SuSoftPro: Sustainability Profiling for Software

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Abstract—The paper presents a SuSoftPro tool for requirement engineers to analyse the requirements' impacts on system sustainability. To perform the analysis of system sustainability, the tool provides quantitative questionnaires for rating high-level requirements within sustainability dimensions via a Fuzzy Rating Scale method. Stakeholders' responses are analysed by applying Technique for Order Preference by Similarity to Ideal Solution. The tool presents sustainability as a five-star rating label, a visualisation of the degree for sustainability dimensions, and a bar graph that illustrates the sustainability level.

I. INTRODUCTION

Sustainability requirements help to improve the individual, social, technical, environmental, and economic sustainability of software systems. Our methodology to analyse sustainability requirements for long-living software systems [1] provides a software sustainability profiling that involves a Fuzzy Rating Scale [2], and uses the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS, cf. [3]). We implemented the methodology as a web-based tool *SuSoftPro* (abbreviated from *Sustainable Software Profiling*) for all requirement engineers to use to enable them:

1) Investigate and rate sustainability of software systems,
2) Analyse the five sustainability dimensions of stakeholders' requirements,
3) Discover the overall impact on sustainability for each high-level requirement,
4) Involve stakeholders to rate their requirements from one or more of the five sustainability dimensions, and
5) Import and export requirements and stakeholder details easily for integration with other tools.

We call a system *sustainable* if it satisfies the sustainability requirements that cover the related sustainability dimensions identified in [4]–[6]:

- **Individual sustainability** is the ability to protect, support, and improve the quality of human life and not threaten human beings;
- **Social sustainability** is the ability to have a society that is equitable, diverse, connected and democratic;
- **Technical sustainability** is the ability to cope with technological obsolescence in a fair manner, and respecting natural resources;
- **Economic sustainability** is the ability to ensure and preserve a positive economic value and capital; and
- **Environmental sustainability** is the ability to protect natural resources from human needs and wastes.

II. SUSOFTPRO: SUSTAINABILITY PROFILING

The general idea of the SuSoftPro process is presented in Figure 1. Below, we discuss the core steps of the process.

A. Defining Stakeholder Groups

A stakeholder group has to be created and allotted to one or more of the five sustainability dimensions. Requirement engineers should group stakeholders based on their role in the system and their areas of expertise. Also, engineers have to allocate requirements to related groups with regard to affected stakeholders and requirement ownership. High-level requirements should be assign to one or more groups, so stakeholders within the group will answer related questions from assigned sustainability dimensions.

B. Defining Questions

To build a new questionnaire, five questions (instructions to rate a requirement with regard to a sustainability dimension) will be generated automatically. The generated instructions can be revised and refined by both requirements engineers and sustainability experts. However, all the amendments can be done only until at least one stakeholder starts answering the questionnaire. All instructions have the following format:

"*Rate the influence of the requirement on the X sustainability*",

where *X* is replaced in a concrete case by the corresponding sustainability dimension: *individual*, *social*, *technical*, *economic*, and *environmental*.

C. Defining Requirements

Requirements engineers can create, export and/or import a Comma-Separated Values (CSV) files with the specifications of the high-level requirements, to assign them to created groups and to display them within a created questionnaire.

D. Assigning Stakeholders

After creating and assigning a group to one or more of the sustainability dimensions and requirements, stakeholders can be allocated to the group. This allocation allows to display the questions and to answer them with regard to selected sustainability dimensions requirements.

SuSoftPro generates an auto-sign-in and unique hyper-link for each stakeholder, permit them accessing and answering the questionnaire, which is customised for the corresponding group.
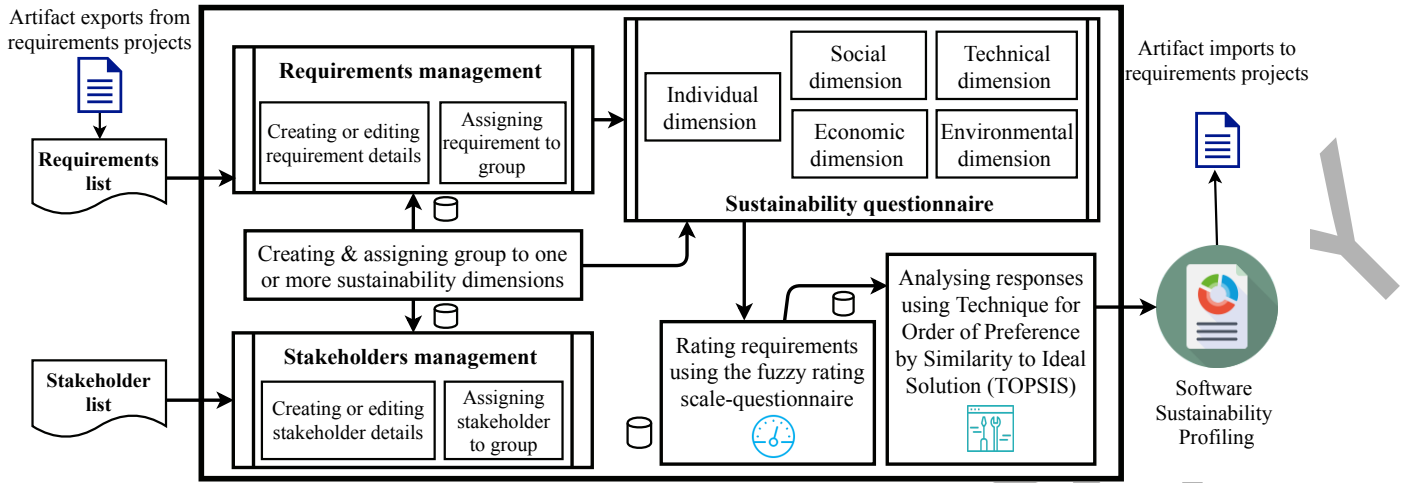
Fig. 1. SuSoftPro: Process Model

The stakeholder list has a column to indicate which stakeholders have the status as *waiting*, *in progress* or *submitted*.

E. Rating Requirements

Stakeholders can respond to a questionnaire when they receive an email with the corresponding access link. Each question in the questionnaire includes

- Description of the requirement,
- Instruction to rate the requirement within the corresponding sustainability dimension,
- Fuzzy Rating Scale to provide the rating.

The stakeholders have the ability to ignore any question that they cannot or do not want to answer if they are not familiar with the requirements or not related to them. The ignored question will not be accounted during the generating sustainability profile.

F. Analysing Sustainability

The results of the rated requirements become inputs for TOPSIS method, which has to be applied twice as follows:

- **First round**: Apply sustainability dimensions as criteria to analyse each dimension within all requirements and overall sustainability rating for the software; and
- **Second round**: Apply requirements as criteria to determine overall sustainabilityimpact for each requirement.

G. Generating Software Sustainability Profiling

The result of TOPSIS analysis allows to generate software sustainability profiling which is visualised representing the

- **Five sustainability dimensions** to illustrate each sustainability level for each dimension; and

result. Responses of the questionnaire are analysed and then presented in the dashboard. The profiling includes:

- **Sustainability five-star rating** to present the average values for sustainability dimensions and requirements (taking into account both TOPSIS rounds);
- **Bar Graph** to show the sustainability impact of each requirement.

III. CONCLUSIONS

This paper presents the *SuSoftPro* methodology and the corresponding web-based tool to analyse system sustainability through requirements analysis and to provide the corresponding sustainability profiling. Requirements engineers and business analysts could analyse sustainability of systems by including SuSoftPro in their toolkit and involving stakeholders to present their perspective of requirements within sustainability dimensions.

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