Designing a Capability-Centric Web Tool to Support Agile Team Composition and Task Allocation: A Work in Progress

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ABSTRACT

A significant number of studies reported models for competence profiling, measuring capabilities of professionals and recommendation systems for roles within agile software development (ASD). These models coordinated in human resource management within ASD. However, in the light of swift, incremental and iterative nature of ASD practices, designing solutions that easily integrate capability measurements with ongoing project management routines, is an important area for investigation. With the support of interviews, grounded theory procedure and workshops, we identified the aspects valued by our industrial collaborator while allocating professionals to tasks. This information was further utilized towards devising a framework for capability-centric Web tool. This tool provides a one-stop solution for project managers to create projects, keep track of capabilities and execute allocation routines.

CCS CONCEPTS

• Software and its engineering → Software creation and management → Software development process management → Software development methods → Agile software development

KEYWORDS

Capability measurement, competence, software project management, software tools, agile software development

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1 INTRODUCTION

The complexity of software systems and the need for organizations to stay competitive makes it imperative for people to work in teams. The fit of a person's profile to a team and the ability to perform brings about diversity of thought and different problem-solving approaches, which substantially affect the outcomes of a project [1].

The rapid adoption of agile methodologies across various organizations [2], [3] enhances the need for individual and interpersonal skills [4]. Within the context of agile software development (ASD), workforce is considered as a key source of agility [5]. The capabilities of software professionals influence the outcomes of a team [6], [7] and a team's capability is crucial for leading the path to a project's success [8], [9]. Thus, considering capabilities while allocating professionals to various roles is crucial for establishing successful ASD teams [4].

In the light of fluid and transitional team structures in agile projects that involves great diversity of professionals with less rigid nature of their involvement [10], managers need to be careful while selecting individuals and assigning project tasks. A failure in suitable assignment would lead to unattainable project deadlines and decrease in service quality [11], [12].

Use of management tools in ASD is acknowledged as adding value in terms of improving traceability and tracking of decisions [13]. Although numerous organizations have been adopting such tools for improving efficiency and productivity [13], these tools majorly fall short in considering the capabilities of people while catering project tasks [14].

Ease-of-use is an important aspect while developing tool support for ASD projects. The operations of a tool should not hinder the software development routines or cause additional overheads during the swift development process. Moreover, a tool built to support an agile development methodology should take into account the underlying values of the method itself. Otherwise, the tool is likely to work against the nature of the method [15].

Acknowledging the needs of our industrial collaborator and bearing the aforementioned points in mind, developing a systematic tool that helps in assessing the capabilities of professionals and assigning capable professionals to teams and projects, would be beneficial to managers.

Towards accomplishing this, in this paper, we described the systematic methodology adopted for designing a capability-centric Web tool that can assist project managers in assembling teams. Further, we presented the details of the tool's framework that was devised in close collaboration with an ASD organization. Finally, we discussed our upcoming research work in this domain.

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2 BACKGROUND AND RELATED WORK

Capabilities correspond to the qualities, features, abilities and skills that can be used and developed [16]. Competence is another closely related term and the European qualifications framework defines it as the proven ability to use knowledge, social abilities and skills towards personal and professional development [17]. Capabilities of an individual not only pertain to professional skills but also relate to social and innovative skills [18].

An insight into the widely used project management tools across various ASD organizations (Atlassian JIRA, Taiga, Version One, Assembla and Asana) [19] reveals that staff planning, which deals with the requirements concerning personnel and their skills, is often overlooked by these automated tools [14]. Moreover, our review of these tools indicated that none of them have a functionality that takes into account the capabilities of professionals while assembling teams or allocating tasks.

In recent times, there has been an appreciable progress in research concerning capability measurement and personnel selection in ASD. Studies [18] and [20] proposed non-automated models for competency profiling and capability assessment of individuals respectively. On the other hand, Colomo-Palacios et al. presented a hybrid recommender system that facilitates formation of the most suitable scrum teams for different work packages. This model requires a project manager to set the competence level specification for a work package. The recommender system then selects appropriate people, based on their competences, to match the competence level specification of the work package [21]. Unlike their model, in our tool, we focus on finding a match between capabilities of people and requirements of sprint.

Although the aforementioned works [18], [20], [21] were evaluated in industrial context, a major shortcoming of these studies is that they primarily lack discussion on strategies for structuring their models in a way that can comply with the development process adopted by the organization in consideration. Secondly, we noticed that there has been no relevant discussion on how these models can be integrated with daily work routines of agile teams.

To the best of our knowledge, we have not come across any Web-based capability-centric tool that coordinates assessment of capabilities, team composition and allocation of project tasks within ASD. However, the tool presented in [10] seems close to ours, as elaborated next.

Sherlock et al. [10] discussed the prototype of a Web-based tool that support personnel management in ASD organizations. They mainly targeted at personality aspects of individuals, where all the participants in agile teams were supposed to answer a set of questions as a part of personality self-assessment. Their tool was intended for assisting managers in balancing a team with the right mix of personalities. Unlike, their prototype, our tool considers the perception of managers regarding the overall capabilities of their employees. In addition, our tool provides a functionality for assigning capable people for critical project tasks that demand specific expertise. Further, on the suggestion of our industrial collaborator, our tool will serve as an extension for their current project management platform.

3 SYSTEMATIC APPROACH TOWARDS DESIGNING THE TOOL

The tool's design was driven by the need of our industrial collaborator, a software company located in Sweden that offers services and products in mobile data services. It is a small sized organization that adheres to agile (scrum) practices for software development. The company management indicated that a tool that assists them in assigning people with precise skills to some of their security-critical sprint tasks, would be beneficial.

In order to figure out what criteria they look into while allocating personnel to sprints and to understand their project management process, we organized interviews with two senior professionals (chief technical officer and project manager). We have adopted the following sequence of steps in our research:

- We conducted semi-structured interviews with practitioners using open-ended questions. These questions mainly targeted at extracting the tacit knowledge of practitioners. Audio was recorded during both the interviews and was later transcribed.
- A grounded theory (GT) based procedure (open coding) was adopted for identifying codes relating to the criteria used for selecting personnel. This procedure further involved analysis of relationship between the codes and identification of categories, under which the codes can be grouped.
- All the categories and codes identified were then synthesized into a list of categories. This list was further supplemented with excerpts from interviews relating to the code's context.
- A follow-up session was organized with both the practitioners, where the resulting codes and categories were presented to check the codes' credibility and conformity to their opinion.
- Further, on practitioners' recommendation, we investigated and proposed possible measures for each of the identified codes. The measures were later approved by both the practitioners.
- An initial interface design (mock-up) for the tool was developed by taking into account the project management details shared by the practitioners in the interviews. This first version of the design consisted provisions for creating a new project, new sprint, profile of a person with a facility for assessing his/her capabilities (based on the measures proposed for each code).
- A preliminary workshop was organized with both the professionals to brain-storm and collect feedback on the initial designs. The practitioners suggested that, for the tool be lucrative in long run, it is desirable to build the tool as an extension to their currently used project management tool (Redmine).
- After the preliminary workshop, seven successive workshops were organized aimed at a) refining the tool's design such that it complies with the ongoing development process at the company and b) making sure that the design allows the project to remain 'agile' and 'light weight'. During these workshops, both the practitioners suggested additional features that they thought would be beneficial for decision making at later stages (e.g. sprint retrospective questionnaire page, registering sprint requirements, assigning critical tasks to capable professionals, etc.). After incorporating all the suggestions, eventually, the fourth version of the design was approved by both of them.

- A prototype was developed by adopting the software tool chain recommended by the practitioners. We developed a Web application powered by a Java based RESTful API on the backend. For the client-side application, we used AngularJS and HTML. The backend API was designed to interact with PostgreSQL database and the API of Redmine.
- A follow-up workshop was organized to demonstrate the prototype to the practitioners. After receiving their approval, plans for packaging and deploying the tool were discussed.

4 A SYNOPSIS OF THE TOOL'S FRAMEWORK

From the categories identified using GT, it was evident that the senior professionals looked at three different facets (see categories listed under Table 1) while allocating personnel to sprints. After a closer look at the categories, designing a tool oriented towards the practices of managers seemed pragmatic.

A series of workshops were organized with both the practitioners to devise a framework for the tool such that capability assessments are integrated with their regular project management routines. In our prototype, the integration was accomplished by utilizing the RESTful API services of Redmine and encapsulating its functionalities. Such integration gives flexibility to managers for creating projects and keeping track of capabilities, sprint requirements and allocation routines, all from one tool while rest of the team members interact with Redmine and devote their complete focus towards accomplishing sprint goals.

The following details present an overview of the framework:

- **Projects, sprints, issues and people:** Projects and people are two independent entities within the framework. Whereas, sprints and issues are dependent entities and their existence is linked to a project. Further, the terminology of issues is adopted from Redmine. The issues herein correspond to user stories in scrum and they form the building blocks of a sprint and project.
- **Managing people:** As our tool's design is inclined towards scrum practices, each professional can have the possibility to work in multiple projects and sprints. Details related to different roles (multiple) a person can undertake in general will be recorded while registering a person (roles indicated in Figure 1).

Table 1: Categories and codes identified using GT

Category	Codes
Sprint classification	Application domain, kind of assets the solution is handling, security risk analysis, security requirements and security level
Company driven factors	Coaching potential, different development environments and technology awareness, management group's decision about project leader and team knowledge diversity
Team building strategy	Developer's commitment, developer's domain knowledge, developer's own interest, individual availability, previous deliverables' quality, previous projects performance, previous formal education, programming experience, programming language knowledge and understanding of software security

Besides that, the capabilities identified from GT analysis (codes under 'team building strategy' category of Table 1) are also associated with each person's profile, as shown in the Figure 1. This gives a manager the flexibility to make a preliminary assessment of capabilities while registering a person. These capabilities can however be reassessed as projects progress and new skills can be added to the list of capabilities.

For registering evaluative information (e.g. skills, work experience, etc.) of a person, we have taken ethical aspects into consideration. On the recommendations from the Swedish data inspection board [22], we focused on restricting the access to capability data with a system of privileges, so that only people who need access to the data (managers and research team) can gain access. Further, we focused on preserving data anonymity to certain degree by employing aliases instead of names of people (see Figure 1). A key was used to link the actual names to aliases and it was securely stored apart from rest of the data.

- **Managing projects:** Besides the project attributes on Redmine, additional attributes like the time frame of a project and estimated effort for completing the project are also associated with each project. Further, the role of a person in a project is decided based on project requirements. This means a person's role can vary between different projects (e.g. although person A works as a developer in project A, he/she can work as a tester in project B). However, within a project, a person bears the same role for all sprints (so, person A participates solely as a developer in all the sprints of project A). Towards the end of each project, manager will be notified with a message on the tool's interface, to assess the capabilities of each of the project's participants.
- **Managing sprints:** The tool herein characterizes a sprint by the list of codes that relates to 'sprint classification' category (see Table 1). In addition, other attributes like sprint timeframe and estimated effort for the sprint are also associated. Further,

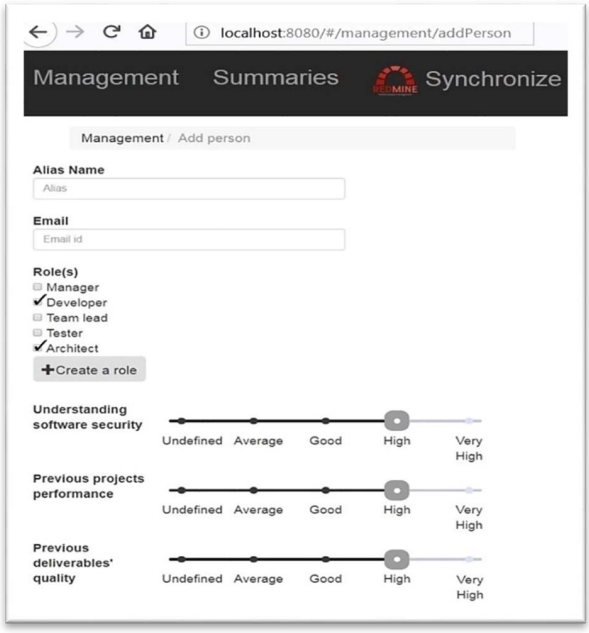

Figure 1: Screenshot from prototype displaying the interface to add new person

for each sprint, multiple expectations can be associated based on the perception of managers (e.g. high security level of deliverables) and towards the end of the sprint, a comment will be attached to each of the expectations. Besides expectations, a sprint retrospective questionnaire will also be answered on the completion of a sprint and manager will be notified to assess the capabilities of the team members that participated in that sprint. Moreover, roles needed for a sprint will be decided based on the requirements of the sprint. On the basis of high level view of the sprint requirements, a manager selects number of roles. Then, professionals are assigned to these roles as elaborated next.

- **Assigning people to sprint:** Professionals will be assigned to the roles selected in the preceding step on the basis of their capabilities. Firstly, people will be shortlisted based on their role in the corresponding project and for each sprint role, the capabilities of multiple people will be compared before assigning a person to a sprint. The group of people thus assigned to various roles constitute a team for the sprint.
- **Assigning people to issues**: Issues can be created by any project participant using Redmine. However, managers tag critical issues and select a list of issues that will be addressed during a sprint. Among these issues, our tool exclusively facilitates managers in assigning people to critical issues. Rest of the issues will be picked based on the choice of team participants, using Redmine.

5 RESEARCH ROADMAP

After the full scale development and deployment of our tool, our next steps in this research will be directed towards 1) periodically gathering capabilities of various team participants. Further, collecting the details of sprint participation, issue allocation, sprint expectations and retrospective questionnaire. 2) Organizing interviews with our collaborators to figure out which project/sprint outcomes (e.g. increased quality, improved security level) are highly valued by them. 3) Utilizing the dataset acquired from step 1 towards developing a prediction model, using machine learning techniques. This model can be trained to assist in assembling teams for achieving the outcomes identified in step 2.

6 CONCLUSIONS

This study focuses on how a tool support for assessing capabilities can be directed such that it complies with the development methodology being adopted at an organization. Our investigation into widely adopted project management tools across agile software development organizations, revealed that none of the existing tools consider the capabilities of professionals while composing teams or allocating project tasks.

Therefore, in our study, we adopted a systematic approach towards designing a Web tool that coordinates capability assessments, team composition and task allocation. Further, in close collaboration with an organization that follows agile practices, we devised a framework for the tool such that capability assessments can be integrated with their regular project management routines.

Our next steps in this research domain will be directed towards deploying the tool in the live work environment of our collaborator and then developing prediction models that can assist them in assembling teams.

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