Empirical Assessment of MDE in Industry
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http://www.cs.toronto.edu/~chechik/courses18/csc2125
Who is Practising MBSE?

Sampling of Embedded Software Developed Using MDD

Anecdotal Evidence of *Benefits* of MBSE

- increased productivity, shortened development time
- improved quality
- use of standards, abstraction, formalisms
- improved maintainability, evolution
- improved communication and information sharing
- support for traceability among software artifacts
- early assessment of design
- improved reuse of software artifacts
- improved portability of solutions to new platforms

Mohagheghi & Dehlen, "Where is the Proof? - A Review of Experiences from Applying MDE in Industry", in ECMDA'08
Anecdotal Evidence of \textit{Drawbacks} of MBSE

- thinking abstractly is hard
- developing and testing code generators takes time
- integrating generated code with legacy code takes time
- keeping the models and code in sync takes time
- MBSE tools are immature, brittle, not interoperable
- MBSE tools are rarely scalable to large models
- inexperience of developers

Hutchinson, Whittle, Rouncefield, Kristoffersen, "Empirical Assessment of MDE in Industry", in ICSE'11
Mohagheghi & Dehlen, "Where is the Proof? - A Review of Experiences from Applying MDE in Industry", in ECMDA'08
Selie, "Personal reflection on automation, programming culture, and model-based software engineering", in ASE 2008
Empirical Assessment of MDE in Industry
Hutchinson, Whittle, Rouncefield, Kristoffersen, "Empirical Assessment of MDE in Industry", in ICSE'11

Objectives of Project
"collect and assimilate information on the way MDE is used in practice, which we will use to determine which approaches work best and provide the most valuable insights into MDE use"

http://www.comp.lancs.ac.uk/~eamde

Research Methodology
• online questionnaire

• structured / semi-structured interviews
  22 experts, from 17 companies working in 12 domains
  collectively have >360 years of software development experience
EA-MDE: General Opinion of MDE

Do you consider MDE to be a good thing? (401 respondents)

- Yes: 84%
- No: 4%
- Neutral: 8%
- Don't know: 4%

SOURCE: J. Hutchinson (thesis data: June 2011)
EA-MDE Study: MDE Experience

MDE was a success (366 respondents)

- Strongly Agree: 21%
- Agree: 38%
- Neither Agree nor Disagree: 23%
- Disagree: 7%
- Strongly Disagree: 11%

SOURCE: J. Hutchinson (thesis data: June 2011)
# Influential Factors

Hutchinson, Whittle, Rouncefield, Kristoffersen, "Empirical Assessment of MDE in Industry", in ICSE'11

Table 3. The impact of MDE activities on productivity and maintainability.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Productivity</th>
<th></th>
<th></th>
<th>Maintainability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increased</td>
<td>Not Used</td>
<td>Increased</td>
<td>Not Used</td>
<td></td>
</tr>
<tr>
<td>Use of models for team communication</td>
<td>73.7%</td>
<td>7.0%</td>
<td>66.7%</td>
<td>6.7%</td>
<td></td>
</tr>
<tr>
<td>Use of models for understanding a problem at an abstract level</td>
<td>73.4%</td>
<td>4.8%</td>
<td>72.2%</td>
<td>6.1%</td>
<td></td>
</tr>
<tr>
<td>Use of models to capture and document designs</td>
<td>65.0%</td>
<td>9.3%</td>
<td>59.9%</td>
<td>10.7%</td>
<td></td>
</tr>
<tr>
<td>Use of domain-specific languages (DSLs)</td>
<td>47.5%</td>
<td>32.6%</td>
<td>44.0%</td>
<td>33.7%</td>
<td></td>
</tr>
<tr>
<td>Use of model-to-model transformations</td>
<td>50.8%</td>
<td>24.6%</td>
<td>42.6%</td>
<td>28.4%</td>
<td></td>
</tr>
<tr>
<td>Use of models in testing</td>
<td>37.8%</td>
<td>33.9%</td>
<td>35.2%</td>
<td>32.4%</td>
<td></td>
</tr>
<tr>
<td>Code generation</td>
<td>67.8%</td>
<td>12.0%</td>
<td>56.9%</td>
<td>12.6%</td>
<td></td>
</tr>
<tr>
<td>Model simulation/Executable models</td>
<td>41.7%</td>
<td>38.3%</td>
<td>39.4%</td>
<td>35.9%</td>
<td></td>
</tr>
</tbody>
</table>
Scope of Assessment

Most questions focus on

• effect on productivity (of code development, testing)
• effect on maintainability
• effect on agility to evolve product
• skill needs / training
• impact of tools on MDE success
Effects of Code Generation assessed through a pair of positive / negative questions

Is your use of code generation an important aspect of your MDE productivity gains?

Is integrating generated code into your existing projects a significant problem?
Impact on Skill Needs / Training

Does using MDE allow you to employ developers with less software engineering experience (e.g. new graduates)?

Does using MDE require you to carry out significant extra training in modeling?
Impact on Agility

Does MDE make you faster at implementing new requirements?

Does MDE prevent you from responding to business opportunities?
Impact on Understandability

Does your use of MDE lead to better understanding between stakeholders?

Does your use of MDE result in unexpected confusion and/or misunderstandings between stakeholders?
If MDE is so good, why isn't everyone using it?
Factors Correlated with (Un)Successful Adoption

Hutchinson, Rouncefield, Whittle, "Model-Driven Engineering Practices in Industry", at ICSE'11
Hutchinson, Whittle, Rouncefield, Kristoffersen, "Empirical Assessment of MDE in Industry", in ICSE'11

Successful Adoption

- Real business need for experimenting with new development processes
- Commitment of team, management
- Incremental adoption
- Process is adapted with experience
- DSL tailored to narrow domain
- Software is component of larger product

Unsuccessful Adoption

- Adoption motivated by MBSE claims rather than by real need
- Commitment of management or team, but not both
- Wholesale adoption of MBSE
- Process is rigid, uniform
Factors that *Inhibit* Successful MBSE


<table>
<thead>
<tr>
<th>Factor</th>
<th>Impact Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture and general resistance to change</td>
<td>3.96</td>
</tr>
<tr>
<td>Lack of Management support</td>
<td>3.30</td>
</tr>
<tr>
<td>Start up cost</td>
<td>3.27</td>
</tr>
<tr>
<td>Modeling tools</td>
<td>3.19</td>
</tr>
<tr>
<td>MBSE training</td>
<td>3.08</td>
</tr>
<tr>
<td>Modeling method, practices, and conventions</td>
<td>2.97</td>
</tr>
<tr>
<td>Modeling language</td>
<td>2.35</td>
</tr>
<tr>
<td>Number of diagrams</td>
<td>2.09</td>
</tr>
</tbody>
</table>
Do organisations adopt MDE for its technical merits?

Do organisations adopt MDE to "jump through hoops" or appear to do so?

Reasons to Model
Hutchinson, Whittle, Rouncefield, Kristoffersen, "Empirical Assessment of MDE in Industry", in ICSE'11
Summary
First step of an empirical assessment of MDE

How MDE is being applied in industry
- modelling for team communication
- modelling for problem solving
- modelling for documentation
- use of DSLs
- model-to-model transformations
- code generation
- model-based testing
- model simulation

Assessment of benefits of successful MDE

Factors that affect MDE's success or failure
- business need
- commitment of MDE users as well as management
- incremental adoption
- adaptable process
References

• R. Cloutier and M. Bone, “Compilation of SysML RFI – Final Report,” Stevens Institute of Technology, 2010


• Selic, “Personal reflection on automation, programming culture, and model-based software engineering,” in ASE 2008