Scrum Sustainability Poker: Assessing the Sustainability Effects of User Stories in Agile Software Development

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Abstract

[Context and motivation] In recent years, the importance of sustainability in the field of requirements engineering has increased significantly. Despite this growing interest, the availability of practical methodologies and tools for assessing sustainability impacts of software systems remains limited. Furthermore, while the majority of existing approaches focus on traditional processes, sustainability is also getting attention within the agile community. [Question/problem] This raises the question, how practitioners can be supported in both traditional and agile software development processes to increase the sustainability of software systems. [Principal ideas/results] In this paper, we present the Scrum Sustainability Poker Tool. Based on the well-known planning poker method, this tool offers a novel approach for estimating the potential sustainability impacts of requirements and user stories. It also stimulates early discussions about sustainability in the development process. A preliminary evaluation of the tool has been conducted with a focus group of practitioners. [Contribution] Beside a novel tool, the main contribution of our research is an investigation of how requirements engineering knowledge can be effectively integrated into agile software development practices. [Demo Video] https://youtu.be/z9gDmyswkDA

Keywords

Sustainability, Requirements Engineering, Sustainability Awareness Framework, Agile Software Development, Scrum, User Stories, Tool Support

1. Introduction

Requirements Engineering (RE) is recognized as a pivotal phase in the software development lifecycle that facilitates the creation of sustainable software systems [1]. The RE research community focusing on new approaches for sustainable software systems is growing since 2010 [2]. In current research, sustainability is understood as a systemic concept encompassing five dimensions (economical, environmental, social, individual, technical) [3]. The Sustainability

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Awareness Framework (SusAF) as the most mature approach [2], provides a workbook for practitioners [4] containing a set of guidance questions that assist in identifying the potential impacts of a software system on these sustainability dimensions.

Agile software development (ASD) is currently the predominant methodology within software development [5]. Despite the recognized importance of sustainability in ASD by practitioners [6], there is still a lack of approaches that address sustainable software systems within ASD [7]. Additionally, there is also a lack of supporting software tools for practitioners in RE [7]. This raises the questions, of what existing RE approaches can be leveraged for ASD, and how practitioners can be supported by new tools.

The contribution of this paper is a prototype tool inspired by SusAF and the widely recognized *planning poker* technique [8]. Its primary objective is to raise sustainability awareness among both stakeholders and the development team, e.g. during backlog refinement. The tool supports practitioners, including Scrum teams and stakeholders, in analysing sustainability impacts of user stories. It facilitates discussions on sustainability and helps to get a shared understanding of the potential sustainability impacts within the team.

The remainder of this paper is structured as follows. Section 2 outlines the research goal and provides an overview of the related work in this field. The tool prototype is detailed in Section 3, followed by a preliminary evaluation in Section 4 and a discussion in Section 5. The paper concludes with Section 6.

2. Research Goal and Related Work

The primary objective of our research is to support practitioners in developing sustainable software systems. Hence, our goal is to enhance practitioners' awareness of sustainability impacts and provide them with practitioners with innovative methods to facilitate informed decision-making. This is particularly relevant in the context of managing and prioritizing the product backlog within ASD. As part of our ongoing work in this area, we conducted a mapping study and observed that only seven out of 55 publications offered tool support through the development of a prototype [7]. The most relevant works in relation to our work are as follows:

Alharthi et al. [9] introduce the SuSoftPro methodology along with a web-based tool designed for requirements engineers. This tool aids in analyzing the impacts of requirements on the sustainability of software systems. Basmer et al. [10] present SusApp, a web-based tool that supports practitioners applying SusAF. This tool facilitates the documentation and visualization of sustainability effects. Albuquerque et al. [11] introduce a sustainability catalog, which has been realized in the form of a web-based tool. Saputri and Lee [12] offer a semi-automated tool to assess the sustainability effects of software artifacts based on defined sustainability requirements. Finally, in a recent publication [2], we introduce a plugin for the Jira project management tool, which facilitates the documentation of sustainability impacts of user stories in ASD processes.

3. Scrum Sustainability Poker Tool

In this section, we outline the user interface, the architecture and the practical application of our tool.

3.1. Users and Use Cases

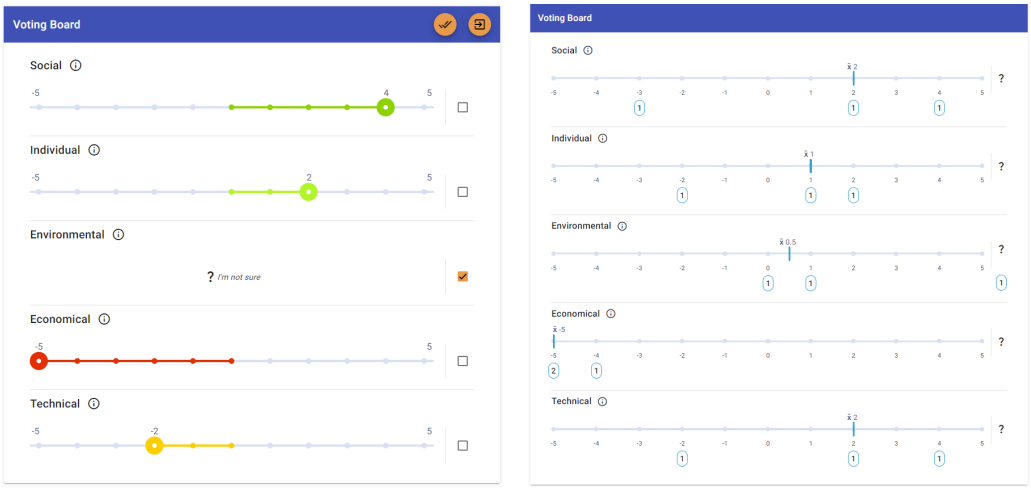
The main objective of our research is to create a software tool that facilitates Scrum team members in evaluating the sustainability impact of user stories across various dimensions. This tool is an extension of our earlier study where we explored the integration of sustainability in Scrum practices [6]. Our findings indicated that product backlog refinement and sprint review are the most suitable events for incorporating sustainability considerations, as perceived by practitioners. In these processes, stakeholders and the product owner play a central role. They are crucial in conducting an early analysis of sustainability impacts, in collaboration with the development team. Moreover, the tool is based on the widely-recognized planning poker technique [8] traditionally used for estimating the complexity or effort required for new user stories. We propose an enhancement to the backlog refinement event to include sustainability assessments, supported by our tool. Alternatively, we suggest the introduction of specific sustainability-focused events, in collaboration with stakeholders, as a part of the existing development processes [2].

3.2. User Interface

To assess the impact of user stories on sustainability dimensions in a team setting, practitioners can establish dedicated virtual rooms. In these rooms, estimations based on user stories are conducted. Team members can access a room through a distinct link. Within a room, user stories can be organized by either importing them as a CSV file, or by manually creating them. This setup allows for a systematic evaluation of the influence of these user stories on various sustainability dimensions.

As shown in Figure 1a, participants in each room are able to provide their estimations for each dimension using a slider. To aid in this process, an overlay featuring the SusAF guidance questions [4] can be activated for additional support. Shifting the slider to the left indicates that the user story being evaluated has a negative impact on the specific sustainability dimension. Moving the slider to the right indicates a positive impact on the corresponding sustainability dimension. The slider's initial central position denotes a neutral impact. For more accuracy, the impact can be quantified on a scale ranging from 1 to 5, representing the intensity of both positive and negative impacts. Additionally, participants have the option to refrain from estimating a dimension's impact, particularly in cases of uncertainty or when limited information about the dimension in question is available for the user story.

After finishing a voting round for a user story, the aggregated results are shown to the participants, as illustrated in Figure 1b. The display includes the count of participants who have selected each scale value for every dimension. Moreover, the median for each dimension is represented visually on the slider. This presentation of the results aims to foster discussions among participants, thereby enhancing awareness of potential sustainability impacts. This in



(a) Voting view (b) Result view

Figure 1: Voting board to estimate the effects of a user story (left) and the result view after a voting round has been completed (right)

turn should assist practitioners in making more accurate evaluations of the product backlog in terms of sustainability considerations.

3.3. Implementation

The prototype was developed as a single-page web application to facilitate smooth operation across various platforms, with a focus on browser compatibility and independence from specific platforms. For the user interface, Angular[1] was chosen as web application framework. Additionally, Firebase[2] was integrated to manage data storage and user authentication. The following provides a detailed overview of the core components of the prototype tool.

Modules: The tool is divided into distinct modules to enhance maintainability, testability, and performance. This modular architecture aims to provide a clear and coherent organization of the application, simplifying the development process. Each module is responsible for specific functionalities that align closely with the primary features of the prototype.

UI Components: The functionalities were further categorized into Angular components. Each of these components encapsulates a specific part of the UI and its associated logic. These components are designed to be highly modular, which facilitates ease of integration, testing, and maintenance. A key aspect of the components is their reusability, supporting a uniform user experience throughout the prototype.

Services: Angular services were used to implement and encapsulate the business logic, data retrieval, and state management. To manage states, Reactive Extensions for JavaScript (RxJS) were used, streamlining the handling of asynchronous events and data streams. The use of observable streams in this context provided an effective approach for managing states. This

[1] https://angular.io/, last accessed March 2024
[2] https://firebase.google.com/, last accessed March 2024

technique ensures clear control over data flows and simplifies the management of state changes.

Data storage: The prototype uses Firebase Firestore as the primary data storage solution, a NoSQL cloud database that provides a robust and scalable foundation for managing the prototype data. Firestore provides a flexible, schemaless data model that allows structured data to be stored and retrieved, but also realtime data synchronization capabilities, that immediately reflect any changes in the user interface.

Authentication: In this tool prototype, Firebase's anonymous authentication has been implemented for user identification, which provides a secure way to identify users without requiring them to create accounts or the provision of sensitive personal information.

4. Preliminary Evaluation

This section describes the results of an initial evaluation of the prototype. Five employees of an Austrian IT services company participated in a focus group to give feedback on the usefulness of the tool. All participants were experienced software development practitioners, but none of them had specifically engaged with sustainability in their field prior to this. A key observation they made was the challenge in achieving a consensus on the concept of sustainability and the proposed sustainability dimensions. However, they recognized, that the tool highlights different perspectives and fosters discussion through its graphical display of estimation results. This visual representation was particularly appreciated for providing clarity in situations where there was a significant divergence of opinions regarding a specific dimension.

Another important finding from the focus group participants was the emphasis on the need for a clear benefit from using the tool, justifying the investment of effort and time required to analyze user stories for sustainability considerations. The focus group highlighted, for the sake of time efficiency, that the analysis of sustainability effects should ideally be integrated with complexity and effort estimations. This integration is suggested to occur during backlog refinement sessions, where user stories are typically examined in depth.

The participants also observed that the outcomes of the tool's analysis might not directly result in the reprioritization of backlog items, but rather serve as additional information for decision-making processes. In this regard, they suggested the inclusion of stakeholders, particularly those with decision-making authority, in the estimation process. Furthermore, they noted that the involvement of diverse stakeholders could introduce new potential sustainability effects through new perspectives.

Overall, the prototype was described as user-friendly and intuitive. However, some participants noted that the tool should be integrated with existing planning poker tools used for complexity and effort estimations. Managing user stories across separate tools, in addition to a primary project management tool like Atlassian Jira is seen as cumbersome.

Additionally, there was a proposal to introduce an overarching sustainability score, rather than having separate scores for different dimensions. This would simplify the process of comparing various user stories in terms of their overall sustainability impacts.

Finally, the participants agreed that the tool effectively raises the awareness about sustainability in software development, if there is a willingness and openness among the development team and the stakeholders to engage with sustainability concerns.

5. Discussion

Our proposed tool should serve as a facilitator for project teams intending to adopt sustainable development practices. Therefore, the tool should primarily foster discourse concerning the diverse impacts that specific software requirements can have on the different sustainability dimensions. Reaching consensus during the development process is thus only a secondary objective.

In a previous study, practitioners highlighted the importance of incorporating sustainability aspects within ASD, listing various strategies for integrating sustainability considerations in agile processes, especially Scrum [6]. This consideration applies not only to the refinement of the product backlog but also to the sprint review phase.

The extent to which stakeholders can take part a sustainability assessment largely depends on the characteristics of the organizations involved and the structure of the development process. Ideally, stakeholders would actively participate in evaluating sustainability and discussions regarding the potential sustainability impacts of user stories. They can potentially provide additional perspectives on sustainability for specific software requirements, most likely with respect to the economical dimension. In our previous work [2] we presented a tool that supports the documentation of sustainability impacts and also generates a report for stakeholders. It is crucial that the advantages of dedicating time and resources are made evident to ensure not only stakeholder engagement but also to motivate the development team itself.

A still open question is whether participants require training on sustainability issues before conducting sustainability assessments or if there is a need for external expertise from a sustainability expert.

The conducted evaluation was a first step to get initial feedback and of course, it undoubtedly requires a more comprehensive assessment over an extended duration (spanning at least several sprints) within a real-world project context. In this scenario, it has to be evaluated how sustainability awareness and understanding evolve over time, and the impact additional sustainability assessments have on the agility of the development process.

6. Conclusion and Future Work

In this paper, we introduced a novel tool designed for integration into agile software development processes, aimed at assisting practitioners in creating more sustainable software systems. Findings from a focus group assessment have already provided valuable insights for enhancements and the development of new features. We are currently planning a more comprehensive evaluation involving a broader range of software development teams across different industries to get deeper insights into the tool's adaptability and impact on promoting sustainable practices.

Following the principles of open science, the source code of our tool is accessible on GitHub[3] and is available for complimentary use[4]. We encourage both researchers and practitioners to use our tool, share their insights, and contribute towards its enhancement.

[3] https://github.com/peter1123581321/scrum-sustainability-poker, last accessed March 2024
[4] https://www.sustainabilitypoker.app/, last accessed March 2024

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