Activity Theory
and the practice of design

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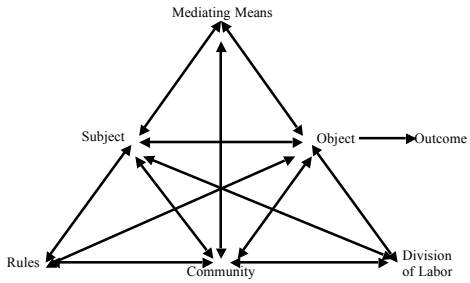
Overview

A Definition

- Activity theory is a way of examining phenomena in the world by considering the relationships of agents, objects, means, and in the case of human collective activity, objectives, community, rules, and division of labor.

Engestrom's Activity System Model



Origins and evolution

- Philosophy – Marx, Engels
- Psychology – Vygotsky, Leontiv, and Luria
- Socio-computing – Engeström, Miettinen, Kuutti, Nardi

Major Model Components

- Model of individual and collective activity (shown above)
- Levels of mediating means
- Some Kinds of Activities: Coordination, Collaboration, Co-construction

Mediating Means

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- *Level One – "Basic" Mediating Means*
- *Level Two – "How" Mediating Means*
- *Level Three – "Why" Mediating Means*
- *Level Four – "Where-to" Mediating Means*

Coordination, Collaboration, Co-construction

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- Coordination – synchronizing the components of an activity to avoid interference
- Collaboration – sharing components of an activity to achieve an object and objective
- Co-construction – enabling coordination and collaboration to help evolve components of the activity (including the activity as an object)

Mediating Means Levels / Classification

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- Level One – "Basic" Mediating Means: physical devices that are tangible and obvious, contributing to the achievement of the shared object and objective.
- Level Two – "How" Mediating Means: tangible and intangible devices that include procedures, rules, norms, and methods, supporting the use of basic mediating means.
- Level Three – "Why" Mediating Means: explanatory models that motivate.
- Level Four – "Where-to" Mediating Means: future visions how work can be facilitated or improved; they motivate evolution.

"What" Artifacts

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Intended to contribute directly to the object.

- Tools
  - SW Applications, Telephone, Manuals
- Signs
  - Language, Models, Metaphors
- Common means
  - Group meetings, classes, seminars

"How" Artifacts

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Intended to support the use of "what" artifacts

- Procedures and rules
  - Documented Process, ISO 9000
- Norms
  - "Quiet Time"

"Why" Artifacts

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Intended to motivate achievement of the object.

- Explanatory Models
  - Process Models, Organizational Charts
- Decision-Rationale
  - Documentation
- Motivational Communications
  - Corporate Strategies

"Where-to" Artifacts

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Intended to motivate evolution.

- "Practices of the Few"
- Mission/Vision/Purpose
- Business Process Re-engineering

Other Aspects to Focus On

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- History (e.g. of community, artifacts, roles, etc.)
- Intervention and Evolution
- Tension, Conflict, and Contradictions

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Study 1 – bug management at a major computer manufacturer

Why Study Bug Management?

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- Cross section of a software development workflow process
- Mediated and highly collaborative activity
- Largest amount of resources
  - 67% approximate relative cost of the maintenance phase of the software life cycle (Schach, 96).
  - Bug fixing made up 33% of the effort of the typical software development at the organization in question according to one engineer.

Methodology

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- Studied the bug management processes, systems for tracking issues and bugs, and associated documentation
- Ethnography
  - Summer 1997
  - Computer manufacturer in Cupertino California
  - 33 open-ended interviews
  - Participant observation, such as formal and informal meetings, attending Star-Trek night, and lunches

A Rationalized View of Bug Management

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Tasks	Subjects (Actors)
Origination	end users, others
Delegation	bug czar (liaison)
Resolution	developers
Verification	testers
Notification of fix	technical support

Visualizing the Puzzle

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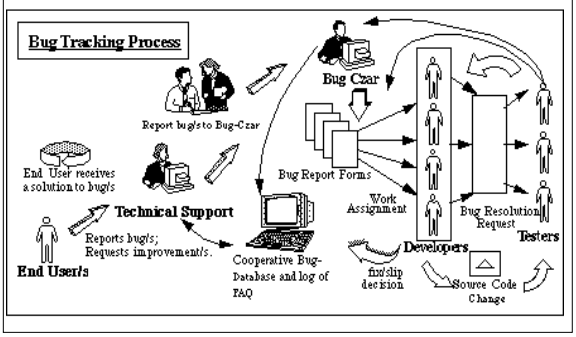

Problem

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- Puzzle Diagram
  - Pieces don't fit neatly!
  - Multiple actors, unaccounted for and tacit mediating means, informal and implicit work paths

Mediating Pieces of a Puzzle

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- Mediating actors:
  - technical support, bug meister, quality assurance person, programmer, tester, test lead, managers, screeners, etc.,
- Mediating means: actors give them meaning
  - Traditionally identified examples: the tracking system, a paper manual, the telephone, etc.
  - Actual examples from bug management process: Bug organizational index, Hit Squads (issue meetings), Bug Meisters, Impromptu and informal meetings, email, voicemail.

Implication for workflow tools

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- Problems
  - Data collection unstructured
  - Workflow tools encompass only a limited set of prescribed tools
- Potential of AT
  - Provide foundation for involving end users in process definition
  - Provide better foundation for process engineers
  - Widen understanding of mediating means

Benefits of AT in this Study

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- Reflecting actual process back to stakeholders (artifacts we produced were adopted)
- Explaining workflow process shortcomings to process engineers.

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Study 2 – customer support in a large software organization

Case Study

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- Problem-Resolution, Knowledge Authoring for Customer Support
  - Subset of software application support
  - Subset of authored knowledge (textual documentation)

Methodology

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- Ethnography as a method for collecting data
  - Semi-structured and open-ended informal interviews with 32 employees
  - Participant observations
  - Access to tools and documents
- Activity Theory as a means to analyze the data and provide results

Knowledge Authoring Activity System Model

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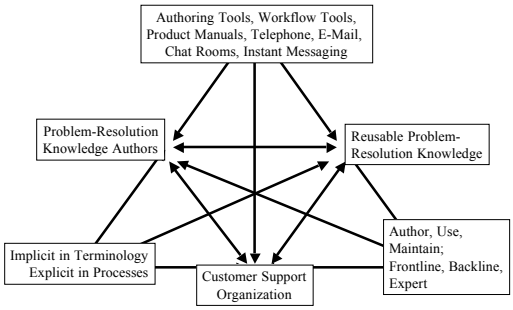

Contradictions, Conflicts and Tensions

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- "Putting out the fire NOW!"
- Playing ambassador
- Such activities in conflict with the objective of documentation

Intervention and Impact

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- Means of intervention and impact
  - Sharing observations through briefings, one-on-one sessions, technical reports, "white" papers
- Scope of impact
  - Specific groups such as sponsors and the knowledge-management strategy initiative
  - Team meetings such as support desk group

Benefits of AT in this Study

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- Reinforced the value of AT as a means of reflecting actual work activities back to stakeholders (including designers of next generation tools)
- Highlighted AT's role in identifying contradictions in work

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Study 3 – software maintenance at a government lab

Purpose

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- To understand *collaborative* software engineering
  - What activities workers engage in
  - What tools they use
  - What future tools they might use

Method

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- Participant Observation
- Informal Interviews
- Shadowing

"MVP" Software Maintenance Activity System Model

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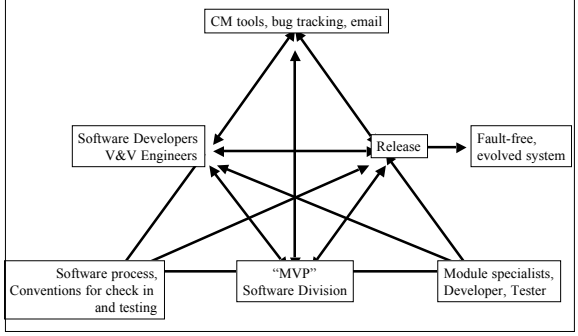

Tensions

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- Between Object and Community
  - Inherent changes of module modifications
  - *Fix: Formal Reviews to minimize negative effects*
  - *Fix: Specify instructions for testing in Bug report*
- Between Rules and Community
  - Check-in's required conflicts and tension (such as recompilation, merging)
  - *Fix: augment CM tool with email notification*
  - *Fix: hold check-in until afternoon*
  - *Fix: be the first to check in*

Improvements?

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- Software Tools
  - Regression testing?
  - Awareness?
- Other "interventions"
  - Reporting findings

Benefits of AT in this Study

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- Maybe some contradictions are unavoidable (but being aware of them might improve work).
- Observed a high degree of dependency among activities (and some activities were “fixes” for deficiencies in tools and work processes).
- Identified potential improvements in tools and work …
- But also a deeper appreciation for the difficulties of adoption (especially historic interdependencies)
- Observations about AT

Characteristics of Activity theory

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- Iterative modeling technique
- An activity may pose no contradictions until there are multiple instances of it
- Interdependencies among work activities resembles software dependency analysis
- AT resembles OO modeling in some ways providing a potential lever for software developers’ adoption

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Summary of AT Benefits

Activity Theory Features and Benefits *Perspective of Modeling Collaboration*

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- Open-ended
- Noninvasive
- Incremental

Activity Theory Features and Benefits *Perspective of Software Design*

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- A checklist for system requirements
- Identification of contradictory requirements
- A means to educate and mediate among stakeholders
- Similar concepts to object-oriented modeling

Activity Theory Features and Benefits Perspective of Organizational Analysis

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- Identify the stakeholders in the process.
- Ensure that technology is designed to benefit the end user.
- Work toward alignment between end users’ rewards and organizational needs.
- Work toward alignment between designers goals and satisfaction and business needs.

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