



From Projects to Product Lines: A Product Line Economics Case Study

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Kai Vuolajärvi, Rauli Käppi, Prof. Jukka Heikkilä

kai.vuolajarvi@cc.jyu.fi, rauli.kappi@cc.jyu.fi, jups@cc.jyu.fi

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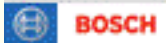
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Question and Objectives

- How to evaluate and quantify financial benefits (ROI) of transferring to product family engineering in a practical setting?
- Objective of this presentation and our work was to examine how to calculate and quantify the direct financial benefits of the product family engineering
- Previously developed calculation method used and applied in real company case study
 - Focus on how to calculate & evaluating the model
 - Non financial benefits excluded from the model

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Previous Research

- **Product line engineering is claimed to bring order of magnitude benefits over the one-at-a-time project based product development (Clements & Northrop, 2002; Toft & al., 2000).**
- **Despite the claimed benefits, not all companies apply product line engineering approach.**
- **As shown in previous studies, moving from the current practices to the software product line engineering is risky (Schmid & Verlage, 2002), burdensome and costly (Reifer, 1997).**
- **Deciding on the shift can also be an awkward and highly contingent decision situation (Schmid & Verlage, 2002).**
- **Several articles and books have acknowledged these problems, but the articles focusing in on how to estimate the costs and benefits to justify the change are rare**

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Introduction to Cost Model

- Return on investment should be used as the basic decision factor when deciding upon product line engineering
- Therefore the model with correct formula, for calculating ROI is essential for product line engineering decision
- A return on investment calculation model for software product lines has been established in Cafe/Families project and published in 2004 [Böckle, Clements, McGregor, Muthig, Schmid, 2004]
- The model can be used to compare ROI of Traditional vs. product line approach in product development
 - ROI = $(\text{Cost of Old Way} - \text{Cost of New Way}) / \text{Investments}$

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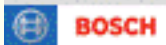
Introduction to Cost Model used

- The formula for calculating the costs of creating a product family is presented below: *(from article)*

$$C_{org} + C_{cab} + \sum_{i=1}^{n1} (C_{unique}(P_i) + C_{reuse}(P_i))$$

- Assumes that you have existing products that you transfer to PFE
- Four variables:
 - Corg : Organizational change costs
 - Ccab : Building a core asset base (platform)
 - Cunique : Building unique parts of the product
 - Creuse : cost of reusing asset base

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Case Description

- High-technology manufacturing company
- Software major part of the products
- Focus on one unit, currently manufacturing 15 stand-alone products
- Company operates in turbulent, fast changing environment and products are changing rapidly
- Currently software engineering inside the unit is distributed to different sites and additionally several vendors provide parts of the SW

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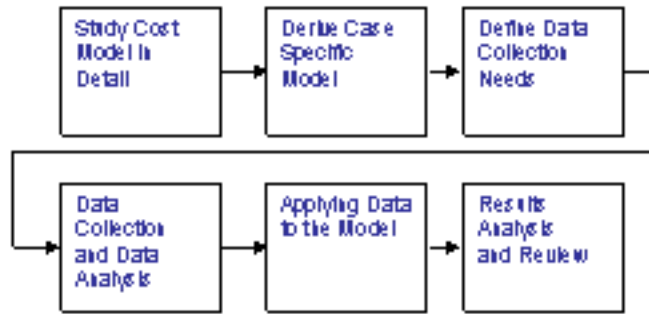
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Approach



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Collecting the Data

Table below presents the data collected for the case study

Cost of building one individual product without PL engineering?	Cprod	1
Number of existing products	Nprod	15
How big is the common part in to be product line? (Rapidly changing, different technologies, distinctive features)	Pcab	40 %
What is the cost of scoping exercise? (Architecture, multisite, programming languages)	Cscoping	1
How much one product changes in version update? (Quality – testing, new technology standards, dynamic)	Pvchge	30 %
How much core asset base changes in version update?	Fcab	10 %
How much effort is needed to train and change organization to adopt PLE? (independent multisite, cultural issues, different standards, processes, to become effective with new code)	Corg	20
How many times more expensive it is to develop software reusable (core asset base)?	Preusecostx	250 %

Note: Cost of Scoping and Cost of Org do not directly represent cost/effort, but is a hybrid of cost/effort, due to comparability issues
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Calculating the variables

Data collected was used to calculate the cost model components

Effort needed to train and change organization to adopt PLE C_{org}	C _{org}	20
Core asset base cost (C_{reusecost} * P_{cab} * C_{prod} + C_{scoping})	C _{cab}	2
Cost of building each products unique part? (1-P_{cab})*P_{vdg}*C_{prod}	C _{unique}	0,18
Cost of updating the core asset base in version update (P_{cab} * P_{cab} * C_{prod})	C _{reuse}	0,04

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$$C_{org} + C_{cab} + \sum_{i=1}^{n1} (C_{unique}(p_i) + C_{reuse}(p_i))$$

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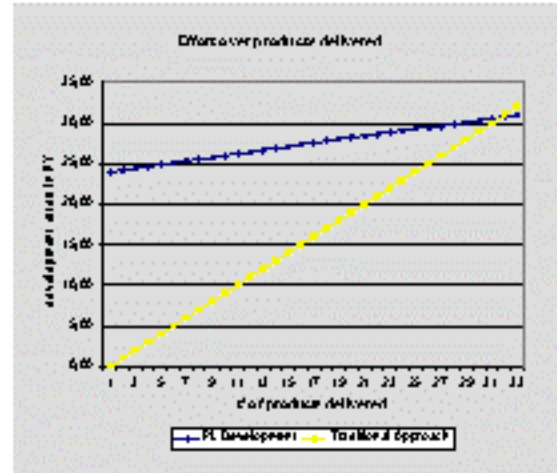
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The Results

- In this case model indicates that in transforming to product line engineering break even would be 29 products
- In this case 15 products, not beneficial
- ROI calculated in this case is -47 %



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Comments on the Results

- **The results suggested by the model are not very encouraging considering PLE**
- **Main reason for this is estimated high training and organizational change costs, reasons for high costs are:**
 - **Multisite development environment**
 - Requires large effort to gain agreement
 - Every site has own wishes, organizational boundaries, traveling costs
 - **Multiple tasks included**
 - Initial resource gathering
 - Architecture planning
 - Resource allocation for component project
 - Training about components for whole personnel
 - Common tools implementation (eg. version management)
 - Individual training + learning time to learn to use certain components
 - **Calculated as a time to become effective with new code & processes & standards**

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Conclusion & Outlook

- **The cost model used is very beneficial in calculating quickly rough estimate of the benefits of the software product line engineering (took 1 month, about 15 man days)**
- **Level of detail is sufficient for rough estimate, but in order to prepare detailed financial calculations to base decision on PLE more detailed model is needed**
- **Anyhow we found the cost model useful for every organization considering PLE approach. Model can be applied very quickly to yield first estimates on the financial effects of the PLE**
- **Model is still 1st revision, limitations exists:**
 - Model does not consider non-financial benefits of product line engineering, e.g. faster time to market, higher product quality
 - Assumes big bang approach
 - Lacks time effect on investment
 - Sensitivity analysis not built in

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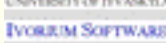
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Cost Model Case Study

- Jukka Heikkilä (Jups@cc.jyu.fi, primary contact)
- Kai Vuolajärvi (Kai.vuolajarvi@nokia.com)

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