MODEL-BASED TESTING OF LARGE-SCALE ENTERPRISE IT SYSTEMS
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Smartesting

- ISV founded in 2003
- Specialized in MBT
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Tutorial Agenda

- MBT for Large IT Systems
  - Current challenges of testing large-scale applications
  - Levels of testing addressed by model-based testing
- Modeling Business Processes and Business Rules
  - Business Process Modeling
  - Business Rules and requirements
  - Test generation and implementation
- Didactic example
- Reuse and packaged applications
- Lessons learned
MBT for Large IT Systems

Full IS level testing
- End-to-end testing
- Critical business processes
- ERP...

Integration level testing
- Multi-applications validation tests

Application level
- Functional test of a single application

Limited number of tests, high value of each test
User-oriented test cases
Large number of test cases, thorough technical validation
MBT for Large IT Systems

- Information System level testing characteristics:
  - Small number of tests
  - Functional knowledge from multiple areas, difficult to acquire
  - Low level of technical skills
  - Potentially high cost of execution (test environment, time, resources)
  - Focus on scenarios testing
  - Multiple actors/contractors
MBT for Large IT Systems

- Integration level testing characteristics:
  - Environment simulation
  - Data injection and control
  - Mix of scenarios and functional testing
  - Various levels of maturity in requirement management
  - Test objectives elicitation
  - Multiple actors/contractors
MBT for Large IT Systems

• Consequences on MBT for this kind of system:
  • Testing a path is more important than testing a single function – end-2-end testing and workflow testing
  • Modeling must remain simple even when representing complex functional rules/data

• MBT Value added:
  • Improves communication and helps share understanding
  • Model can be considered as a knowledge base
  • Helps control requirements and functional coverage
  • Ensure test content consistency
Modeling Business Processes and Business Rules

Model Assets

Business Needs

MBT Test Production

Test Design Automation

MBT Automated Traceability

Test Requirements

Test Repository

Test Execution

automated
guided
manual

User Conference on Advanced Automated Testing

20-22/10/2015
Modeling Business Processes and Business Rules

Test Analyst

Business Analyst

Test Assets

Model Assets

Business Models & Flows

Test Analyst

Business Rules & Data

Automation engineer

Tester

User Conference on Advanced Automated Testing
Modeling Business Processes and Business Rules

- Business process modeling is the best choice for modeling in this context
  - Focus on scenarios
  - Easy to understand by all stakeholders (including Business Analyst)
  - Sometime already used in organizations (in such case, also provides BP validation)
- Business process models can be considered as a requirements by testers
Modeling Business Processes and Business Rules

- Business Rules modeling using **decision tables**
- Business rules are associated to Business process tasks
- A requirement can be related to a specific part of a business rule
- Both relationships can be represented by a decision table
Modeling Business Processes and Business Rules

- Test steps descriptions from Business Process Tasks
  - Action details are related to BP task execution
  - Content depends on data input and expected results
  - Content is also related to decision table
Modeling Business Processes and Business Rules

- Data can be concrete or abstract in the model
  - As long as a business rule applies the same way, abstract data can be used (equivalent classes)
  - Ex: user can be ESS (standard user) or ADMIN
  - ESS can be used as a type, or replaced by a concrete username
  - Abstract to concrete values will be processed during publication
Modeling Business Processes and Business Rules

• Test Generation needs to provide complete implementation
  • Data inputs
  • Expected results
  • User actions
  • Requirements traceability
  • Pre-requisites

• No modification should be necessary after Test Generation/Implementation
Modeling Business Processes and Business Rules

- Test Generation
  - From each Business Process Task
  - From each line in each decision tables
  - Based on partial or complete path coverage of the Business Process
  - Consistent with data values and conditions in tables
Modeling Business Processes and Business Rules

- Test Generation
  - Path selection in process
  - Each line in decision table represents passing / non passing configuration
Modeling Business Processes and Business Rules

- What is the best number of test cases?
  - $\text{NbTasks} \times \text{NbLines(Task)} \times 1.7 + \text{NbTasks}/2$ ?
  - $\text{NbTasks} \times \text{NbLines(Task)}^2 - \text{NbLines(Task)}/4$ ?
  - ...

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Modeling Business Processes and Business Rules

- The best number of test cases is a tradeoff between risk and testing cost

Graph:
- X-axis: Coverage / number of tests
- Y-axis: Risk and Testing Cost
- MBT supports the Test Analyst to achieve the right balance!
Modeling Business Processes and Business Rules

• Test Implementation and Test publication
  • Test cases are stored in a standard Test Repository (HP ALM, TestLink, etc)
  • Each project has its own test organization in the test repository
  • Test publication must conform to project usage
  • MBT Tool is NOT the only source of test implementation (there are still some tests built manually)

• Test publication must be highly customizable
  • Test repository organization
  • Project/repository management attributes (priority, functional domain, ...)
  • Only manual test scripts or automated test scripts or both
Modeling Business Processes and Business Rules

- Test publication and data
  - For abstract data, the generation has defined tests with abstract values.
  - Test publication will transform this abstract data to concrete data.
  - Multiple tests can then be published from one generated test.
  - Ex: user ESS becomes abo, you, someoneelse, etc.
  - Test by test or by groups with strategies.
  - Creating test data or using existing ones.
Didactic example

- Example of a consumer credit
  - Credit is defined in a dedicated application, linked to an existing CRM
  - Credit is acceptable if the credit details fulfill conditions defined in specifications
  - Customer is acceptable if his situation fulfills conditions defined in specifications.
Didactic example

• Business Process
Didactic example

- Decision table
- Check Credit Eligibility Task

<table>
<thead>
<tr>
<th></th>
<th>Amount?</th>
<th>Duration?</th>
<th>TypeOfGoods?</th>
<th>Eligibility</th>
<th>Outcome</th>
<th>Requirement</th>
<th>Test Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Less than 300€</td>
<td>Less than 12 months</td>
<td>Games</td>
<td>Eligible</td>
<td>Credit is accepted</td>
<td>Credit for Gaming</td>
<td>Less than 300€</td>
</tr>
<tr>
<td>2</td>
<td>Less than 1500€</td>
<td>Between 12 and 48 months</td>
<td>Video</td>
<td>Eligible</td>
<td>Credit is accepted</td>
<td>Credit for Video</td>
<td>Middle Video</td>
</tr>
<tr>
<td>3</td>
<td>Less than 1500€</td>
<td>Between 12 and 48 months</td>
<td>Appliances</td>
<td>Eligible</td>
<td>Credit is accepted</td>
<td>Credit for Appliances</td>
<td>Less than 1500€</td>
</tr>
<tr>
<td>4</td>
<td>More than 48 months</td>
<td></td>
<td></td>
<td>Duration is too long</td>
<td>Credit is refused</td>
<td>Credit refused</td>
<td>Long duration</td>
</tr>
<tr>
<td>5</td>
<td>More than 4000€</td>
<td></td>
<td></td>
<td>Amount is too high</td>
<td>Credit is refused</td>
<td>Credit refused</td>
<td>High amount</td>
</tr>
</tbody>
</table>
Didactic example

- Decision table
- Check Customer Eligibility Task

<table>
<thead>
<tr>
<th>Age</th>
<th>Professional Status</th>
<th>Eligible Customer</th>
<th>Outcome</th>
<th>Requirement</th>
<th>Test Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Over 18</td>
<td>Student</td>
<td>Eligible</td>
<td>Customer is accepted</td>
<td>Customer Eligibility</td>
<td>Student over 18</td>
</tr>
<tr>
<td>2 Over 18</td>
<td>Employee</td>
<td>Eligible</td>
<td>Customer is accepted</td>
<td>Customer Eligibility</td>
<td>Employee over 18</td>
</tr>
<tr>
<td>3 Senior</td>
<td>Employee</td>
<td>Eligible</td>
<td>Customer is accepted</td>
<td>Customer Eligibility</td>
<td>Employee Senior</td>
</tr>
<tr>
<td>4 Senior</td>
<td>Retired</td>
<td>Not Eligible</td>
<td>Customer is refused</td>
<td>Customer Eligibility</td>
<td>Retired Senior</td>
</tr>
<tr>
<td>5 Under 18</td>
<td></td>
<td>Not Eligible</td>
<td>Customer is refused</td>
<td>Customer Eligibility</td>
<td>Under 18</td>
</tr>
</tbody>
</table>
Didactic example

- High Level description for actions
- Check Customer Eligibility Task

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Professional Status</th>
<th>Eligible</th>
<th>Action</th>
<th>Outcome</th>
<th>Requirement</th>
<th>Test Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Over 18</td>
<td>Student</td>
<td>Eligible</td>
<td>Customer details: Age: Over 18 Professional Status: Student</td>
<td>Customer is accepted</td>
<td>Customer Eligibility</td>
<td>Student over 18</td>
</tr>
<tr>
<td>2</td>
<td>Over 18</td>
<td>Employee</td>
<td>Eligible</td>
<td>Customer details: Age: Over 18 Professional Status: Employee</td>
<td>Customer is accepted</td>
<td>Customer Eligibility</td>
<td>Employee over 18</td>
</tr>
<tr>
<td>3</td>
<td>Senior</td>
<td>Employee</td>
<td>Eligible</td>
<td>Customer details: Age: Senior Professional Status: Employee</td>
<td>Customer is accepted</td>
<td>Customer Eligibility</td>
<td>Employee Senior</td>
</tr>
<tr>
<td>4</td>
<td>Senior</td>
<td>Retired</td>
<td>Not Eligible</td>
<td>Customer details: Age: Senior Professional Status: Retired</td>
<td>Customer is refused</td>
<td>Customer Eligibility</td>
<td>Retired Senior</td>
</tr>
<tr>
<td>5</td>
<td>Under 18</td>
<td>Not Eligible</td>
<td>Not Eligible</td>
<td>Customer details: Age: Under 18 Professional Status: any</td>
<td>Customer is refused</td>
<td>Customer Eligibility</td>
<td>Under 18</td>
</tr>
</tbody>
</table>
Didactic example

- low Level description for actions
- Check Customer Eligibility Task

<table>
<thead>
<tr>
<th>Actions</th>
<th>Expected results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Enter customer details</td>
<td>Details page must be displayed</td>
</tr>
<tr>
<td>2 Enter customer age: Over 18</td>
<td>For an existing customer, the age must be displayed</td>
</tr>
<tr>
<td>3 Enter customer professional status: Student</td>
<td>For an existing customer, the professional status must be displayed</td>
</tr>
<tr>
<td>4 Run customer eligibility check</td>
<td>The following message must be displayed:</td>
</tr>
<tr>
<td></td>
<td>Customer is Eligible</td>
</tr>
</tbody>
</table>
Didactic example

- Test implementation
- An example in HP ALM

<table>
<thead>
<tr>
<th>Step Name</th>
<th>Description</th>
<th>Expected Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Enter credit duration: between 12 and 48 month</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>Enter credit amount: less than 1500 euros</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>Enter goods type: Appliances</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>Select “Check Credit Eligibility”</td>
<td>Credit should be Eligible</td>
</tr>
<tr>
<td>Step 5</td>
<td>Enter customer details</td>
<td>Details page must be displayed</td>
</tr>
<tr>
<td>Step 6</td>
<td>Enter customer age: Over 18</td>
<td>For an existing customer, the age must be displayed</td>
</tr>
<tr>
<td>Step 7</td>
<td>Enter customer professional status: Student</td>
<td>For an existing customer, the professional status must be displayed</td>
</tr>
<tr>
<td>Step 8</td>
<td>Run customer eligibility check</td>
<td>The following message must be displayed: Customer is Eligible</td>
</tr>
<tr>
<td>Step 9</td>
<td>Select Compute Payments</td>
<td>Payments list should be displayed</td>
</tr>
<tr>
<td>Step 10</td>
<td>Select Contract Signature and sign contract</td>
<td>Signature must be accepted</td>
</tr>
<tr>
<td>Step 11</td>
<td>Select Existing Contracts for customer</td>
<td>The signed contract must appear</td>
</tr>
</tbody>
</table>
Reuse and packaged application

• Multiple flavours for reuse
  • A model is easy to copy and to modify for a different context
    • Families of similar projects
  • A ‘generic’ model can be defined, to be customized in a real project
    • Project template, always customized

• Generic models can be designed for:
  • A precise business need with multiple implementations
    • Ex: HR declined by country / by company / by software
  • A packaged application with customized usage
    • Ex: ERP like SAP
Reuse and packaged application

- Sample nominal process for SAP Sales order processing

From generic process, customization of
- Processes
- Tasks
- Decision tables
- Descriptions
Reuse and packaged application

- Example of customization.
- Customer Consignment Process
- Partial Generic Process
Reuse and packaged application

- Example of customization.
- Customer Consignment Process
- Same part customized
Lessons learned

• Team skills
  • High business skills
  • Low technical skills
  • Testers are more business experts than programmers
  • Some types of graphical modeling are understandable, but not scripting nor object concepts
  • Simplify MBT concepts is key, but productivity gains must be kept
Lessons learned

- Communication and teams
  - Usually multiple contractors are involved
  - Modeling can be seen as a knowledge base
  - Modeling can be seen as a communication asset
  - Introducing MBT is a transformation project
Lessons learned

- Importing Processes from Business Team
  - In some organization, the business team uses BPM
  - These processes can be directly imported and reused by Testers
  - BUT, as the processes are only used as documentation:
    - The BPM can be semantically wrong
    - The BPM can be old
    - The BPM can be addressing a different level of abstraction
Lessons learned

• Importing Processes from Business Team
• Importing also means:
  • Controlling
  • Managing life cycle
  • Reshaping
Lessons learned

• Automation
  • Automation is only used for regression testing
  • Usually felt as a pain
  • MBT allows to have the same design for manual and for automated test
  • MBT is a real opportunity by separating business and technical concerns
CONCLUSION

• MBT can be used for large IT Systems
• Productivity gains come from:
  • Improved communication
  • Knowledge consolidation
  • Easier automation
• Challenge is technical complexity of modeling
QUESTIONS?