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Presentation Title:	Test automation with models
Intended Audience:	Tester engineers, Test managers, System architects, Quality assurer, Project Managers

Abstract

Quality assurance of complex software-intensive systems is a challenging and resource-consuming activity. An important discipline of QA is dynamic testing, i.e., the execution of a system in order to find defects. Since today's systems become more and more complex and distributed, the testing discipline needs to keep pace by developing new and more efficient techniques. One of those techniques is model-based testing (MBT). In model-based testing, formal models are leveraged in order to generate tests out of them. Even though this is not a new idea, the upcoming and ultimately wide-spread acceptance of models (to mentioned UML in the first place) and the idea of model-driven architecture (MDA) in the industry have shed a new impulse on model-based testing techniques. In the last decade, new approaches, methods and tools have been developed based on the principle of MDA, leading to general terms like model-driven testing (MDT) or, more accepted, model-based testing (MBT).

This tutorial aims at presenting the state of the art in model-based testing as a general technique to increase the degree of automation in the testing of software-intensive complex systems. The overall target is provide a comprehensible and concise overview of the different kinds of models that can be distinguished in an MBT approach, which task of a test process might be influenced by MBT and the outcome of industrial standardization work regarding MBT. The proposal will conclude with findings from the industry regarding benefits and shortcomings of MBT approaches.

Tutorial Outline and Timing (90 minutes)

Part 1: Introduction — 5 minutes
- Status and challenges of testing
- Improvement potentials for testing

Part 2: Test automation at a glance — 15 minutes
- What is test automation
- State of the art
- Test automation with models (model-based testing)

Part 3: Models for test automation — 25 minutes
- System and test models and their relations
- Use of models in the test process

Part 4: Industrial standards and notations — 15 minutes
- Standards for languages and notations
- Standards recommending model-based testing
- Standards for education

Part 5: Findings from Industry — 25 minutes
- Is model-based testing already accepted by industry?
- Challenges and recommendations for MBT integration
- ROI considerations and improvement potential
- Selected tools for industrial application

Part 6: Conclusion & Discussion — 5 minutes

Summary

Part 1: Introduction

In the introductory part we give a motivation for why model-based testing (MBT) is considered a helpful technique for certain test challenges that have not been solved for decades. This discussion leads to the improvement potential that MBT bears and the ingredients MBT is based on. The introduction provides the audience with an understanding, why MBT should be considered by the industry.

Part 2: Test automation at a glance
Since MBT is a technique to improve the degree of automation throughout the test process, this part will discuss the idea of test automation and the current state of the art in test automation at industry at first. This discussion also exhibits the opinion of experts regarding effort distribution in a test process to motivate the idea of using models. We then will prospect how and where models could or already are applied to increase the degree of automation in testing. This leads finally to part 3, where we will discuss test automation with models to a greater extent.
At the end of this part, the audience will have a foundational knowledge about how test automation is currently seen in the industry, its weaknesses and how models could be leveraged in order to further increase the degree of test automation.

Part 3: Models for test automation
Most of the published literature considers MBT as an interaction of different kind of models. Those model kinds are commonly classified as test models, system models and additional models. Whereas the first two kinds are rather intuitive, the third one is a placeholder category for any kind of model that cannot be assigned to one of the first two kinds. Requirements models, usage models or risk models are just three representatives of that third category. For the understanding of model-based testing, it is important to get a good understanding what these models stand for and how they are related with one another. This leads to a discussion of the different approaches to MBT as they are currently understood and applied.
Afterwards, we will highlight different task in a test process (inspired and similar to the ISTQB[1] fundamental test process). In particular, the following tasks are subject of consideration:
- Test design using models (test generation from models)
- Test execution support exploiting models (key-word driven testing with models)
- Test results analysis and reporting on models (tracing via model elements)

The lessons learned in this chapter are manifold. At first, the audience will have been made aware of the kinds of models which are considered relevant in any MBT approach. The audience will be able to distinguish the purpose of these model kinds. In addition, the interaction of these models is clarified by showing different approaches to MBT. Advantages and shortcomings of these approaches are highlighted. Ultimately, the audience will have learned how models can be used and applied within different testing task such as test design or test execution.

Part 4: Industrial standards and notations
Industrial and, thus, wide-spread acceptance and application of model-based testing techniques are influenced by a number of aspects. An important influencing factor is the availability of industrial standards. In the last few years, standardizations activities have been started around model-based testing, leading to new vocabularies, languages or qualification schemes in the realm of MBT. In this tutorial, we summarize the, from our point of view, most important activities with this regard. The standardization activities are separated into standards for languages and notations (i.e., standard for actually doing MBT), standards recommending MBT (i.e., industrial standards that recommend applying MBT for certain reasons) and standards teaching MBT (i.e, providing the necessary knowledge to the industry).
For standards for languages and notations, we will briefly introduce the latest results produced by working groups at OMG and ETSI, including:
- OMG’s UML Testing Profile
- OMG’s Test Interchange Format
- ETSI’s Requirements for Modelling Notations (ETSI ES 202 951)

[1] ISTQB stands for International Software Testing Qualification Board and is a world-wide consortium of national testing boards (such as the German Testing Board) that is aiming at providing a globally accepted and aligned certification and qualification schema for software tester. For further information see http://www.istqb.org

For standards that recommend model-based testing, we will summarize only a few industrial standards (such as the new ISO/IEC 61508 or ISO26262) we are faced in our daily work and examine them with respect to whether they are mentioning MBT techniques.
For the last category, we will provide insights to a currently on-going work of the Special Interest Group Model-Based Testing (SIG MBT) established under the umbrella of iSQI (http://www.isqi.org). SIG MBT is aiming at developing a new qualification schema and syllabus for the popular Certified Tester schema at ISTQB.
The lessons learned in this part or most interesting to the industrial representatives, since it shows on what existing work, preliminarily done by industrial experts in the realm of test automation and MBT, proprietary approaches can be built upon. This part provides a helpful reference to the audience for getting start with MBT in their specific context.

Part 5: Findings from industry
This part is most probably the most interesting for the industrial representatives in the audience. MBT bears great potential to improve the efficiency of software testing processes of the industry through automation. The question is whether MBT is already accepted and applied by the industry or whether it is still an academic hype. We will collect and gather statements from publications and surveys which were written by experts in the test (automation) domain to give the audience insights about industrial application of MBT approaches and ROI considerations. Furthermore, success and failure stories will be briefly summarized, which were mainly presented at the last two Model-Based Testing User Conferences (MBTUC) 2011 and 2012. Finally, this part will conclude with popular tools for doing MBT.

Part 6 concludes the tutorial with a rough summarization. Finally, there will be some time for discussions and questions.

Tutorial Materials
We plan to prepare hand-outs for the entire slide set (two or three slides per page), so that the audience can take notes in parallel to the tutorial

Intended Audience
The tutorial is interesting for industrial and academic attendees with both beginner and intermediate knowledge about model-based testing.

- Test engineers
- System/Software engineers
- Project managers
- Domain experts

Further Details (optional)
None.

Authors
Marc-Florian Wendland
Marc-Florian Wendland has been working for Fraunhofer FOKUS since 2008, at first as a student, afterwards as researcher in Prof. Dr. Ina Schieferdecker's team in the competence center MOTION. His interests and research topics are model-driven development and model-based testing, especially by using the well-known OMG standards like UML, UTP and SysML. Most recent research activities included risk-based testing and the transition from risk analysis to systematic generation of risk-optimized test suites leveraging models. He is leading a development team of a test modelling environment based on UTP, called Fokus!MBT. Marc-Florian Wendland has been the chairman of the last two UML Testing Profile revisions (1.1 and 1.2) at the OMG. He is a member of SIG MBT at iSQI, who is in charge of elaborating a qualification scheme for the ISTQB certified tester programm for model-based testing. Most recently, he was elected as one of five ETSI experts who are in charge of developing a dedicated language (Test Description Language, short TDL) for model-based testing at ETSI.

Ina Schieferdecker
Prof. Dr.-Ing. Ina Schieferdecker studied Mathematical Computer Science at Humboldt-University Berlin and did her PhD in 1994 at Technical University Berlin on performance-extended specifications and analysis of QoS characteristics. Since 1997, she is heading the Competence Center for Testing, Interoperability and Performance (TIP) at the Fraunhofer Institute on Open Communication Systems (FOKUS), Berlin and is heading now the Competence Center Modelling and Testing for System and Service Solutions (MOTION). She is Professor on Model-Driven Engineering and Quality Assurance of Software-Based Systems at Free University Berlin since 20011 and was Professor on Engineering and Testing of Telecommunication Systems at Technical University Berlin 2003-2011. Prof. Schieferdecker works since 1994 in the area of design, analysis, testing and evaluation of communication systems using specification-based techniques like UML (Unified Modelling Language), MSC (Message Sequence Charts) and TTCN-3 (Testing and Test Control Notation). Prof. Schieferdecker authored many scientific publications in the area of system development and testing. She is co-founder of the Testing Technologies IST GmbH, Berlin, member of the German Testing Board, and member of the German Academy of Technical Sciences (acatech).