economic, environmental, and technical sustainability. For every *value* in these categories, we provide a definition, a rationale (why this value matters), and an example. We then ask (1) how well the value is currently taken into account, (2) how important the participant considers it to be, and (3) whether the participant can think of an example in their own experience where consideration might have been beneficial.

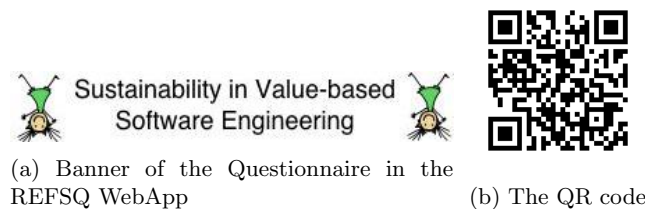


Fig. 1: WebApp Banner and QR code

To complete the survey at <http://ww2.unipark.de/uc/REFSQ14-sustain> including examples will take 10-15 minutes, depending on how much use of the free text fields the participants make. In case participants would agree to be contacted for a personal interview or would like to be informed about the survey's results, we provide them with the opportunity to leave their email address on the last page of the survey. The survey is attached in the appendix.

4 Success Factors

4.1 Threats to validity

The constraints of performing the study at REFSQ are:

- Software engineers attending the conference might be better educated than the general software engineer. Therefore, they might be more aware of sustainability issues and rate their importance higher than the average practitioner. Considering the fact that sustainability is on one hand perceiving a lot of attention anywhere in industry right now and is just being picked up as research topic, this threat is limited.
- Participants with a rather academic background might not have as many situations to recall upon where they had to take decisions in software development that would have been affected by the sustainability aspects due to the fact that many of the software systems researchers develop are prototypes to prove concepts and not software products. This would not limit the validity of the study but it would narrow the richness of the data. However, REFSQ attendance does have a decent percentage of practitioners and our efforts will be directed at gathering many participants from industry.

4.2 Publicity

As described in the subsection *Subjects*, the first author will advertise throughout the conference in person and hand out little paper slips with the QR code (see Fig 1b) and URL of the questionnaire that can also be answered on a handheld device. Apart from convincing potential participants in personal conversation, we will also hand out little give-aways and sweets. We will also set up a “surprise” box with those give-aways with little wrapped versions that include the QR code and URL to reach out to those conference attendants who might prefer to be less engaged in conversation but tend to pick up flyers and goodies.

5 Conclusion

This study reaches out to participants via a questionnaire to gather data on the perception of different aspects of sustainability in software product management and requirements engineering. Participants are asked to rate the actual and the envisioned importance of sustainability values and are encouraged to provide examples from their own experience. Follow-up interviews will be conducted if agreed to. The analysis and results will be reported back to the participants and the research community.

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