

The 1st IEEE Workshop on the Next Level of Test Automation (NEXTA 2018) - From the Program Chairs

Sigrid Eldh¹, Serge Demeyer², Markus Borg³, and Adnan Causevic⁴

I. WELCOME FROM THE CHAIRS

Welcome to the 1st IEEE Workshop on the Next Level of Test Automation (NEXTA 2018), co-located with the 11th IEEE Conference on Software Testing, Verification and Validation (ICST 2018) in Västerås, Sweden.

Test automation has been an acknowledged software engineering best practice for years. However, the topic involves more than the repeated execution of test cases that often comes first to mind. Simply running test cases using a unit testing framework is no longer enough for test automation to keep up with the ever-shorter release cycles driven by continuous deployment and technological innovations such as microservices and DevOps pipelines. Now test automation needs to rise to the next level by going beyond mere test execution. The NEXTA workshop will explore how to advance test automation to further contribute to software quality in the context of tomorrow's rapid release cycles. Take-aways for industry practitioners and academic researchers will encompass test case generation, automated test result analysis, test suite assessment and maintenance, and infrastructure for the future of test automation.

As the topic is highly relevant for both research and industry, the aim of the workshop is to attract both academic researchers and industry practitioners. Test automation has been a hot topic in industry for years, and after the initial hype many organizations have realized the limitations. We believe the time is right for a workshop on how to bring test automation to the next level. Thus, we particularly want to attract industry participants by focusing discussions on problems and solutions relevant to industry practice. Our strategy is for the workshop to co-locate with major conference in the field, to reach a broad audience and to attract and disseminate among the best academic researchers and practitioners. This year, the decision was to co-locate with the 11th IEEE Conference on Software Testing, Verification and Validation (ICST 2018) in Västerås, Sweden in April 2018.

The workshop organizers broadcasted a call for papers on various fora and received fifteen papers by January 19, 2018. These papers were reviewed by a program committee consisting of twenty-one test experts with a heterogeneous

background. All papers received four reviews and based on that the workshop organizers accepted eleven papers, resulting in an acceptance ratio of $11/15 = 73\%$. The key to a successful workshop is to focus on quality papers, not on the acceptance number – to yield a good discussion. Authors were encouraged to incorporate the reviews into a second iteration of their papers, which resulted in the papers you are reading in this volume. In addition, we made the format open, suggesting both tool papers and video submission in addition to experience reports and research papers.

We would like to express our gratitude to the program committee members for their efforts in providing very thorough evaluations of the submitted papers. We also wish to thank all contributors and participants for sharing their practice and real-world experiences. Finally, we owe special thanks to the local organization committee of the ICST conference for their support. In addition – we would like to thank the EUREKA ITEA3 and Vinnova for the funding of the TESTOMAT Project that allowed us to make this workshop happen.

II. BACKGROUND – THE TESTOMAT PROJECT

The TESTOMAT Project is an EUREKA ITEA3 Project consisting of 6 countries and 35 Partners. The goal of the project is to help software teams to strike the right balance by increasing the development speed without sacrificing quality in the context of test automation in an agile context. As the TESTOMAT Project contains experts from the field of test automation and is a mix of practitioners, academic researchers and a series of solution providers, such as consultants and tool vendors in the field, the industry drive is in the context of agile processes. This means the project is actively opening up the community – to challenge contemporary ways of working. In theory, everything can be automated in the test process, but still, the know-how of how far we can push the limits is yet unsolved – and smart, cost-effective solutions are still to be invented.

The TESTOMAT Project is organized into four technical work packages: 1) test effectiveness, 2) test prioritization, 3) testing for quality standards, and 4) test automation improvement model. Next, we briefly introduce the work packages to set the scene for NEXTA 2018.

A. Test effectiveness

Industry acknowledges software testing as a critical but expensive software engineering activity, thus companies are aware of the importance of test effectiveness — including the effectiveness of automated testing. However, while being

¹S. Eldh is with Ericsson AB, Sweden. sigrid.eldh@ericsson.com

²S. Demeyer is with University of Antwerp, Belgium. serge.demeyer@uantwerpen.be

³M. Borg is with RISE SICS AB, Sweden markus.borg@ri.se

⁴A. Causevic is with Mälardalen University, Sweden. adnan.causevic@mdh.se

considered important in industry, the approaches to assess and improve the effectiveness of automated testing are often ad-hoc or based on simplistic measures. To improve state-of-practice test effectiveness TESTOMAT will make contributions in five complementary themes: i) test maintenance, ii) test result analytics, iii) code coverage, iv) mutation testing, and v) GUI testing.

B. Test prioritization

Due to limited test resources, it is often necessary to prioritize and select test cases for a given system under test. In addition to existing prioritization techniques, the TESTOMAT Project seeks to develop new prioritization goals. Prioritization sources are links to artifacts (e.g., requirements), metrics per test cases (e.g., cost, time, and risk), metrics from system under test code (e.g., coverage, results from static/dynamic analysis, and version control commits), the test-run-feedback loop (e.g., recent and past failures), and even increased test coverage over time (e.g., many pairwise runs eventually lead to 3-wise coverage). Prioritization shall then be used for test selection. This can be post-selection (in terms of re-sorting existing test suites), guided generation of prioritized test suites, selection and ordering at test execution time, and even be used in conjunction with mutation testing.

C. Testing for quality standards

Software often needs to be compliant with quality standards. These standards include generic quality standards (e.g., ISO/IEC 25010 and 25023) and domain specific safety standards (e.g., RTCA/DO-178C and ISO 26262). The TESTOMAT project will identify and provide a set of metrics and test techniques to assess the functional and non-functional properties and quality characteristics of software-intensive systems. Based on such quality metrics, the goal is to determine if and to what extent different standards are fulfilled, and also evaluate the quality characteristics of the system in terms of performance, safety, reliability, maintainability, etc. To enable such evaluations, appropriate mechanisms such as traceability between test cases, requirements and code artifacts will also be studied. Moreover, the TESTOMAT Project will also look into process aspects related to testing non-functional properties in a continuous integration environment, including the efficiency of test generation and execution after design refinements. The focus will be to implement measurements that can automatically identify a non-functional quality through test case analysis verdicts, and to automatically analyze them over time.

D. Test automation improvement model

The TESTOMAT Project will develop a stepwise improvement ladder for industries based on the Test Automation Improvement Model (TAIM) [1]. This will become a handbook that will serve as a reference guide, listing best practices, and contain measurements to automatically assess whether the next level of TAIM has been reached. The TESTOMAT Project will measure the software testing teams active within the consortium, and utilize their experiences. The handbook

will be published as an eBook to ensure easy access for the target audience. Inspired by similar improvement models from the past (e.g., CMMI and TMMI) TAIM will define key improvement areas in test automation, with the focus on measurable improvement steps [Eldh2014]. In that sense, we explicitly avoid human interpretation via external auditors assessing the current test automation level by means of interviews of key persons in the testing team. Instead the model will exploit the presence of continuous integration tools and tap into the logs to get quantitative data about the effectiveness of the tests. The actual best practices to improve the test automation level will be documented in a pattern catalog.

III. WORKSHOP THEME AND TENTATIVE PROGRAM

Partly driven by agile development, partly driven by technological innovations, software is being deployed in ever-shorter release cycles. Software teams all over the world tend to embrace faster release cycles as “the” way to incorporate customer feedback into product development processes. A much faster release cycle implies rethinking the typical view on software quality.

High-quality software has long been synonymous with software “without bugs”. Today, however, quality software has come to mean “easy to adapt” because of the constant pressure to change. Consequently, modern software teams seek for a delicate balance between two opposing forces: striving for reliability and striving for agility. The old view does not match well with the challenges trusted on today’s software testing teams. Traditional quality assurance was based on strict processes, comprehensive documentation, and rigorous planning; valuable assets yet corresponding to a development process optimized for perfection. Agile software development, on the other hand, forwards a series of other values: customer value, iterative and incremental development, continuous integration, hence optimizes for ease of change.

The next level of test automation must facilitate future software teams’ strive to increase the development agility without sacrificing quality. To achieve this, test automation tools and frameworks must seamlessly integrate with the rapid delivery pipelines of the future – test automation must advance to the next level to keep up.

Automating testing is a challenge. Practitioners often think of test execution automation and researchers in academia tend to focus on automating the test case generation – the test design. NEXTA 2018 is a workshop that focuses on the next level – taking test automation focus beyond the current scope. The DevOps context brings continuous testing and continuous delivery, which also includes testing back-end aspects. One example is closing the loop by automatic fault localization and automatic program repair. NEXTA 2018 targets automation of all aspects in the test process, from automatic test requirements capturing, real-time analysis to adapt the testing, new techniques that embrace automatic tests, and challenges in testing both simple and complex systems. There is clearly a need for a new workshop on

the subject, focusing on making efficient and effective test automation.

To elaborate on the next level of test automation, we accepted 11 papers to NEXTA 2018, organized into four topics:

- Automated GUI Testing
 - Challenges in Automated Testing through Graphical User Interface (Pekka Aho and Tanja Vos)
 - Introducing automated GUI testing and observing its benefits: an industrial case study in the context of law-practice management software (Vahid Garousi and Erdem Yildirim)
 - Maintenance of Android Widget-based GUI Testing: A Taxonomy of test case modification reasons (Riccardo Coppola, Marco Torchiano and Maurizio Morisio)
 - Automatically Generating Test Scripts for GUI Testing (Toshiyuki Kurabayashi, Muneyoshi Iyama, Hiroyuki Kirinuki and Haruto Tanno)
- Automated Testing in the Context of Embedded Systems
 - Design of High Confidence Embedded Software Hardware-in-loop Simulation Test Platform Based on Hierarchical Model (Gao Feng and Deng Fei)
- Test maintenance
 - Uncover Your Tracks: Using CodeScene to Supervise the Quality of Automated Tests (Adam Tornhill).
 - Evaluating Test Data Generation for Untyped Data Structures Using Genetic Algorithms (Ralf Gerlich and Christian Praus)
 - Feature based testing by using model synthesis, test generation and parameterizable test prioritization (Martin Reider, Stephan Magnus and Jan Krause)
 - Software metrics for policy-driven SDLC automation (Leonid Borodaev, Rix Groenboom, Rein Smedinga and Alex Telea)
- Organizational impact of test automation
 - The Next Level of Test Automation: What About the Users? (Kristian Wiklund and Monika Wiklund)
 - A Preliminary Study on TESTOMAT Project's Impact: Software Test Automation Acceptance and Use at a Company in Turkey (Özlem Albayrak)

IV. WORKSHOP ORGANIZATION

The roles of the NEXTA 2018 workshop organization follow:

- Sigrid Eldh, general chair
- Serge Demeyer, program co-chair
- Markus Borg, program co-chair
- Adnan Caucevic, program co-chair

Furthermore, the NEXTA 2018 was made possible thanks to reviews by 20 Program Committee members from around the world:

- Alessandra Bagnato, Softeam, France
- Benoit Baudry, Royal Institute of Technology, Sweden
- Hyunsook Do, University of North Texas, US
- Leire Etxeberria Elorza, University de Mondragon, Spain
- Michael Felderer, University of Innsbruck, Austria
- Vahid Garousi, Wageningen University, Netherlands
- Andrew V. Jones, Vector Software, UK
- Peter M. Kruse, Assystem, Germany
- Yvan Labiche, Carleton University, Canada
- Bernard Legeard, Smartesting, France
- Mika Mäntylä, University of Oulu
- Karl Meinke, The Royal Institute of Technology, Sweden
- Ali Parsai, University of Antwerp, Belgium
- Damiano Torre, Carleton University, Canada
- Tanja Vos, Universitat Politècnica de Valencia, Spain and Open University, Netherlands
- Marc-Florian Wendland, Fraunhofer Fokus, Germany
- Elaine Weyuker, Rutgers University, US and Mälardalen University, Sweden
- Kristian Wiklund, Ericsson AB, Sweden
- Franz Wotawa, Graz University of Technology, Austria
- Tao Yue, Simula Research Laboratory, Norway

V. ACKNOWLEDGEMENTS

Thanks go to the participants of the workshop and all the authors of submitted papers for their important contribution to the event. In addition, we want to thank our sponsors for the workshop; IEEE Computer Society, as well as the Swedish chapter in Region 8, The Eureka ITEA 3 TESTOMAT Project this time the workshop is funded in Sweden by Vinnova, the ICST Workshop organisers Dr. Gregory Gay and Dr. Mike Papadakis as well as the entire ICST 2018 organisation for their support.

REFERENCES

- [1] S. Eldh, K. Andersson, A. Ermedahl, and K. Wiklund. Towards a test automation improvement model (TAIM). In Proc. of the 7th IEEE International Conference on Software Testing, Verification, and Validation Workshops, ICSTW'14, pp. 337–342, 2014.