From Business Application Execution to Design through Model-Based Reporting

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Context and Background

Enterprise Systems Become Increasingly Complex

- unify different technologies
- are adapted for new and emerging technologies
- need to comply with imposing requirements

Model-Driven Engineering (MDE)

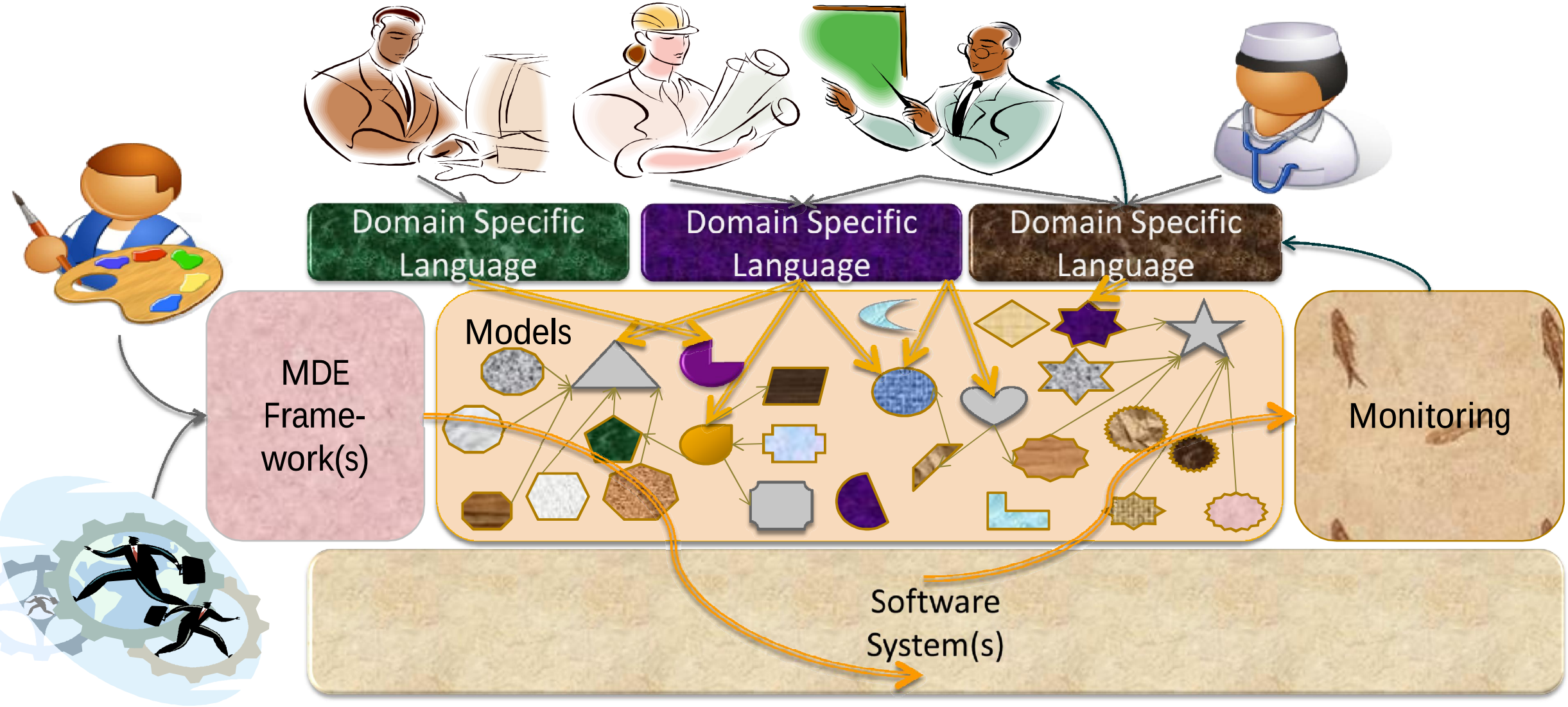
- helps to master complexity (design-time)
- utilizes **models** as central artifacts

Motivation: Foster the Use of Models in Software Systems

Models are cross-disciplinary accepted as a means to deal with complexity.

- precisely specified
- instances can be validated
- can be (d|r)efined at different abstraction levels
- are suitable to be represented to stakeholders
- can be bound to tailored domain specific languages (DSLs)
- a view-based approach can support the separation of concerns (SoC) principle

A Model-Centered World



Problems

MDE does not (yet) cover the whole lifecycle.

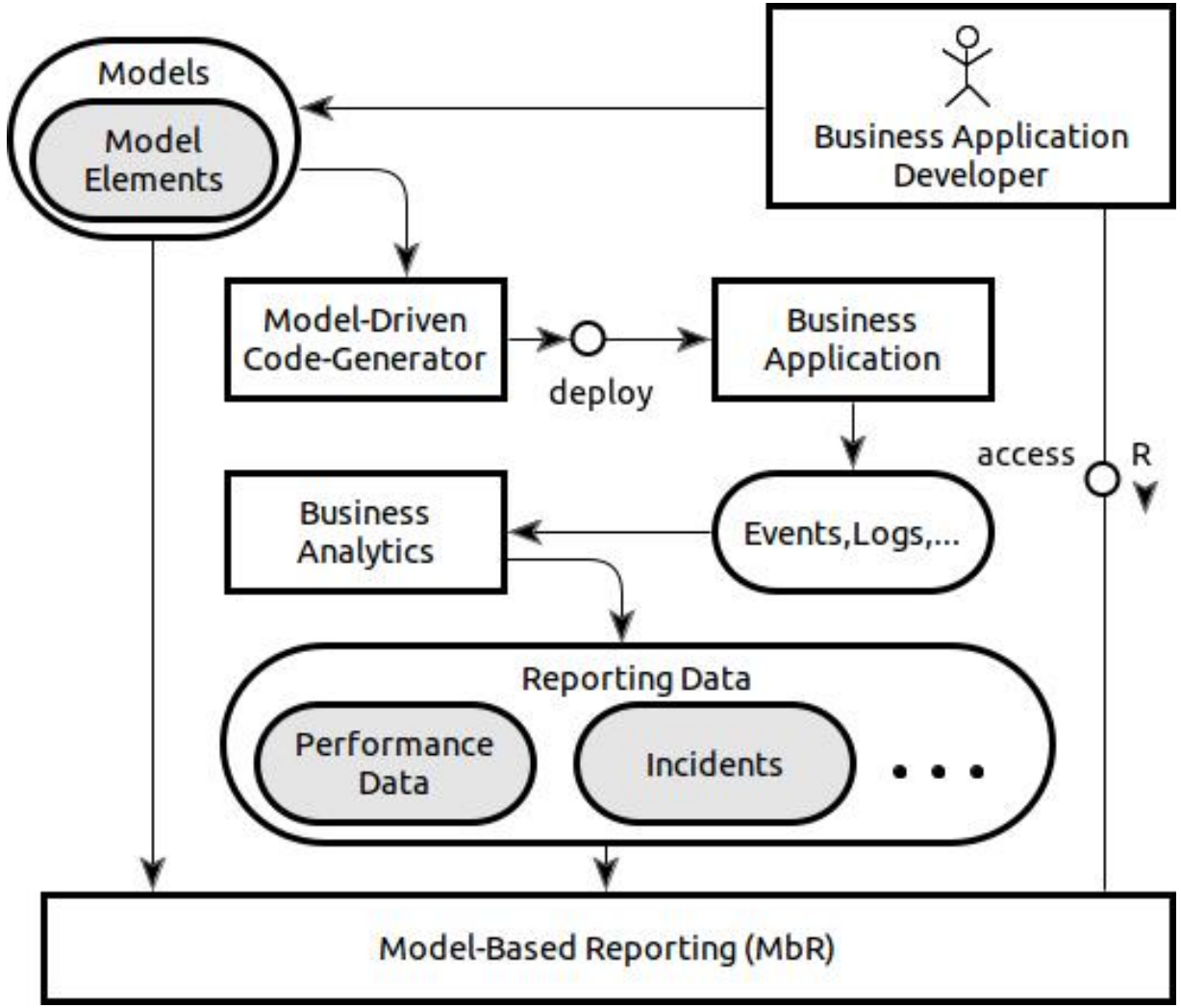
- Traceability is often lost after a generation step.
- Model-driven systems have no relation to their models.

Legacy systems are not connected to conceptual models at all.

In other cases

- synchronization is expensive.
- model-related reporting is specific to a domain (e.g., BPM) or product
- and is not easily extensible towards new types of reporting data.

Contribution: Model-Based Reporting



Some Assumptions for Model-Based Reporting

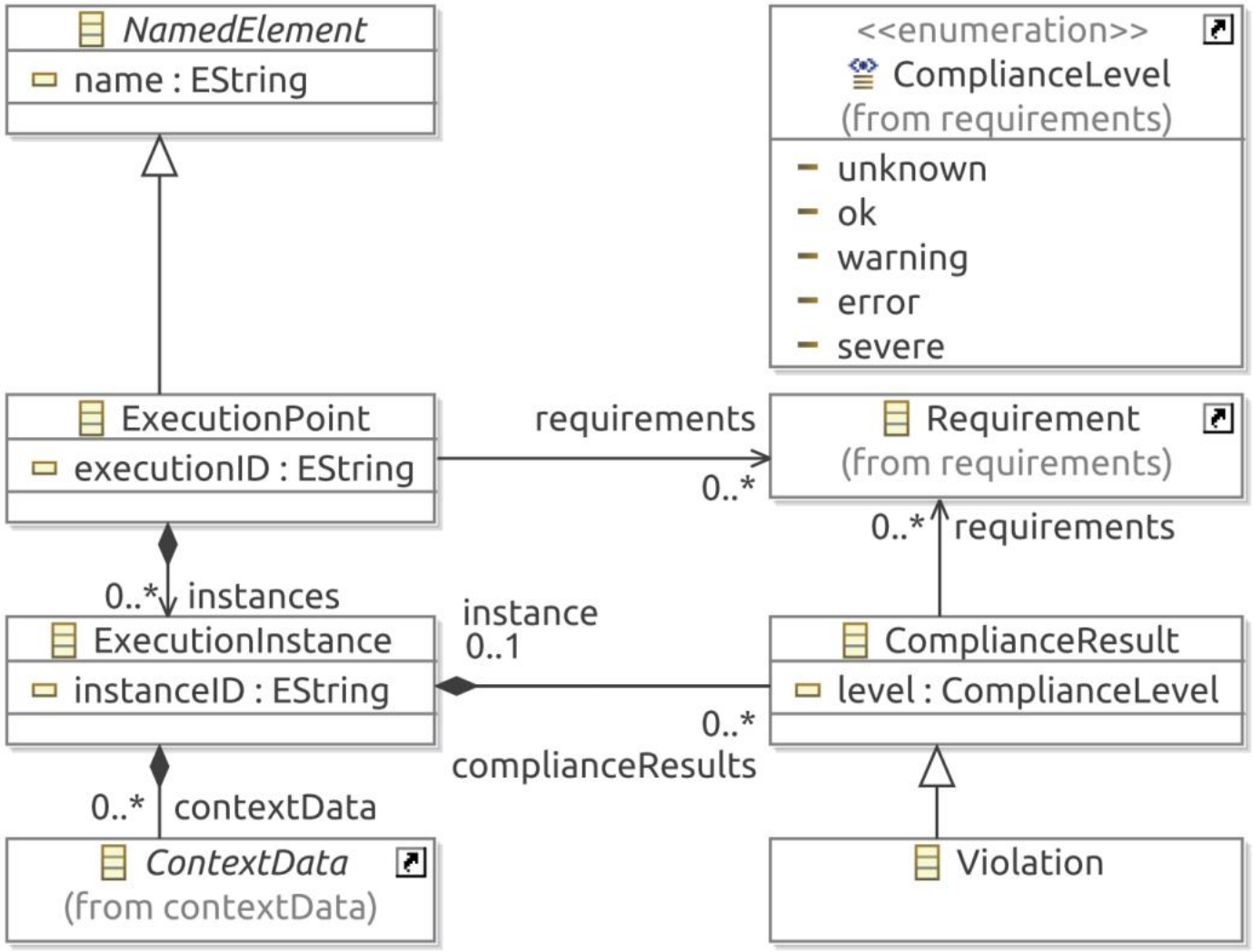
1. **model: apply the MORSE Principle [1]**
   - i.e., assign a universally unique identifier (UUID) to every model and model element (`modelElementID`)
     - via annotations directly in the model
     - or by registering the model in a MORSE repository

2. **application: provide for traceability**
   - generate UUIDs for execution points (`executionID`)
   - instrument the code
     - with eventing: raise an event containing the `executionID` and an `instanceID`

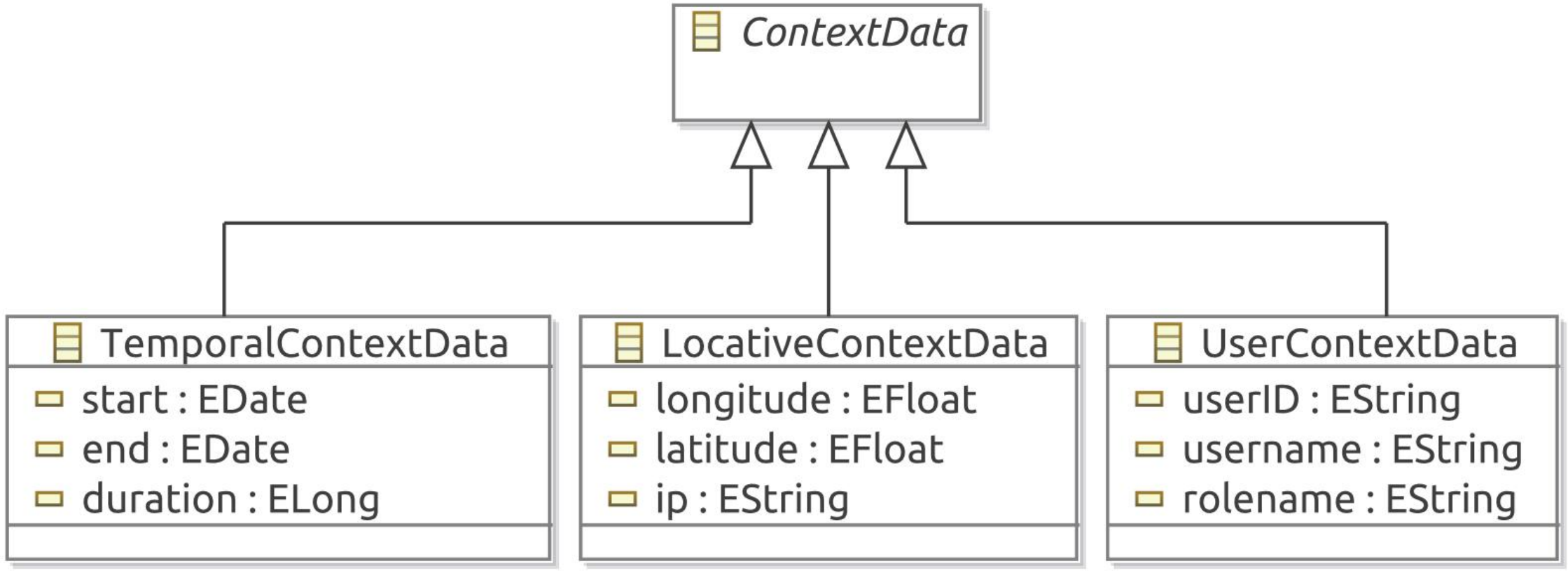
3. **MbR correlation service: create a MbR view**
   - register `modelElementIDs` with `executionIDs`

[1] Holmes, T.; Zdun, U.; Dustdar, S. ”MORSE: A Model-Aware Service Environment”, *APSCC*, **2009**, 470-477

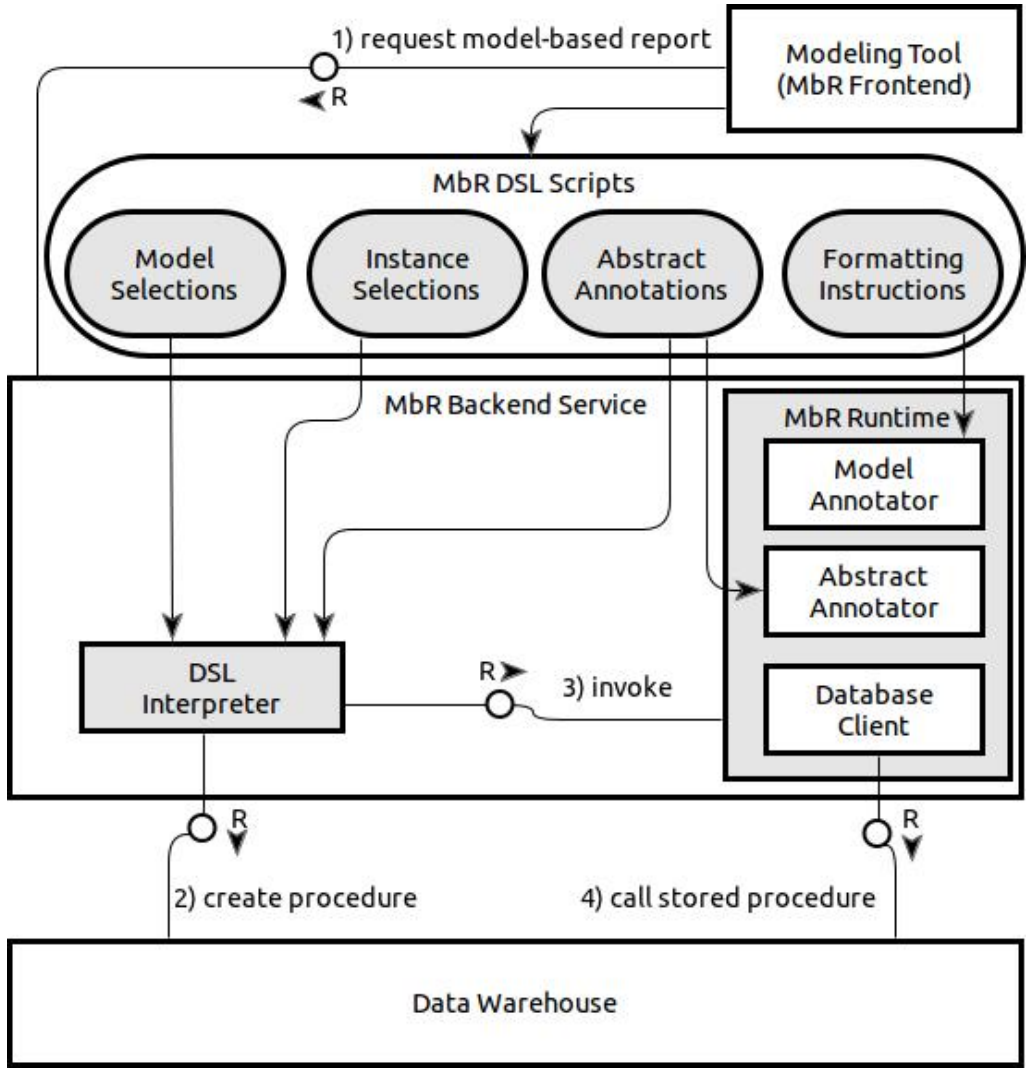
Reporting Data (Proof of Concept) **Metamodel**



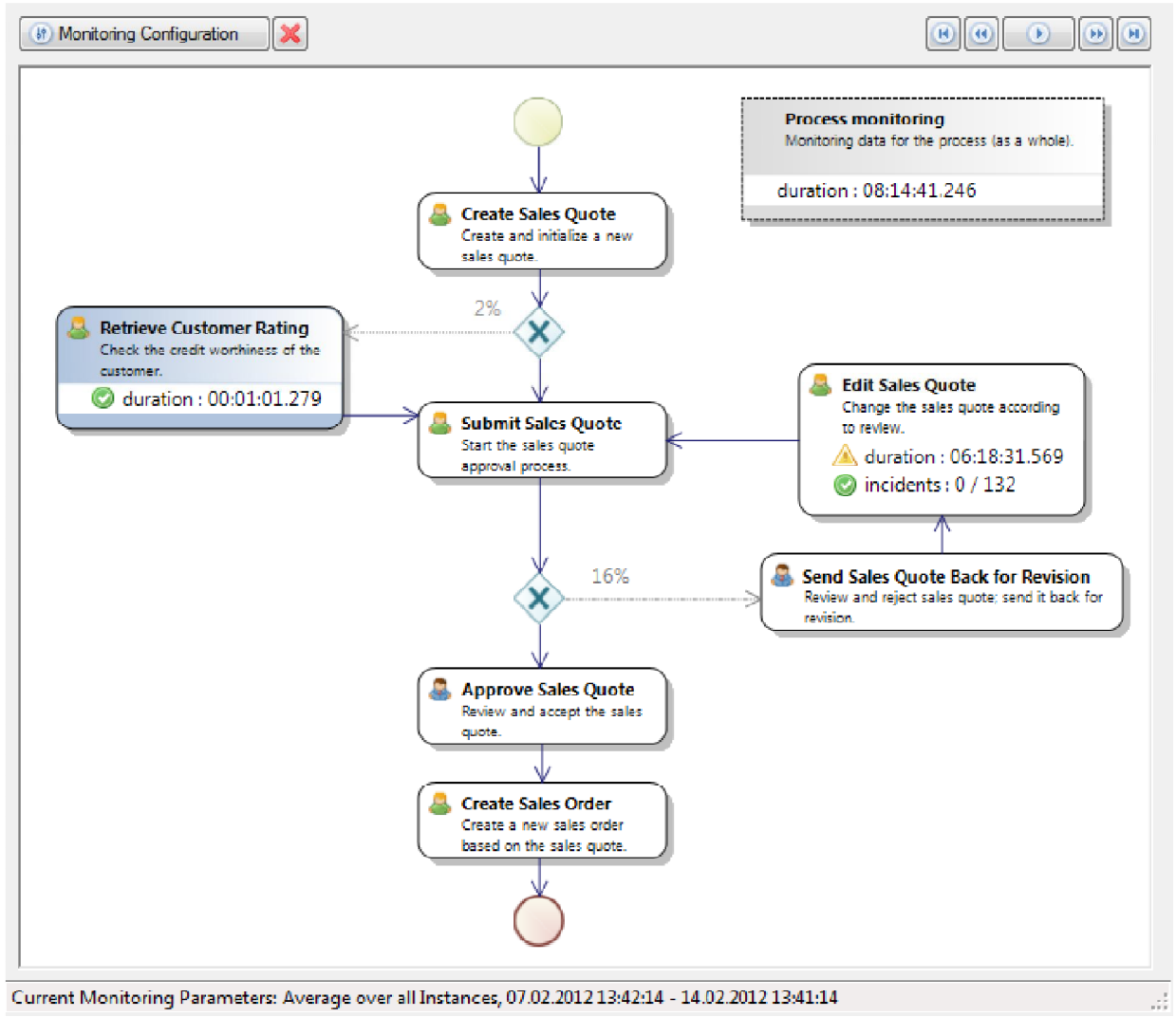
Runtime Context Data (Proof of Concept) **Metamodel**



Model-Based Reporting — Architectural Overview



Business Process Monitoring – Powered by MbR



MbR DSL Script – Sales2Order Example

```
1   // Model Selection (1st  part)
2   m: Order2Cash
3
4   // Instance Selection (2nd  part)
5   b: m.start >= "2012-02-07 13:42:14"
6      &  m.end < "2012-02-14 13:42:14"
7
8   //  Abstract Annotation (3rd  part)
9   m << duration = AVG(b.duration)
10
11  557dbb5d-7558-4f8e-acc6-d618f12487a6
12  b3b6e8e5-3b30-44a3-8dd5-29f354c60877
13      << rate = COUNT(b.visit)/COUNT(b*)
14
15  8ee48a10-01f0-49a3-b4f5-e13acb5829c5
16      << durRCR = AVG(b.duration)
17
18  f35837fa-7fcc-4fc4-9e2a-ac2ddbd696ed
19      << durESQ = AVG(b.duration)
20      << incidents = COUNT(b.violation)
21                   + " / " + COUNT(b*)
```

```
23 //  Formatting Instructions (4th part)
24 duration >> Rectangle {
25     display: absolute; x: 465; y: 60;
26     background: lightgray;
27     gradient: left2right;
28     gradient-color: white;
29     dashstyle: dash;
30 }{}
31 rate >> Edge {
32     display: relative; y: -15;
33 }{
34     color: $ < 50 ?
35            rgb(128,128,128) : rgb(255,255,255);
36     dashstyle: $ < 50 ? dot : dash;
37 }

46 durESQ("duration"),incidents >> Comment {
47     display: inline;
48 }{
49     display-compliance: true;
50 }
```

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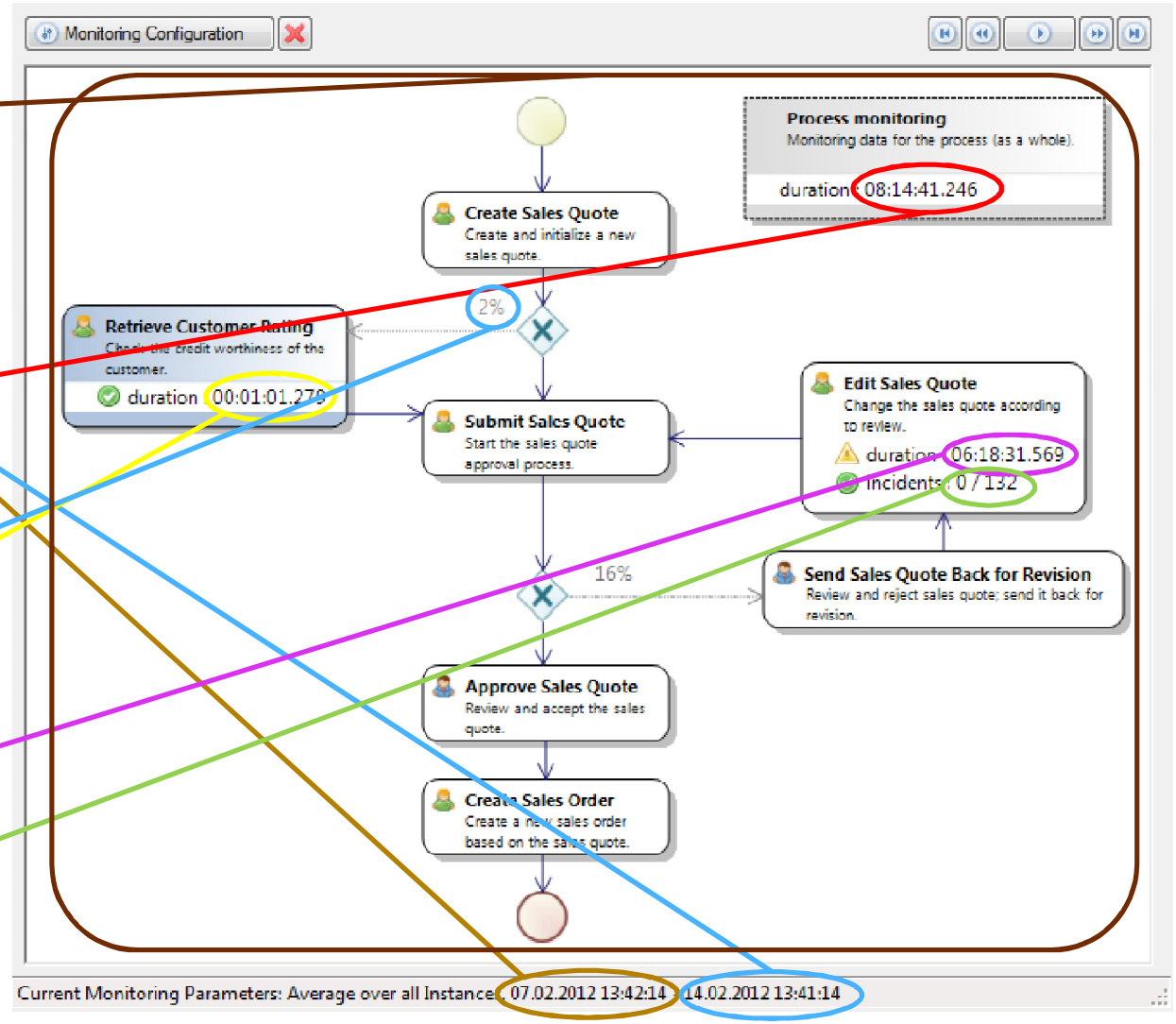

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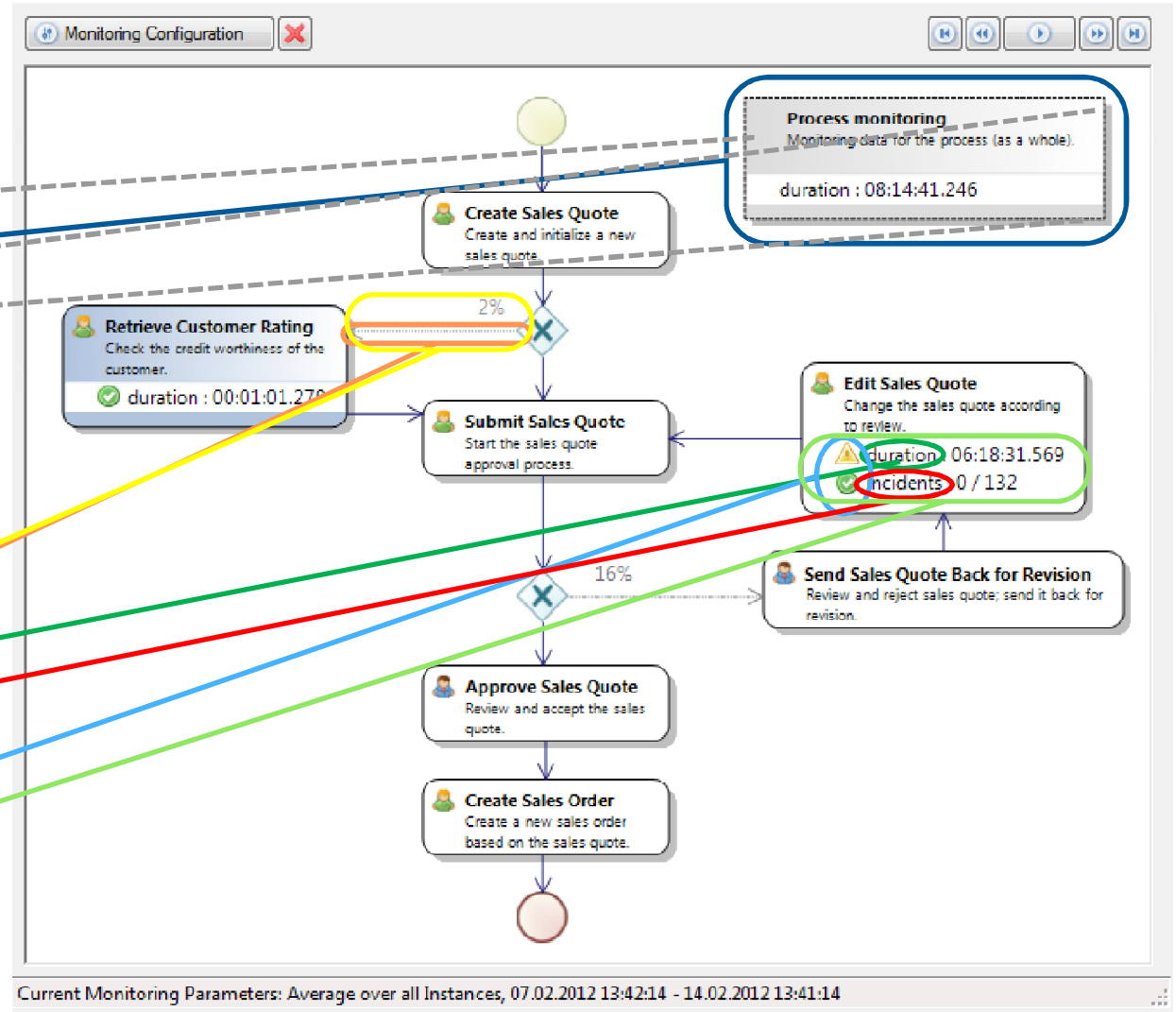

Model Annotations: Results from the MbR DSL Script Execution

```
<ModelAnnotations>
   <annotationElements xsi:type="modelAnnotations:Comment„
                       modelID="557dbb5d-7558-4f8e-acc6-d618f12487a6">
       <styles xsi:type="presentation:PositionStyle" display="relative" y="-15"/>
       <styles xsi:type="presentation:ColorStyle" color="#888888"/>
       <styles xsi:type="presentation:LineStyle" dashstyle="dot"/>
       <contents xsi:type="annotationContent:Metric" value="2" unit="Percent"/>
    </annotationElements>
    <annotationElements xsi:type="modelAnnotations:Comment„
                        modelID="f35837fa-7fcc-4fc4-9e2a-ac2ddbd696ed">
       <styles xsi:type="presentation:PositionStyle" display="inline"/>
       <contents xsi:type="annotationContent:KeyValuePair" complianceLevel="warning"
                                                           key="duration">
           <value xsi:type="annotationContent:Metric" value="06:18:31.569" unit="Time"/>
       </contents>
       <contents xsi:type="annotationContent:Text" complianceLevel="ok"  value="0 / 132"/>
    </annotationElements>
    <!--  ...  //-->
</ModelAnnotations>
```

Benefits

- MbR approach is platform & technology independent through DSL
  - decouples the reporting (diverse products; one MbR service backend)
  - domain agnostic
- extensible reporting data metamodel
- unified environment for business application engineering
  - frontend for different phases of the lifecycle (e.g., modeling & reporting tool)
  - MbR frontend can be integrated into a modeling tool

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Thank You!
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