Ownership & Evolution of Local Process Representations

Thomas Moran, Tara Matthews, Laurian Vega*, Barton Smith, James Lin†, Stephen Dill

IBM Almaden Research Center, California, USA
*Dept of Computer Science, Virginia Tech, Virginia, USA
†Google, California, USA
Evolution of process documentation is important

Many activities are carried out with the help of documentation

- Planning & running a summer undergrad research program at a university with a government grant

Documentation that guide or help manage a process are important because

- Help novices learn how to carry out the process
- Help experts more efficiently carry out the process
- Give teams a common frame of reference for carrying out a process – avoiding mistakes, arguments
  - Especially important for coordinating complex processes with interdependencies

Documentation will be less effective if inaccurate, out-of-date, or not customized to local working conditions

- maintaining/evolving it over time is important
- understanding how it is evolved will help us build tools to support
How do workers evolve local process representations?

**Locally-owned processes** – knowledge workers formulate their own objectives for business processes and work out strategies and methods for attaining them

- Adapted to local work situations even when workers are following centrally-defined organizational processes, or *central processes*
- Workers often create some form of process representation to guide local processes

**Local process representations (LPRs)**

- activity management – instructions, to-dos, status, etc.
- products – presentations created, papers written, research compiled, etc.

We investigate how workers evolve LPRs over time
Research Overview

Focus: How do workers evolve LPRs for collaborative, locally-owned processes?

Aspects to study

(1) the organizational context
(2) cognitive capabilities and working styles of the workers involved

Approach

- **Field study**: Describe how factors like group roles and documentation purposes effect the evolution of LPRs
- **Lab study**: Provides behavioral details on the ways people carried out the evolution practice

Contribution

- Design implications for collaborative activity support tools focused on supporting the evolution & reuse of work required for repeated, local processes
Field Study

Goal: Explore and discover the processes for which LPRs are created, the roles people had in updating LPRs, and the practices for revising LPRs

Participants: 14 people who coordinated processes
- 3 organizations: a large company, a university, a home owners association
- 8 departments
- 7 job roles: administrator, director of development, program manager, HR, department manager, graduate student, professor, fiscal technician

Method
- 40-90 minute, semi-structured, in-person interviews, in participant’s working context
- Discussed how they and their teams used and evolved LPRs for processes that had some aspect of local ownership, were collaborative, & were repeated

Data
- Interviews were audio-recorded; interview notes & transcripts were analyzed
- Collected copies of process representations
Results Overview

Repeated, collaborative, locally-owned processes discussed (26 total)

- E.g., on-boarding new hires, disclosing inventions, planning various events & programs, evaluating employees, creating products, moving offices, teaching classes
- Participants & their teams maintained a total of 40 LPRs over time

Main findings

1. People spent effort to maintain LPRs for four specific purposes
2. LPRs were updated at different times depending on the way they were used
3. Roles emerged in teams for how people participated in evolving LPRs
Results: Four Purposes for Maintaining LPRs

1. Explicit & complete **how-to** information for a complex activity

2. Maintaining **status** information for a complex activity

3. **Informational** documentation used during an activity

4. Final **product** of a process
Results: Four Purposes for Maintaining LPRs

1. Explicit & complete **how-to** information for a complex activity

2. Maintaining **status** information for a complex activity

3. **Informational** documentation used during an activity

4. Final **product** of a process
Results: Four Purposes for Maintaining LPRs

1. Explicit & complete **how-to** information for a complex activity
2. Maintaining **status** information for a complex activity
3. **Informational** documentation used during an activity
4. Final **product** of a process
Results: Four Purposes for Maintaining LPRs

1. Explicit & complete how-to information for a complex activity
2. Maintaining status information for a complex activity
3. Informational documentation used during an activity
4. Final product of a process
Results: Four Purposes for Maintaining LPRs

1. Explicit & complete **how-to** information for a complex activity
2. Maintaining **status** information for a complex activity
3. **Informational** documentation used during an activity
4. Final **product** of a process
Results: Timing for LPR Updates

Participants updated LPRs at varying times in process life cycles, depending on the way the LPR was used and the process itself:

- **Prep**
  - Just before reusing the documentation

- **Iterative refinement**
  - After completing the process
  - While carrying out the process

- **Tracking status**
  - As new process information arose
Results: Roles for How People Participated in Evolving LPRs

Creator
- Creates the initial LPR

Coordinator
- Usually did bulk of LPR updates since they are responsible for the process
- Type of coordinator affected involvement: managerial, administrative, partial, overall

Team member
- Tended to not modify LPRs much
- Would update LPRs when no coordinator or LPR was a product of the process

Advisor
- Not involved in process, but would contribute LPRs as guidance
Summary & Design Implications

People spent effort to maintain LPRs for four specific purposes

1. how-to
   - *How-tos* should be findable
   - Audience should be explicit since LPRs are tailored for specific local conditions

2. status
   - Designers should enable creation of custom status views, like state diagrams

3. informational
   - Since email so commonly used, important for tools to tightly integrate with email

4. final product
   - Support iterating & commenting on drafts & transitioning content to final format

LPRs were updated at different times depending on the way they were used

   - It is important that documentation can be easy to revise at any time

Roles emerged in teams for how people participated in evolving LPRs

   - Tools may need different functionality for documenters & other participants
Lab Study Overview

Goal: Explore people’s capability to carry out a practice of evolving LPRs
Task & Instructions

Invention Disclosure Instructions

1. (Coordinator & Inventor) Decide on the subject matter of the patent.
2. (Coordinator) Write up a draft Patent Abstract.
3. (Coordinator) Give the draft Patent Abstract to the Inventor for approval.
5. (Coordinator) Give the draft Patent Abstract to the Attorney for prior art search.
6. (Attorney) Search for prior art to make sure the invention is novel.
7. (Attorney) Give the found prior art to Coordinator.
8. Write how invention differs from prior art.
9. (Coordinator) Give the draft Patent Abstract to the Manager for approval.
12. (Coordinator, Attorney, Inventor) Confirm that the process is done.
Situations

Invention Disclosure Instructions

1. (Coordinator & Inventor) Decide on the subject matter of the patent.
2. (Coordinator) Write up a draft Patent Abstract.
3. (Coordinator) Give the draft Patent Abstract to the Inventor for approval.
5. (Coordinator) Give the draft Patent Abstract to the Attorney for prior art search.
6. (Attorney) Search for prior art to make sure the invention is novel.
7. (Attorney) Give the found prior art to Coordinator.
8. Write how invention differs from prior art.
9. (Coordinator) Give the draft Patent Abstract to the Manager for approval.
12. (Coordinator, Attorney, Inventor) Confirm that the process is done.

Wait, I need to approve the abstract as well.

I don’t do that step, the attorney does.

We need to confirm we have the budget for this.
### Discrepancies & Fixes

#### Invention Disclosure Instructions

<table>
<thead>
<tr>
<th>Step</th>
<th>Role(s)</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Coordinator &amp; Inventor</td>
<td>Decide on the subject matter of the patent.</td>
</tr>
<tr>
<td>2.</td>
<td>Coordinator</td>
<td>Give the draft Patent Abstract to the Inventor for approval.</td>
</tr>
<tr>
<td>3.</td>
<td>Coordinator</td>
<td>Write up a draft Patent Abstract.</td>
</tr>
<tr>
<td>5.</td>
<td>Coordinator</td>
<td>Give the draft Patent Abstract to the Inventor for prior art search.</td>
</tr>
<tr>
<td>6.</td>
<td>Attorney</td>
<td>Search for prior art to make sure the invention is novel.</td>
</tr>
<tr>
<td>7.</td>
<td>Attorney</td>
<td>Give the found prior art to Coordinator.</td>
</tr>
<tr>
<td>8.</td>
<td>Attorney</td>
<td>Write how invention differs from prior art.</td>
</tr>
<tr>
<td>9.</td>
<td>Coordinator</td>
<td>Give the draft Patent Abstract to the Manager for approval.</td>
</tr>
<tr>
<td>12.</td>
<td>Coordinator, Attorney, Inventor</td>
<td>Confirm that the process is done.</td>
</tr>
</tbody>
</table>
Discrepancies & Fixes

Invention Disclosure Instructions

1. (Coordinator & Inventor) Decide on the subject matter of the patent.
2. (Coordinator) Write up a draft Patent Abstract.
3. (Coordinator) Give the draft Patent Abstract to the Inventor for approval.
5. (Coordinator) Give the draft Patent Abstract to the Attorney for prior art search.
6. (Attorney) Search for prior art to make sure the invention is novel.
7. (Attorney) Give the found prior art to Coordinator.
8. (Coordinator) Write how invention differs from prior art.
9. (Coordinator) Give the draft Patent Abstract to the Manager for approval.
12. (Coordinator, Attorney, Inventor) Confirm that the process is done.
Study Conditions, Between-Subjects Groups

\[ \begin{array}{cc}
\text{stable} & \text{stable-static} & \text{stable-evolving} \\
\text{drifting} & \text{drifting-static} & \text{drifting-evolving} \\
\end{array} \]
Lab Study Overview

Goal: Explore people’s capability to carry out a practice of evolving LPRs:
- Can they cope with discrepancies between the LPR & the situation?
- How do different situations effect their ability to modify the LPR?
- What kinds of modifications do they make or not make?

Participants: 27 total, employees from a large company
- 14 employees, 13 interns
- All were novices to the study task

Data
- Instructions revised by participant
- Survey completed after study task
- Interview after study task (asked about how they felt the activity went, what changes they made to the instructions, and why)
Results: Coping with Discrepancies & Evolving LPRs

- Most participants were able to cope with discrepancies, modify the LPR, and complete the activity.

- In stable situations, passing on revised instructions allowed participants to optimize the instructions over time
  - But, this happened over multiple iterations

- In drifting situations, participants could keep discrepancies manageable by passing on revised instructions
Fixes: Improving LPRs

**Fix:** changes to the LPR that were positive remedies to discrepancies

- Participants only fixed 41% of discrepancies on average!
  - Reasons for low fix rate (based on interviews):
    - Did not notice they had coped with a discrepancy (10 participants)
    - Felt like a novice in the disclosure task (5)
    - Confused by the instructions (2)
    - Forgot (1)
    - Limited time to make revisions (1)
    - Believed that some discrepancies were so minor they were “not worth recording” (1)
  - Implication: iterations may be needed to optimize instructions

- Two types of discrepancies were fixed with differing frequency
  - **role** discrepancies: unassigned & incorrectly assigned roles
    - 60% were fixed
  - **step** discrepancies: incorrect, irrelevant, missing, & out-of-order steps
    - 40% were fixed
Fixes: Improving LPRs

**Fix**: changes to the LPR that were positive remedies to discrepancies

- **Participants only fixed 41% of discrepancies on average!**
  - Reasons for low fix rate (based on interviews):
    - Did not notice they had coped with a discrepancy (10 participants)
    - Felt like a novice in the disclosure task (5)
    - Confused by the instructions (2)
    - Forgot (1)
    - Limited time to make revisions (1)
    - Believed that some discrepancies were so minor they were “not worth recording” (1)

- Two types of discrepancies were fixed with differing frequency
  - **role** discrepancies: unassigned & incorrectly assigned roles
    - 60% were fixed
  - **step** discrepancies: incorrect, irrelevant, missing, & out-of-order steps
    - 40% were fixed
Fixes: Improving LPRs

Fix: changes to the LPR that were positive remedies to discrepancies

- Participants only fixed 41% of discrepancies on average!
  - Reasons for low fix rate (based on interviews):
    - Did not notice they had coped with a discrepancy (10 participants)
    - Felt like a novice in the disclosure task (5)
    - Confused by the instructions (2)
    - Forgot (1)
    - Limited time to make revisions (1)
    - Believed that some discrepancies were so minor they were “not worth recording” (1)

- Two types of discrepancies were fixed with differing frequency
  - role discrepancies: unassigned & incorrectly assigned roles
    - 60% were fixed
  - step discrepancies: incorrect, irrelevant, missing, & out-of-order steps
    - 40% were fixed
Enhancements: Effects of Other Changes to LPRs

**Enhancement**: any change participants made to instructions that were not discrepancy fixes

- 6 enhancements made per session on average (not dependent on delta)
- Most were to add clarifying content to a step (43% of all enhancements)
- Enhancements were not always good
  - 25% of enhancements were *incorrect*, introducing discrepancies
  - sometimes led to verbose, confusing instructions

Types of enhancements

- step-oriented (74% of all enhancements)
- role-oriented (21%)
- other (5%)
Summary & Design Implications

Limited number of problems people could recognize and fix in LPR (a fairly constant rate of 41% for experimental situations)

- Iterations may be needed to optimize LPRs

Different revision types: problem fixes (objective) & enhancements (subjective)

- Support for different types could help users maintain usable documentation
Conclusion

Two methods provided different results & design implications

- Field study -- focused on contextual factors difficult to simulate in a lab
- Lab study – explored capabilities of individuals
Thanks!

Thomas Moran  
tpmoran@us.ibm.com

Tara Matthews  
tara@almaden.ibm.com

Laurian Vega  
laurian@vt.edu

Barton Smith  
basmith@almaden.ibm.com

Jimmy Lin  
james.lin@acm.org

Steve Dill  
dill@us.ibm.com
Extra Slides
Results: processes discussed

Local versions of central processes:
- On-board new hire
- On-board interns
- Disclose inventions
- Plan/run employee volunteer program
- Plan/run charitable donations program
- Carry out employee evaluation
- Move offices
- Continuity of operations plan
- On-board new grad students
- Order materials
- Plan/run summer undergrad research program
- Plan/run club event
- Schedule a meeting & room
- Plan/run club showcase
- Plan hardware education event
- Plan/run multi-university seminar
- Plan/teach a course

Local-only processes:
- Plan/run science & technology camp
- Plan/run community service program
- Schedule a colloquium
- Plan/run research conference
- Plan technical conference
- Create a presentation
- Plan a guest’s visit
- Write a paper
- Plan/run Homeowners Association meetings
A Model for the Practice of Evolving LPRs
A Model for the Practice of Evolving LPRs

local process

actors & resources
A Model for the Practice of Evolving LPRs

local process

inventor attorney

actors & resources
A Model for the Practice of Evolving LPRs

local process

activity

is an instance of a local process in a specific work situation

inventor attorney

manager

inventor

attorney
A Model for the Practice of Evolving LPRs

local process

activity
is an instance of a local process in a specific work

situation

inventor attorney

manager

attorney

inventor

LPR
A Model for the Practice of Evolving LPRs

activity 1
is an instance of a local process in a specific work situation

activity 2
is an instance of a local process in a specific work situation’
A Model for the Practice of Evolving LPRs

activity 1
is an instance of a local process in a specific work situation

activity 2
is an instance of a local process in a specific work situation'

discrepancy

drift

time
A Model for the Practice of Evolving LPRs

activity 1
is an instance of a local process in a specific work situation

activity 2
is an instance of a local process in a specific work situation'

LPR
inventor

LPR
inventor

manager

attorney

coordinator

attorney

evolve

drift

time
A Model for the Practice of Evolving LPRs

When a discrepancy is encountered:

breakdown → cope → reflect → decide → document
Lab Study – Session Situation Results

Static Instructions

Evolving Instructions

Stable Situation

Drifting Situation