Some Recent Directions in Automated Software Engineering Research

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Outline

- What is "Automated" Software Engineering?
- Some recent ASE research @ UoA:
  - Meta-tools
  - Performance engineering via test-bed generation
  - Component discovery/integration/validation
  - Collaborative work
  - Adaptive user interfaces
  - Software architectures to support this stuff
- Conclusions

Automated Software Engineering

- Generative – try and generate code from high-level, abstract descriptions (models)
- Component-based – "build applications from bits" approach; ultimately "autonomous agents" composition
- Adaptive – components/agents discover environment and adapt to the circumstances they find themselves in
- Dynamic – ideally can do the above at run-time while the software is in use
- Formalisms necessary – specifications we can reason with; generate code from; verify vs validate models/code

Why?

- Code is too low-level for tasks we want it for – who wants to write code anyway?
- Engineering is about building models of problems/products – can we have models higher level than code? If so, can do much more with them than with program code...
- Can generate huge code base from small abstract models (if all goes to plan...)
- Some successes – domain-specific languages; IDEs; 4GLs; rapid prototyping tools; CASE/CAD tools; hardware synthesis
- Still lacking sufficient formal models for practical use
- Validation/verification become crucial issues
- Can get emergent behaviours esp. with agent-based systems

Examples from our work

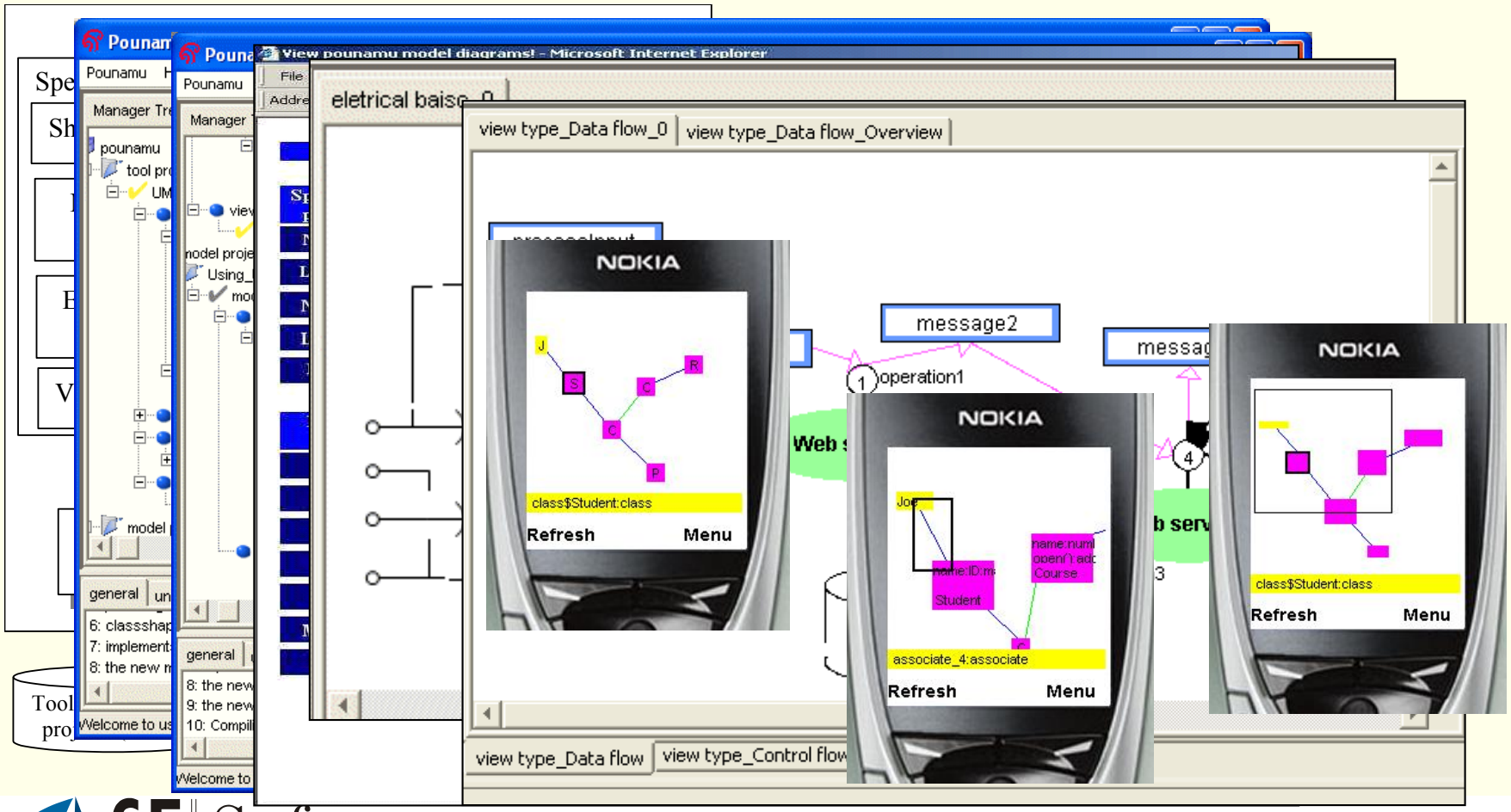
- Pounamu (a meta-CASE tool):
  - Specifying & evolving software tools
- Argo/MTE (a test-bed generator):
  - Performance engineering via test bed code generation
- Aspect-oriented component engineering:
  - Adaptive component-based systems
  - Deployed component validation
- Adaptive user interfaces:
  - E-whiteboard, PDAs, mobile phones etc.
- Some of our current/future directions...

Meta-tools: Pounamu

- A meta-tool (tool for building tools…)
- Specify visual, multiple view "tools"/applications
- Framework provides for dynamic, run-time tool modifications
- Various plug-in extensions: web-based & mobile PDA/phone-based diagramming; collaborative work support; web services APIs; dynamic tool integration

Pounamu example

HCC 2003
HCC 2004
AUIC 2005
ASWEC 2005

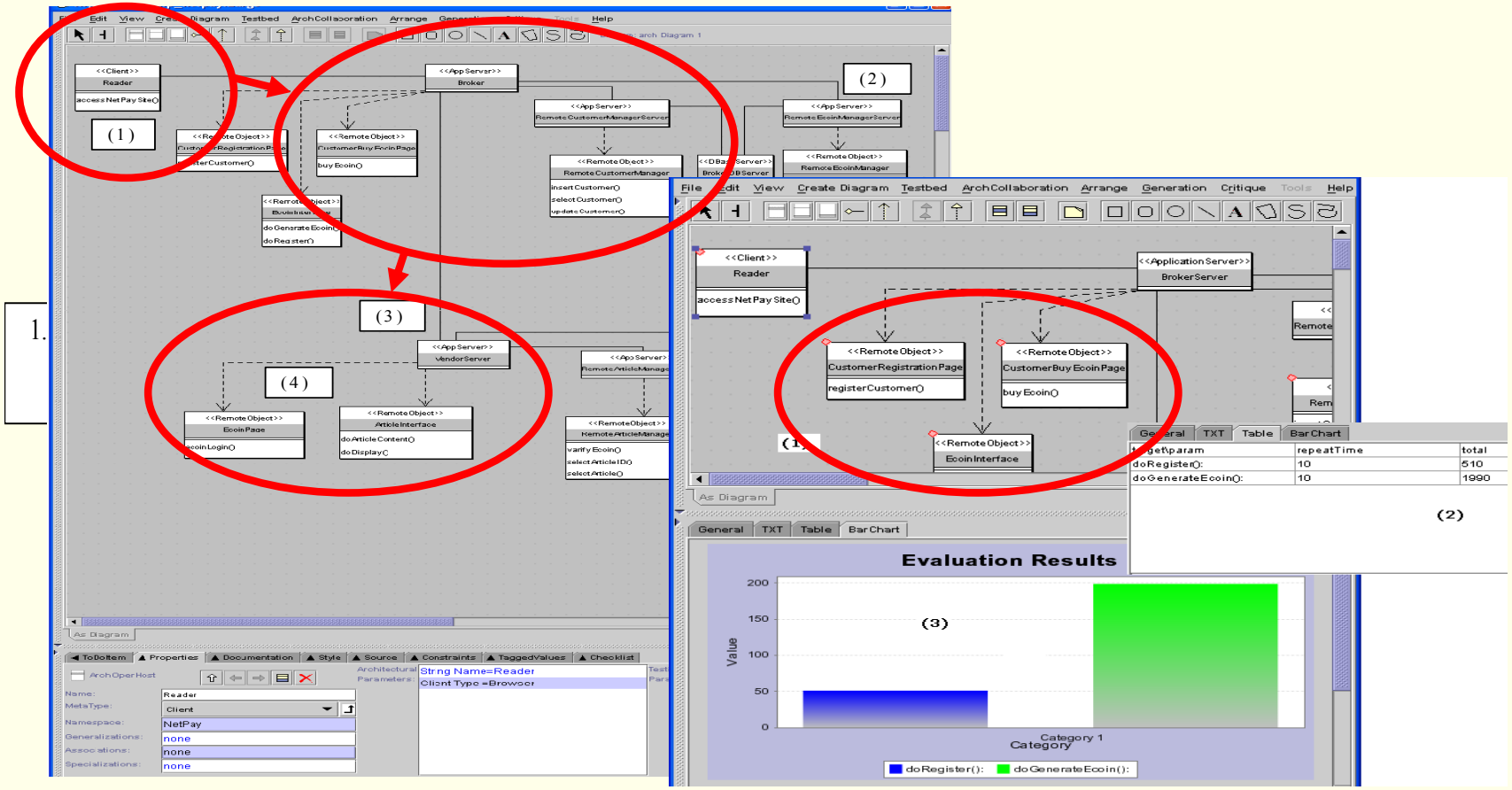


Code generation: Argo/MTE

- For performance engineering – very difficult to estimate likely system performance during design
- Our approach: generate real performance test-bed (code etc) from software architecture model
- Run performance tests and visualise results
- Extension to ArgoUML open-source CASE tool

Argo/MTE example

ASE 2001
SEKE 2004
ASE 2004
ASE J 2005

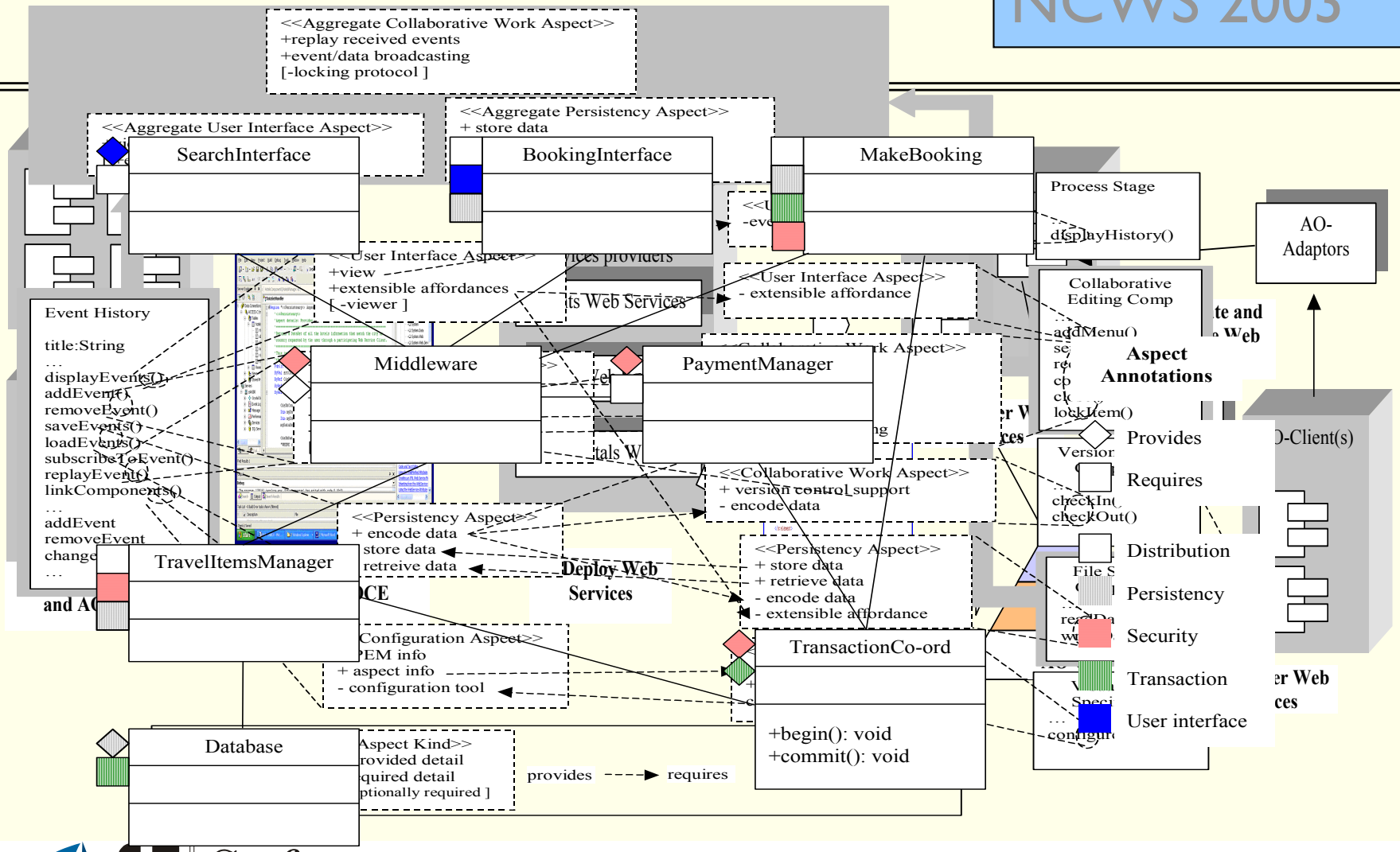


Components: AOCE

- Software components = "build from bits" model
- Problem – understanding/characterising the components to use
- Our solution – apply aspect-oriented techniques to identify cross-cutting concerns to characterise
- Developed method, basic tool support
- Can apply at run-time for dynamic adaptation too

AOCE Examples

IJSEKE 2000
S-P&E 2002
NCWS 2003

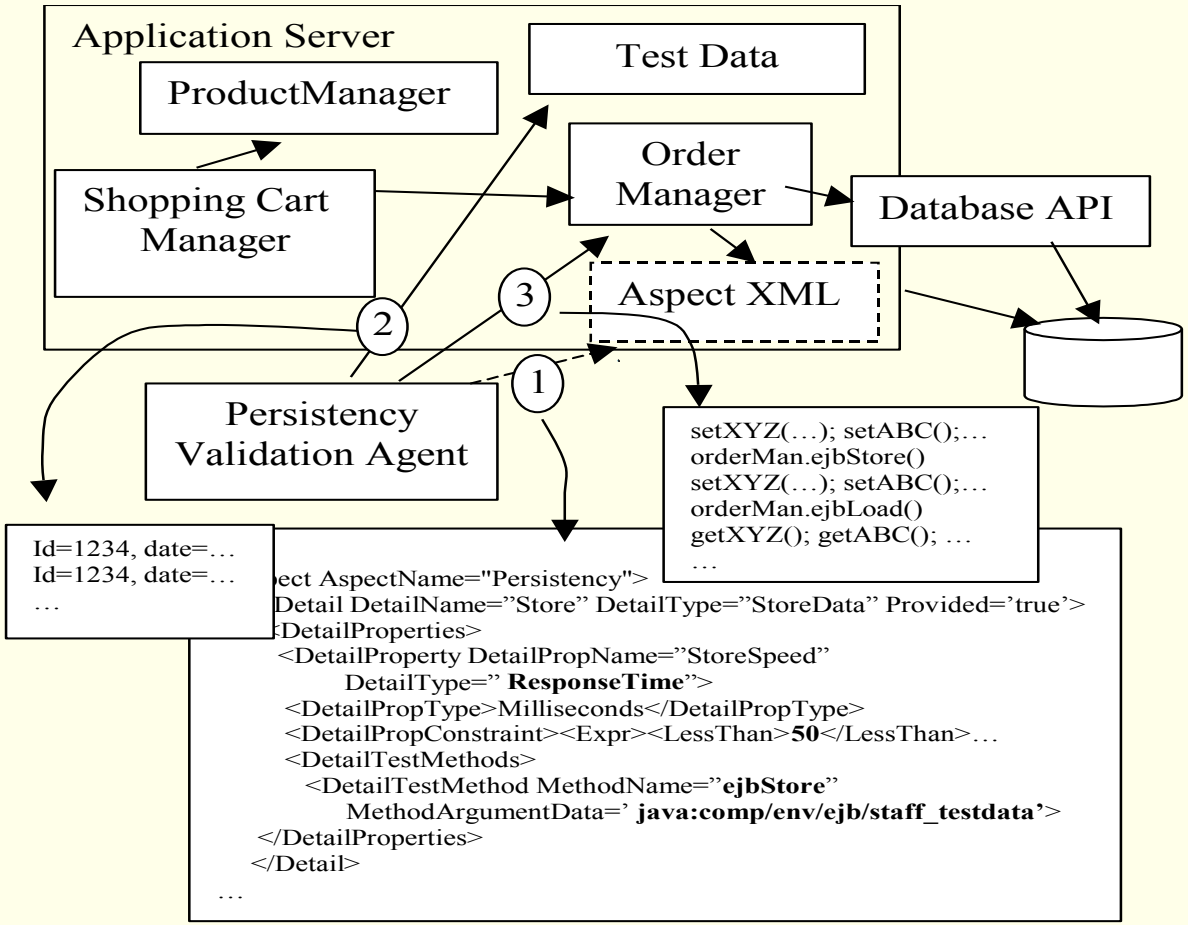


Component Validation

- How do we check deployed components meet their requirements?
- Our approach:
  - Characterise component behavioural/non-functional requirements
  - When deployed, inspect these characteristics
  - Synthesise tests to check these constraints have been met
- Requires more detailed information about components at design/run-time

Component Validation Example

ASE 2002
NCWS 2003
JSS 2004



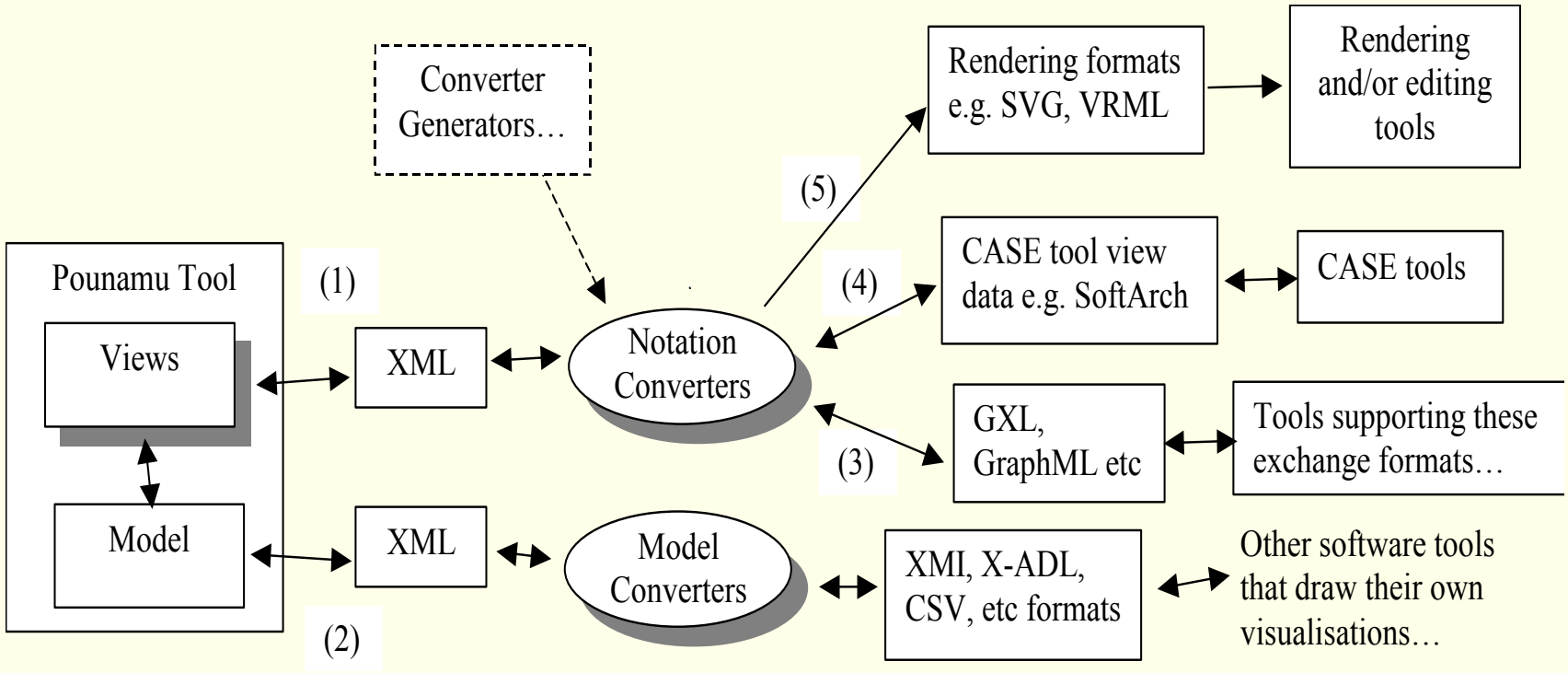
Some of our current work

- Adaptive user interfaces for tools:
  - Web browsers
  - Mobile devices
  - Sketching-based interfaces
- AOCE for web services
- Collaboration "agents"/components
- Visual languages/tools for integration
- DSLs for Data and notation translations

Adaptive UIs

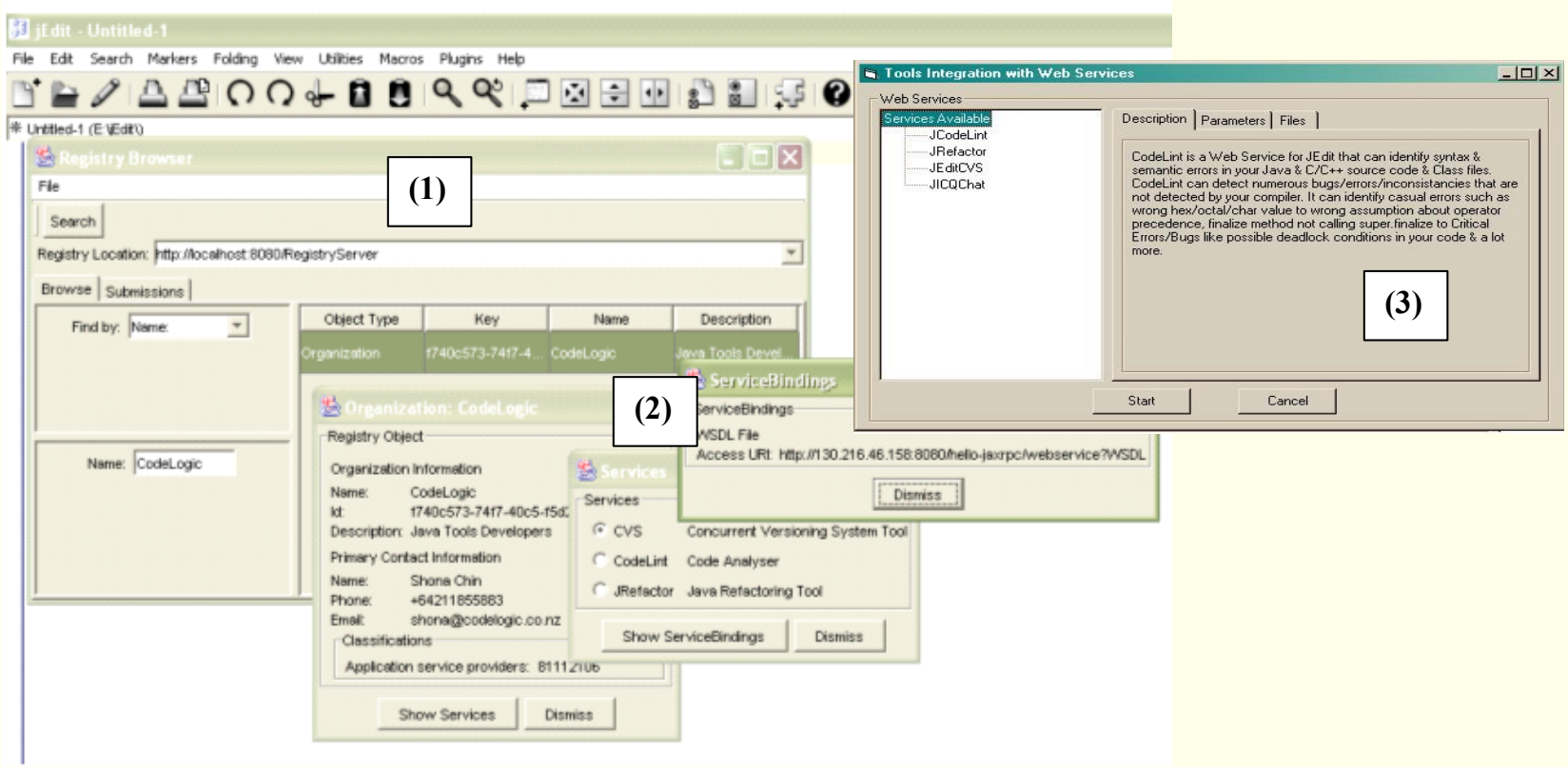
IwC 2002
HCC 2003
MUI 2003
IV 2003

How achieved



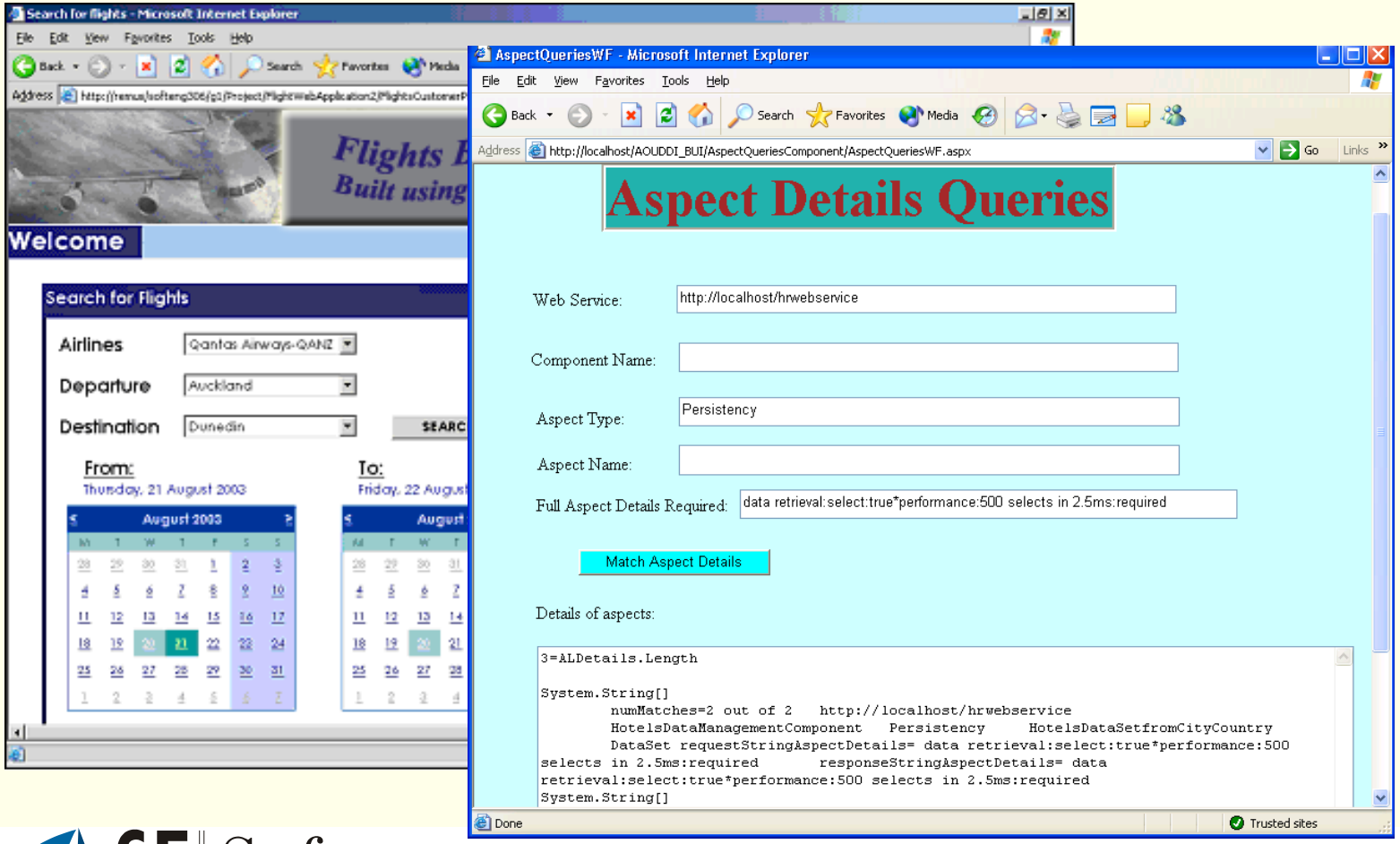
Extensible Software Tools

IST 2000
S-P&E 2002
ASWEC 2005



Web Services-extended AOCE

NCWS 2003
ASAW 2004



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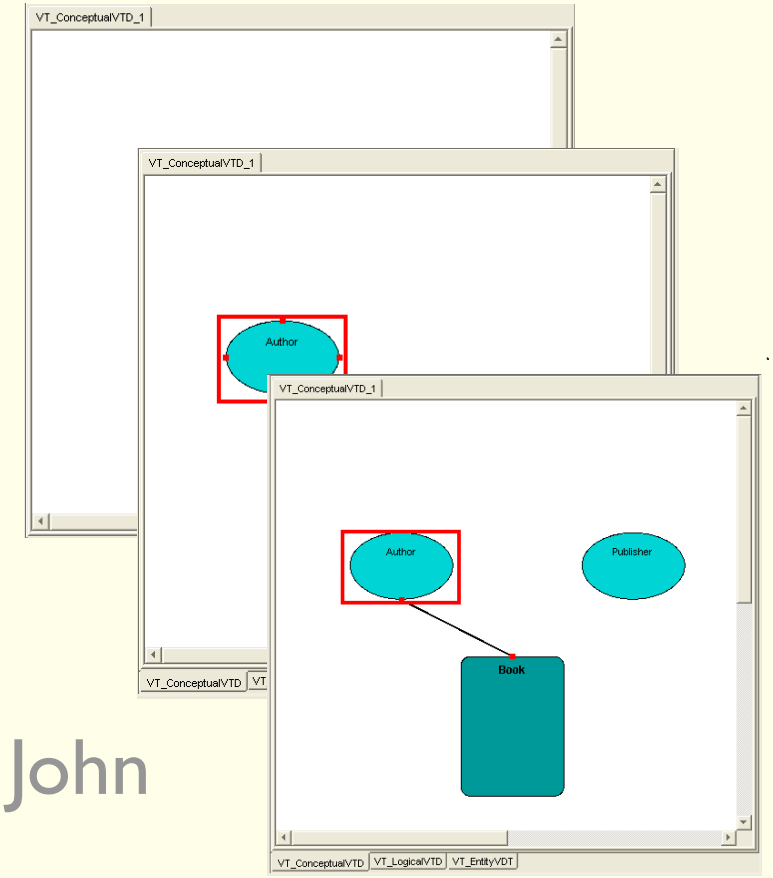
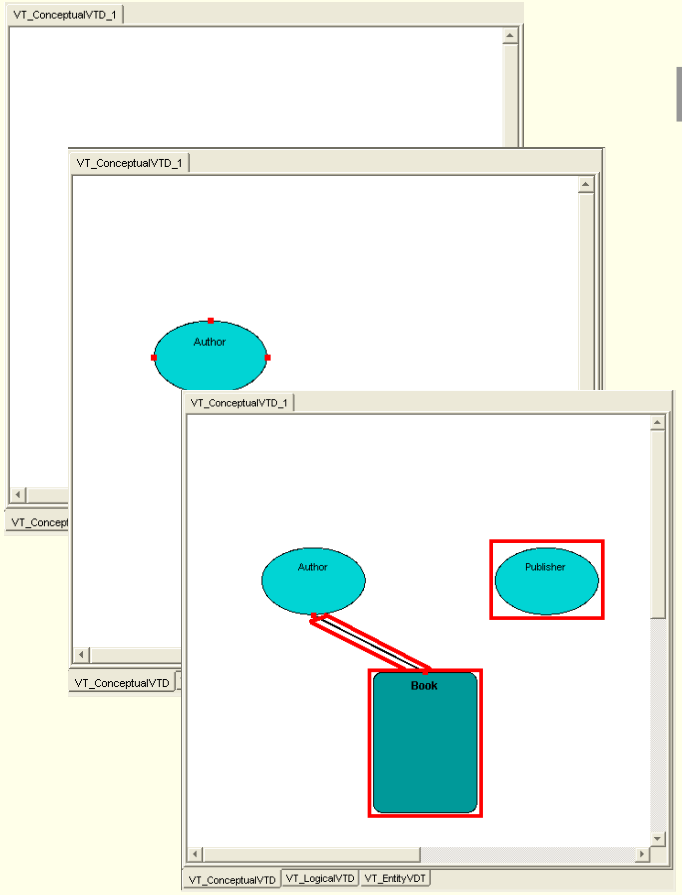
Collaboration Components

S-P&E 2002
WoDiSEE 04



John



Mark

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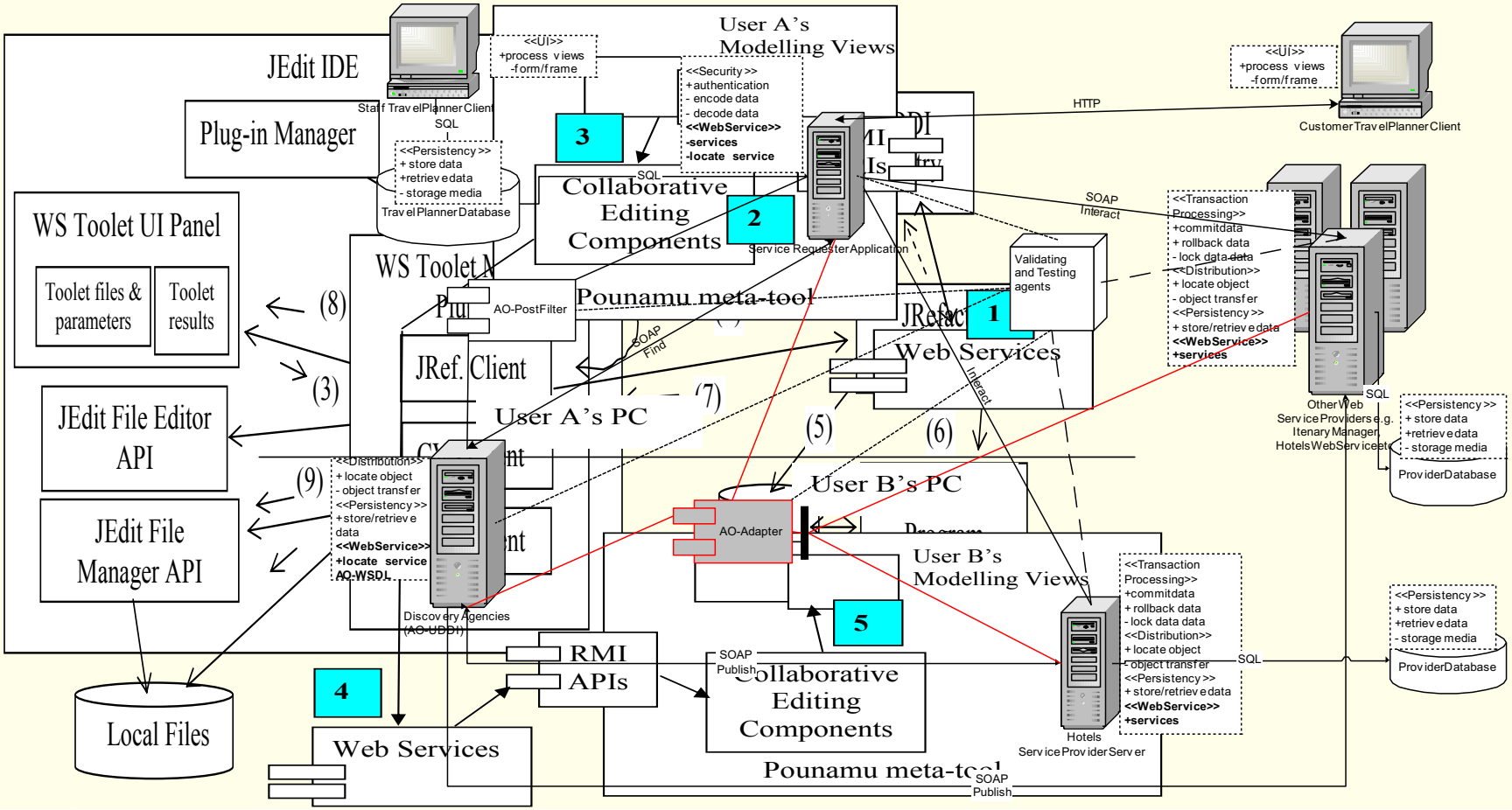
How achieved/achieving…



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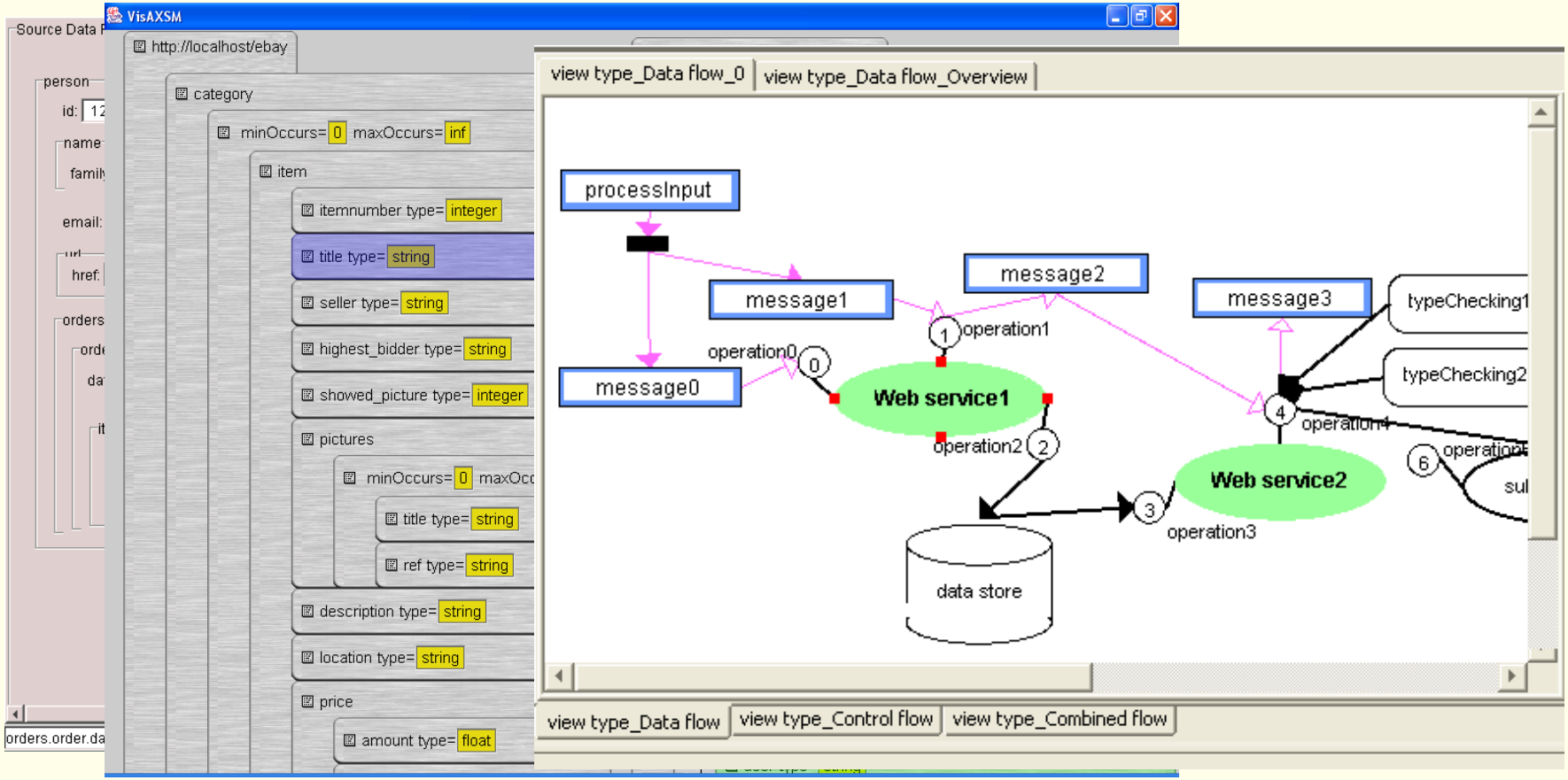
Integration Visual Languages

HCC 2002
ASE 2004
JVLC 2004



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Conclusions

- Automated Software Engineering = generate/adapt software from high-level models
- Our work focuses on component-based system composition, synthesis of UIs, and architectural enhancements to assist these
- Promising results to date in these areas
- Future work includes more formal specifications of components; better tools to support composition/integration/synthesis
- Commercialisation of some of this research underway