Software Process Simulation and Modeling: A Review

Walt Scacchi
Institute for Software Research
UCIrvine
Wscacchi@uci.edu

http://www.ics.uci.edu/~wscacchi/Presentations/ProSim03/Keynote

Overview

- ProSim, ISPW, FEAST/IWSE
- ProSim tools, techniques, concepts
- Results, findings, accomplishments
- Emerging R&D opportunities
- Conclusions

ProSim, ISPW, FEAST/IWSE

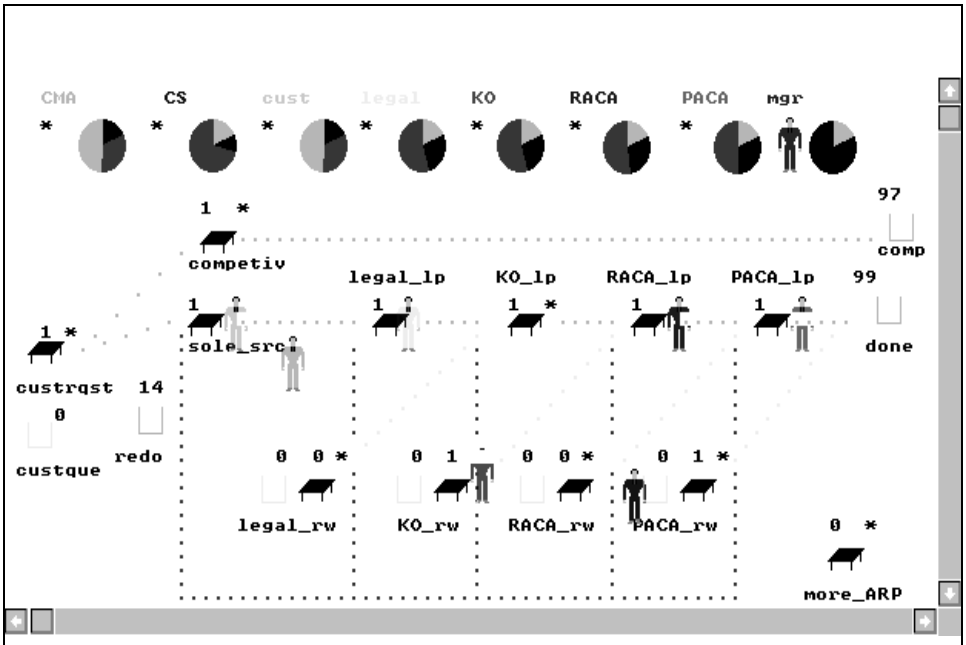
- ProSim roots: Intern. Software Process Workshops 1980-1990s (ten)
- ProSim Workshop legacy: 1998-2003 (four)
  - 40 journal papers (*JSS*, *SPIP*)
- ProSim cousins:
  - Feedback, Evolution and Software Technology (FEAST)
  - Intern. Workshop on Software Evolution

ProSim Focus Areas

- Software Process Simulation and Modeling
  - Project modeling and simulation
  - Process simulations and simulators
  - COTS vs. custom simulation packages
  - Group, team, engineering and evolution processes
  - Centralized and distributed processes
  - Relation to other process engineering activities
    - Analysis, redesign, visualization, scheduling, etc.

ProSim Tools

- Commercial simulation & modeling packages
  - Discrete-event
  - Systems dynamics (continuous systems)
- Research prototypes
  - Knowledge-based systems
  - Multi-agent systems
  - Distributed systems
  - Model-driven process support environments
  - Meta-modeling/process ontology interpreters



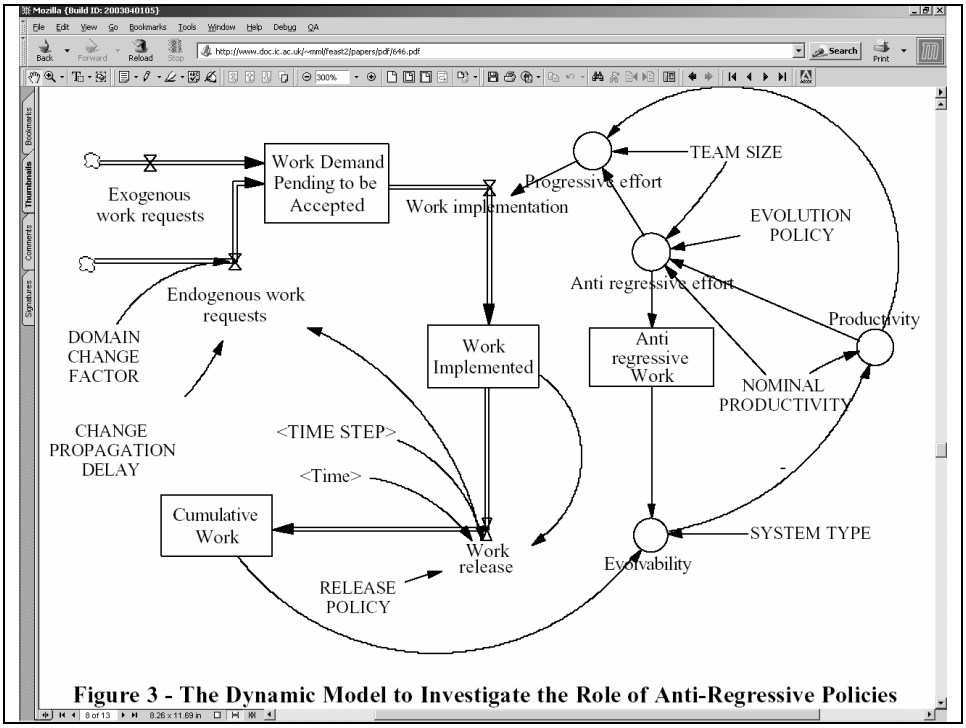
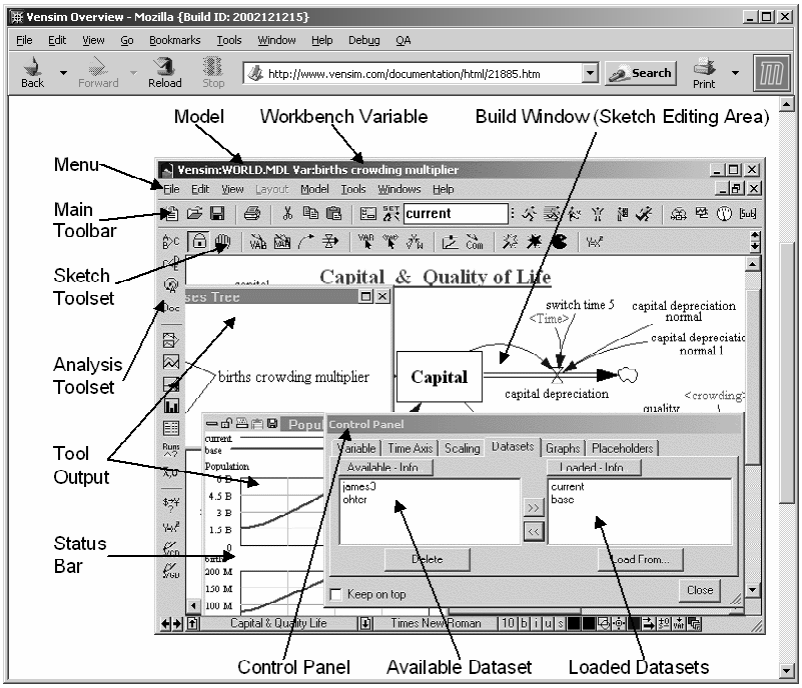
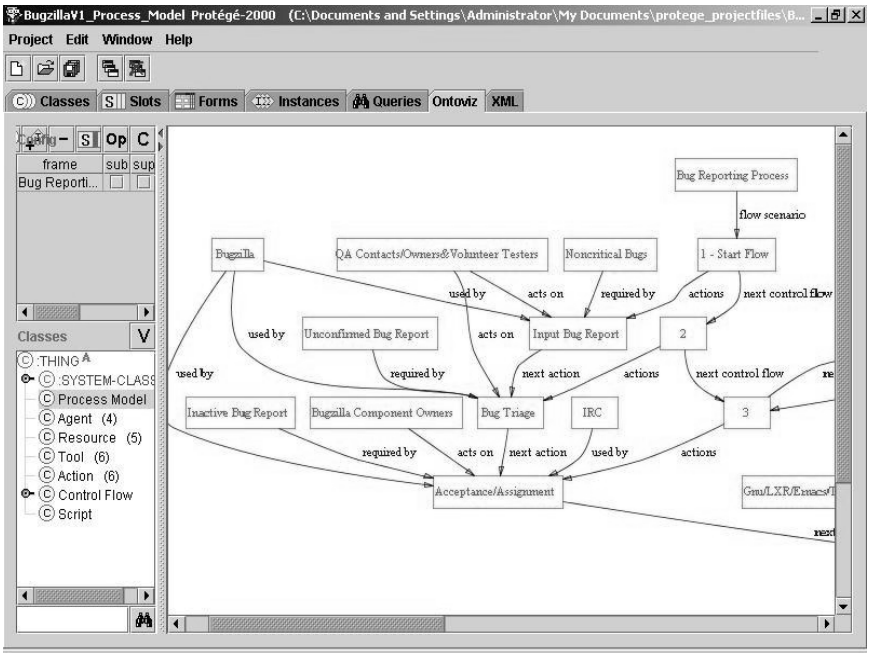


Figure 3 - The Dynamic Model to Investigate the Role of Anti-Regressive Policies





ProSim Techniques

- *Descriptive* M&S: Collect empirical data on existing software processes to reproduce observed patterns, or to improve them
- *Pro/Prescriptive* M&S: Construct M&S that demonstrate advantages of new processes compared to some real/imaginary baseline
- *Experimental* M&S: Construct M&S that test theoretical propositions or enable exploration of emerging concepts

Text Editor V3 – order-d.tab, dir; /home/chaph4/sfsv/demo/exam-bus/

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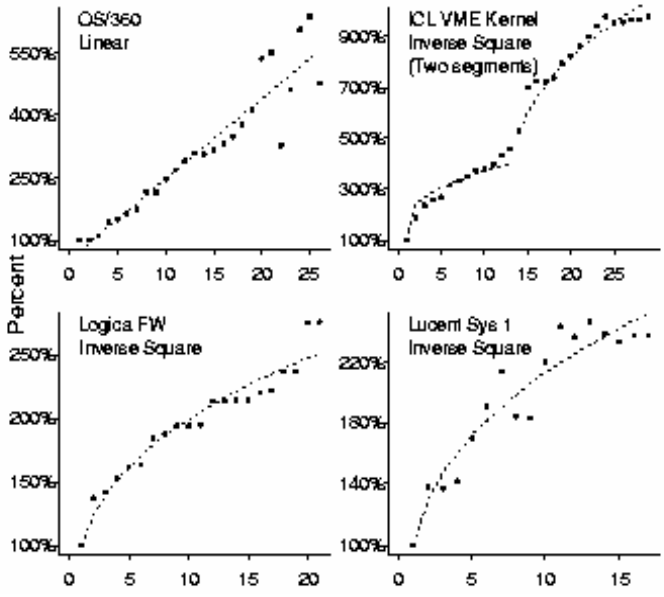
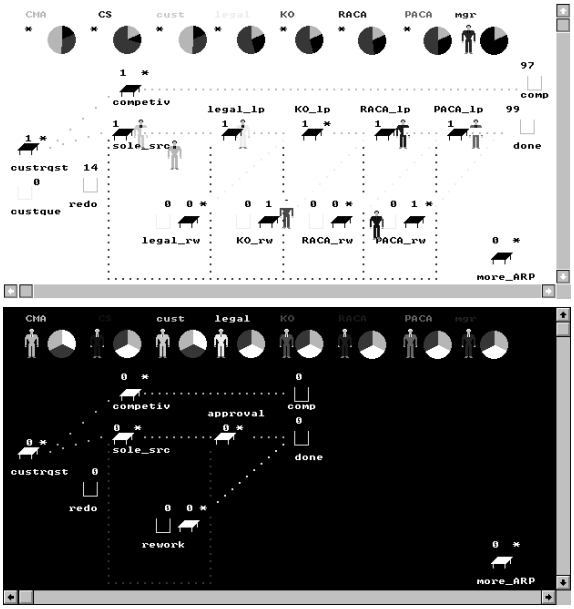
; process defintion for order fullfillment

;Level	Type	Task	Predecessor	People	Input	Output	Tool
0	TC	manage_order	n/a	n/a	n/a	n/a	n/a
1	A	price_and_delivery_quote	n/a	sales (1)	n/a	system_quote	emacs
1	TC	credit_approval	price_and_delivery_quote	n/a	n/a	n/a	n/a
2	TC	credit_request	n/a	n/a	n/a	n/a	n/a
3	A	contact_credit_div	n/a	field_sales (1)	n/a	cust_info_received	
digital_comm							
3	A	record_cust_info	contact_credit_div	credit_clerk (1)	cust_info_received	cust_info_recorded	elect_comm
n/a	n/a	n/a	n/a	n/a	n/a	n/a	
digital_comm							
2	TC	credit_check	credit_request	n/a	n/a	n/a	n/a
3	A	assign_cr_request	n/a	credit_mgr (1)	cust_info_recorded	cr_assignment	elect_comm
3	A	review_cr_request	assign_cr_request	credit_agent (1)	cr_assignment	reviewed_request1	elect_comm
n/a	n/a	n/a	n/a	n/a	n/a	n/a	
digital_comm							
3	IB	check_loop_begin	review_cr_request	credit_agent (1)	reviewed_request1	n/a	n/a
3	A	review_cr_history	check_loop_begin	credit_agent (1)	n/a	credit_history	cr_database
3	A	resolve_cr_probs	review_cr_history	credit_agent (1)	credit_history	n/a	telephone
n/a	n/a	n/a	n/a	credit_mgr (1)	n/a	credit_dept_approval	telephone
3	IE	check_loop_end	resolve_cr_probs	credit_agent (1)	n/a	n/a	n/a
n/a	n/a	check_loop_begin	n/a	n/a	n/a	n/a	n/a
3	A	prepare_cr_report	check_loop_end	credit_agent (1)	credit_dept_approval	credit_report	word_proc
3	A	record_credit_info	prepare_cr_report	credit_agent (1)	credit_report	cr_report_recorded	elect_comm
n/a	n/a	n/a	n/a	n/a	n/a	n/a	dss
2	TC	terms_development	credit_request	n/a	n/a	n/a	n/a
3	A	write_std_clauses	n/a	terms_agent (1)	cr_report_recorded	std_clauses	
terms_database							
n/a	n/a	n/a	n/a	n/a	n/a	n/a	
digital_comm							
n/a	n/a	n/a	n/a	n/a	n/a	n/a	elect_comm
3	IB	compile_loop_begin	write_std_clauses	terms_agent (1)	n/a	n/a	n/a
3	A	write_special_clauses	compile_loop_begin	terms_agent (1)	n/a	special_clauses	n/a
3	A	ensure_acceptable1	write_special_clauses	terms_agent (1)	special_clauses	n/a	telephone
n/a	n/a	n/a	n/a	terms_mgr (1)	std_clauses	terms_dept_approval	telephone
3	IE	compile_loop_end	ensure_acceptable1	terms_agent (1)	n/a	n/a	n/a
n/a	n/a	compile_loop_begin	n/a	n/a	n/a	n/a	n/a
3	A	prepare_terms_doc	compile_loop_end	terms_agent (1)	terms_dept_approval	terms_document	word_proc
3	A	record_terms_info	prepare_terms_doc	terms_agent (1)	terms_document	terms_doc_recorded	elect_comm
n/a	n/a	n/a	n/a	n/a	n/a	n/a	
digital_comm							
2	TC	pricing	credit_request	n/a	n/a	n/a	n/a



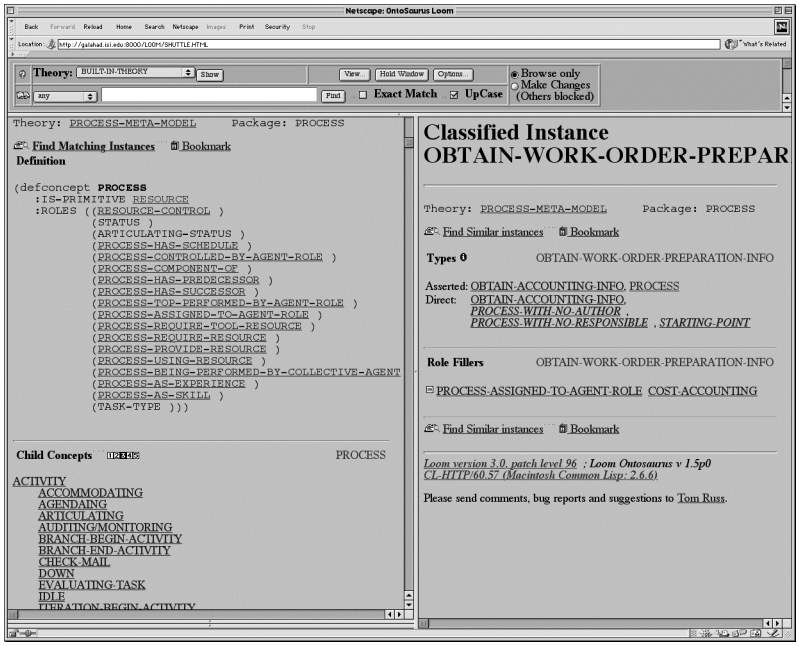
ProSim EngineeringTechniques

Meta-modeling	Visualization	Instantiation and enactment
Modeling	Prototyping and walkthrough	Monitoring and measurement
Analysis	Change management	History capture and replay
Simulation	Integration	Repair and Improvement
Redesign	Environment generation	Evolution and asset mgmt.



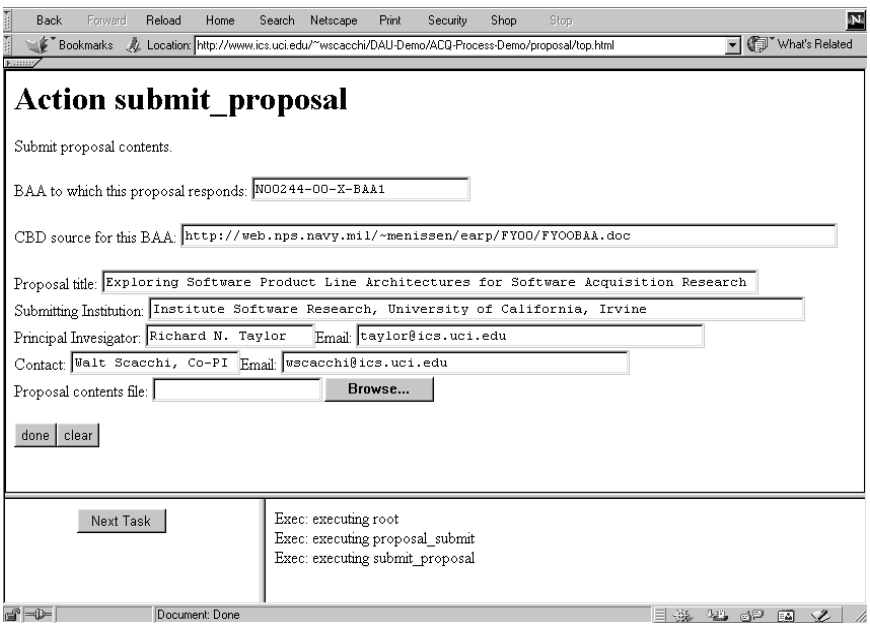
ProSim Concepts

- Meta-modeling vs. modeling
- Model-driven process support environments
  - Simulators, PSE/IDEs, Web-based process hypertext/media
- Process improvement via simulation, analysis, and redesign
- Process depth vs. breadth

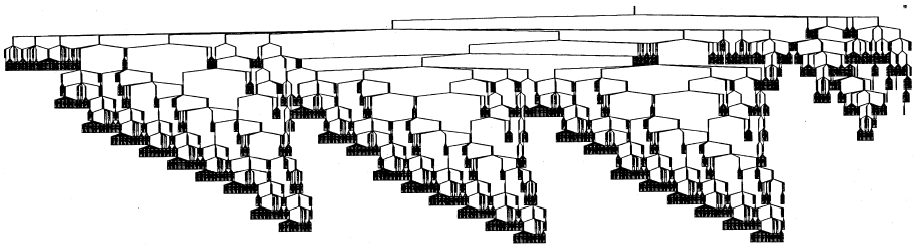


Results, Findings, Accomplishments

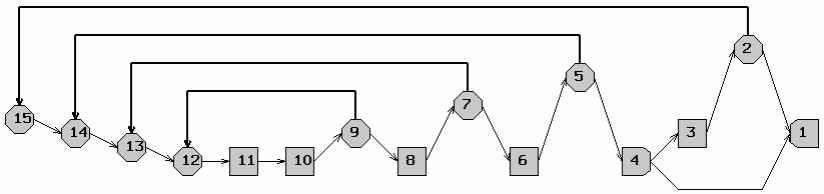
- Identifying high-yield and pathological processes and process domains
- Software evolution
- Software process improvement/redesign
- Software process vs. business process
- Hybrid simulations/models
- Process modeling languages
  - JIL, PML, xPADL, BPEL4WS (?)



A complex SDLC process model:
a *decomposition-precedence* relationship view
(19 levels of decomposition, 400+ tasks)



Research grant justification and approval process at Office of Naval Research



Missing Results, Findings, Accomplishments

- M&S of CMM assessed processes
- M&S of alternative SDLC process/tool frameworks (Waterfall vs. Spiral vs. Agile)
- M&S software deployment/release, diffusion, and adoption processes
- M&S of software evolution process across
  - Product lines
  - Product/technology generations

Emerging ProSim R&D Opportunities

- M&S open source software development/evolution processes
- Open source ProSim tools and M&S examples
- Global ProSim interoperability testbeds
- Computer Game-based ProSim tools and techniques

Emerging ProSim R&D Opportunities

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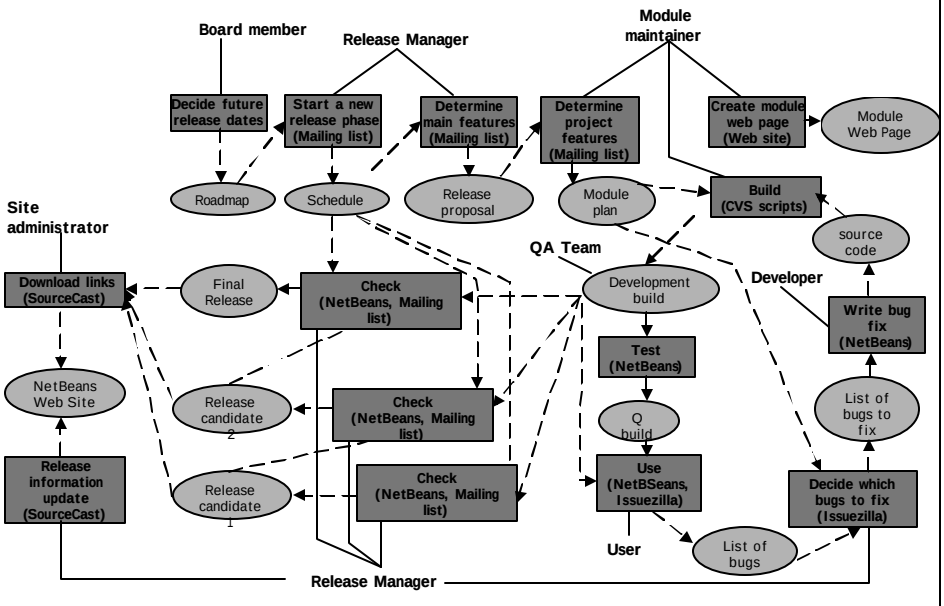
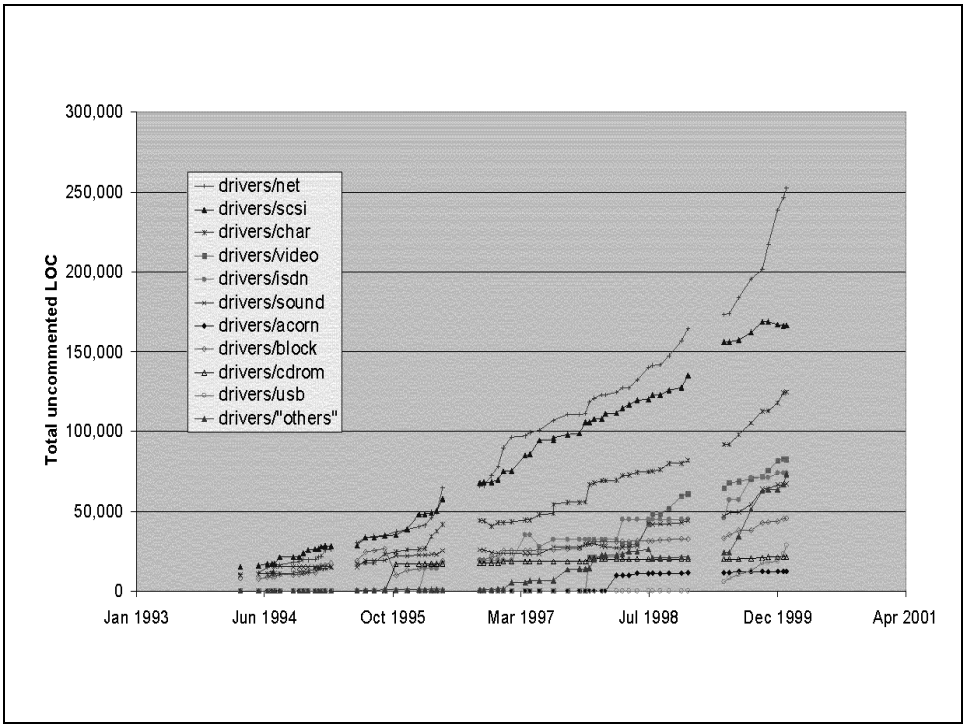


Release Process for NetBeans.org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Apr 2001
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drivers/scsi
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drivers/isdn
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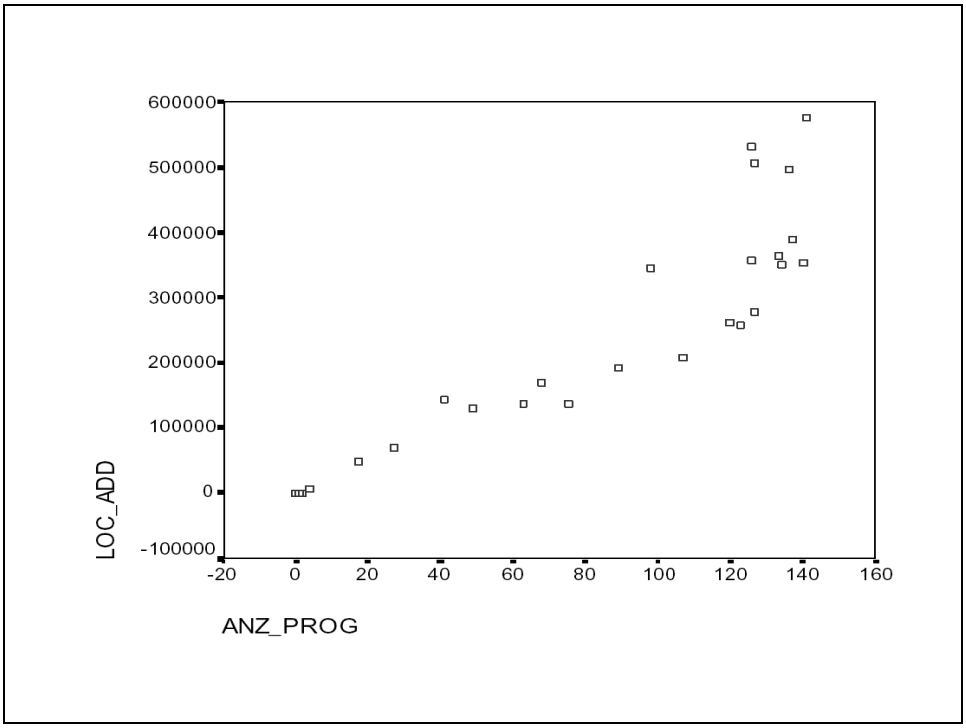
drivers/cdrom
drivers/usb
drivers/"others"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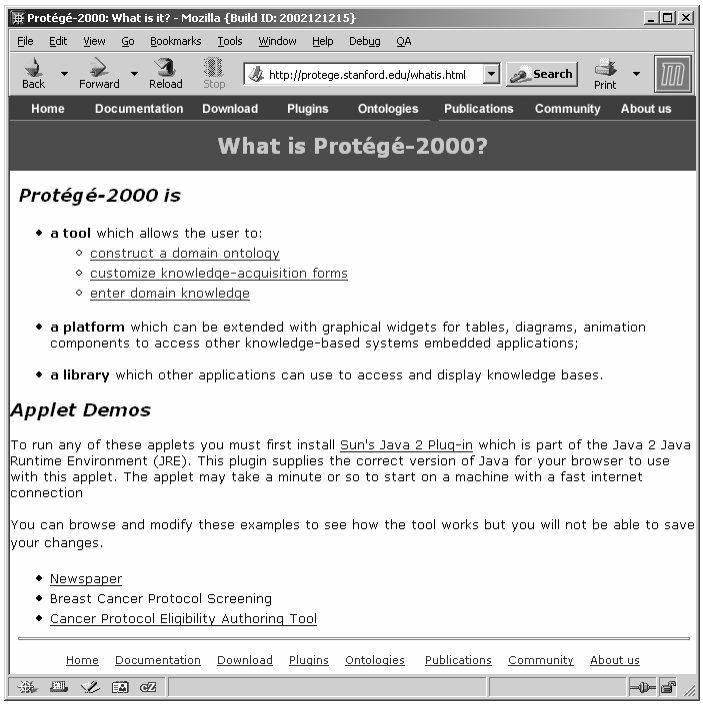
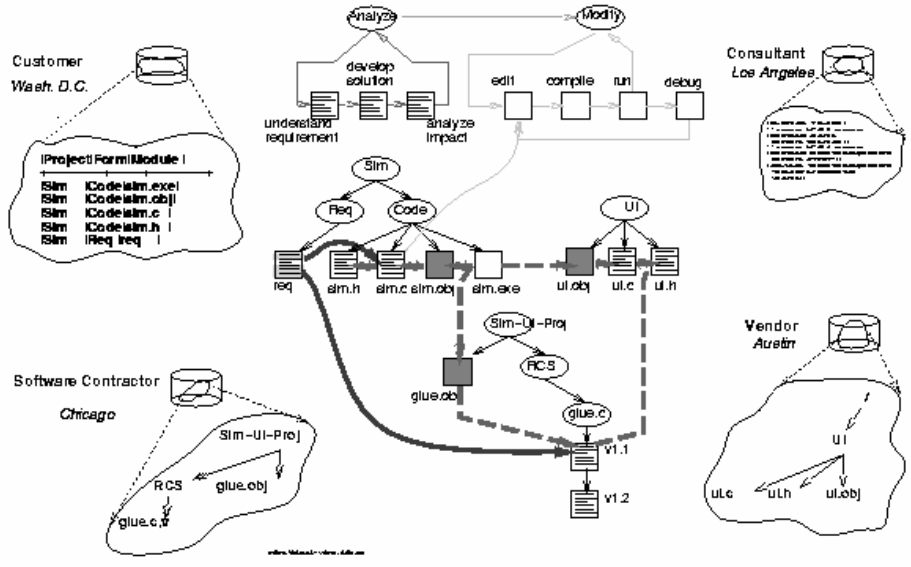
Emerging ProSim R&D Opportunities

- Open source ProSim tools and M&S examples



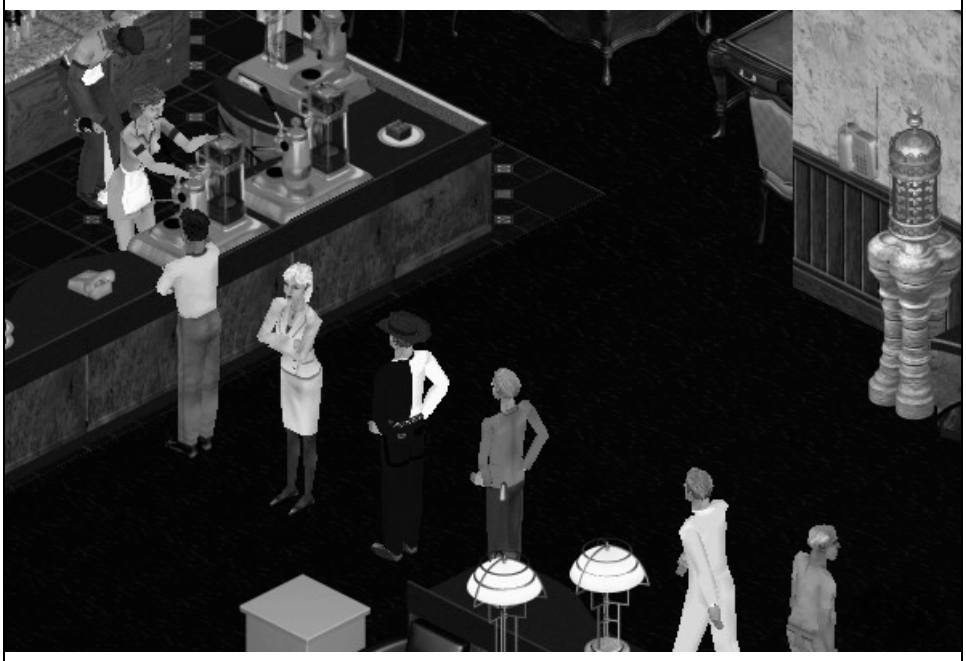
Emerging ProSim R&D Opportunities

- Global ProSim interoperability testbeds



Emerging ProSim R&D Opportunities

- Computer Game-based ProSim tools and techniques



Conclusions

- R&D in Process Simulation and Modeling is active, sustained, growing
- Systems Dynamics remains the major mode of ProSim research, though this may require rethinking
- ProSim has produced substantial results and accomplishments
- New opportunities for ProSim R&D are apparent and high value

Acknowledgements

- The research in this presentation is supported by grants from:
  - National Science Foundation
    - #IIS-0083075, #ITR-0205679, #ITR-0205724
  - *No endorsement implied*.
- Collaborators: Mark Ackerman (UMichigan), Les Gasser (UIUC), John Noll (SCU), Margaret Elliott and Chris Jensen (UCI-ISR)