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DMGame: A Gamified Collaborative Requirements Prioritisation Tool

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Abstract—Automated decision-making techniques have been proposed to support engineers in selecting and prioritising requirements. However, to be effectively used in practice they need to be integrated into the organisational context, and their users, namely the members of the development team, and more generally the project’s stakeholders, need to be engaged in the resulting tool-supported decision-making process. In this demo paper, we present a tool-supported collaborative requirements prioritisation process, which exploits game elements to engage distributed stakeholders to contribute to the overall decision-making process. AHP and Genetic Algorithms are used as key component of the game engine, which enables an iterative prioritisation process. The tool is part of the tool-suite developed in the SUPERSEDE project which aims at supporting a flexible feedback- and data-driven software evolution approach.

Index Terms—gamification; collaborative requirements prioritisation; automated reasoning techniques

I. INTRODUCTION

Collaborative decision-making in Requirements Engineering (RE) becomes crucial when developing software products that build on highly evolving, innovative technologies, which rest on a combination of different specialised knowledge areas, thus requiring multi-disciplinary competences in the engineering team. The intrinsic limits of human resources, together with context constraints, such as pressing deadlines and parallel projects which compete for the same resources makes collaborative decision-making challenging, even when agile or lean approaches are in place. The objective of our research is to address these challenges, especially focusing on requirements prioritisation, a key task for projects with limited resources (e.g., time, budget, etc.), and that demands selecting requirements with higher priority to be implemented first.

Several decision making techniques have been proposed to support requirements prioritisation [1], but they seem to be poorly adopted in state-of-the-art practices, especially in small software companies and in distributed settings [3]. In [2] we analysed main issues in adopting automated decision-making in these organisational settings, and proposed a tool, called DMGame, which combines automated decision-making techniques with gamification to engage distributed stakeholders in contributing to the overall decision-making process.

In this demo paper we present the DMGame tool, which helps stakeholders to create, participate to, control the progress

of, and eventually conclude a discussion concerning the relative importance of a set of requirements. Simple online interfaces minimise effort and allow participation at different times and places. Automated techniques can be invoked, automatically or on-demand, in various phases. Currently, DMGame uses the Analytic Hierarchy Process (AHP) method [6], and Genetic Algorithms (GA) [4]. AHP was selected because of its pairwise comparison mechanism. It allows us to perform a fine-grained analysis of the motivations that lead to a resulting ranking, thus exploiting at best the different skills and expertise of the decision makers. GA allows to overcome some of the limitations of AHP, e.g. it allows managing dependent requirements, at the cost of a reduced granularity of the ranking. The set of participants and their roles is determined at the beginning of a prioritisation process, keeping it flexible from an organisational perspective and enabling the involvement of a varying set of stakeholders. Various performance indicators are collected over a number of runs and, according to a gamified approach, transformed in scores that can be exploited both to engage users and to feed further algorithms, e.g. to help selecting participants and their roles when starting a new prioritisation process.

The DMGame tool is part of the tool-suite developed in the SUPERSEDE project¹ which aims at supporting a flexible feedback- and data-driven software evolution approach. This tool-suite includes: feedback gathering and contextual data monitoring tools; a big-data storage component and data analysis techniques which provide requirements for software evolution and dynamic adaptation to be analysed by engineers using a decision-making platform; and a release planning tool. We will showcase the DMGame tool on a main scenario, in which a collaborative requirements prioritisation process is performed. Other usage scenarios can be considered, which cover situations in which new requirements information, coming from the analysis of end-user feedback and monitored data, need to be evaluated and prioritised [5], or situations in which the DMGame tool is configured for a specific organisation or project. The tool has been validated in the three industrial use cases of the SUPERSEDE project. In the rest of this demo

¹SUPERSEDE (Supporting evolution and adaptation of PERSONalized Software by Exploiting contextual Data and End-user feedback), H2020 - n. 644018

paper we detail the first scenario and summarise the main game elements used and technology used for its implementation.

II. COLLABORATIVE REQUIREMENTS PRIORITISATION WITH DMGAME

We consider a scenario in which we have a set of requirements that need to be prioritised for their inclusion in the next release of a given software product. These requirements might be at the same level of abstraction or not and can be independent or interdependent. There are different criteria along which those requirements can be prioritised (e.g. value for the customer, development complexity, cost), and might have different levels importance. The decision-makers to be involved in the prioritisation process are stakeholders with different roles and importance in the project (e.g. customers, end-users, project developers, technology experts, development team managers, product managers, etc.).

The objective we consider in such scenario is that of finding a requirements ranking that considers all the relevant criteria and all the preferences given by the different decision-makers, in order to maximise the overall stakeholder perceived satisfaction, and also optimise the resource utilisation. We use the DMGame tool variant that exploits AHP as automated reasoning component to set up a gamified collaborative requirements prioritisation process as depicted in Figure 1. The resulting process involves 3 main roles: the *Supervisor* who manages the process, the *Opinion Provider* who assigns preferences on requirements and the *Negotiator* who resolves preferences conflicts.

- Step 1: the information needed for the collaboration process, henceforth called game, are collected (namely requirements, criteria, stakeholders with their roles, and user feedback).
- Step 2: the *Supervisor* uses such information to configure the game, and starts it.
- Step 3: each *Opinion Provider* has a time slot (till the collaboration is open) to participate to the game by expressing his/her preferences. This can be done in different times, when the participant is available.
- Step 4: the *Negotiator* manages the agreement among participants. S/he makes authoritative decisions, or engages Opinion Providers in new and extended rounds of voting.
- Step 5: *Negotiator and Supervisor* (supported by the algorithms) compute the rank of preferences to obtain the list of prioritised requirements, and close the game. The output can be used for performing release planning.

III. GAMIFICATION

The DMGame uses game elements as a means to foster the engagement of decision makers in contributing to requirements prioritisation, thus optimising the time and resource utilisation. Game elements taken into consideration include: *Progress*, that is user completion rate is reported to each user; *Time Pressure*, that is the process has a fixed duration, and actions done after the process expiration are discarded; *Pointsification*, that is a point attribution mechanism has been designed, with the

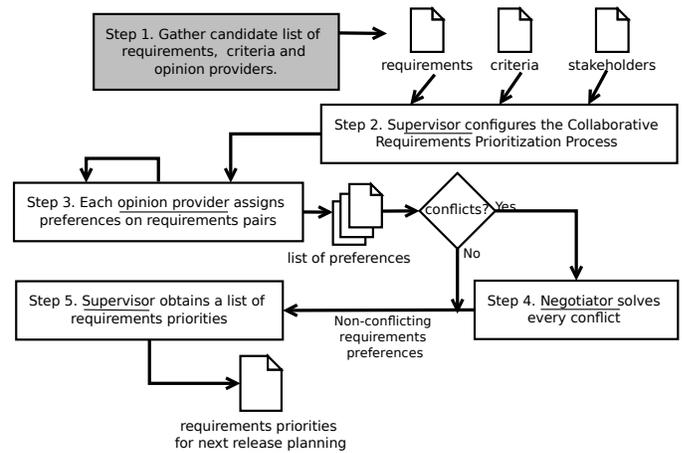


Fig. 1: Steps of the Collaborative Requirements Prioritisation Process [2]

purpose of providing an incentive to (i) perform the voting task quickly, and (ii) perform an accurate voting. The purpose is to balance the two incentives, towards the twofold demands of increasing speed and decision accuracy.

IV. TOOL

The DMGame has been implemented through a web application, which can be used by users to configure and run a DMGame process. It exploits various technologies: Java is used on the server side, relying on the Spring framework (<https://projects.spring.io/spring-framework/>) and running from an Apache Tomcat² server. On the client side, AngularJS³ and jQuery⁴ are used to enrich the web pages and make the REST calls. All the data is stored in a PostgreSQL⁵ database, accessed through a Hibernate⁶ proxy. The tool is accessible at https://github.com/supersede-project/dm_game.

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