Industrial Adoption of Model-Driven Engineering: Are the Tools Really the Problem?

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What is the
biggest challenge
that companies face
when adopting MDE?

Most would say tools…

- Den Haan:
  - One of the main reasons MDE fails
- Kuhn:
  - Five problems of MDE; all tool related
- Staron:
  - Too immature for cost efficient adoption

We don't understand how tools are actually used in industry.

Contribution

A taxonomy of issues professionals have with MDE tools

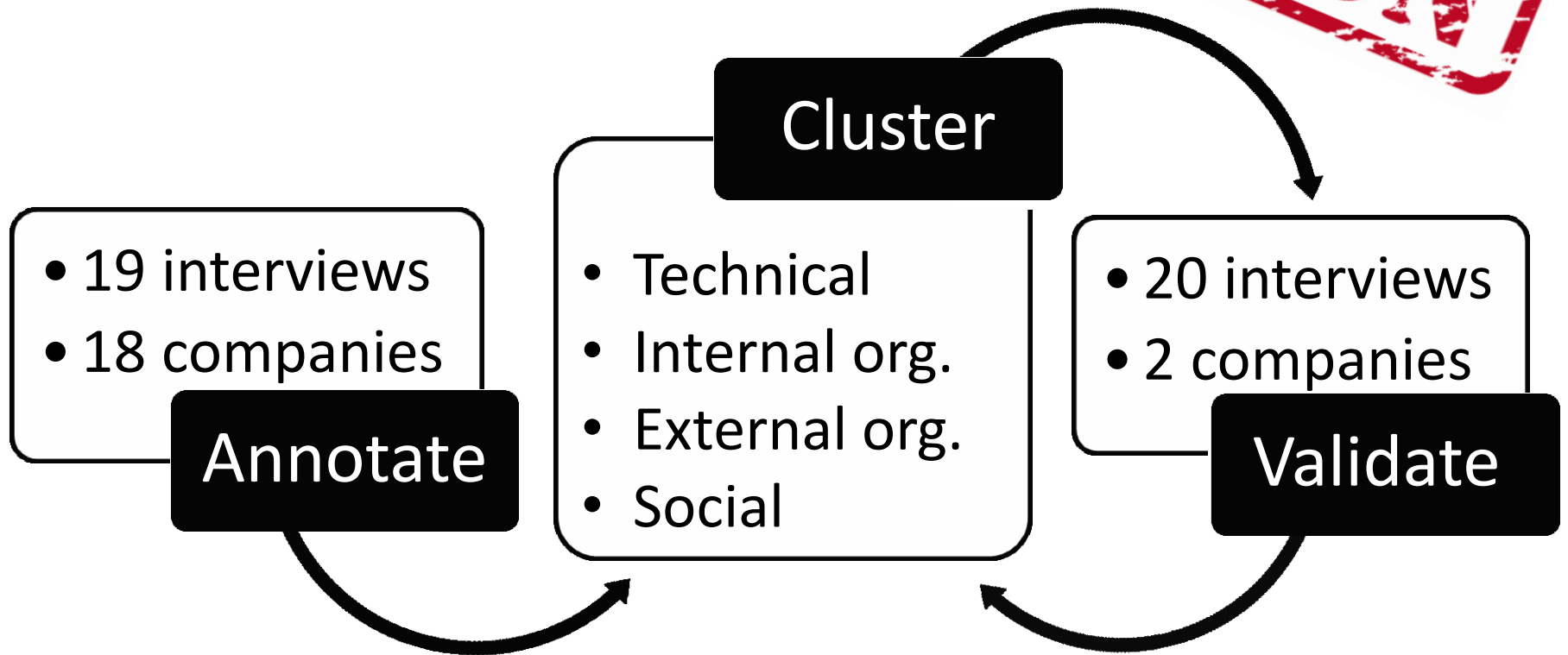We asked practitioners about their experiences about MDE tools

20 companies
39 professionals
100s of data points
300,000 words of transcribed data

Method

CAUTION

Annotate
- 19 interviews
- 18 companies

Cluster
- Technical
- Internal org.
- External org.
- Social

Validate
- 20 interviews
- 2 companies

Purpose of the taxonomy

Checklist for developing new tools

Framework for evaluating existing tools

Identifies Technical,

   Organizational and

   Social factors

of MDE tools that open new research possibilities

Taxonomy

Table 1. Technical Categories.

Category	Sub-Category
Tool Features *Specific functionalities offered in tools*	- Modeling Behavior - Action Languages - Support Domain-Specific Languages - Support for Architecture - Code Generation Templates - UML Profiles - Scoped Code Generation
Practical Applicability *Ch... pr...*	- Tool Scal... - Tool ver... ...ether ...uality of Generated Code ...f Tools ...Tools
Co... *Challenges brought on by excessive complexity in tools*	...exity - Language Complexity - Accidental Complexity Introduced by Tools
Human Factors *Consideration of tool users*	- Whether Tools Match Human Abstractions - Usability
Theory *Theory underpinning tools*	- Theoretical Foundations of Tools - Formal Semantics
Impact on Development *Impact of tools on technical success criteria*	- Impact on Quality - Impact on Productivity - Impact on Maintainability

Table 4. Social Categories.

Category	Sub-Category
Control *Impact of tools on w...et in control of their pro...*	
Trust *Impact of trust on tool use and adoption*	Vendor Trust Engineers' Trust

Table 3. External Organizational Categories.

Category	
External Influen... *Factors which ... no direct contr...*	
Commercial Aspects *Business consider...io on tool use and applic...*	

Table 2. Internal Organizational Categories.

Category	Sub-Category
	- Tailoring to Existing Processes - Sustainability of Tools

Level

Social

Technical

External Organizational

Internal Organizational

Usability

**If you want
intuitive tools
develop your own.**

Accidental complexity

Tool versioning
(or the Portability Paradox)

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Social

External Organizational

Internal Organizational

Level

Tailoring tools to existing…

Q

… processes
… culture

Q

Low hanging fruit

...but be careful not to over-generalize

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Cost

Q

Marketing issues

High

Low

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Technical

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External Organizational

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Internal Organizational

Level

Trust…

… the tool?

… the vendor?

… the change?

Control

Open communities

Taxonomy

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Tool Features *Specific functionalities offered in tools*	- Modeling Behavior - Action Languages - Support Domain-Specific Languages - Support for Architecture - Code Generation Templates - UML Profiles - Scoped Code Generation
Practical Applicability *Challenges of applying tools in practice*	- Tool Scaleability - Tool Versioning - Chaining Tools Together - Industrial Quality of Generated Code - Flexibility of Tools - Maturity of Tools
Complexity *Challenges brought on by excessive complexity in tools*	- Tool Complexity - Language Complexity - Accidental Complexity Introduced by Tools
Human Factors *Consideration of tool users*	- Whether Tools Match Human Abstractions - Usability
Theory *Theory underpinning tools*	- Theoretical Foundations of Tools - Formal Semantics
Impact on Development *Impact of tools on technical success criteria*	- Impact on Quality - Impact on Productivity - Impact on Maintainability

Table 4. Social Categories.

Category	Sub-Category
Control *Impact of tools on whether stakeholders feel in control of their project*	Interaction with Tool Vendors Subverting Tools
Trust *Impact of trust on tool use and adoption*	Vendor Trust Engineers' Trust

Table 3. External Organizational Categories.

Category	Sub-Category
External Influences *Factors which an organization has no direct control over*	- Marketing Issues - Government and Industry Standards
Commercial Aspects *Business considerations impacting on tool use and application*	- Business Models - Cost of Tools - Selection of Tools

Table 2. Internal Organizational Categories.

Category	Sub-Category
Processes *Adapting tools to processes or vice-versa*	- Tailoring to Existing Processes - Sustainability of Tools - Appropriation - Integration Issues - Migration Issues - Offsetting Gains - Maintenance at Code versus Model Level
Organizational Culture *Impact of cultural attitudes on tools and their application*	- Tailoring to Existing Culture - Inertia - Over Ambition - Low Hanging Fruit
Skills *Skills needed for tools to succeed*	- Training - Availability of Skills

Conclusion &
Future research directions

1) Match tools to people

2) Support for creativity

3) Right tool – right problem

4) More focus on processes, less on tools

5) Open MDE communities

Are the Tools Really the Problem?

Yes

Tools are unintuitive
and complicated

Tools need to adapt to an
imperfect world
– not the other way
around

No

People and

Organizations
are just as important