SE Software Engineering
The University of Auckland

Generating domain-specific Eclipse graphical editors from high-level meta-tool specifications

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Outline

- Domain-specific visual languages
- Meta-tool specifications in Pounamu
- Eclipse IDE
- Marama – a set of Eclipse plug-ins for DSVLs
- Example usage
- Design and Implementation
- Evaluation
- Current & Future work
- Summary

What are Domain-specific visual languages (DSVLs)?

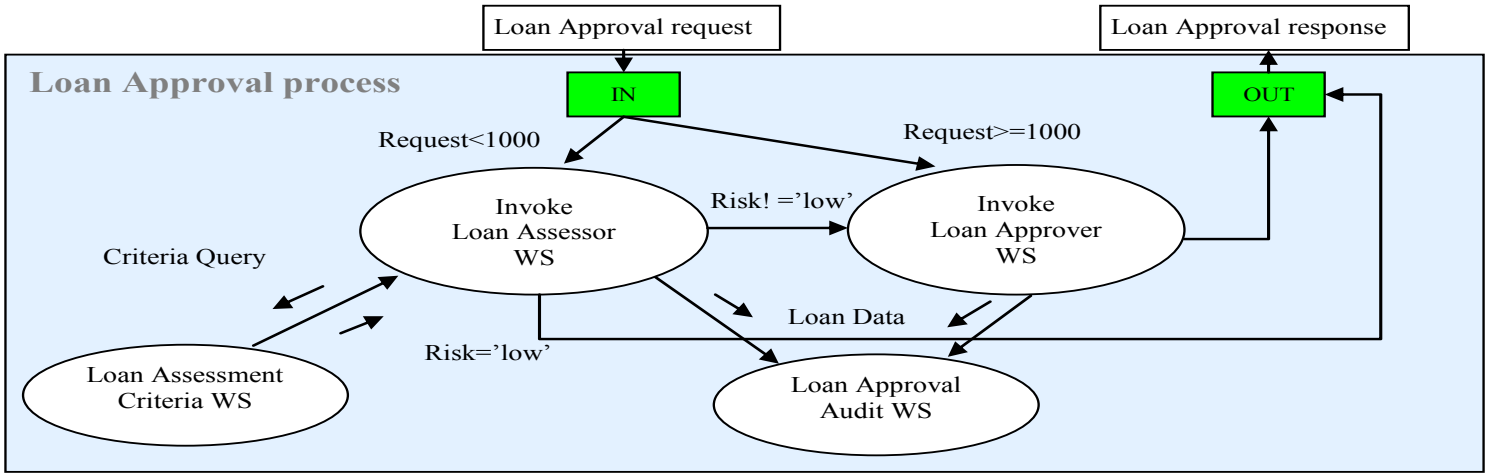
- Much of Engineering is about developing models of engineered products (or rather, models of products to engineer…)
- We've developed models for a whole range of SE "products" and activities:
  - Software processes
  - Requirements
  - Software design
  - Data structures
  - Software architecture
  - Software behaviour
  - Interface design
  - …
- We've also developed visual representations of these models – some are "abstract" (UML, ADLs); some are "concrete" e.g. WYSIWYG UI design…

But…

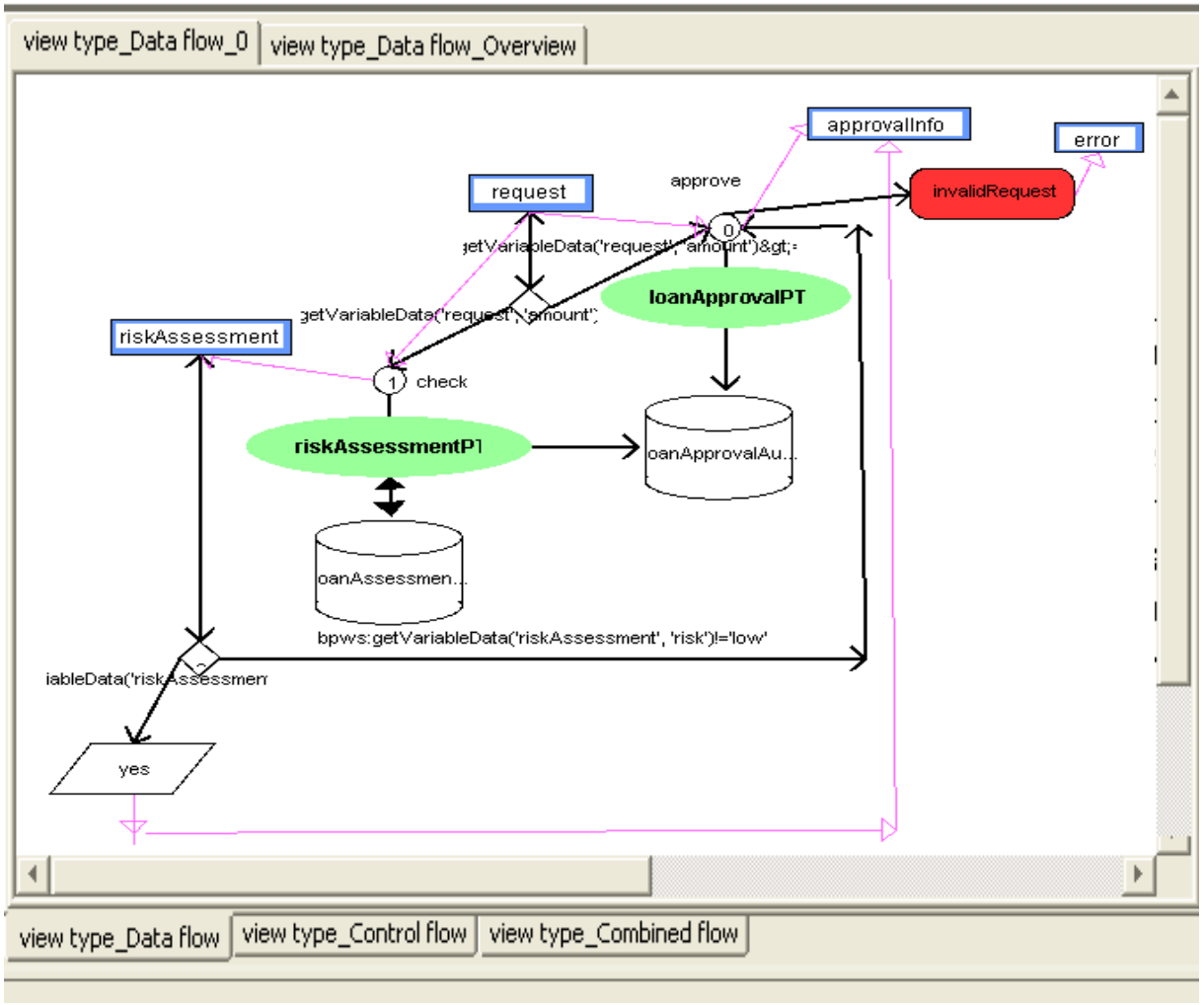
- Our models often get too complex, too unwieldly, hard to understand/maintain using only "abstract" or "general-purpose" model representations
- Example: any non-trivial Model-Driven Architecture application…
- Domain-specific languages (DSLs) – models that focus on expressing problems in a PART of software engineering, using less general but more expressive constructs
  - E.g. a scripting language for handling event responses
- Domain-specific visual languages provide way to represent such domain-oriented models using a wide variety of visual "metaphor(s)"
- Idea is to have a metaphor providing closer mapping to the problem domain than vanilla, general-purpose abstract model
  - E.g. show event-condition-action rules as flow charts
- DSVL tools provide environment to construct these models, configure existing components, generate code etc.

Example: ViTABaL-WS Web Service composition tool

- Idea of "web services" – software components can dynamically discover, integrate, communicate with
- Want to support users specifying WS compositions
- Usual approach: code "Business Process Execution Language for Web Service (BPEL4WS)" or simplar textual specification
- Really want visual composition metaphor/tool…

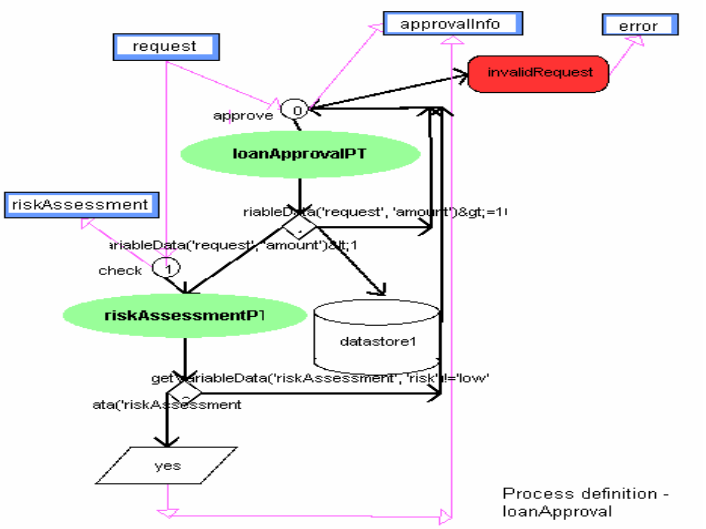


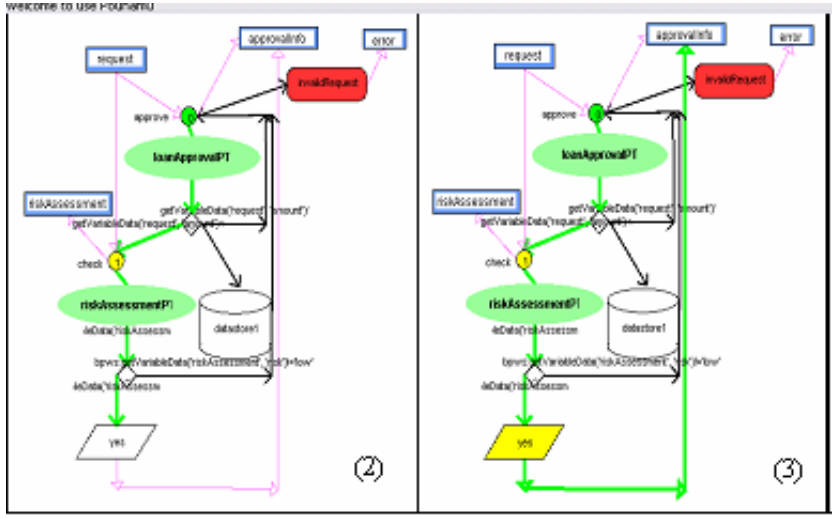
ViTABaL-WS



- Environment for modelling compositions of web services
- Uses a "tool abstraction" paradigm (metaphor)
- Generates BPEL4WS
- Provides "debugger" for running BPEL

BPEL4WS Generation & Execution





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         variable="request"
         createInstance="yes">
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</receive>
<invoke name="invokeapprover" partnerLink="approver"
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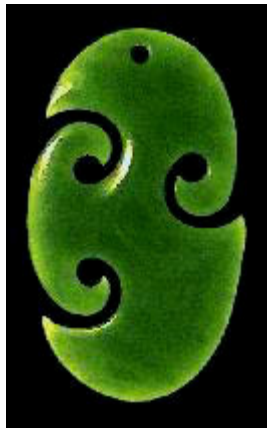
         <!-links-->
</invoke>
```

IBM BPWS4J Workflow Engine

Building DSVL Tools…

- Its hard to build these things…
  - What are the "right" visual metaphor(s)?
  - What model(s) do we need to represent/build?
  - How to generate code/configurations from model?
  - How do we achieve integration with other tools
  - How do we make them practical for users?
- Our approach to date:
  - Meta-tool – visual models/meta-model
  - Import/export from model (XMI, Java, BPEL, WSDL, etc)
  - Web service/RMI APIs for other tools/plug-ins
  - Web browser, phone, collaboration plug-ins



Pounamu

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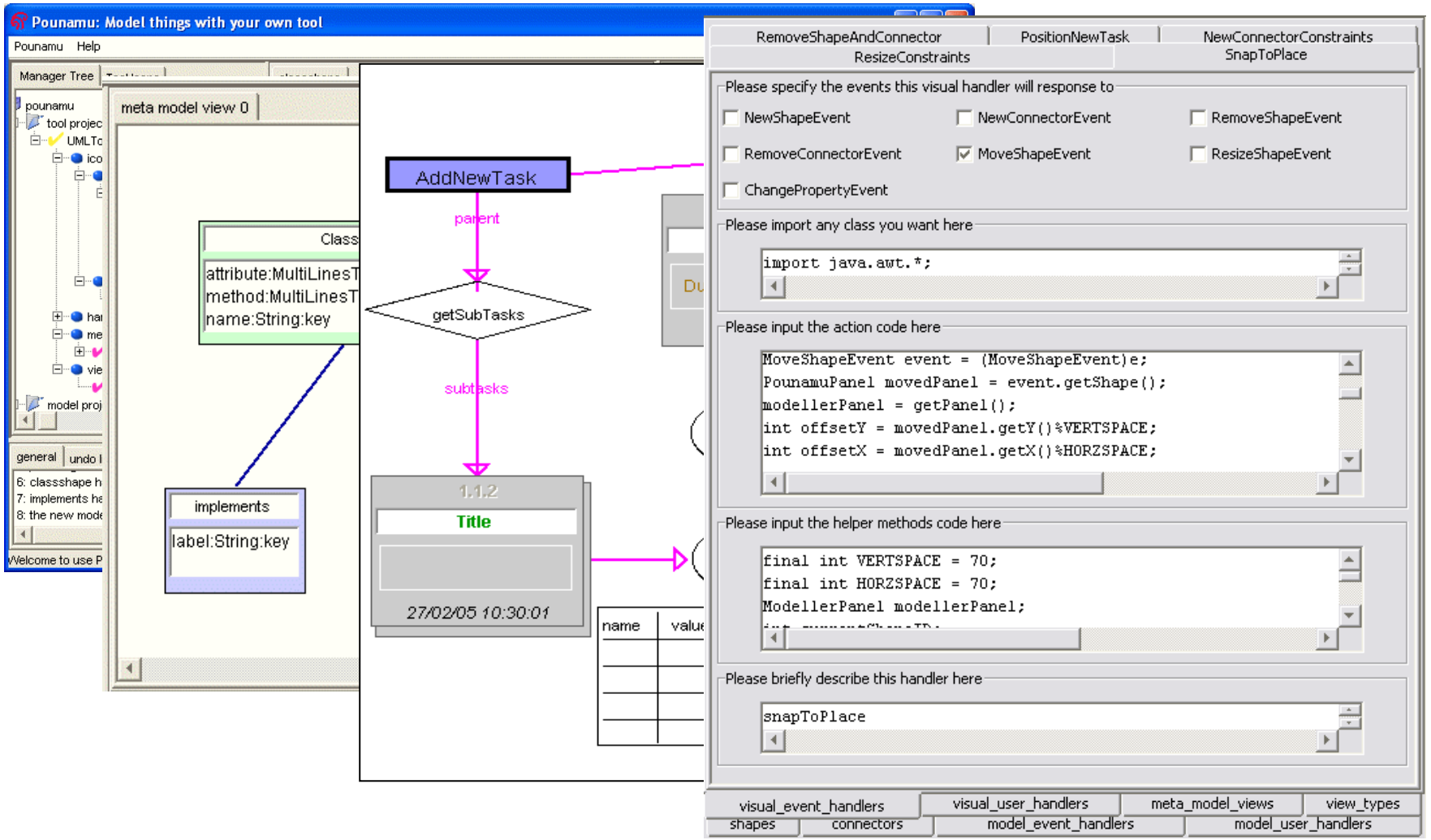
Pounamu Meta-tools (themselves DSVLS!)

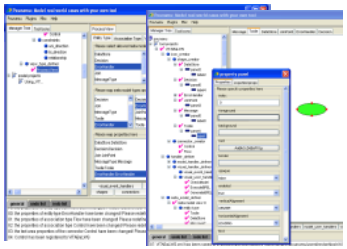


But…

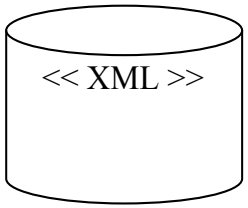
- Pounmau is stand-alone, our own IDE
- While it has good extensibility/integration support via web services API, not a "commercial quality" IDE
- Still too difficult to integrate 3rd party tools

- Solution: Use the open-source, commercial quality Eclipse IDE to realise Pounamu-specified DSVL tools
- Eclipse provides:
  - Open architecture IDE via plug-ins, very nice APIs
  - Wide range of 3rd party tools
  - Nice plug-ins & tools for building DSVL tools: EMF, GEF, JET, …
  - Very well-engineered system

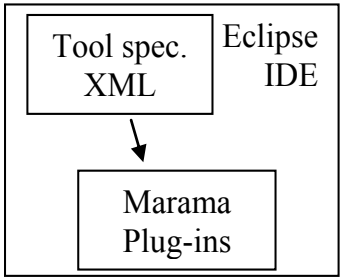
Marama ("the moon")



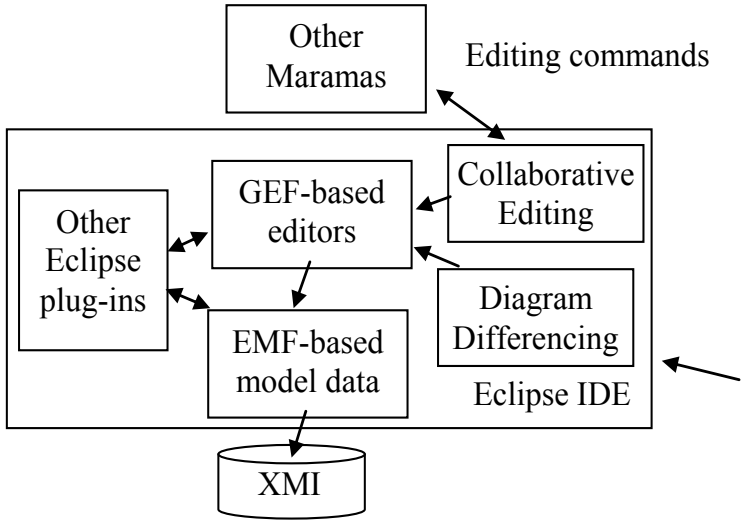
1. Visual language tool specification in the Pounamu meta-tool



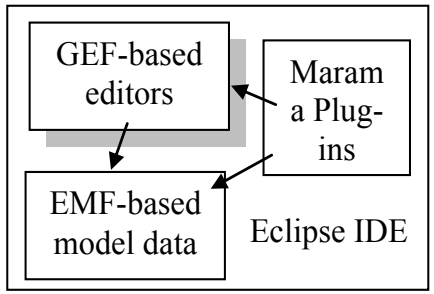
2. Pounamu saves tool specification to XML files



3. Load tool specification into Marama plug-in

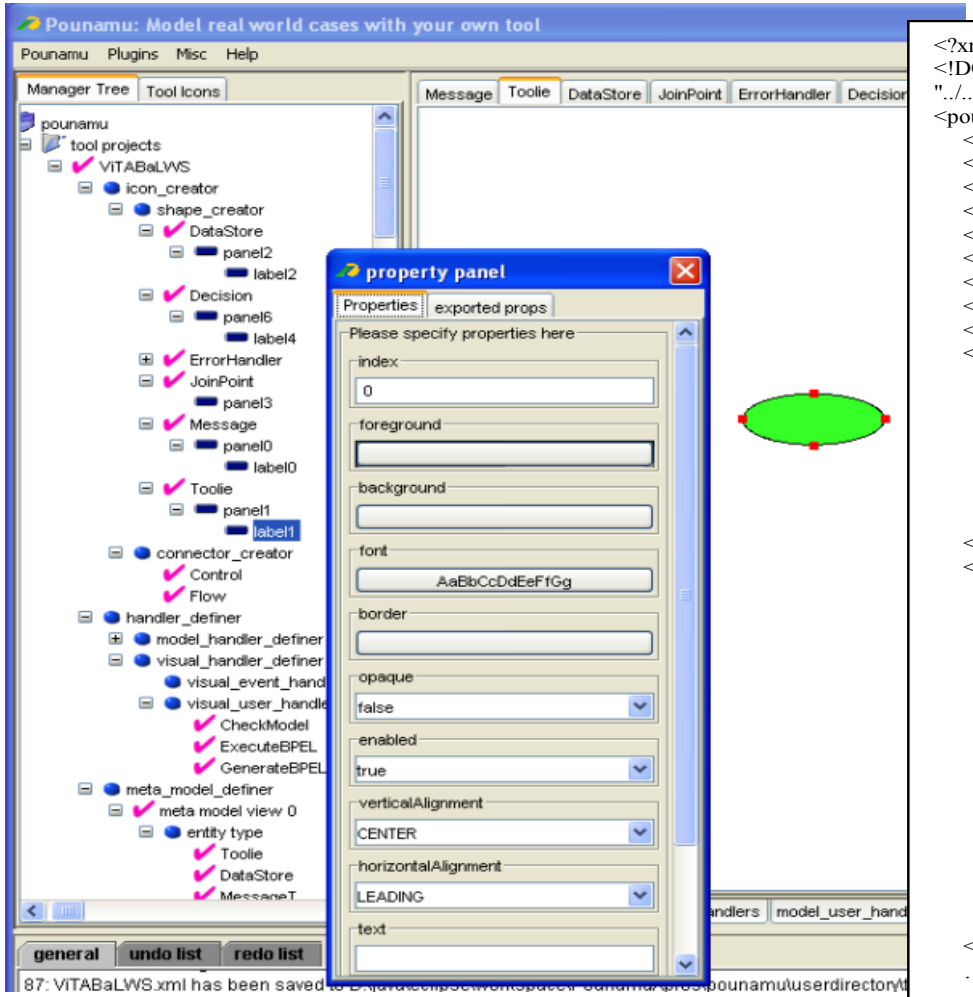


5. Modelling tool data saved/loaded as XMI; multi-user support via plug-ins



4. Marama dynamically configures GEF editors; uses EMF-based model data

Example Usage: 1. Develop Pounamu DSVL tool spec




```
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<!DOCTYPE pounamushape SYSTEM
"../../../../../nonjavafiles/icon.dtd">
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    <source>Toolie</source>
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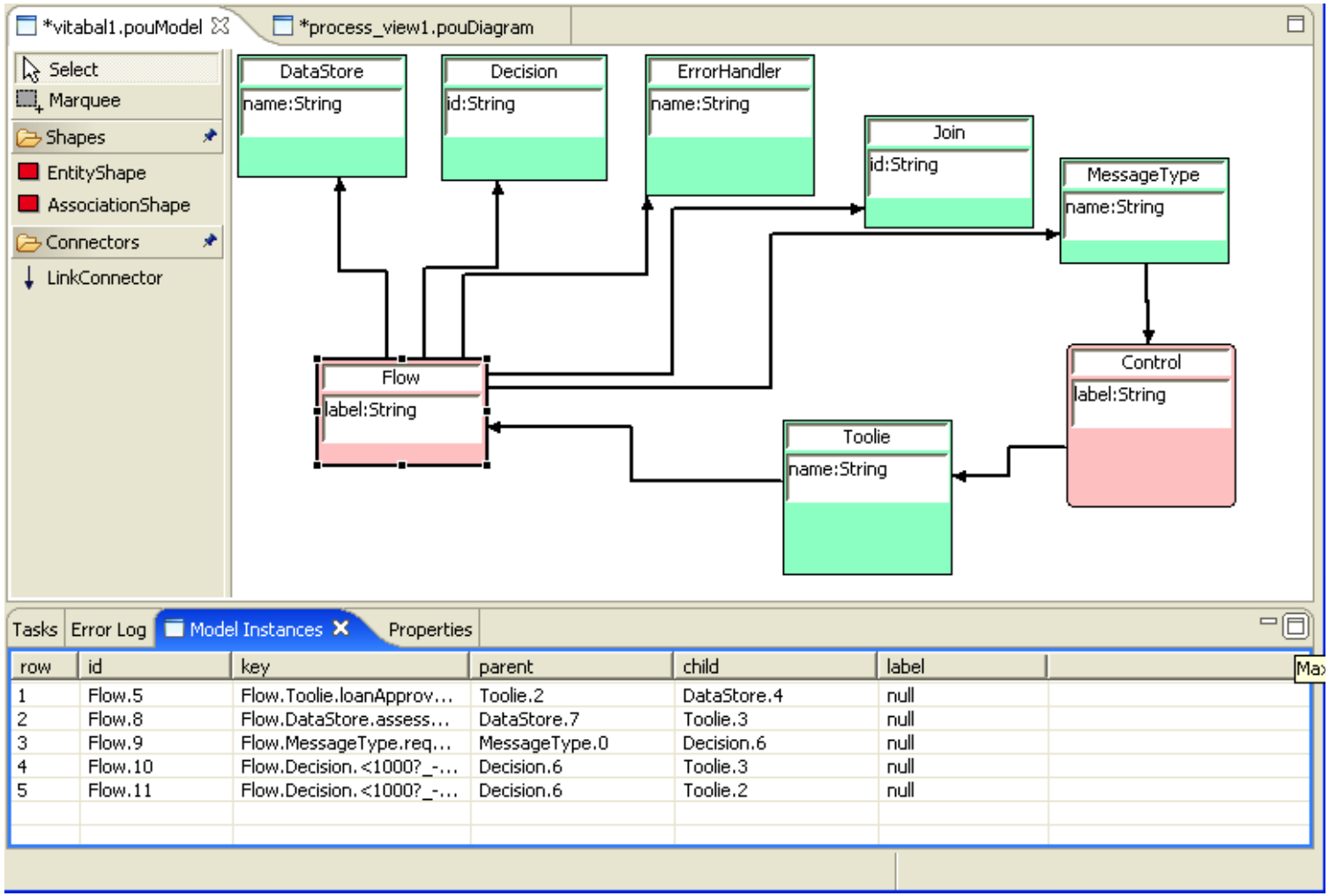
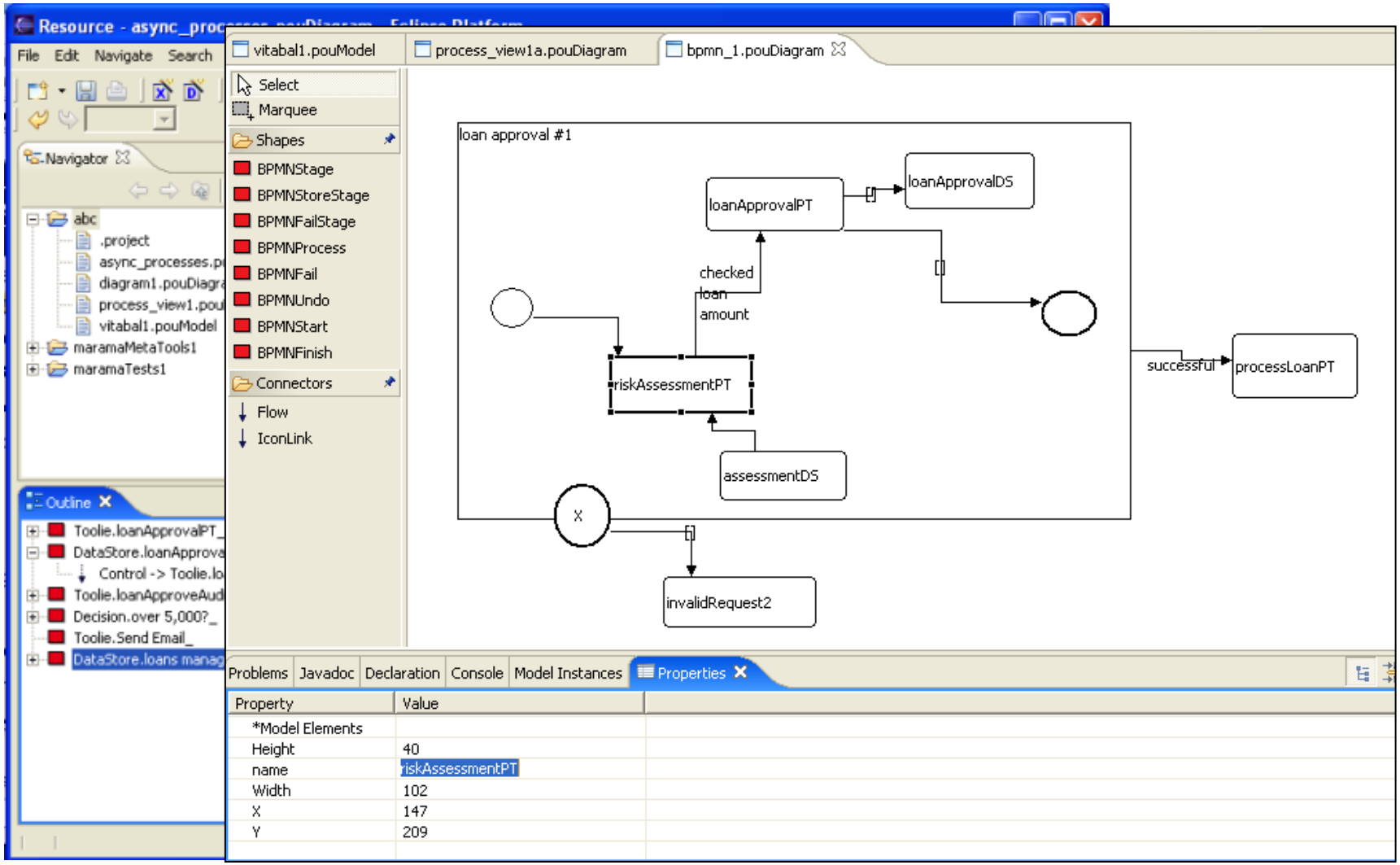
    </property>
    …
```

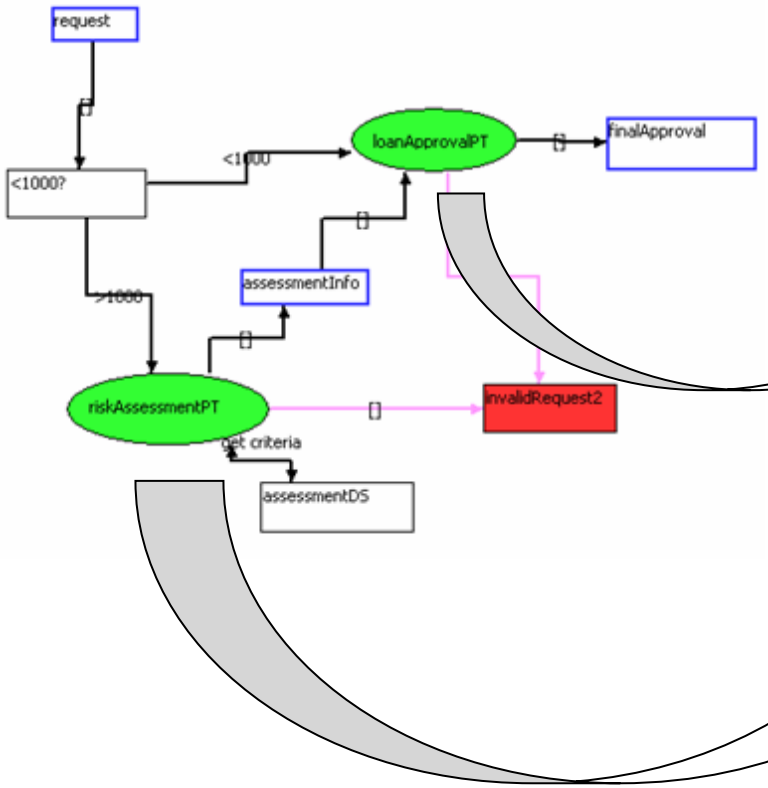
2. Load tool specification into Marama



3. Create Visual Models



BPEL Generation




```
<receive name="receive" partnerLink="customer"
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         <!--links-->
<invoke name="invokeapprover"
partner  k="approver"
         rtType="loanApprovalPT"
         operation="approve"
         inputVariable="request"
         outputVariable="FinalApproval">
         <!--links-->
<invoke name="invokeassessor"
partner  nk="assessor"
         portType="riskAssessmentPT"
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         nputVariable="request"
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         <!--links-->
```

Other Marama DSVLs...

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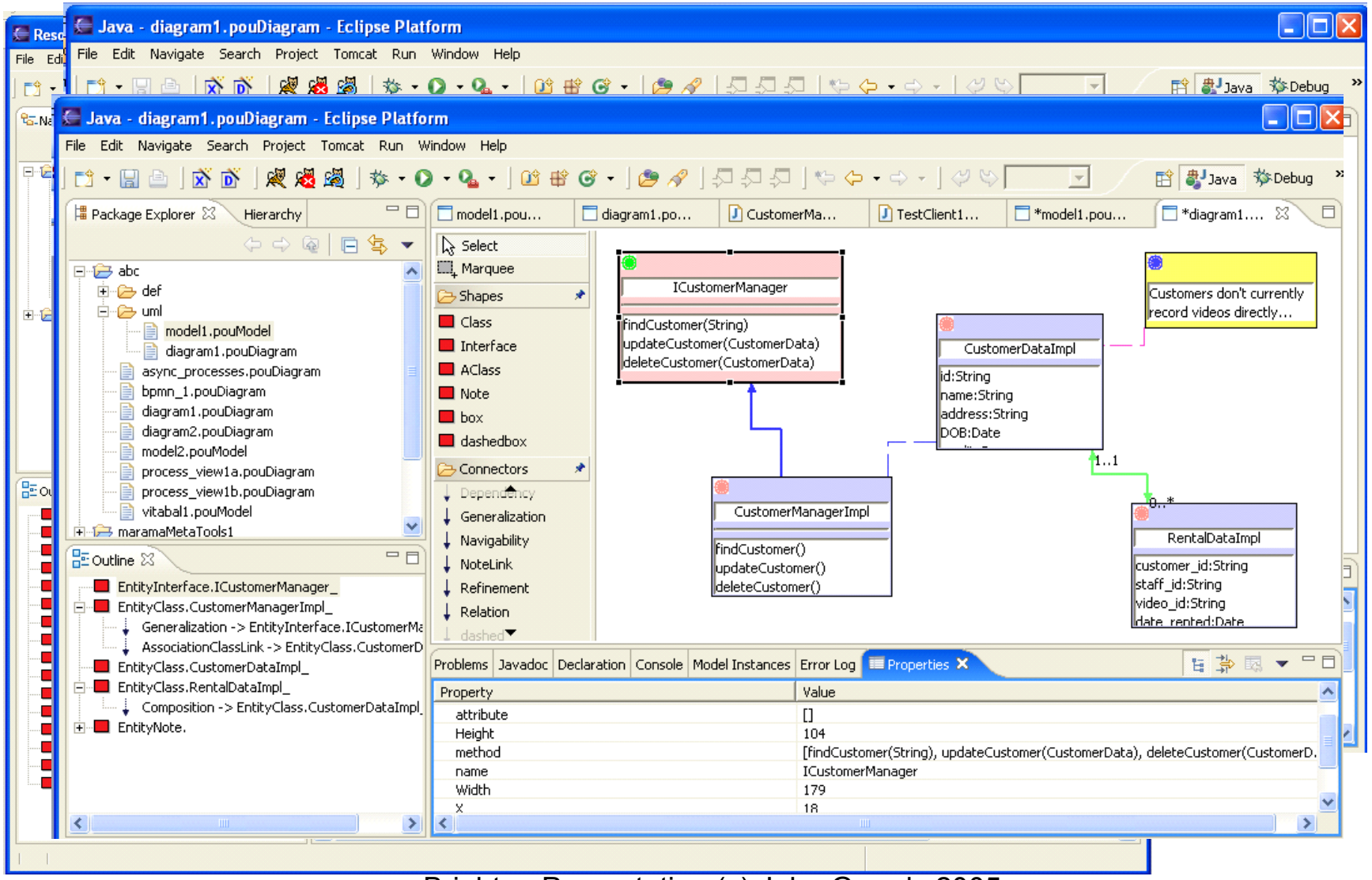
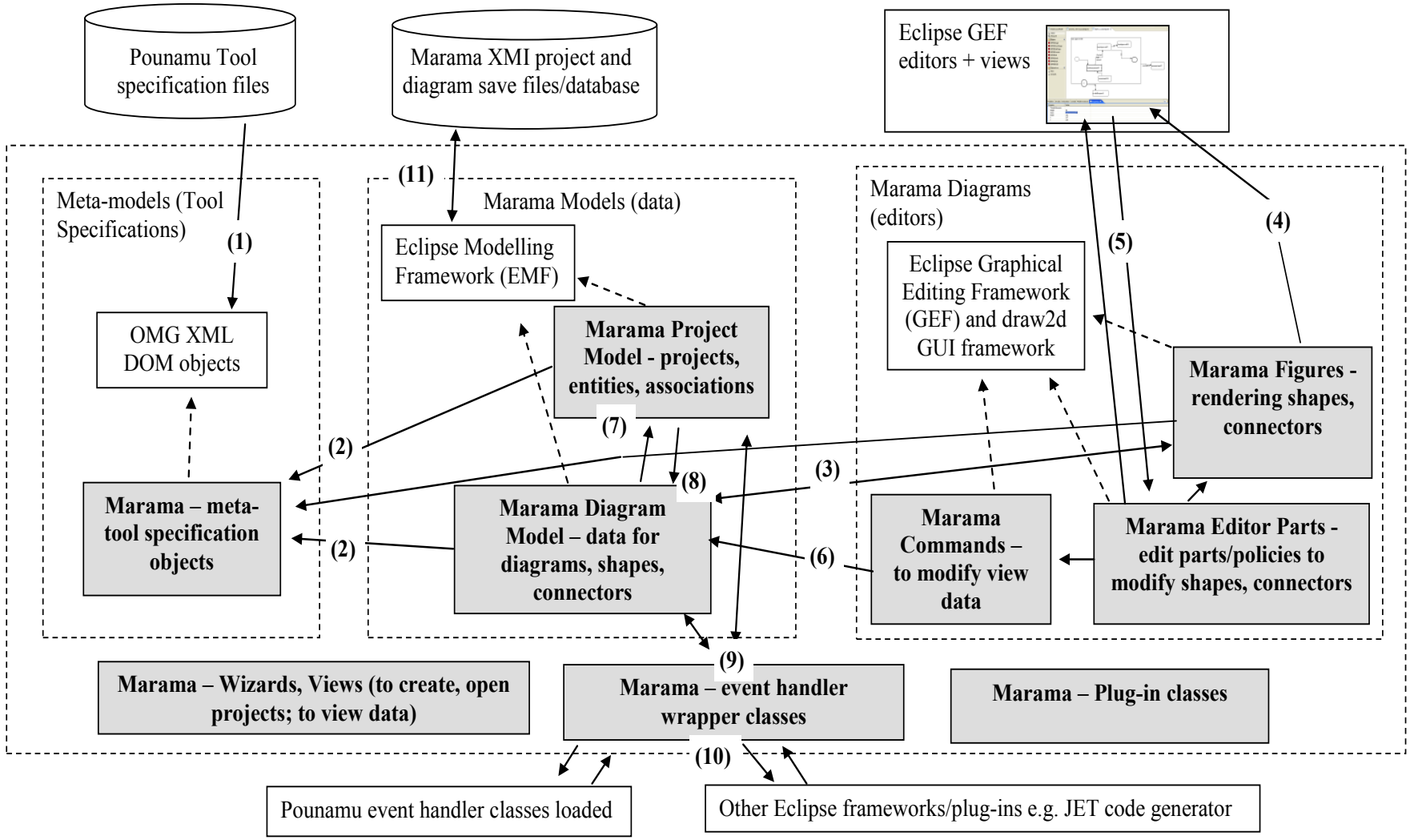


Marama Design



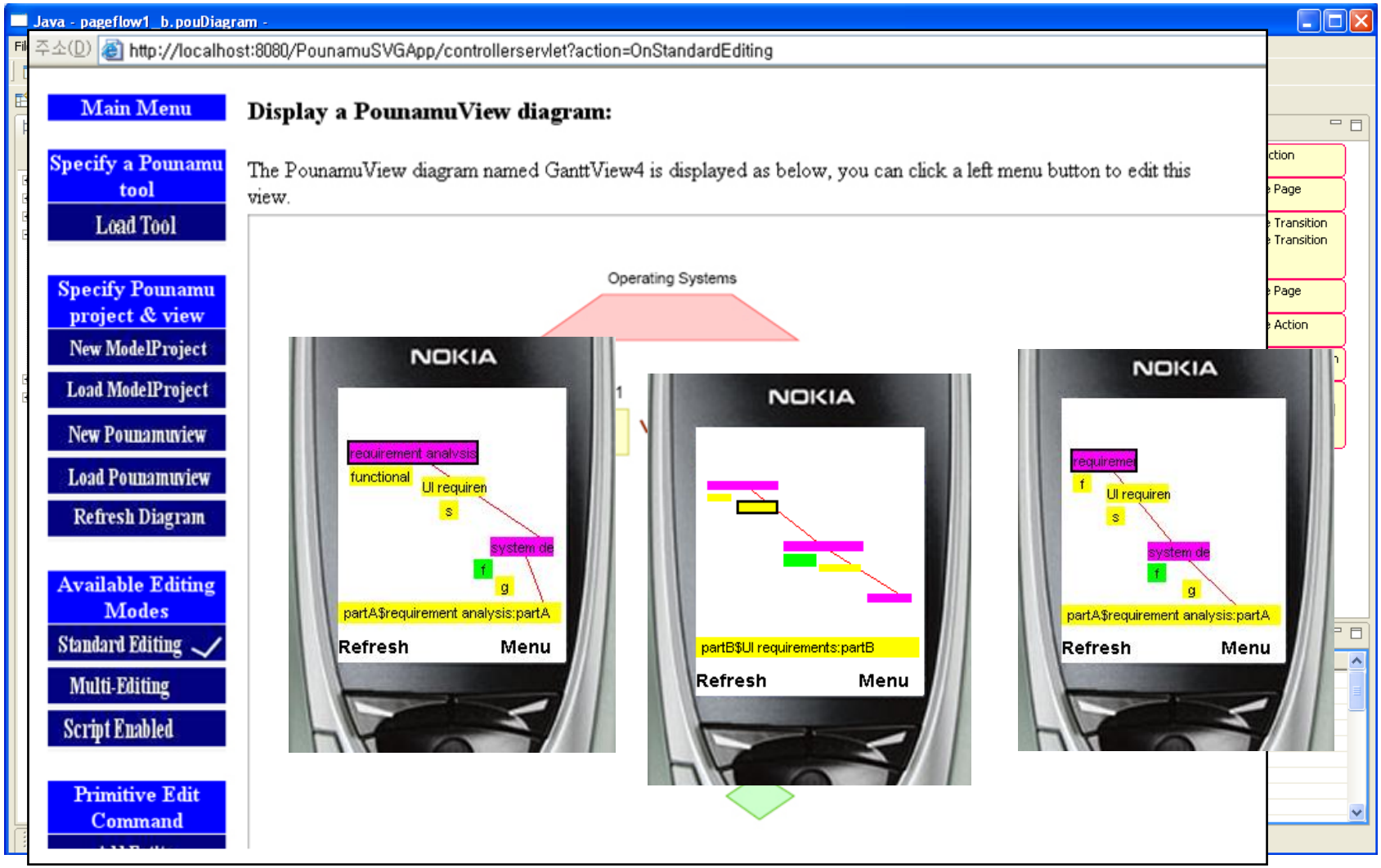
Evaluation

- Various DSVL prototype tools:
  - UML design tools
  - Web service orchestration
  - Process modelling and project management tools
  - Circuit design tool
  - Performance test bed generation tool
  - Visual data mapping tools
  - Marama meta-tools… ☺
- Cognitive Dimensions evaluation: Marama vs Pounamu
  - Better *Closeness of Mapping* ; higher tool *Viscosity*; good *Consistency* & low *Error-proneness*; much improved *Hidden dependencies* and *Juxtaposability*

Current/Future Work

- Re-implementing Pounamu meta-tools in Marama – as Marama DSVL tools!
- Enhancing specification of dependencies using spreadsheet-style formulae and event-condition-action DSVL
- Extending DSVL editing/rendering support e.g. better support composite shapes, editing in-situ of text etc
- Marama provides dynamic interpretation of Pounamu specifications – also looking at static EMF/GEF generation (hope to feed into Eclipse GMF work…)
- Collaborative work support; thin-client diagramming
- Building more DSVLs (can never have enough… ☺)

Examples: MaramaDiffer; MaramaThin



Summary

- Domain-specific visual language tools provide powerful model representation, modelling support
- Building DSVL tools is hard; integrating with existing tools challenging
- Pounamu provides meta-tool specification
- Marama provides Eclipse plug-ins to realise these specifications as near-commercial quality DSVL tools
- Allows us to deploy DSVL tools on realistic problems, with industry, and to scale DSVL research results
- Various extensions to Marama including its own meta-tools (which themselves are Marama DSVLs)

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