Adaptation and Generalisation in Software Product Development

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Overview

• Context
  – Cluster, KP-Lab, Case

• Basic issues

• Conceptual framework
  – Activity theory and Evolving artifacts

• Data and analysis

• Summary and open issues
ICT & Learning @ Work

- The InterMedia research cluster *ICT and Learning at Work* do research on
  - Blended learning and long-distance leadership
  - Developing protocols for analysis of learning and knowledge creation on multiple levels
  - Developing conceptual models of learning at work
  - Design user interfaces to support workplace learning
  - Techniques for studying and intervening in practice
  - *User-initiated product development*

- We have background in CSCW, Education, HCI, Health informatics, Information systems
People

Sten Ludvigsen, Professor and director
Anders Morch, Associate professor
Anne Moen, Affiliated associate professor
Cecilie Flo Juhreie, PhD student
Thomas de Lange, PhD student
Annett Hillestad, PhD student
Kathrine A. Nygård, PhD student

Sturle Nes, PhD Student
Shazia Mushtaq, Master student
Yulia Kudrik, Master student
Karin Heiene, Master student
Eduard Mollenkamp, Master student
Elin Hultkvist, Master student
Jorgen Taut Walton, Master student

More info: http://www.intermedia.uio.no/display/im2/ICT+and+Learning+at+Work
KP-Lab project

- Large EU-funded integrated project (IP) with 22 partners from 14 countries
- Technology development of a shared learning environment for education and workplaces
- Developing tools for creation, modification, and monitoring of evolving knowledge artifacts
- Collaborative design of pedagogical models for scenarios in education and workplaces
- InterMedia has been WP leader for “knowledge practices in workplaces”
KIKK, a case in KP-Lab

• **About the case**
  - Company is a small software house in Norway
  - Produces project planning tools for the oil and gas industry
  - Software development is characterized by frequent customer interaction with some of their customers
  - “Project,” “Planner,” and “Microsoft Project Extension (MPX)” are three of their products
  - The company employed 25-30 people when we started
  - Rapidly expanding staff and searching out new market

• **Our roles**
  - Researchers and designers
Planner screens
Methods

- 2-year data collection (4 finished master students, 1 PhD)
- Interviews with developers and customers
- Observation and field notes
- Directed observation
  - Seek out the active users and inquire about their activities (von Hippel, 2005)
- Strategic ethnography
  - “Following artifacts” (software products) as they evolve (Pollock & Williams, 2008)
- Participatory design
  - Engage users in workshops with stakeholders
  - Interactive web prototype using agile (software engineering) methods
Multiple support tools for different types of customer interaction

- Company developer
- Customer
- Planning tool
- Consultancy
- Training
- Support
- Further development
- Social forum

Proposal

Adaptation and Generalisation
Intervention by participatory design

Adaptation and Generalisation
Basic issue and discrepancy

- On one hand the company wants to maintain good relations with existing customers by creating customized products
- On the other, the company wants to expand to new markets to get new customers and increase revenue
- Multiple initiatives over many years to resolve this discrepancy, from help desk to CRM system
- A focus has been to improve communication, information sharing and knowledge management internally in the company and with customers
Research questions

1) How does the company expand its business to new markets and its products to new users?

2) How does the company interact with customers to leverage their contributions to development?

3) How can we understand these two activities in terms of how their components interact (e.g., to what extent are there paths, stages, transitions, breakdowns, contradictions, traces, etc.)?
Basic concepts: Framing the study

- **Community of practice**: people who have common goals; they interact and strive towards those goals (Wenger, 1998).
- **Community of interest**: people who exchange ideas and thoughts about a given passion, but may know (or care) little about each other outside of this area. A CoI can bring one or more CoP’s together (Fischer, 2001).
Analytic framework: Two perspectives

- Cultural-Historical Activity Theory
  - Object, subjects, communities
  - Co-configuration (knotworking), boundary crossing

- Evolving artifacts
  - Aggregation, emergence
  - Predecessor artifacts, stable intermediate form

- In common
  - Understanding historical development,
  - Intellectual roots in ideas of Mead and Vygotsky

- Differences: object-oriented activity vs. artifacts
Example: Predecessor artifacts

Mobile phone ←→ Coin-operated phone

Overhead projector

Computer beamer
Predecessor artifact as stable intermediate form in product line development

Fiat 500 (2009-) ←→ Fiat 500 (1957-1975)
Stable intermediate form

- Herbert Simon used the term stable intermediate form or subassembly to characterize a special type of building block of artifacts/systems (intermediate stages)
- “Complex systems will evolve from simple systems much more rapidly if there are stable intermediate forms than if there are not” (Simon, 1996, p. 209)
- Stable intermediate forms, according to Simon, are parts organized in part/whole (aggregation) hierarchies to cope with complexity
- We argue there is a material/symbolic duality in a class of stable intermediate forms that we call predecessor artifacts
Emergence

• George Herbert Mead defined emergence as “the presence of things in two or more different systems, in such a fashion that its presence in a later system changes its character in the earlier system or systems to which it belongs” (Mead 1932, p. 62), and further

• “Emergence involves a reorganization, but the reorganization brings in something that was not there before.” (Mead, 1934, p. 198)

• When interaction of two different systems produce something that is more than sum of the individual systems on their own, something new emerges
Interpretation of emergence and stable intermediate form

- Emergence provides an explanation for the “material/symbolic” duality of designed artifacts
- Predecessor artifacts are both physical (material) parts of an artifact and a symbolic reminder of something outside themselves
  - Of human knowledge: an idea, a design rationale
- Pred. artifacts represent historical development
- The symbolic reminders and/or material “traces” of PAs emerge when reorganizing in an effort to integrate the artifact with users in public domain
Evolving software artifacts and emerging objects

• The evolving artifacts approach has been further developed and applied to software development in our work:
  • It follows an iterative and cumulative process of (1) creating, (2) discussing, (3) accumulating, and (4) formalizing representations for mutual understanding (Fischer & Ostwald, 2001), among customers and developers
  • Hypothesis and empirical question: Two kinds of processes must be managed: Adaptation (specific development and active customer contributions) and Generalization (general development and expansion)
Evolving software artifacts in company
Data extract 2: Major change in software product line

“The reason we came into contact with Microsoft was that in 2001 Statoil decided to obtain a project management tool for all its PCs, which are a few thousand; it was something like six to eight thousand PCs, and we won the bid with an adaptation of Planner. Microsoft was the one that lost the bid.”
Data extract 3: Emerging new object

6. Researcher:
You didn’t launch a strategic design initiative, you didn’t adapt the products or make a new product, and these are the same products?

7. Respondent2:
Exactly the same products that are used in another market, but because some of those who have come [into the new market] have higher standards for project management and wanted to use tools they were used to. For instance in Ahus [large hospital being built in Norway] where you have people who have managed projects in the oil and gas industry for 25-30 years; they wish to do things in a certain way, and have also instructed their sub-contractors to report in a certain way, and they [sub-contractors] have to find suitable tools as well. It is the same way project management spread to the oil and gas industry some thirty years ago.
Data extract 5: Improvement requests

9. Interviewer 1: Are there any customers that have participated in the development of your products?

10. Respondent 2: […] Statoil [oil company in Figure 2] is an example. When we delivered version 3 of Planner, Statoil was a major initiator of the development. Much of what we incorporate in our products comes from our customers.

11. Interviewer 1: How do you receive customer requests, how is the process accomplished?
Data extract 5 cont’d

12. Respondent2: Customers send us a wish list for new functionality or modifications to existing functionality. During development, if [the request for new functionality] seems reasonable, e.g. if others are asking for it, if it is an area we should look closer into and maybe look at in a broader perspective. For example, if you are writing reports and [someone] wants new functionality, we include it because we are already are in there [altering the report-module in the product]. This enables late requests to be taken into account, assuming it doesn’t have side effects, requiring changes to many of the other modules in the product.
Data extract 7: spread of user innovation

[..] our main customer, Statoil, has spread ([the product]) throughout the organisation, and based on that we have received numerous requests for new functionality. We have agreed to do this as long as they pay for the development costs. And as a result more functionality has been added to the product.
**In sum:** In company there is a path from adaptation to generalization

- Improvement requests (from one customer) or tailoring done on a local instance of a product
- When communicated back to the company it can lead to an adaptation for this customer
- Some adaptations that were rated good (or possible and paid for) have been incorporated in a later release of the product and made available to all customers (generalization)
- Generalization can also happen without software changes, driven by changes in market and work
Findings: Two kinds of developmental activities

- **Specific development**
  - Development triggered by local events (automated bug reports, users’ problem description, workarounds, local adaptations, hacks) some of which may lead to general development (*short term activity*)
  - Requires communication with professional developers for broader impact

- **General development**
  - Development of a product family, seeking out new market share, and planning successive releases (builds, versions, etc) of the various software products (*long term activity*)
Findings: the long path to generalization

- *End-users are encouraged to create* proposals; which are rated as *good, possible, or bad* by company developers.
- “*Good and possible*” proposals can be included in new versions of the product, assuming property rights are properly handled.
- *Developers* create user options, patches, builds, and versions for specific customers, and projecting forward.
Findings: the “short” path to generalization

• No changes to any of the products
• New objects emerge as the result of migration of workers/users from downsizing in one industry and scaling up in another
  – Oil and gas --> building construction
• With new markets come new customers
• The same functionality are used in different application domains; this is possible because there are common features of project planning
Summary and conclusions

- Problems and solutions suggested by customers serve as an important source for new product features in company.
- New products are developed in interaction with customers, and build on existing products.
- Two examples are Planner’s influence on MPX (Microsoft Project Extension) and the collaboration with Microsoft to spawn MPX.
- Customer requests are rated as good (accepted as is), possible (if paid for), and bad (rejected).
- Generalization is often lengthy but can happen without any adaptation, by creating a new object (market).
- An example is the company’s expansion from oil and gas to building and construction without changing its products (however, this is an exception rather than the rule).