Engineering

Stiftung Universität Hildesheim 2003

Lessons from Product Line Engineering in Germany

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Product Line Engineering Lessons

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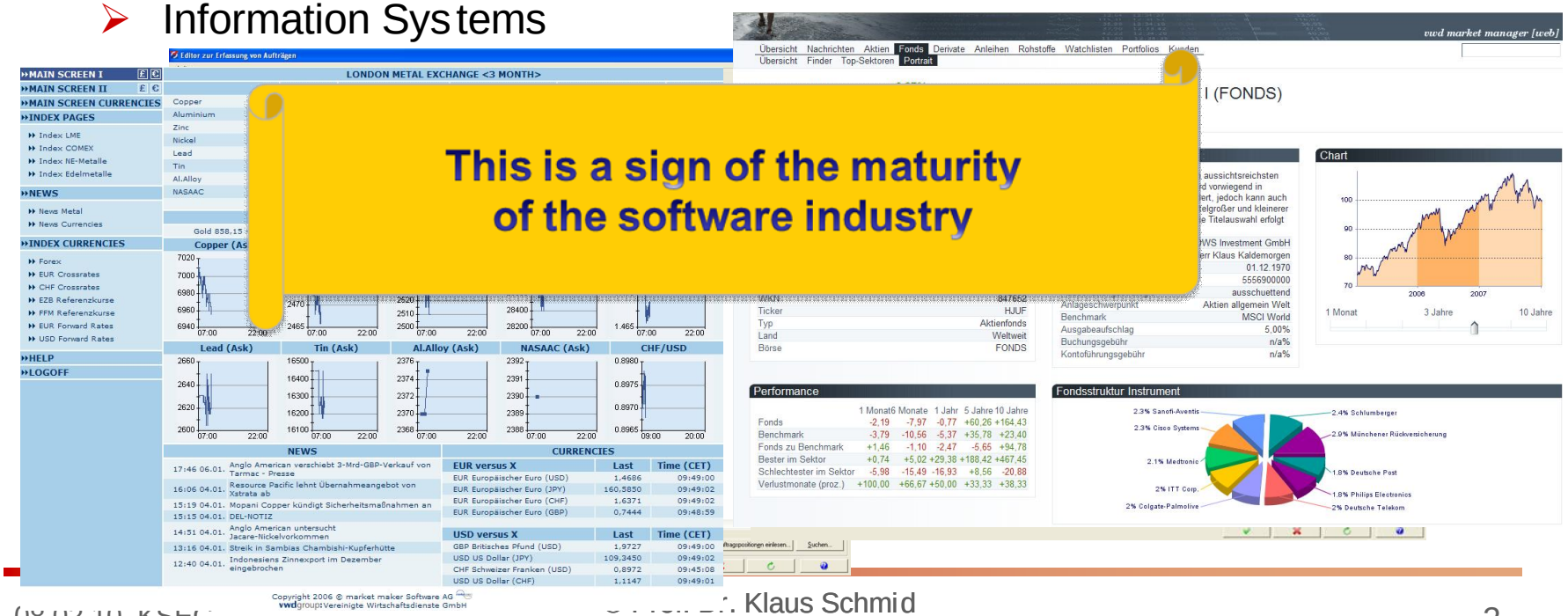
Product Line Engineering Lessons

Observation

- Companies increasingly focus on specific types of systems
- Build them in a broad variety
  - Embedded Systems
  - Information Systems



Vision of Product Line Engineering

Key Goal:

exploit commonality in externally (visible) properties of the software (system) in terms of commonality of the implementation

Product Line Engineering vs. Traditional Softw are Engineering

All further issues are a consequence of this focus shift

- How to relate system properties and system implementation?
- How to deal with differences among systems?
- What products to plan foré ?
- ..

Product Line Examples

- PLE is a major shift from traditional Software Engineering
  - Traditional: project at the center
  - New: widen the focus to a set of products

- Domain-Independent approach
  - So far: mostly in embedded systems

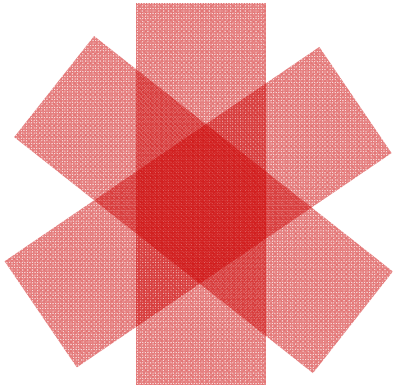
Lesson 1: Need and potential is easier to communicate there



  - But also a continuous stream of information system projects

Core Idea of Product Line Engineering

- Product 1
- Product 2
- Product 3

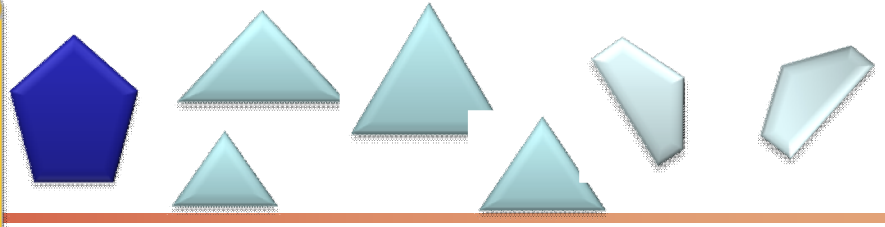


- **Core idea:** Similarity of Products =

Commonality + (reg.) Variability + Product-specific parts

develop once | make selectable | single development

Develop building blocks



Product Line Engineering as a form of production

- craftsman – all from a single hand
- manufacture – division of work, formal work processes
- early production line
  - decomposition in partial products
- modern production line (lean production)
  - systematic variation
  - production and delivery synchronized with whole production
- production robot
  - production and assembly by robots

Where many companies are!!

Product Line Engineering is about applying modern production approaches to software engineering

The Challenge

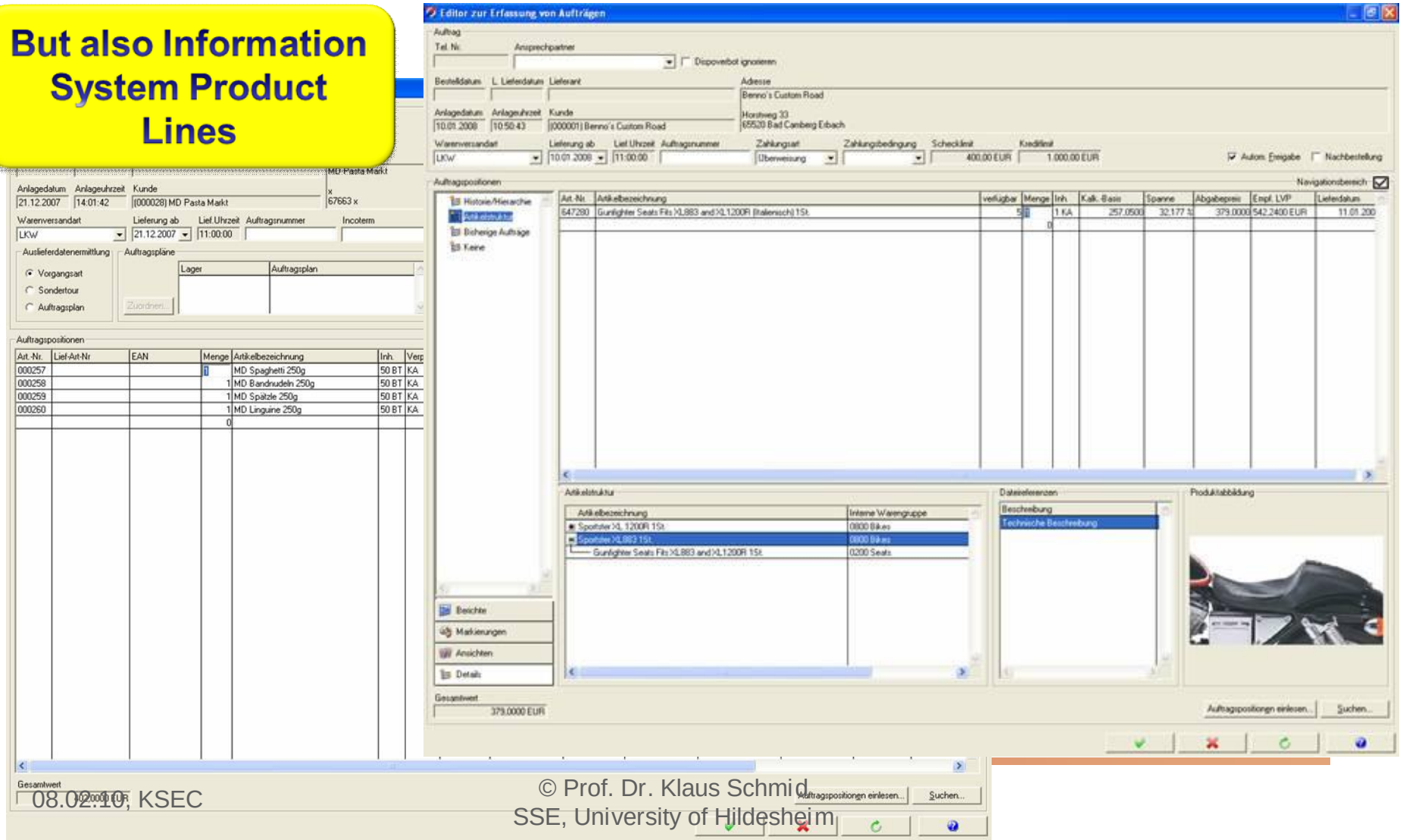
- Embedded systems

- Information systems

Product Line Engineering Lessons

What is Product Line Engineering

But also Information System Product Lines



Product Line Engineering Lessons

What is Product Line Engineering

Also Webbased Products

Übersicht Finder Top-Sektoren Portrait

99,62 EUR +0,27% 04.01.2008

Übersicht Kennzahlen Kursverlauf

Preis

Rückn.	99,62 EUR	Datum	
Vortag	99,35 EUR	Ausgabe	
Diff	+0,27 EUR	Hoch	
	+0,27 %	Tief	

Stammdaten

Name	DWS Vermögens
ISIN	
WKN	
Ticker	
Typ	
Land	
Börse	

Performance

	1 Monat	6 Monate	1 Jahr
Fonds	-2,19	-7,97	-0,77
Benchmark	-3,79	-10,56	-5,37
Fonds zu Benchmark	+1,46	-1,10	-2,47
Bester im Sektor	+0,74	+5,02	+29,38 +
Schlechtester im Sektor	-5,98	-15,49	-16,93
Verlustmonate (proz.)	+100,00	+66,67	+50,00

SCREEN I
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- CHF Crossrates
- EZB Referenzkurse
- FFM Referenzkurse
- EUR Forward Rates
- USD Forward Rates

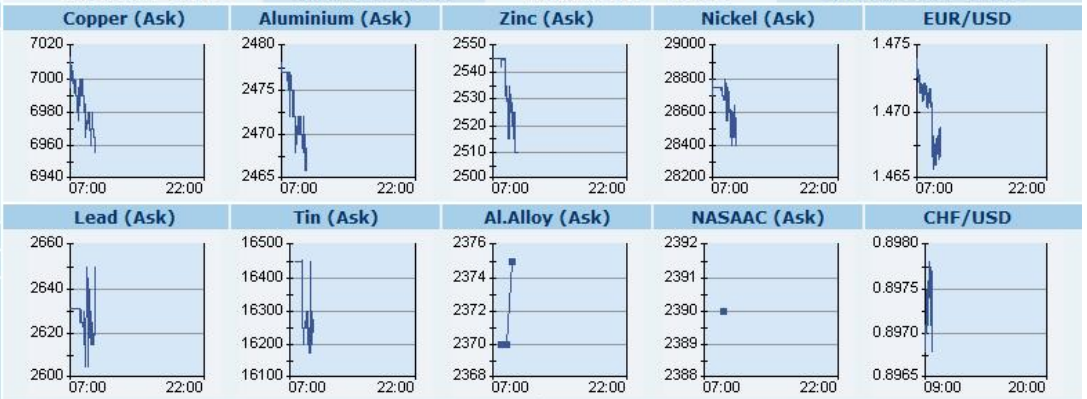
HELP
LOGOFF

LONDON METAL EXCHANGE <3 MONTH>

	Time (CET)	3-MT		CSH3MT		OFFICIAL	
Copper	09:49:42	SEL 6.955,00	6.960,00	SEM -39,00	-35,00	0,00	0,00
Aluminium	09:49:29	SEL 2.465,00	2.468,50	SEM -51,00	-47,00	0,00	0,00
Zinc	09:49:08	SEL 2.505,00	2.510,00	SEM -3,000	1,000	0,00	0,00
Nickel	09:49:14	SEL 28.210,00	28.400,00	AM1 -290,00	-260,00	0,00	0,00
Lead	09:49:44	SEL 2.615,00	2.623,00	TRI -8,00	-3,00	0,00	0,00
Tin	09:49:27	SEL 16.175,00	16.250,00	SEM -135,00	-85,00	0,00	0,00
Al.Alloy	09:12:11	BAC 2.325,00	2.375,00	SEM -38,00	-28,00	0,00	0,00
NASAAC	09:12:15	BAC 2.330,00	2.390,00	SEM -52,00	-42,00	0,00	0,00

"-" = CONTANGO

Gold 858,15 - 858,85 | Silber 15,19 - 15,24 | Platin 1.526,00 - 1.530,00 | Paladium 364,00 - 368,00



NEWS

17:46 06.01.	Anglo American verschiebt 3-Mrd-GBP-Verkauf von Tarmac - Presse
16:06 04.01.	Resource Pacific lehnt Übernahmeangebot von Xstrata ab
15:19 04.01.	Mopani Copper kündigt Sicherheitsmaßnahmen an
15:15 04.01.	DEL-NOTIZ
14:51 04.01.	Anglo American untersucht Jacare-Nickelvorkommen
13:16 04.01.	Streik in Sambias Chambishi-Kupferhütte
12:40 04.01.	Indonesiens Zinnexport im Dezember eingebrochen

CURRENCIES

EUR versus X	Last	Time (CET)
EUR Europäischer Euro (USD)	1,4686	09:49:00
EUR Europäischer Euro (JPY)	160,5850	09:49:02
EUR Europäischer Euro (CHF)	1,6371	09:49:02
EUR Europäischer Euro (GBP)	0,7444	09:48:59

USD versus X	Last	Time (CET)
GBP Britisches Pfund (USD)	1,9727	09:49:00
USD US Dollar (JPY)	109,3450	09:49:02
CHF Schweizer Franken (USD)	0,8972	09:45:08
USD US Dollar (CHF)	1,1147	09:49:01

Copyright Stocks Market maker Software AG
vwdgroup:Vereinigte Wirtschaftsdienste GmbH

Viewpoints on Product Line Engine ering

External Viewpoint

- Organizations become very efficient at developing products
  - Lower Time-To-Market
  - Lower costs
  - Higher quality

Internal Viewpoint

- Strategic investments in product line infrastructure
- Develop a building block system

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Typical Goals of Introducing Product Line Engineering

- Reduction of development effort / costs
  - per product
  - total (for all products)
- Reduction of time-to-market
- Flexibility of development
- Quality improvement
- Unifying systems (usability, total cost of ownership)
- Reduction of certification costs
- Improve adaptability of systems
- Deal with labor shortage
- Improve internal knowledge management
- é

Case Studies

Large

Philips
Nokia
Telvent
Thales
Siemens
Bosch
Cummings
CelsiusTech
ABB
HP
Boeing
..

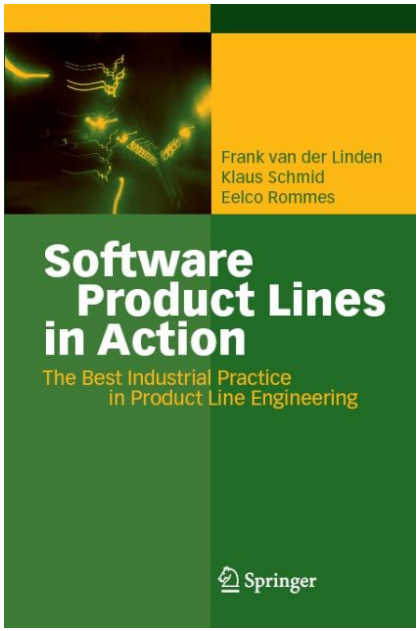
Small

- market Maker
- Testo
- maxess
- Salion
- é

http://www.sei.cmu.edu/productlines/plp_hof.html

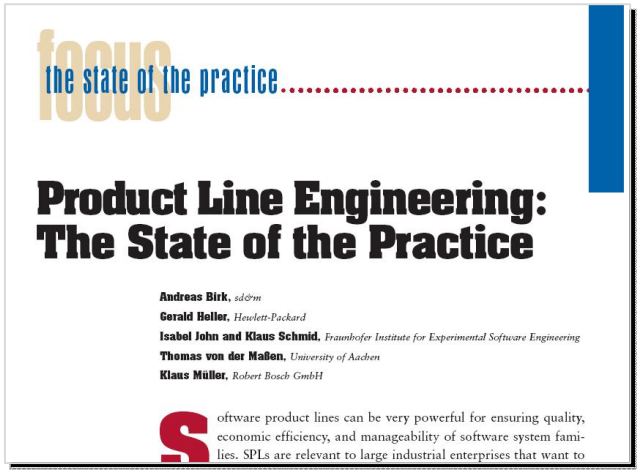
http://www.sei.cmu.edu/productlines/casestudies/catalog/index.cf m

Product Line Engineering Experiences



Linden, Schmid, Rommes
Product Lines in Action
Springer, 2007

http://www.spl-book.net



Birk, Heller, .., Schmid, ..
IEEE Software, Nov/Dec, 2003

But also other studies

Lessons from Product Line Engineering in Germany

Product Line Engineering Results

Development cost reduction:	2-4
Maintenance cost reduction:	~50-60%
Time-To-Market:	2-4
Products to break even:	2-6
Reduced defect density:	~50%

Increase of issue resolution time / development complexity

Note, these are prototypical numbers: significant variations may be due to specific approach, company situation, etc…

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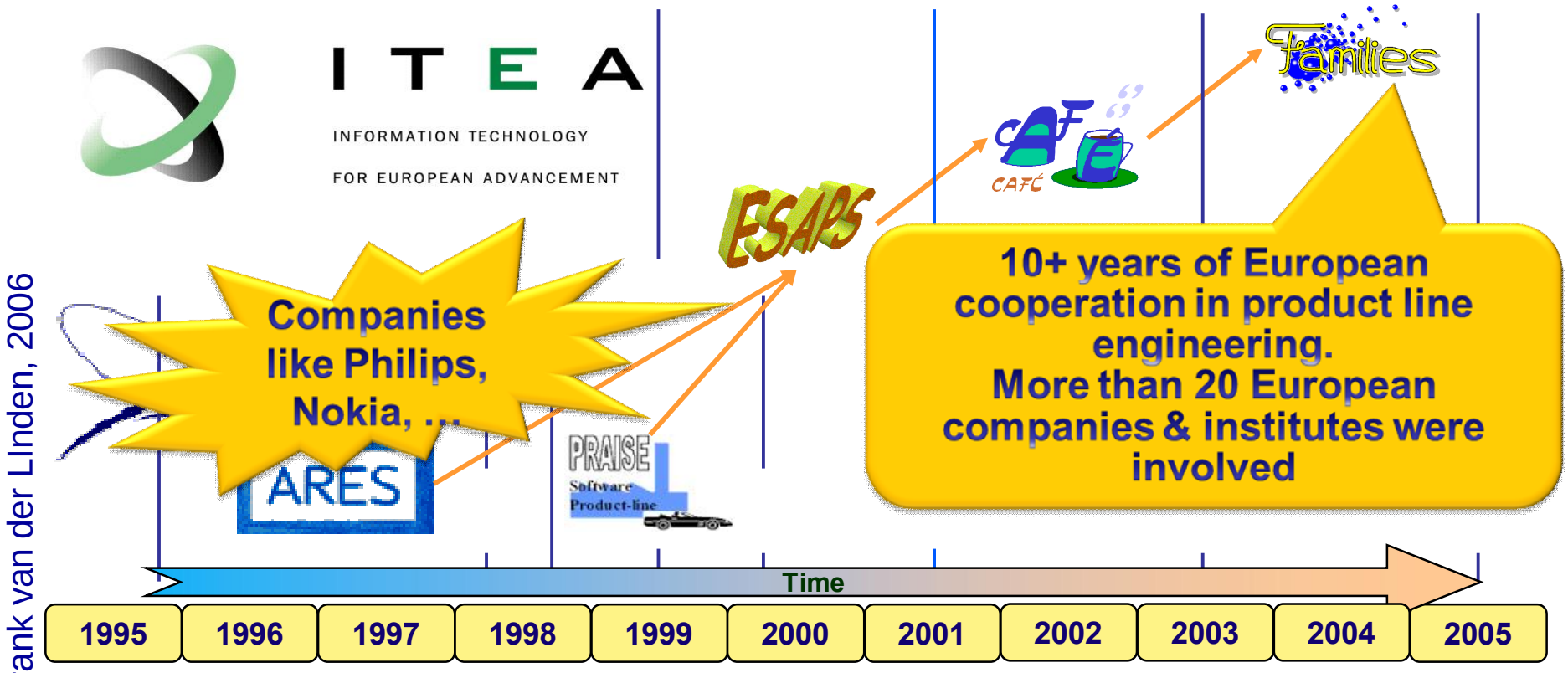
A Historical Perspective

Product Line Engineering in Europe



Lessons from uct Line Engineering in Germany

A German Perspective

First efforts in Germany

- Fraunhofer IESE: 1997 ï work on the PuLSE approach started
- Soon group / department was funded

Personal viewpoint

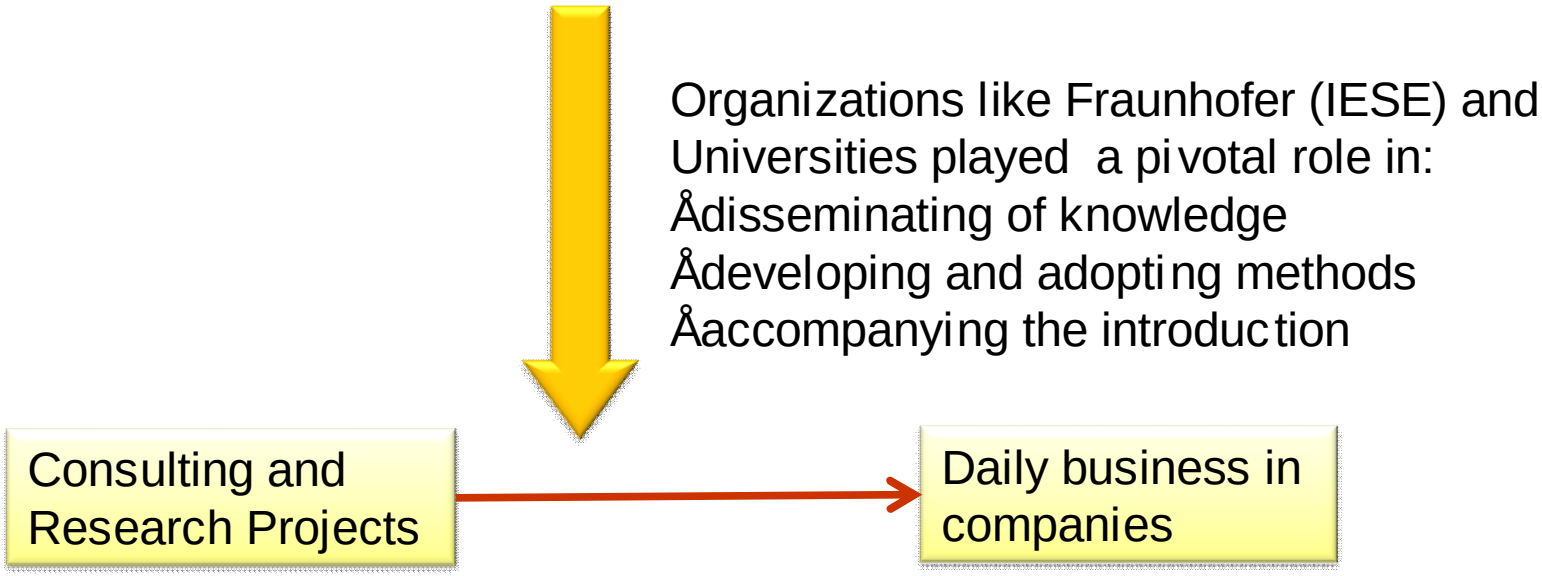
- Was part of the team that developed the first comprehensive product line engineering approach (PuLSE)
- Developed a comprehensive scoping approach (PuLSE-Eco)
- Work in variability management
- Industrial transfer work
- Increasing roles

Most of what we did was directly applied research!

Product Line Knowledge in Germany

Role out in Germany

- Initially product line engineering completely unknown
- Problem: Reuse had a bad name
- Only few companies started this early, (e.g., Siemens, Bosch)



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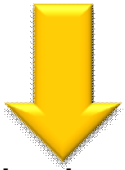
Product Line Knowledge in Germany

Visibility in technical and scientific community

- Initially only at specialized conferences (PFE, SPLC, ..)
- Rarely at other events



Basically ubiquitous:

- Industry events
- Scientific events

Companies that provide service and advertise their competence with PLE

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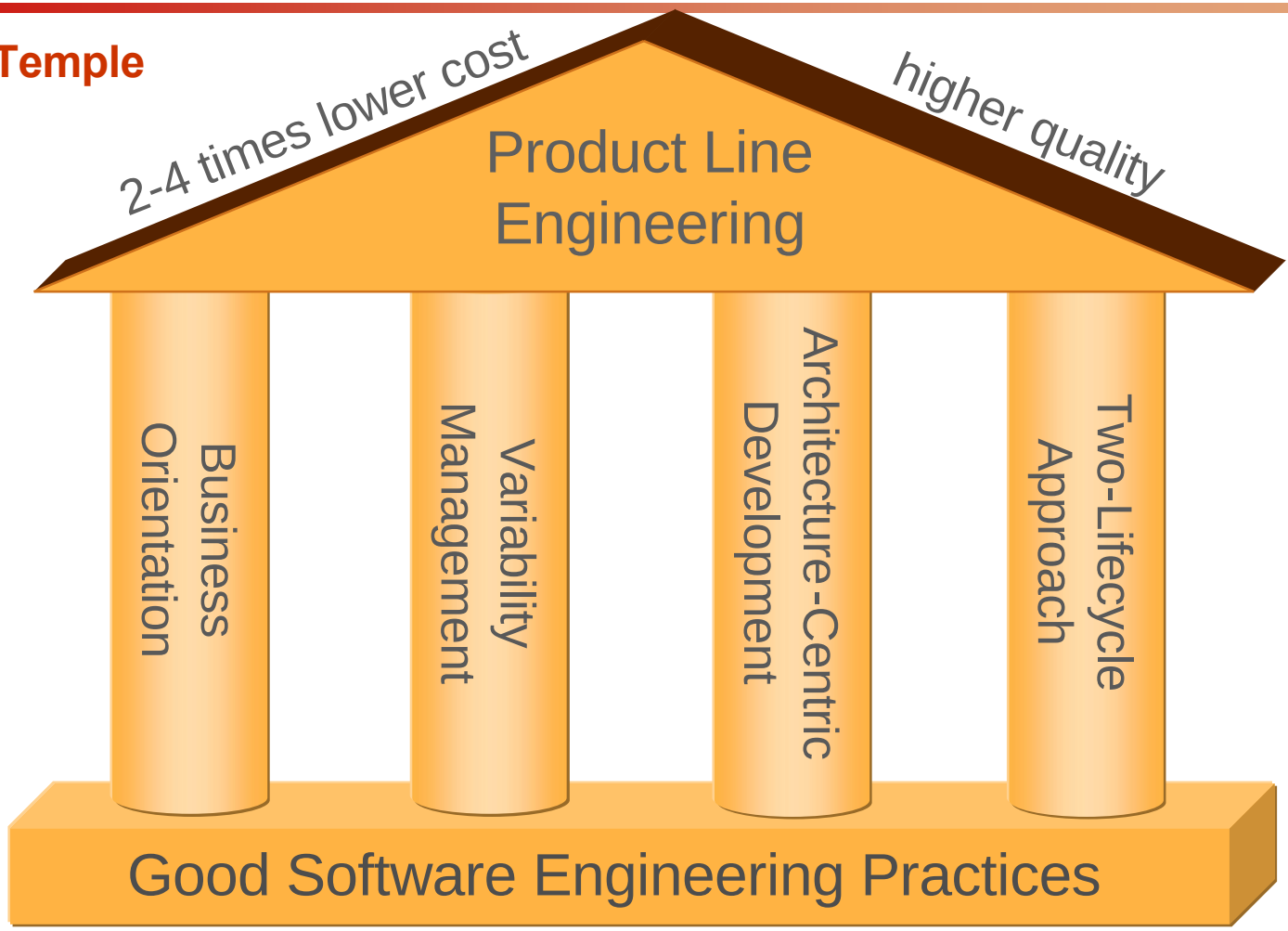
Product Line Engineering Lessons

What makes PLE successful

PLE Temple



Business Success Factors

Management Level

- Upper management makes an explicit commitment to PLE
  Note: it needs time
- Technical knowledge or trust in right people (and they are given power)
- There is a clear business strategy for products
  - *Know your markets!*
  - *Know what you want to build!*

Market Level

- Business strategy fits product line engineering

Golden Rule: have good products

Organizational Success Factors

Personal and Organizational Factors

- Cooperation among relevant departments, engineer, etc.
- Communication channels are put into place
  - *Among product units*
  - *Between product line infrastructure unit product units*

Often required:

- Organizational restructuring
- Process alignment
- Internal standardization

Engineering Success Factors

PLE Practices

- Scoping
- Variability Management
- Architecting
- …

These are just examples

Key practice:
Think in product lines instead of products

Note:
There are tools,
however, it is not about tools –
it is about people doing *the right things*

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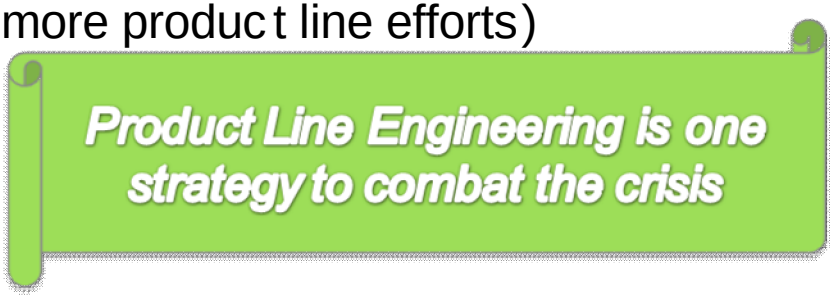
Product Line Engineering in Times of Crisis (1)

- Companies that had already established PLE typical went on and where happy
- Other companies were frozen by shock, but meanwhile increased their efforts in being efficient
  (leading to more product line efforts)



Product Line Engineering in Times of Crisis (2)

Times of crisis are times of opportunity

Some take the opportunity to make now the adaptations for the next upswing

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Summary

- Over the last 10-15 years product line engineering has matured in Europe and Germany from an exotic approach to a widely-known and applied method
- Incubators are necessary to mature the knowledge and transfer it from theory into practice
  - In Germany: Fraunhofer IESE was one such incubator
  - Other Fraunhofer institute and several universities also were involved
- Early adopters could evolve a very good market position by using this approach
- Laggards are now trying to come on board in order to remain competitive

Outlook

- Product Line Engineering is constantly evolving and combinations with new approaches come into existence:
  - Model-Based Development
  - Domain-Specific Languages
  - Dynamic Software Product Lines
  - Service-Based Approaches

Technology-Transfer institutions support maturation and dissemination of these approaches