

Identifying New Market Opportunities through Process Discovery

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Starting Points

- All organizational processes consume, use, or produce resources, and thus depend on external markets (other processes) to facilitate resource instantiation and flow into, through, or out of them.
- Multi-scale organizational processes can serve as a model for how to structure scalable, concurrent processing technologies for new markets/applications.

Overview

- Motivation and approach
- Process discovery methods and examples
- Multi-mode process modeling
- Process re-enactment
- Discussion
- Conclusions

Objective and Motivation

- *Goal*: Discover hidden processes within large-scale, global, loosely-coordinated community/project-oriented Web sites.
 - Thousands of participants in community sites and game-based virtual worlds (*WoW*, *Second Life*)
 - Developing, managing, and evolving over one million knowledge artifacts
 - Weakly coordinated by centralized authorities
 - All data of interest may be available (e.g., open source)
 - Exploit scalable multi-core processor technologies

Motivation for Open Source Software (OSSD) Projects

- Most organizations and OSSD projects don't know their processes
- Companies and new OSSD projects want to adopt "OSSD best practices"
- Process improvement, redesign, transformation, or automation requires explicit models of processes

Other Motivating Applications

- Game-based virtual worlds
 - Most MMOG companies don't know their own processes, nor those active/emerging within game community (e.g., external/gray markets for in-game resources)
- Business/national intelligence and security informatics
 - Most companies, government agencies, or autonomous groups do not know which of their operational processes can be remotely detected and manipulated.

Multiple levels of concurrent socio-technical and computational processing

- Individual participation
- Resources supporting activities
- Coordination and control in teamwork
- Alliances and social networks across projects
- Multi-project ecosystems
- Social movements, social worlds, institutions
- Thread
- Core
- CPU package
- Board
- Blade
- Cluster
- Grid, network

Approach

- Discover, model, re-enact, and redesign social/technical processes of interest
- Recognize, mine, and synthesize process context, participant roles, tools, resources, interdependencies within and across projects remotely over the Web
- Example: Discovering processes in OSSD projects

Traditional process discovery approach

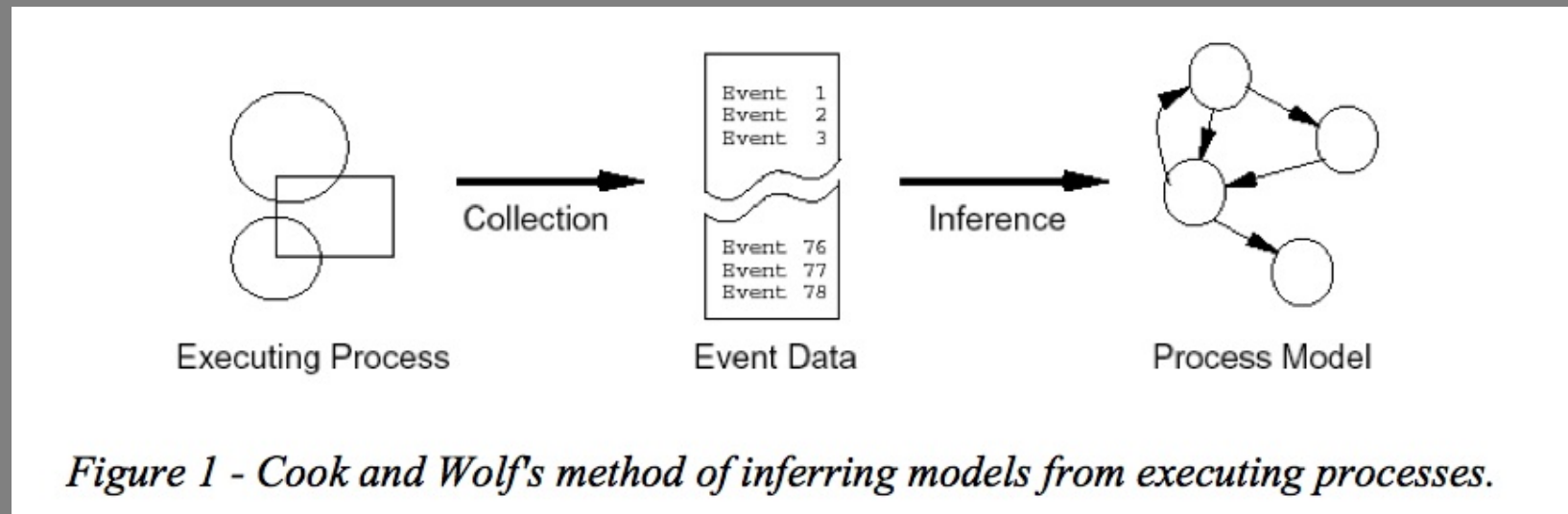
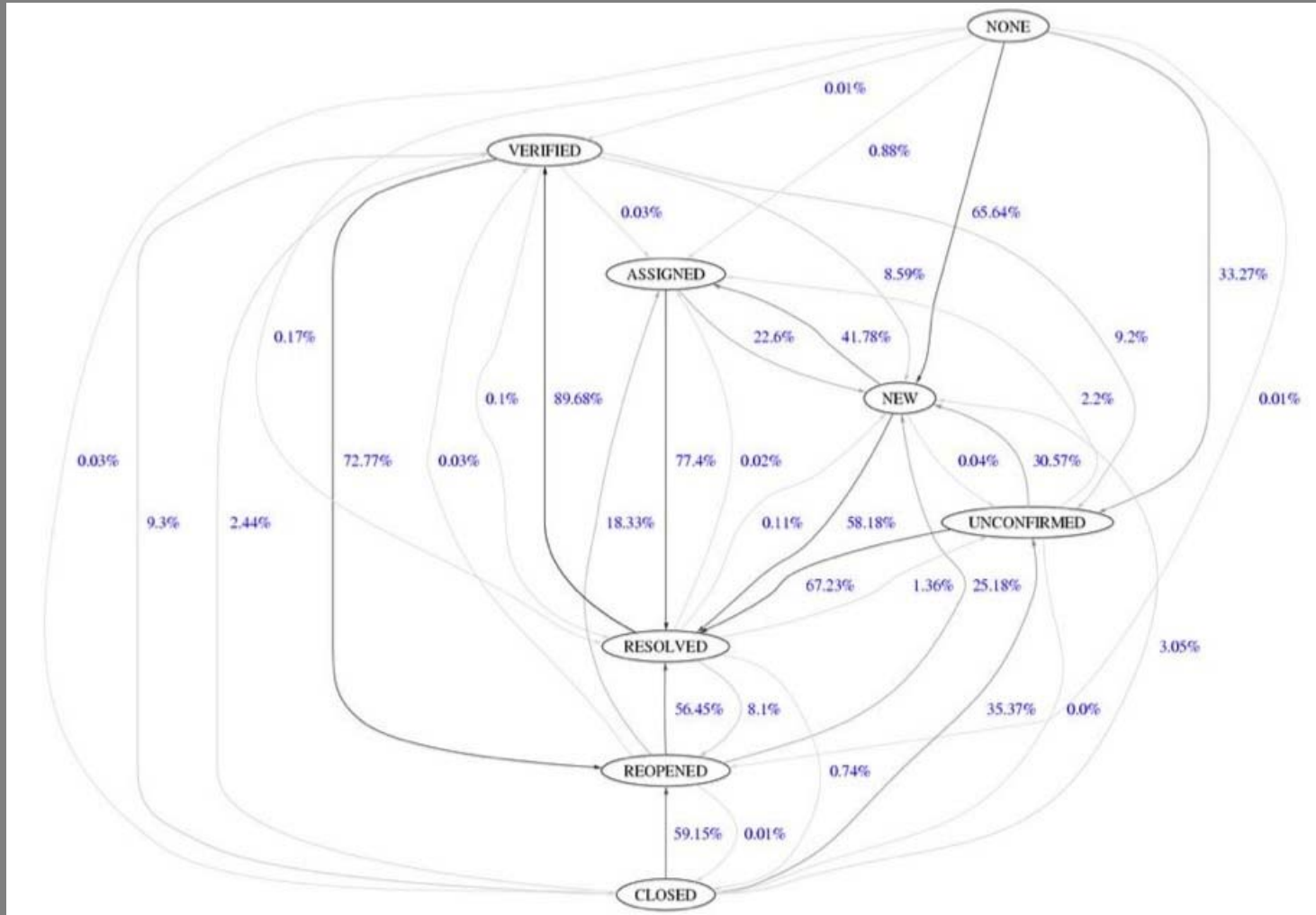


Figure 1 - Cook and Wolf's method of inferring models from executing processes.

J. Cook and A. Wolf, Discovering Models of Software Processes from Event-Based Data, *ACM Transactions on Software Engineering and Methodology*, 7(3), 215-249, 1998.

Discovering state-transition processes in OSSD projects



Ripoche, G. and Gasser, L., Scalable Automatic Extraction of Process Models for Understanding F/OSS Bug Repair, *Proc. 6th International Conference on Software Engineering & its Applications (ICSSEA-03)*, Paris, France, December, 2003.

Assessment

- Traditional process discovery approaches limited to single application domain
 - *We seek applicability to multiple domains*
- Relies on data extracted from single, locally maintained repository (homogeneous data)
 - *We seek remote collection of data from multiple repositories (heterogeneous data)*
- Can support synthesis of formal models at a single level of processing analysis
 - *We seek capabilities for process discovery that can scale across multiple levels of socio-technical and computational processing*

Process discovery

- Participant observation (online, Web-based ethnography) to tailor process meta-model
- Collection, annotation, and tracking of participant created/modified artifacts
 - Objects of interaction marking events and event flow
 - How objects are situated in facilitating collaboration, conflict, or conflict mitigation
 - Requires scalable, concurrent content crawling and indexing
 - Guided by meta-model and multi-mode process models
- Scalable, automated process recognition, mining, and synthesis of formal/enactable models should be achievable.

Discovering socio-technical and cultural evolution processes

- New OSSD processes under study
 - *Joining and contributing to a project in progress*
 - *Role-task migration: from project periphery to center*
 - *Alliance formation and community development*
- Independent and autonomous project communities can interlink via social networks that manipulate objects of interaction
 - Enables possible exponential growth of interacting and interdependent community as *socio-technical interaction network*

Annotated online chat transcript

(Individual participant level data)

- <CB> Hello (**Outsider Critique-1**)
- <CB> Several images on the website seem to be made with non-free Adobe software, I hope I'm wrong: it is quite shocking. Does anybody know more on the subject ?
- <CB> We should avoid using non-free software at all cost, am I wrong ? (**Extreme belief in free software (BIFS)-1**)
- <CB> Anyone awake in here ? (**Outsider Critique-1**)

Multi-Mode Modeling OSSD Processes

- *“Rich Pictures”* -- overall scenarios and stakeholders
- *Use cases* -- hyperlinked from Rich Pictures
- *Attributed flow graphs* -- process control flow, data flow, role and tool bindings
- *Process meta-model* -- provides formal reference model and domain ontology
- *Computational process models* -- formal representations that can be executed or re-enacted
- **Example case study** -- recognizing, mining, and synthesizing the “requirements and release” process in the NetBeans.org OSSD project.



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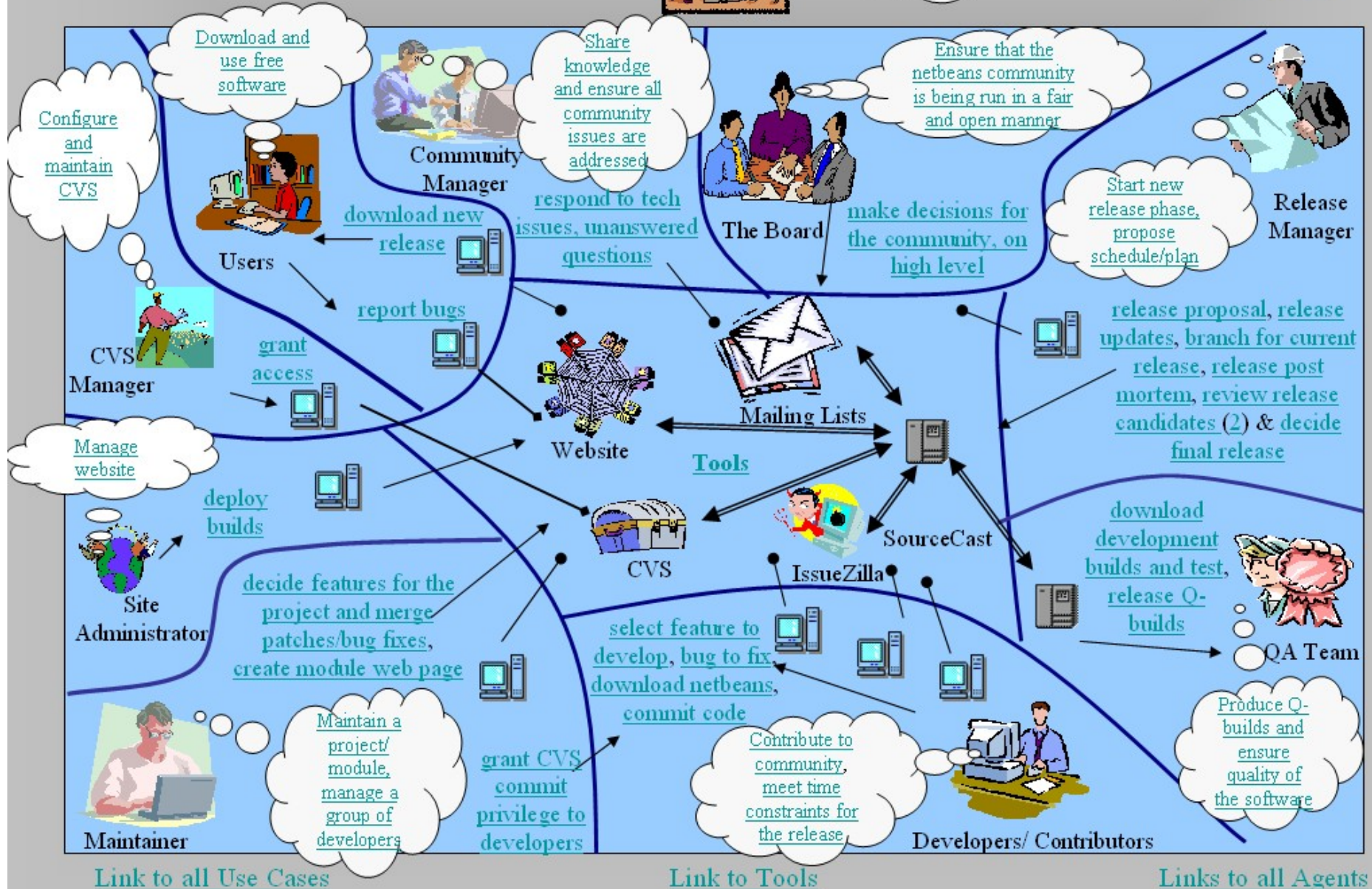


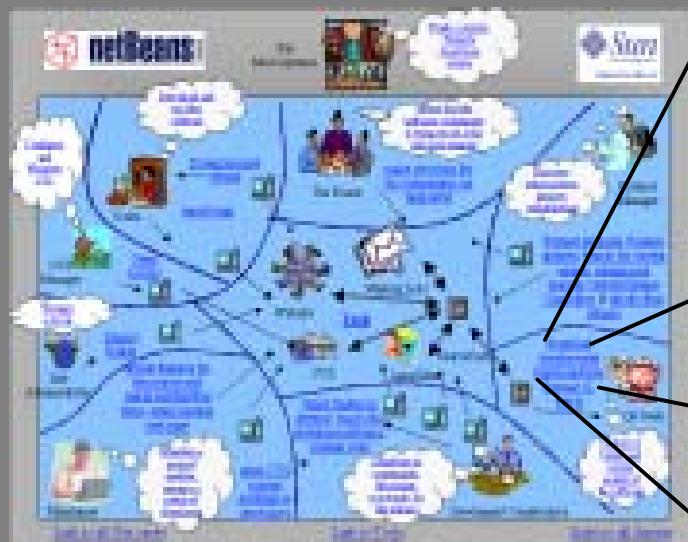


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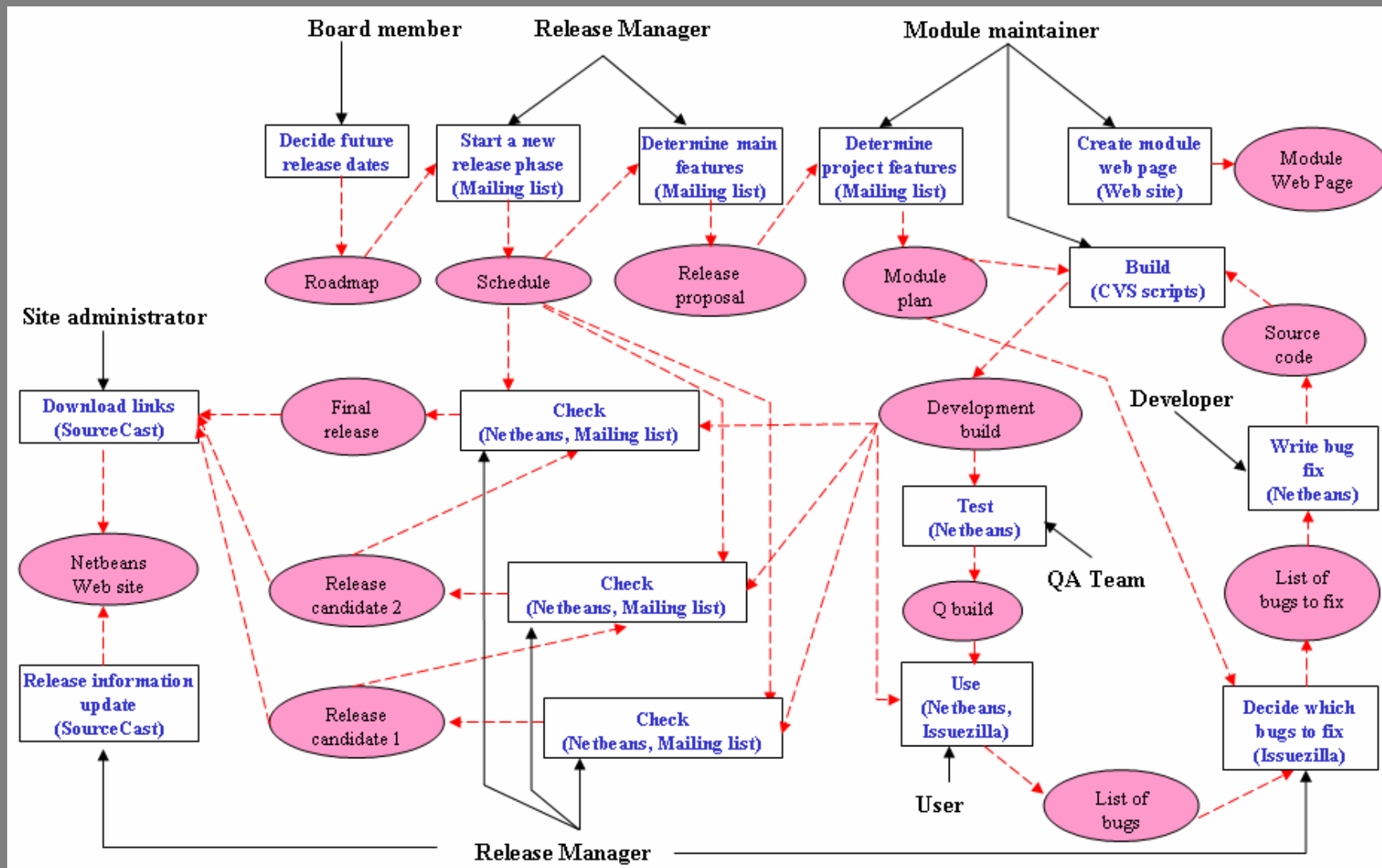


Test Builds

- The QA team tests the latest nightly builds every Friday
- QA team executes a set of manual tests on the builds as well as some sanity checks
- Test results are categorized as
 - Š [Bug Types](#)
- *User Constraint:*
 - Š The tests depend on the manual tests specification
- *System Constraint:*
 - Š Not all bugs may be identified

Figure 2. A hyperlink selection within a rich hypermedia presentation that reveals a corresponding case.

NetBeans.org R&R Process Resource Flow Model



Process re-enactment

- Synthesizing executable or re-enactable process specifications derived from ontology
- “Low-fidelity” process re-enactment support
 - We don’t try to model everything
 - Focus on resource flow patterns
 - Accommodate gaps and detect inconsistencies in process enactment models
- Re-enactments are interactive, navigational, and grounded in artifacts, tools, roles, and resource dependencies resulting from discovery and modeling

Formal model of an OSSD process coded in PML (excerpt)

- ...
- sequence Test {
 - action Execute automatic test scripts {
 - requires { Test scripts, release binaries }
 - provides { Test results }
 - tool { Automated test suite (xtest, others) }
 - agent { Sun ONE Studio QA team }
 - script { /* Executed off-site */ }
 - action Execute manual test scripts {
 - requires { Release binaries }
 - provides { Test results }
 - tool { NetBeans IDE }
 - agent { users, developers, Sun ONE Studio QA team, Sun ONE Studio developers }
 - script { /* Executed off-site */ }
- iteration Update Issuezilla {
 - action Report issues to Issuezilla {
 - requires { Test results }
 - provides { Issuezilla entry }
 - tool { Web browser }
 - agent { users, developers, Sun ONE Studio QA team, Sun ONE Studio developers }
 - script {
 -
Navigate to Issuezilla
 -
Query Issuezilla
 -
Enter issue } }
- ...

PML validation analysis

Summary of analysis for netbeans_req_release.pml

Model size (source lines): 307

Actions: 36

Resources: 72

Actions neither requiring nor providing resources: 1

Resources required but not provided (potential inputs): 0

Resources provided but not required (potential outputs): 0

Miracles: 2

Black holes: 6

Transformations: 30

Peos

File View Help

netbeans_req_release.pml (0)

Process: 0

/home/jnoll/projects/peos/src/models/ne

- ReviewNetBeans
- SetReleaseDate
- branch
 - ChangeBuildBranchName
 - MakeInstallTarForEachPlatform
 - UploadInstallTarFilesToWebRepository
 - UpdateWebPage
 - MakeReadmeInstallationNotesAndCha
 - SendReleaseNotificationToCommunityl
 - ExecuteAutomaticTestScripts
 - ExecuteManualTestScripts
- iteration
 - ReportIssuesToIssuezilla**
 - UpdateStandingIssueStatus
 - PostBugStats
 - ExamineTestReport
 - WriteBugFix
 - VerifyBugFix
 - CommitCodeToCvsCodeRepository
 - UpdateIssuezillaToReflectChanges
- iteration
 - ChangeBuildBranchName
 - MakeInstallTarForEachPlatform
 - UploadInstallTarFilesToWebRepository
 - UpdateWebPage
 - MakeReadmeInstallationNotesAndCha
 - SendReleaseNotificationToCommunityl
 - ExecuteAutomaticTestScripts
 - ExecuteManualTestScripts
- iteration
 - ReportIssuesToIssuezilla
 - UpdateStandingIssueStatus
 - PostBugStats
 - ExamineTestReport

ReportIssuesToIssuezilla

State: NONE

Required Resources: TestResults

Provided Resources: IssuezillaEntry

Script: "[Navigate to Issuezilla](#) [Query Issuezilla](#) [Enter issue](#)"

Start Finish Suspend Abort

Peos

File View Help

netbeans_req_release.pml (0)

Process: 0

/home/jnoll/projects/peos

- ReviewNetBeans
- SetReleaseDate
- branch
 - ChangeBuildBranchName
 - MakeInstallTarForEachIteration
 - UploadInstallTarFilesToSvn
 - UpdateWebPage
 - MakeReadmeInstallationInstructions
 - SendReleaseNotification
 - ExecuteAutomaticTestScripts
 - ExecuteManualTestScripts
- iteration
 - ReportIssuesToIssuezilla
 - UpdateStandingIssues
 - PostBugStats
 - ExamineTestReport
 - WriteBugFix
 - VerifyBugFix
 - CommitCodeToCvsCode
 - UpdateIssuezillaToReflectCode
- iteration
 - ChangeBuildBranchName
 - MakeInstallTarForEachIteration
 - UploadInstallTarFilesToSvn
 - UpdateWebPage
 - MakeReadmeInstallationInstructions
 - SendReleaseNotification
 - ExecuteAutomaticTestScripts
 - ExecuteManualTestScripts
- iteration
 - ReportIssuesToIssuezilla
 - UpdateStandingIssues
 - PostBugStats
 - ExamineTestReport

Issuezilla - Konqueror

Location Edit View Go Bookmarks Tools Settings Window Help

Location: http://www.netbeans.org/issues/query.cgi

netBeans.org

Downloads Products Plugins Docs & Support Community About

USERNAME
PASSWORD
LOGIN

PRINTABLE VERSION

HOME > Community

Project Issue Tracking:.netbeans.org

Issue [New](#) | [Query](#) | [Reports](#)

Tracking:

Query This page lets you search the database for recorded issues.

Issue type:	Component:	Subcomponent:	<input type="button" value="Submit query"/>
DEFECT ENHANCEMENT FEATURE TASK PATCH	**UNCATEGORIZED** 3rd-party ally accelerators ant antlr	*ALL* *NEW* accessibility actions annotations ant	
Status:	Resolution:	Priority:	
UNCONFIRMED NEW STARTED REOPENED	FIXED INVALID WONTFIX LATER	P1 P2 P3 P4	

1 2 3 4 jnoll@localhos... Console emacs@localh... Peos Konqueror 17:42:57

Discussion

- Validation strategies and tactics
- Implications and opportunities for new products/services in emerging markets
 - Business intelligence
 - (National) intelligence and security informatics
 - Massively multiplayer online games, and game-based virtual worlds with ECommerce and EBusiness

Validation strategies and tactics

- Multi-mode modeling
 - Collection and annotation of artifacts
 - Rich pictures with hyperlinked Use Case scenarios
 - Directed and attributed resource flow graph
 - Process domain ontology construction
- Simulated process re-enactment
 - Process model language generated from ontology
 - PML compiled into re-enactment environment
 - Automated PML source validation
 - Simulated walkthrough of process
- Open to independent validation and interactive traceability
 - Process models can be exported, shared, re-analyzed, re-enacted, modified (improved or redesigned), and redistributed.

Implications and opportunities

- Business intelligence
 - Customer (external/internal) and competitor analysis
- Intelligence and security informatics
 - Interdiction, service denial, attack denial
- Massively multiplayer online games
 - Market synthesis and mediation
- Process code (models) can be shared as open source software

Conclusions

- Described an approach to process discovery applicable to multiple domains.
- Highlighted how process discovery is amenable to scalable, concurrent computational processing.
- OSSD processes can be recognized, mined, and synthesized into models for simulation and enactment.
- Multi-level discovery and multi-mode modeling techniques can be used to study complex organizational processes.
- Discoverable processes may be applied to massively multiplayer online games and other concurrent computational processing domains.

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