



Adaptation and Generalisation in Software Product Development

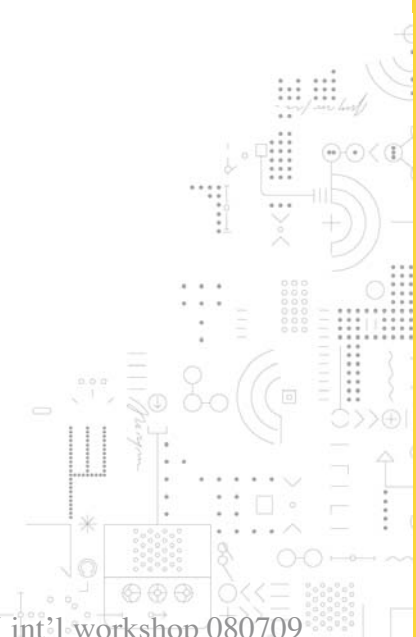
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Overview

- 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	Sturle Nes, PhD Student
Anders Morch, Associate professor	Shazia Mushtaq, Master student
Anne Moen, Affiliated associate professor	Yulia Kudrik, Master student
Cecilie Flo Jahreie, PhD student	Karin Heiene, Master student
Thomas de Lange, PhD student	Eduard Mollenkamp, Master student
Annett Hillestad, PhD student	Elin Hultkvist, Master student
Kathrine A. Nygård, PhD student	Jorgen Taxt Walnum, 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”

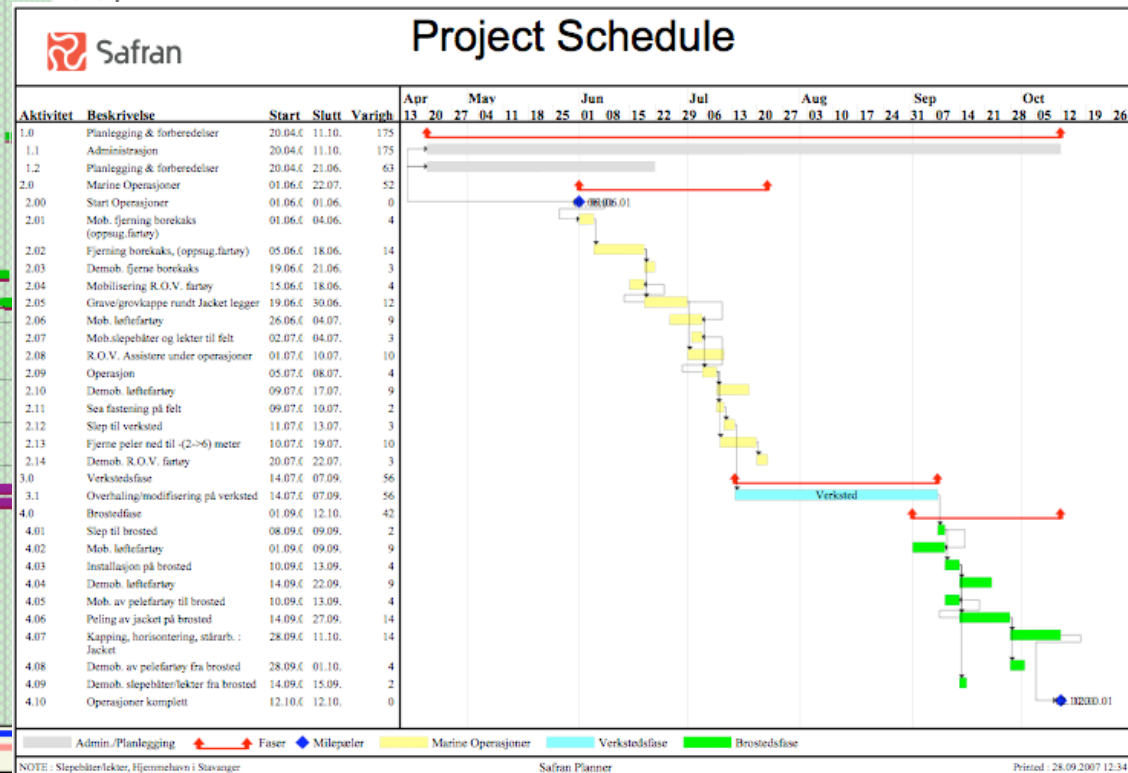
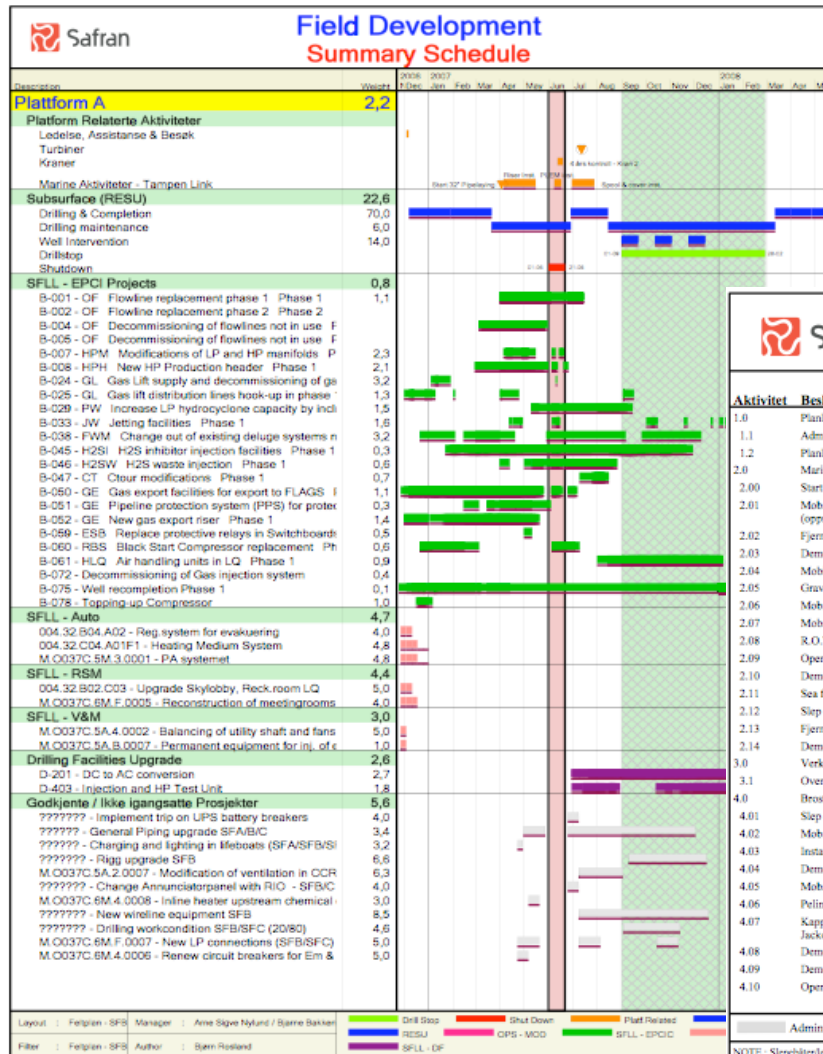


KIKK, a case in KP-Lab

- 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



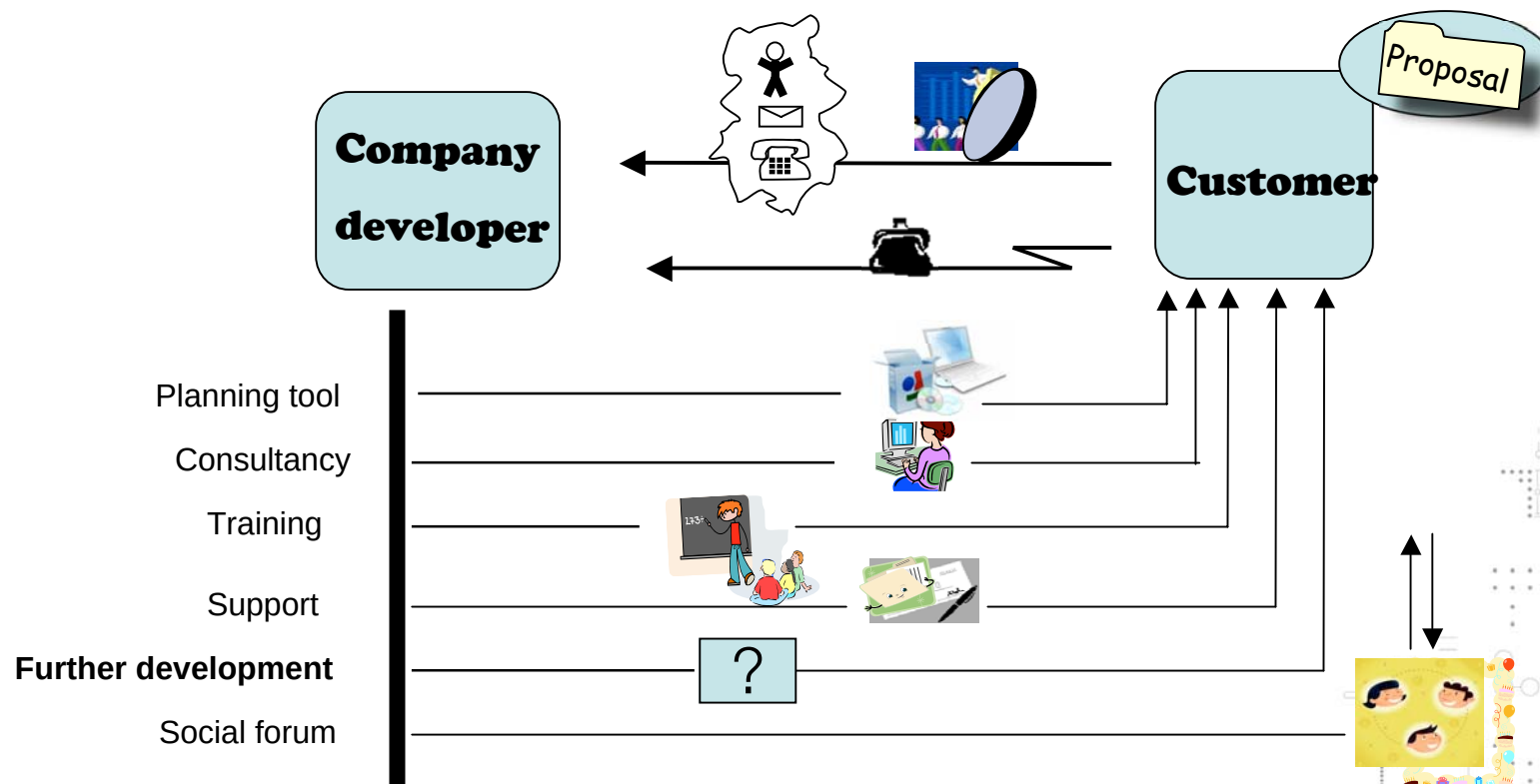
Planner screens



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
 - *Workshops* with stakeholders
 - Interactive web prototype using agile (software engineering) method

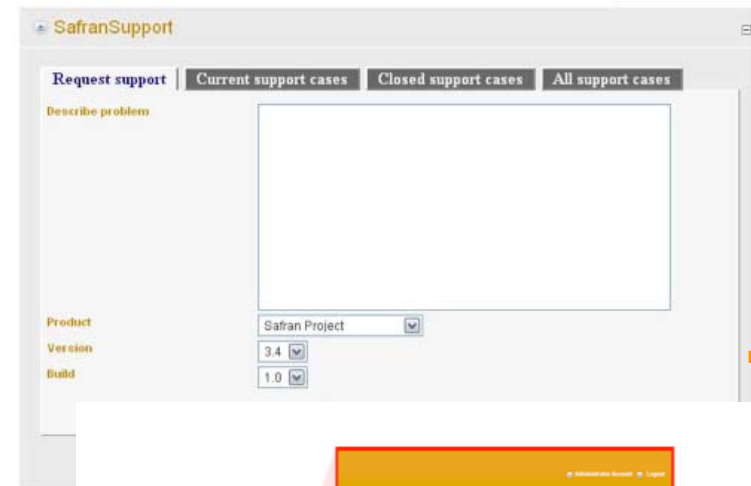
Multiple support tools for multiple forms of customer interaction



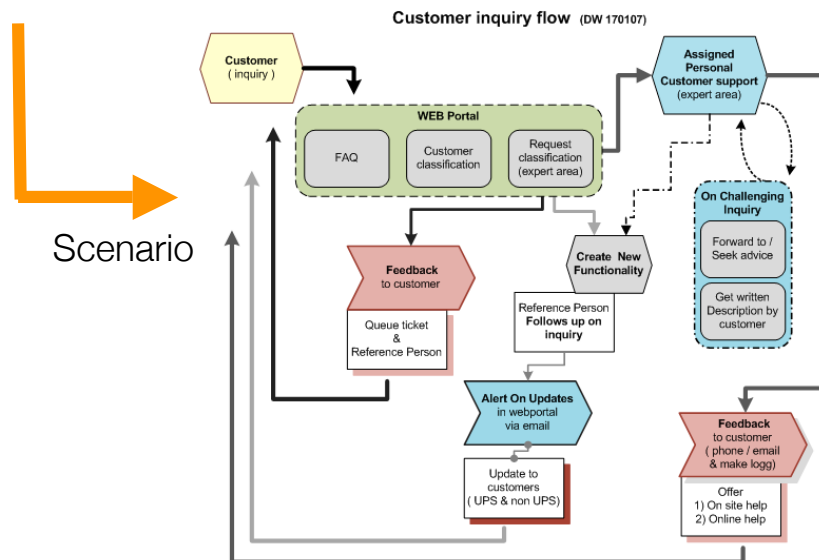
Intervention by participatory design



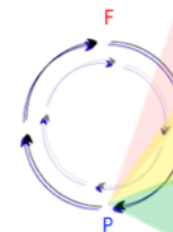
Design workshop



1st prototype



Scenario



Iterations





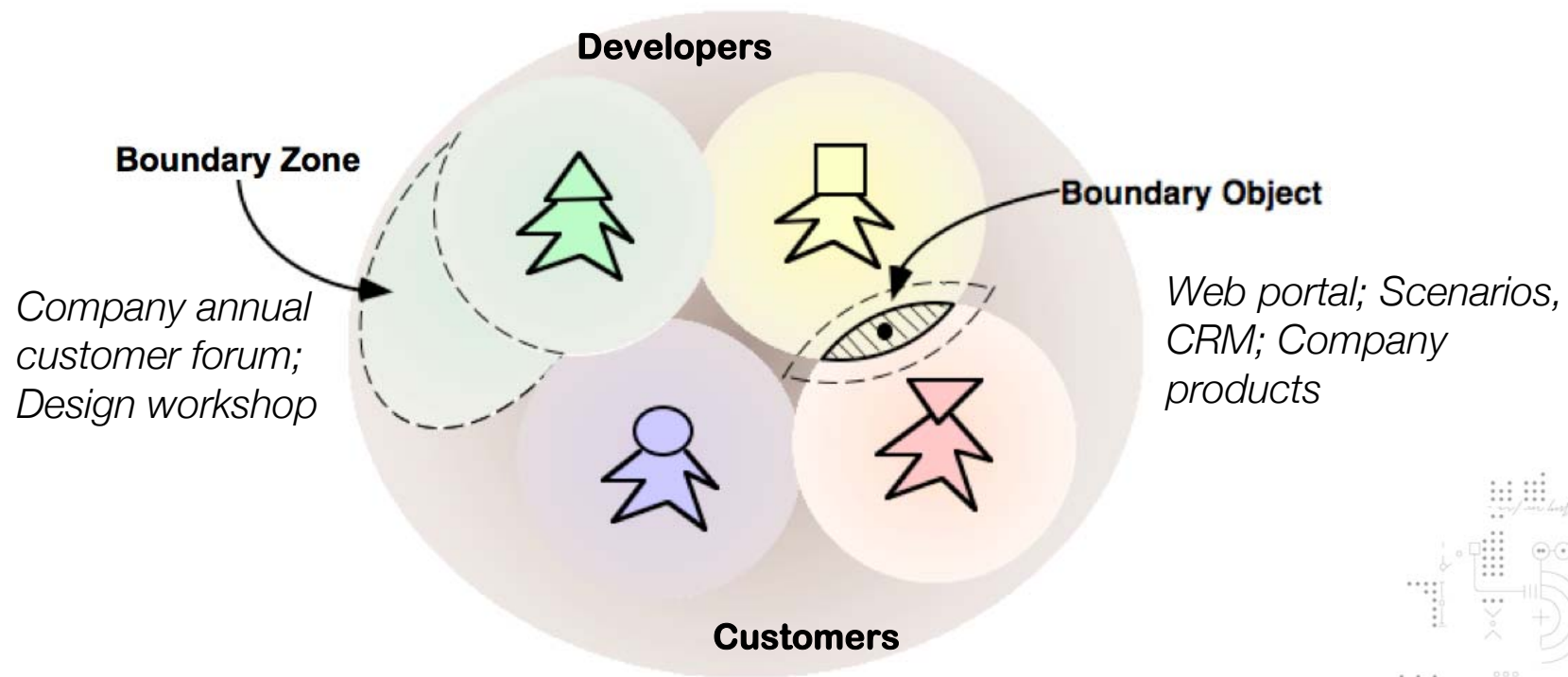
Basic issue and discrepancy

- *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 increased 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 $\longleftrightarrow$ Coin-operated phone



Overhead projector



Computer beamer

Predecessor artifact as stable intermediate form



Fiat 500 (2009-) <—> Fiat 500 (1957-1975)

Stable intermediate form

- Herbert Simon used the term stable intermediate form or subassembly as intermediate stages (building blocks) of artifacts/systems
- “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 are parts organized in part/whole (aggregation) hierarchies to cope with complexity

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*



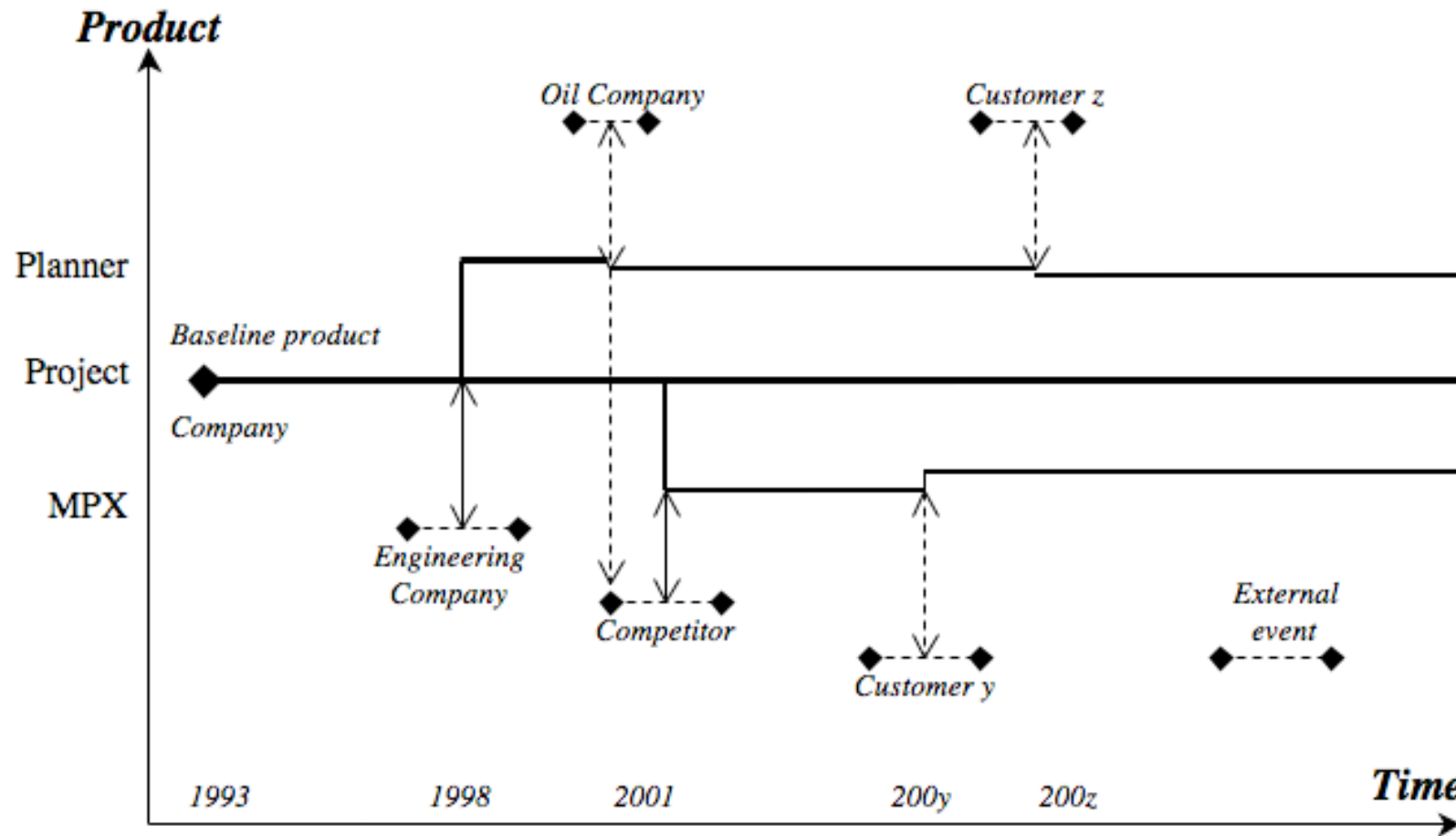
Appropriation of emergence and stable intermediate form

- Emergence provides an explanation for the “material/symbolic” duality of predecessor artifacts
- Predecessor artifacts are more than mere parts; they refer to something outside themselves
 - Earlier versions of the same type of artifact
- They symbolize historical development
- The symbolic aspect emerges in an effort to “reorganize” the artifact to integrate it with users

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. Interviewer1: Are there any customers that have participated in the development of your products?
10. Respondent2: [...] 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. Interviewer1: 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

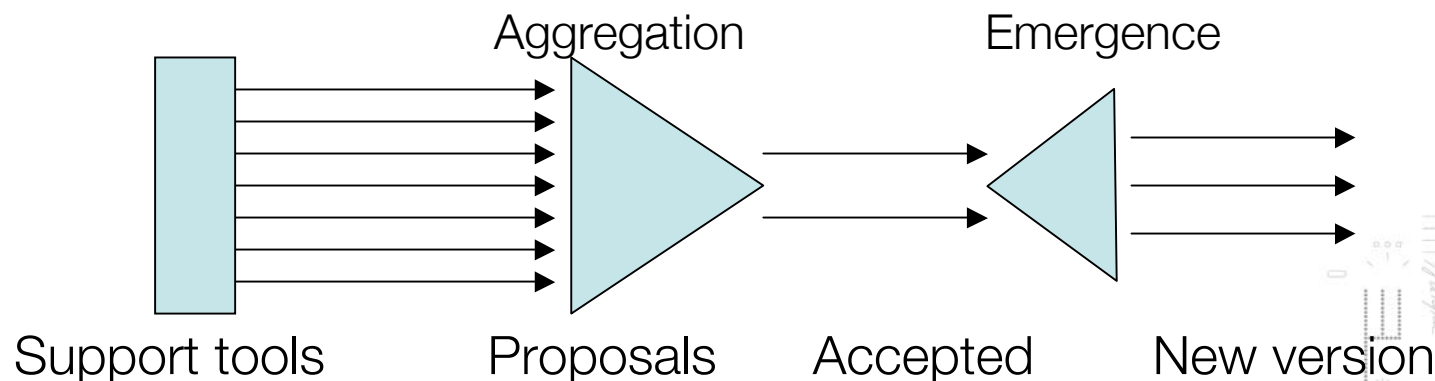
- *Improvement requests* (from one customer) or *tailoring* done on a local instance of a product
- When communicated back to the company it can lead to an *adaptation* for this customer
- Some adaptations that were rated good (or possible and paid for) have been incorporated in a later release of the 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 will often be included in new versions of the product
- *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 emerging as a result of migration of workers/users from downsizing in one industry and scaling up in another
 - Oil and gas --> building construction
- New markets with new customers
- Same functionality used in other application domain for complex project planning



Summary and conclusions

- Problems and solutions suggested by customers serve as important source for new product features in company
- New products are developed in interaction with customers, and build on previous 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 can happen without adaptation, by creating a new object for the company. An example is the expansion of the business from one application domain (oil and gas) to another one (building construction)