Teaching Software Project Management by Simulation: Training Team Leaders for Real World Projects

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***Abstract*—This half-day tutorial shows how a flexible and scalable simulation environment can be applied to train project management skills in a realistic way by simulating problems practitioners are facing in their daily work. Based on the simulation goals, the participants act as project managers determining the simulated development process by adequate staffing and allocating software development as well as quality assurance tasks.**

***Keywords*-Project management skills; simulation of real world situations; education of project leaders; team issues**

I. Objectives

The AMEISE (A Media Education Initiative for Software Engineering) approach focuses on the simulation of software project management processes. Based on Stuttgart University's SESAM (Software Engineering Simulation by Animated Models) [1], the AMEISE tool-set allows for repeatedly experiencing the complexity of software project management within a game-like simulation environment [2], [3], [4].

The tutorial participants have the opportunity to run an AMEISE simulation using the so-called quality assurance (QA) simulation model focusing on test and review activities. Based on the description of the required project (simulation goals, available resources), the participants act as project managers who have to decide about adequate staffing and the allocation of software development as well as the different quality assurance tasks. After the simulation process, the success of each project is analyzed using the AMEISE self-assessment feature. Participants get new perspectives within the area of software engineering education. In more detail, the objectives are:

- to become acquainted with AMEISE as a simulation environment,
- to experience ”exercising” software engineering project management with AMEISE,
- to see how AMEISE can be used to focus on different aspects related to software project management (e.g. staffing or developers' qualification)
- to learn how to adjust (scaling up/down) the simulation environment as well as the problem range (complexity) to be solved by the trainees according to the needs of a particular software project management lecture, and
- to be able to evaluate the prospective usage of AMEISE for own educational purposes.

II. Relevance of the Tutorial

An experience-dominated subject like software project management cannot be learned by merely attending lectures [5], [6]. Additional labs, however, even with only modest real-life projects, call for substantial effort to be spent by the instructors as well as by the partaking students. With these issues in mind, we developed the concept for AMEISE, a simulation framework for practicing management of software engineering projects.

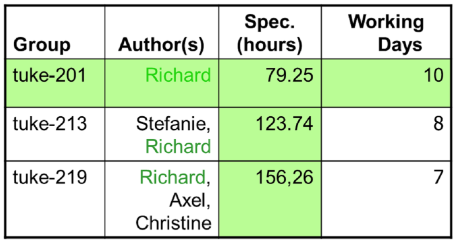
This tutorial addresses both academic instructors as well as practitioners giving them the opportunity to obtain first-hand experience with an environment applicable for teaching and learning software project management by simulation.

In accordance with the objectives of CSEE&T 2015, team issues are emphasized from several points of view:

- First, team factors are promoted by allowing for experimenting with different team settings and by stressing careful project planning.
- Second, the AMEISE environment allows for a qualified judgment on the effects of project decisions and the team setting on the quality of the software product resulted from each simulation run (see Tab. 1 and Tab. 2 for examples).
- Third, the AMEISE environment supports batch processing of commands and rollback of decisions. So, one is able to play around with different team settings and decisions.

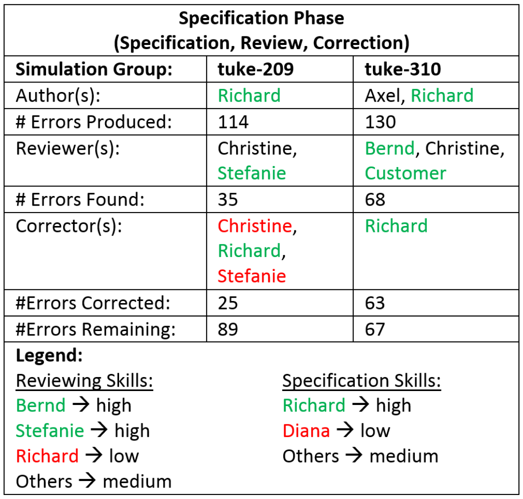
As part of the tutorial, selected features of the AMEISE environment will be presented. There are the following two different strategies to examine the effects of team related issues during and after AMEISE simulation runs:

(i) A first simulation run is done by hand, until its end (based on the master project plan), and then the simulation steps are exported into a batch file. Then, a



Group	Author(s)	Spec. (hours)	Working Days
tuke-201	Richard	79.25	10
tuke-213	Stefanie, Richard	123.74	8
tuke-219	Richard, Axel, Christine	156,26	7

Figure 1. Example of feedback (development team, time needed to write a specification document) provided to the trainees at the end of a simulation run. It summarizes the effort needed depending on the team size and skills of the developer(s).



Specification Phase (Specification, Review, Correction)		
Simulation Group:	tuke-209	tuke-310
Author(s):	Richard	Axel, Richard
# Errors Produced:	114	130
Reviewer(s):	Christine, Stefanie	Bernd, Christine, Customer
# Errors Found:	35	68
Corrector(s):	Christine, Richard, Stefanie	Richard
#Errors Corrected:	25	63
#Errors Remaining:	89	67

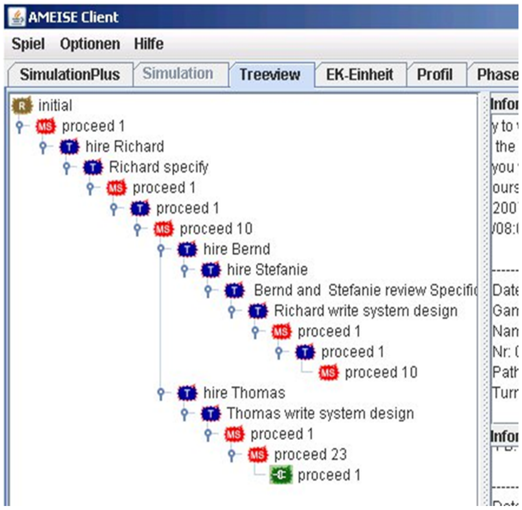
Legend:

Reviewing Skills:	Specification Skills:
Bernd → high	Richard → high
Stefanie → high	Diana → low
Richard → low	Others → medium
Others → medium	

Figure 2. Example of feedback (quality of the reviewing process) provided to the trainees at the end of a simulation run. It summarizes the number of errors produced and found in the specification document depending on the team size and skills of the developer(s).

second run is done by re-running the batch file until a specific point in time (at step n) and by continuing with an alternative solution by hand again. At the end, the AMEISE analysis tool is able to compare the effects of the different strategies by looking at the detailed results (e.g. the effort, number of errors, and time needed) which are stored for all simulation runs in our MySQL database persistently.

(ii) The simulation run is done by hand, but at a specific point in time, the trainee decides to roll back parts of his decisions. When the rollback-mode is turned on, the AMEISE environment allows for jumping back in time to specific points in the simulation run (i.e. to the beginning and the end of phases and milestones). The simulation then contains alternative paths, which is represented by a simulation tree (as depicted in the TreeView mode of AMEISE in Figure 1). As it is possible to jump to any path in the tree, the trainee is able to compare some of the effects of his or her decisions already during the simulation run.



initial
proceed 1
hire Richard
Richard specify
proceed 1
proceed 1
proceed 10
hire Bernd
hire Stefanie
Bernd and Stefanie review Specific
Richard write system design
proceed 1
proceed 1
proceed 10
hire Thomas
Thomas write system design
proceed 1
proceed 23
proceed 1

Figure 3. Example of rollback and alternative endings of a project management plan as it is implemented in the AMEISE simulation environment (using the TreeView feature of the client software).

III. Presenters

The tutorial is held by up to three persons: Andreas Bollin from the University of Klagenfurt, Elke Hochmüller from the Carinthia University of Applied Sciences, and Csaba Szabó from the Technical University Košice.

Andreas Bollin received his Ph.D. and Venia Docendi from the University of Klagenfurt where he is currently active as Associate Professor at the Software Engineering Research Group. His research interests are Informatics didactics, project management, and software engineering (with a focus on reverse engineering and formal methods). He is also active in the area of e-learning and new technologies to enhance various aspects of teaching computer science.

Elke Hochmüller received her Ph.D. from the University of Vienna and the Venia Docendi from the University of Klagenfurt, respectively. She is currently Full Professor in the Network and Communication Engineering Programme at the Carinthia University of Applied Sciences. Apart from more than 25 years of experience in software engineering education, her teaching and research activities focus on various software engineering topics, like requirements engineering and process modelling.

Csaba Szabó received his Ph.D. from the Technical University of Koice, where he is currently active as an Assistant Professor, teaching topics related to software engineering. His research interests include behavioral description of software, self-* systems, and software and test evolution. He is also active in introducing computer simulations and virtual reality into the education process.

IV. Environment and Setting

The duration of the tutorial is 180 minutes and the maximal number of participants is limited to approx. 28

persons. The minimum number of participants is 4.

The tutorial consists of two presentation sessions and one online simulation session. The following course material is handed out at the beginning of the tutorial:

(i) presentation slides,
(ii) description of simulation goals,
(ii) list of available resources (budget, time, developers), and
(iv) a list of commands (employee management, task assignment, project control).

AMEISE is a client-server application. The server is running at the AMEISE service provider in Klagenfurt/Austria. Apart from a permanent internet connection, no special technical equipment is needed. With only a restricted or even without any internet connectivity, the AMEISE tutorial is organized in a scaled-down version (cf. Section VI) with the possibility of a stand-alone version on the participants' laptops.

V. Preparation

There are no particular prerequisites required to be able to follow the tutorial effectively. The tutorial starts with a short introduction (summary) of the most important terms; however, basic knowledge of phase-driven process models, software development activities (requirements specification, system design, module design, coding ...), QA activities (review, test), and resource and staff management are advantageous.

Depending on the number of participants, the simulation runs are done in groups of two or as single work. In order to be able to run the AMEISE simulator, we assume that most of the attendees are equipped with their own computer. The AMEISE client is a Java Swing application (prerequisites: at least Java RE 6).

VI. Tutorial Activities and Format

The tutorial consists of three sessions. It starts with a general introduction to software project management, the AMEISE system and the concepts behind it. In the second session, teams of two (depending on the number of participants) are formed and the tasks of the simulation model are discussed. The objective is to prepare a first (small) project plan and to apply it using the AMEISE simulation environment. The last session concludes with discussing the results that can be drawn from the simulation runs.

With only restricted internet connectivity available, the second session can be adjusted in such a way that the trainees are not accessing the AMEISE server in Klagenfurt/Austria. It is possible to install AMEISE locally on the presenters' laptops and to access these via a local network.

Without any internet connection available, the second session is down-scaled, with the trainees preparing their own schedule followed by a single simulation with alternatives expressing differences in employee management and task assignment. Individual simulation runs are then only being supported by the post-event support.

VII. Post-Event Support

Experience showed that a big share of the learning effect is due to the assessment report and the reflections phase at the end. Owing to time constraints (a simulation run normally lasts 2 and a half hours), it is possible that not all attendees will manage to finish their own simulation runs during the tutorial. In order to make the best of it, all the trainees will have the opportunity to finish their simulation runs (or to start new ones) within two weeks after the tutorial. All finished simulation runs will be evaluated, and each tutorial participant will get a PDF file containing his/her assessment report via email.

To improve the quality of learning outcomes and to use the simulation power of AMEISE, the above mentioned report will contain the comparative assessment of all simulation runs completed by the participant within the above mentioned time period so that he or she can obtain a qualitative overview on the implementations of the developed alternative plans.

References

[1] A. Drappa and J. Ludewig, "Simulation in Software Engineering Training," in *Proc. 23rd International Conference on Software Engineering, IEEE-CS and ACM*, 2001, pp. 199–208.

[2] R. Mittermeir, E. Hochmüller, A. Bollin, S. Jäger, and M. Nusser, "AMEISE - A Media Education Initiative for Software Engineering: Concepts, the Environment and Initial Experiences," in *Proceedings International Workshop ICL - Interactive Computer Aided Learning, Villach*, M. Auer, Ed., 2003, iSBN 3-89958-029-X.

[3] A. Bollin, E. Hochmüller, and R. Mittermeir, "Teaching Software Project Management using Simulations," in *Proc. 24th IEEE-CS Conference on Software Engineering Education and Training (CSEE&T 2011). Waikiki*, J. B. Thompson, E. O. Navarro, and D. Port, Eds., 2011, pp. 81–90.

[4] A. Bollin, E. Hochmüller, R. Mittermeir, and L. Samuelis, "Experiences with Integrating Simulation into a Software Engineering Curriculum," in *Proc. 25th IEEE-CS Conference on Software Engineering Education and Training (CSEE&T 2012). Nanjing*, D. Chen, M. Barker, and L. Huang, Eds., 2012, pp. 62–75.

[5] M. Shaw, "Software Engineering Education: A Roadmap," in *Future of Software Engineering 2000*, A. Finkelstein, Ed. ACM, 2000, pp. 373–380.

[6] J. B. Thompson, "Software Engineering Practice and Education: An International View," in *Proc. SEESE'08*. ACM, 2008, pp. 95–102.