Product Line Case Studies

KV Product Line Engineering (343.354)

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Motivation

[van der Linden et al. 2007]

- „The **ultimate test** for any software engineering approach is **only possible in the real world**“
- „Only practical experience can show whether and how SPLE works“

- SPLE is rather difficult to analyse
  - It is not a single technique which can easily be analysed in experimental settings -- instead rather **longitudinal studies are required**
  - **Several influences** have to be taken into account
  - → SPLE has to be analysed **in realistic organisational contexts**

- SPLE is still a comparably new approach
  - Even in organisations that already strive to perform SPLE, the **full potential of the approach is not yet achieved**

- Only feedback from actual experience can „close the learning loop“

Many companies are developing Product Lines

akvasmart

Feed control and farm management software

ABB Asea Brown Boveri

Gas turbines, train control, semantic graphics framework

AXIS COMMUNICATIONS

Computer printer servers, storage servers, network camera and scanner servers

BOEING

Bold Stroke Avionics

Dialect

Internet payment gateway infrastructure products

DNV

Customized solutions for transportation industries

E-COM Technology Ltd.

Medical imaging workstations

ERICSSON

AXE family of telecommunications switches

GM

Software for engines, transmissions and controllers

hp invent

Firmware for computer peripherals

LG

Elevator control systems

LSI LOGIC

RAID controller firmware for disk storage units

Lucent Technologies
Bell Labs Innovations

5ESS telecommunications switch

NOKIA

Mobile phones, mobile browsers, telecom products for public, private and cellular networks

NASA

Interferometer product line

Many companies are developing Product Lines

PHILIPS

High-end televisions, PKI telecommunications switching system, diagnostic imaging equipment

Rockwell Collins

Commercial flight control system avionics, Common Army Avionics System (CAAS), U.S. Army helicopters

symbian

EPOC operating system

NAVSEA WARFARE CENTERS

Test range facilities

RICOH

Office appliances

SALION TARGET. WIN. DELIVER.

Revenue acquisition management systems

TELVENT

Industrial supervisory control and business process management systems

U.S.ARMY

Command and control simulator for Army fire support

BOSCH

Automotive gasoline systems

SIEMENS

Software for viewing and quantifying radiological images

testo

Climate and flue gas measurement devices

alltel FIDELITY NATIONAL FINANCIAL

Support software

MOTOROLA

Pagers product line

Exercise 3: Evaluation of selected Case Studies

- Case Study 1: Bosch Gasoline Systems
- Case Study 2: market maker Software AG
- Case Study 3: Philips Consumer Electronics
- Case Study 4: Philips Medical Systems
- Case Study 5: Siemens Medical Solutions

  From:

  F. van der Linden, K. Schmid, E. Rommes, *Software Product Lines in Action - The Best Industrial Practice in Product Line Engineering: Springer, 2007.*

- Students (in teams of 2-3) shall summarize the important aspects of one case study on a few (ca. 5-10) slides and present these during the next lecture
  - The time frame for each presentation is 10min
  - You can start now, I will be around
  - Anyway: prepare the presentation until/for next week

Structure of the Case Studies

- The case studies are structured according to the BAPO aspects
  - Motivation – what motivated the transition to SPLE
  - Approach – before and after transition
  - **B**usiness – business involvement in SPLE and var management (costs, profits, market value, var planning)
  - **A**rchitecture – relationship between domain and application architectures and how they are related via variability (variation mechanisms, reference architecture vs. application architectures)
  - **P**rocess – which SPL processes are used and what their maturity is (evaluated e.g. using CMMi)
  - **O**rganization – effectiveness of the distribution of domain and application engineering over the organization
  - Results – major impacts/obstacles/limits
  - Lessons Learned – what went good, what bad?

Exercise 3: In the Presentation, answer the following Questions

- **Context**: What kind of organization adopted/applied SPLE?
- **Motivation**: What motivated the transition to a product line approach in the first place?
- **System**: For what (kind of) system did they apply SPLE?
- **Goal**: What was the goal?
- **Approach**: How did they adopt SPLE? What processes were affected, and how?
- **Results**: What are the important results with regard to business, architecture, process, and organization?
- **Issues**: What problems did they have?
- **Conclusions**: What did they learn?

Used/Useful References

- [van der Linden et al. 2007]

  F. van der Linden, K. Schmid, and E. Rommes, *Software Product Lines in Action - The Best Industrial Practice in Product Line Engineering*: Springer Berlin Heidelberg, 2007.
- [Pohl et al. 2005]

  K. Pohl, G. Böckle, and F. J. van der Linden, *Software Product Line Engineering: Foundations, Principles, and Techniques*: Springer, 2005.
- [Clements and Northrop 2002]

  P. Clements and L. Northrop, "Salion, Inc.: A Software Product Line Case Study," TECHNICAL REPORT CMU/SEI-2002-TR-038 ESC-TR-2002-038 2002.
- [Deelstra et al. 2005]

  S. Deelstra, M. Sinnema, and J. Bosch, "Product derivation in software product families: a case study," *Journal of Systems and Software*, vol. 74(2), pp. 173-194, 2005.
- [Sinnema and Deelstra 2007]

  M. Sinnema and S. Deelstra, "Industrial Validation of COVAMOF," *Journal of Systems and Software*, 2007 (in press).
- [Clements and Northrop, 2001]

  P. Clements and L. Northrop. *Software Product Lines: Practices and Patterns*. SEI Series in Software Engineering, Addison-Wesley, 2001.

Summaries of Diverse Product Line Case Studies

ABB (Asea Brown Boveri)

[Pohl et al. 2005]

- Power and automation technology for utility and industry customers
- 112.000 employees (2007), $ 29 Billion revenue (2007), www.abb.com
- Product Lines?
  - ABB Gas Turbine Family -- 35 to 270 MW with five basic turbine types varying in size, combustion technologies, and equipment
  - Semantic Graphics Framework supports the development of graphical applications that realise special requirements in the engineering domain
  - Train control product line is an embedded real-time software system for controlling train movement

AKVAsmart

[van der Linden et al. 2007]

- Feed control and farm management software for the fish-farming industry
- 100 employees (2006), € 15 Million revenue (2006), www.akvagroup.com
- Product Lines?
  - Marketed Product Line called Fishtalk
    - ~300 KLOC, Microsoft.NET/C#
    - Framework for role-based access control, dynamic plug-in loading, scheduling, multi-language, workflow, configuration, licensing
    - Reporting, Planning, Budgeting, Fish Health, Quality, etc.

Boeing Company

[Pohl et al. 2005]

- one of the leading manufacturers of commercial jetliners, military aircraft, satellites, missile defence, human space flight, and launch systems
- 159.000 employees (2007), $ 61,5 Billion revenue (2006), www.boeing.com
- Product Lines?
  - Bold stroke software product line initiated 1995 at McDonnell-Douglas to avail reuse potentials in the operational flight program (OFP) software across multiple fighter aircraft platforms
    - distributed, realtime embedded applications supporting the avionics as well as the cockpit functions for the pilot

Bosch Gasoline systems

[van der Linden et al. 2007]

- One of the largest automotive suppliers
- Bosch: 271.000 employees (2007), € 46,32 Billion revenue (2007), www.bosch.com
  - Bosch Gasoline systems: ~1000 developers
- Product Lines?
  - Defined for market segments Asia East-EU, West-EU, NAFTA, West-EU high
    - Based on the needs of these market segments
      - Asia East-EU: price
      - West-EU: consumption, emission, price
      - NAFTA&West-EU high: consumption, emission, price, driving pleasure
  - Large-scale roll-out in organization incl. CMMi

CelsiusTech Systems AB

[Pohl et al. 2005]

- Originally a department of Philips, now affiliated with Saab Group, Sweden: SaabTech AB.
- leading supplier of avionics and electronic warfare systems
- Saab Group: 12.830 employees (2005), € 2 Billion revenue (2005), www.saabgroup.com
- Product lines?
  - one of the first software product lines, which is still running today, under the name ShipSystem 2000
    - Motivation: In the mid 1980s, CelsiusTech simultaneously obtained two contracts to build naval control systems. The systems had to be hard real time, fault tolerant, and highly distributed. They had to interface with radars and other sensors, missile and torpedo launchers

Cummins Inc.

[Pohl et al. 2005]

- a global leader in engines and related technologies, including fuel systems, controls, air handling, filtration, emission solutions, and electrical power generation systems
- 33.700 employees (2007), $ 13 Billion revenue (2007), www.cummins.com
- Product Lines?
  - Engine control software product line
    - Cummins Inc. is able to build over 1000 different products based on this software product line

Dacolian B.V.

[Sinnema and Deelstra 2007]

- one of the leading developers of advanced, real-time video analysis, classification and recognition software
- world‘s leading supplier of OEM software modules for intelligent trafficsystems that utilize automatic license plate recognition
- www.dacolian.nl
- Product Lines?
  - Product line called Intrada
    - Intellectual property software modules for Intelligent Traffic Systems (ITS)

DNV

[van der Linden et al. 2007]

- provides services for managing risk, certification, classification (Maritime sector), consulting and training for several industry sectors (IT, finance, climate change, food, automotive, energy, aerospace, healthcare)
- 7691 employees (2007), € 1 Billion revenue (2007), www.dnv.com
- Product Lines?
  - Nauticus product line to support DNV Maritime business area
  - RMS product line for developing products for risk and consequence analysis
  - SESAM product line for strengh assessments of large structures in the marine and off-shore industries
  - BRIX software platform
    - Microsoft COM → Microsoft .NET

Hewlett-Packard

[Pohl et al. 2005]

- one of the world's leading IT companies with many different business areas, reaching from consumer handheld devices to powerful supercomputer installations
- 209.000 employees (2008) $104,3 Billion revenue (2007), www.hp.com
- Product Lines?
  - Owen Firmware Cooperative to install a product line approach for a wide range of different firmware of different products for printing, copying, scanning, and faxing

LG Industrial Systems Co., Ltd.

[Pohl et al. 2005]

- Korean manufacturer of electric power equipment including industrial electric equipment, distribution, automation, and control systems
- 160.000 employees (2006), $94,8 Billion revenue (2007), www.lg.net
- Product Lines
  - Software product line for Elevator Control Systems
    - embedded control software
    - high diversity of customer needs

Lucent Technologies

[Pohl et al. 2005]

- telephony or data communication systems, services, and software
- composed of what was formerly AT&T Technologies, which included Western Electric and Bell Labs; In 2006 Lucent merged with Alcatel SA France
- 30.500 employees (2006) $ 9,55 Billion revenue, www.lucent.com
- Product Lines?
  - Domain Engineered Configuration Control (DECC) project to standardise the configuration control software and to establish a software product line
    - monitors the run-time configuration of hardware components and maintains their status
    - configuration process and tool for generating new software based on core assets

Market Maker

[van der Linden et al. 2007]

- stock market software for private and professional users
- 60 employees (2004), € 5 Million revenue, www.market-maker.de
- Product Lines?
  - i* software product line for managing and displaying stock market data and financial market news
    - Motivation was to enter new Market of Internet Services
    - Needs: showing different information in different representation formats based on different customer needs

Nokia

[van der Linden et al. 2007]

- focused on wireless and wired telecommunications
- world's largest manufacturer of mobile telephones
- 116.000 employees (2008), € 51 Billion revenue, www.nokia.com
- Product Lines?
  - Goal: SPL approach to support the evolution of architecture
  - UML model operation tool to help induce new commonality from individual architecture models to derive a product line architecture model
  - Used to identify the commonality of several selected products of a mobile phone software product line

Philips Consumer Electronics

[van der Linden et al. 2007]

- one of the largest electronics companies in the world
- consumer electronics systems like TV-sets, radio receivers, CD and DVD players and recorders, as well as set-top boxes
- 125.000 employees (2007), €26,98 Billion revenue (2006), www.philips.com
- Product Lines?
  - software product lines for audio-video equipment like TV sets
    - customers have high demands with respect to performance
    - mass-market nature: cheapest memory and processor chips
    - products have to be very reliable as they are offered in the mass market

Philips Medical Systems

[van der Linden et al. 2007]

- portfolio of medical systems including products like X-ray, ultrasonic or computed tomography and services like training, business consultancy, or financial services
- Product Lines?
  - software product line for medical imaging systems
    - motivated by an increasing complexity and diversity in this domain
    - High demands on safety and reliability as the products may have a crucial impact on the health of the patients

Salion Inc.

[Clements and Northrop 2002]

- Software company specialising in software solutions for Supplier Customer Relationship Management
- Less than 50 employees, $ 1,75 Million revenue, www.salion.com
- Product Lines?
  - RAM platform comprising Salion Revenue Process Manager, Salion Knowledge Manager, and Salion Business Link
  - No full-scale/proactive product line approach was followed
    - reactive approach to SPL
      - a configuration management tool and techniques were developed to allow multiple product variations based on first product

Siemens Medical Solutions

[van der Linden et al. 2007]

- Hospital applications from X-ray tubes and magnetic resonance and CT scanners to complete infrastructure support in hardware and software for hospitals/medical practitioners
- Product Lines?
  - SIENET COSMOS product line for picture archiving and communication systems
  - Two other product lines: SIENET SKY and SIENET Magic

Telvent

[van der Linden et al. 2007]

- IT and industrial automation company specializing in IT systems for pipeline, energy utility, traffic and environmental monitoring industries
- 2600 employees (2006), www.telvent.com
- Product Lines?
  - Real-time television software platform

Testo AG

[Pohl et al. 2005]

- one of the leading suppliers of portable electronic measuring instruments, e.g. for the measurement of temperature, pressure or humidity
- www.testo.de
- Product Lines?
  - Product line for portable measuring instruments

Thales Nederland B.V.

[Deelstra et al. 2005]

- information systems and services for the Aerospace, Defense, and Security markets
- 68.000 employees (2007), € 10 Billion revenue (2004), www.thalesgroup.com
- Product Lines?
  - Combat Management Systems product line

The National Reconnaissance Office

[Pohl et al. 2005]

- Designs, builds, and operates reconnaissance satellites for US governmental institutions such as the Central Intelligence Agency (CIA) or the Department of Defense (DoD)
- www.nro.gov
- Product Lines?
  - Control Channel Toolkit (CCT) product line for groundbased spacecraft command and control software

The Naval Undersea Warfare Center

[Pohl et al. 2005]

- The US Navy's research, development, test and evaluation, engineering, and fleet support centre for undersea warfare technology
- http://www.nuwc.navy.mil/
- Product Lines?
  - Software product line called RangeWare to manage the commonalities and complexity of range facilities
    - A Range is composed of a set of resources and the physical assets required to conduct a specific test or training exercise