Software Product Line Engineering

Processes and SPL

Organizational Issues

SPI/SPA

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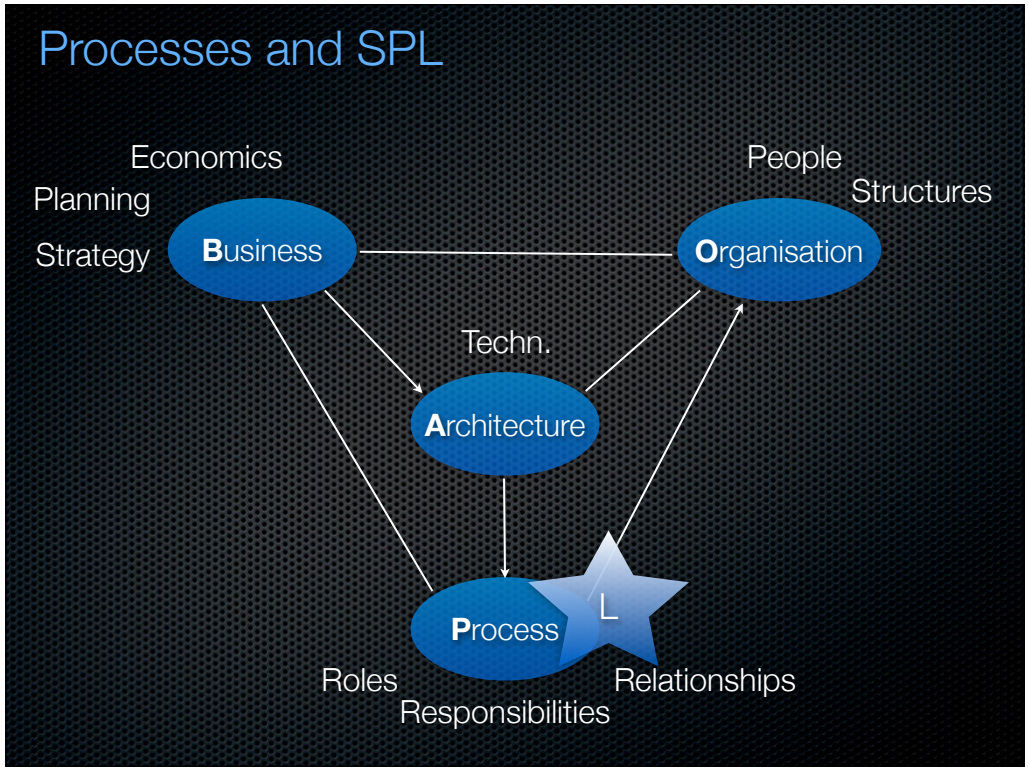
Tony Gorschek

- Engineer / Problem Solver / Researcher

  - PhD (Tekn. Dr.) Software Engineering, B.Sc. Business
  - 10+ years in industry (5 start-ups, CTO, Consultant, Chief Architect)
  - 8 years as a researcher

- Research Areas

  - Technology Product Management, Strategic and Value based Product Development, Requirements Engineering, Process Assessment/Improvement, Quality Assurance, Practical Innovation
  - Domains/partners: ABB (CRC, Substation Automation, Robotics), Ericsson (Charging), IBM (Tools and Dev. Support, Daimler (R&D), Volvo PV, Sony Ericsson, Danaher (AGVs)


Processes and SPL
Economics
Planning
Strategy
Business
People
Structures
Organisation
Techn.
Architecture
Process
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Roles
Responsibilities
Relationships

Processes

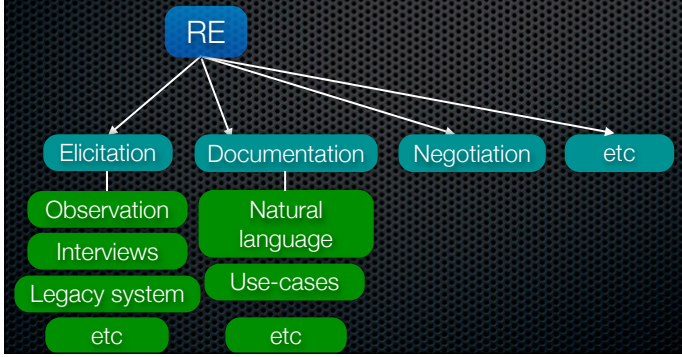
- Software Engineering Process: the total set of software engineering activities needed to transform requirements into software
- Product Development Process: the total set of engineering activities needed to transform requirements into products
  - Software (product) engineering refers to the disciplined application of engineering, scientific, and mathematical principles and methods to the economical production of quality software (products).

Process examples

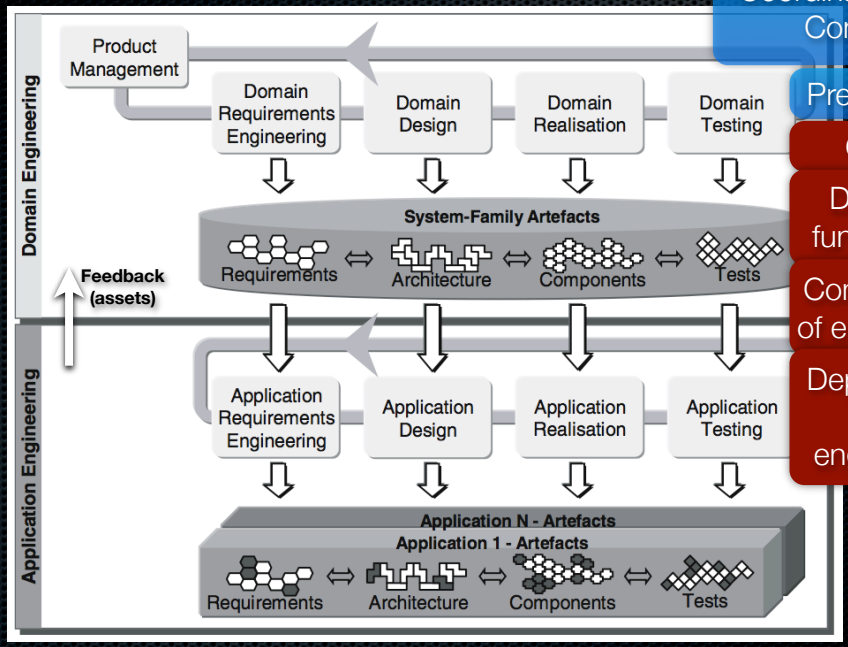
- Requirements Engineering (Main Process Area)
  - Elicitation (Sub-process Area)
    - Task observation (Activity/Action)
- Configuration Management
  - Configuration Item Identification
    - Risk analysis
    - Volatility (change Prone) analysis

Process examples

- Requirements Engineering (Main Process Area)
  - Elicitation (Sub-process Area)
    - Task observation (Activity/Action)
- Configuration Management (MPA)
  - Configuration Item Identification (SPA)
    - Risk analysis (Action), Change Prone analysis (Action)



SPL Process



Coordination and Control

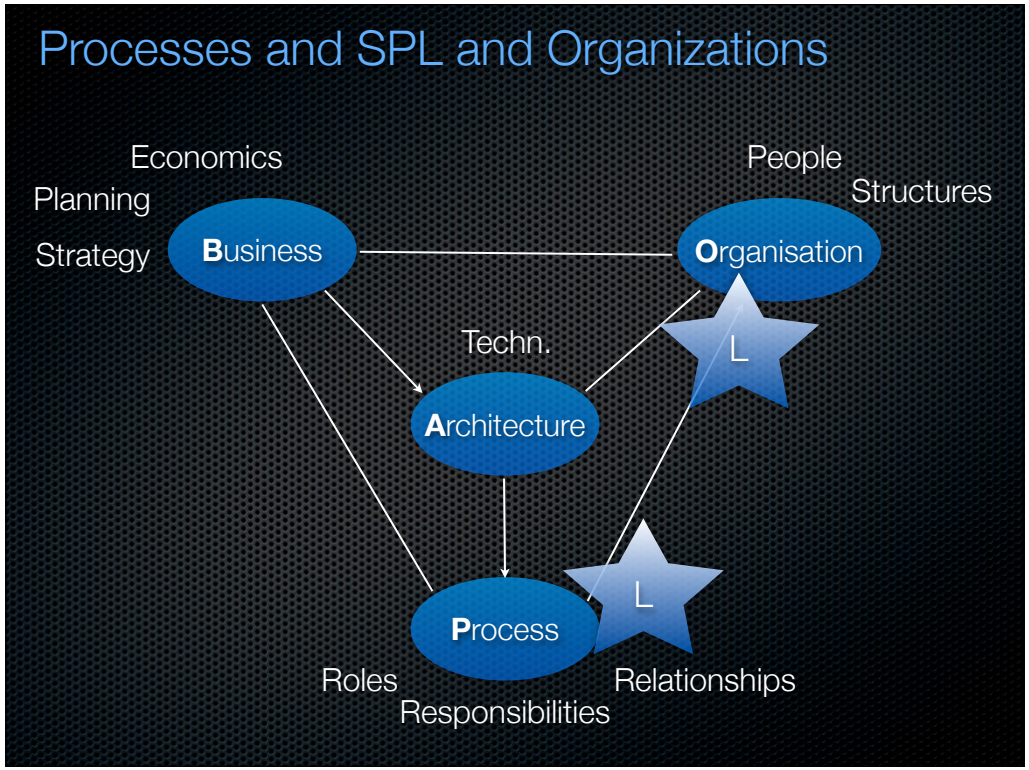
Predictability

Quality

Delivered functionality

Commonality of engineering

Dependency heavy engineering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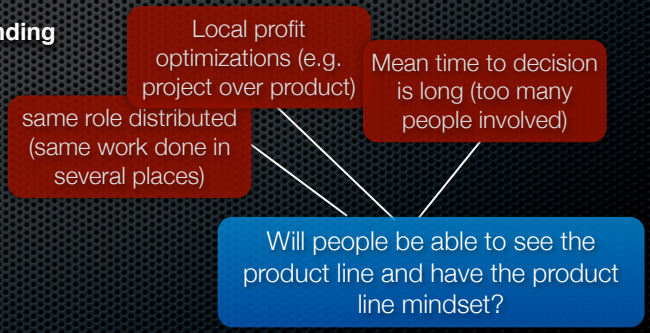
Organization, roles and responsibilities

why should we bother with this...

- **Mapping of activities (actions) and process and roles to organization is critical as it is central to the successful realization and use of a PL**
  - **Amount of people working together (coherence within unit vs. collaboration btw units)**
  - **Accountability and funding**
  - **Decision hierarchy**



Organization, roles and responsibilities

why should we bother with this (2)...

- **Mapping of activities (actions) and process and roles to organization is critical as it is central to the successful realization and use of a PL**
  - **Organizational SIZE is crucial as it speaks to the impact of the organizational structure and the role and responsibilities division on the product line...**

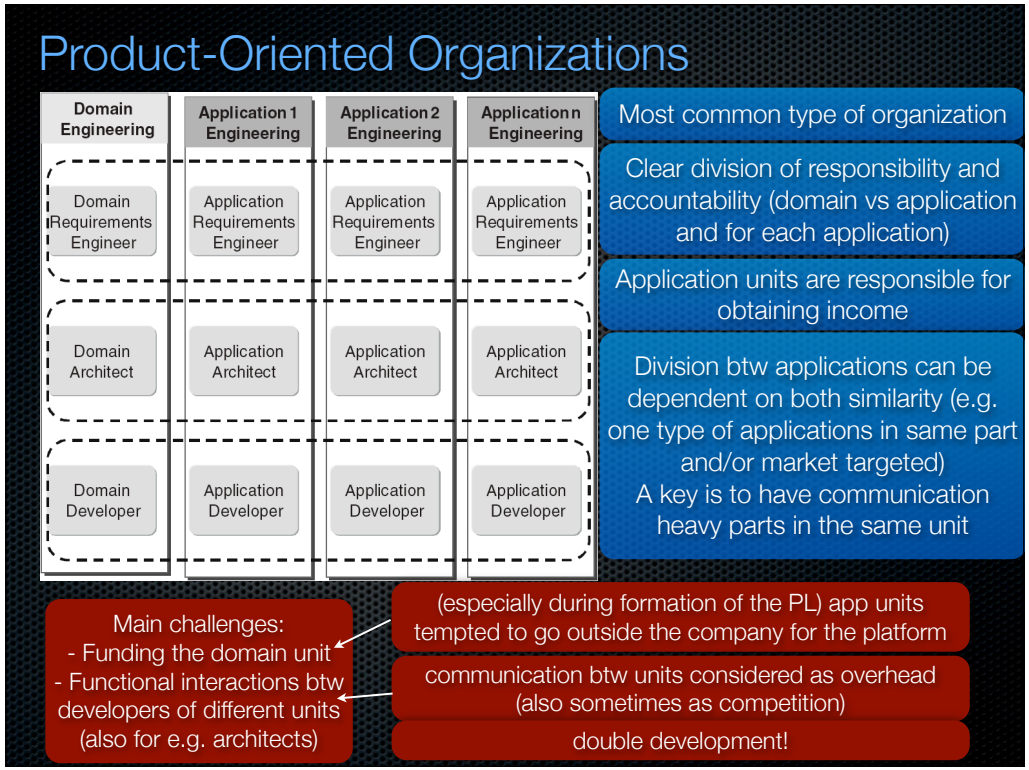
Small organization has “closeness” and familiarity that can compensate for inadequacies, LARGE organizations DO NOT

“not my job”

Personal mind-set, and motivational structure plays a crucial role if a PL succeeds or not, much more so than having a perfect architecture or variability analysis

Imbalance in the organization (e.g. domination of application engineering over domain engineering)

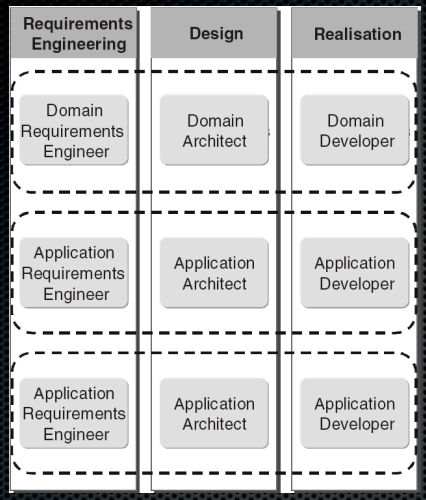
What are individual engineers good at (like to do), skill set! E.g. Domain Eng. (high quality components and maintenance) vs. App. Eng. (build apps fast w. given components)



Funding: budgetpressure... application units tempted to choose other company to provide domain (base)...
(especially initially when forming the PL, then after the domain part is so adapted to the apps that the apps cant find a better match

Interactions: communication btw units -> overhead, addition of additional structure - can be compensated by accepting some overhead + formation of functional units

Process-Oriented Organizations



Functional hierarchy is prime!

Functional interaction is facilitated

Flexible allocation of resources depending on need (btw application but also btw domain and application)

People develop similar functionality for different products:
- Easier to ensure integrity of architecture
- Focus on reusability as it benefits you...

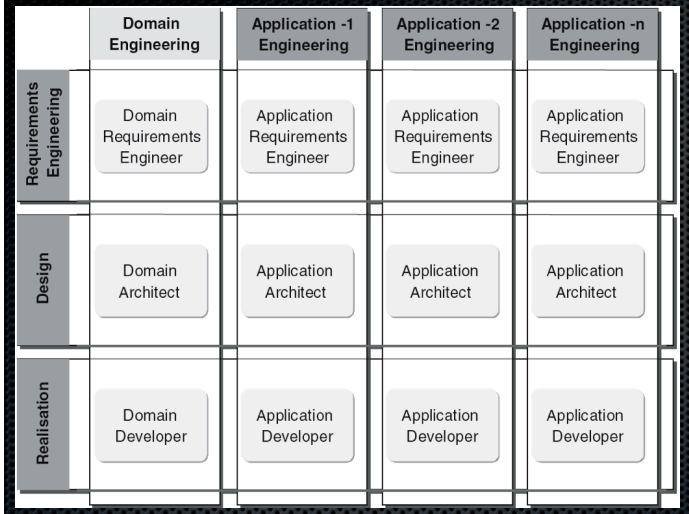
more common in smaller organizations where communication is less of a problem

Main challenges:
- Different phases of engineering are not close
- Domain engineering spread out

communication btw units and planning is necessary

accountability (especially for domain assets is not clear)

Matrix Organizations



Compromise btw product and process focus

Main challenges:
- Scattered focus
- Complex management

Process Evaluation and Improvement

...what is it?

A process
- ...a sequence of steps performed for a given purpose, e.g. the software development process (IEEE-STD-610)
- ...the set of activities, methods, and practices used in the production and evolution of software (SEI CMM)

SPI (CMM,ISO/IEC15504,ISO9000,MIL-STD-498,Trillium, the V-Model etc)

SPI(RE) (REAIMS,SPICE,CMMI,REPM, iFLAP)

Process improvement
- Continuous, Small-steps
- Evolutionary
- Measurement points
- **Evaluation – choice – plan – execute - evaluate**

Process Evaluation and Improvement

...why?

- Do more with less!
- Quality assurance
- Repeatability
- Measurability
- Performing better than your competitors
- Performing better than you did before…
- Customer satisfaction
- Going from individual HEROES to a CURAGEOUS ORGANIZATION (not afraid to better itself)
- Evolvement
- Effective use of the resources available

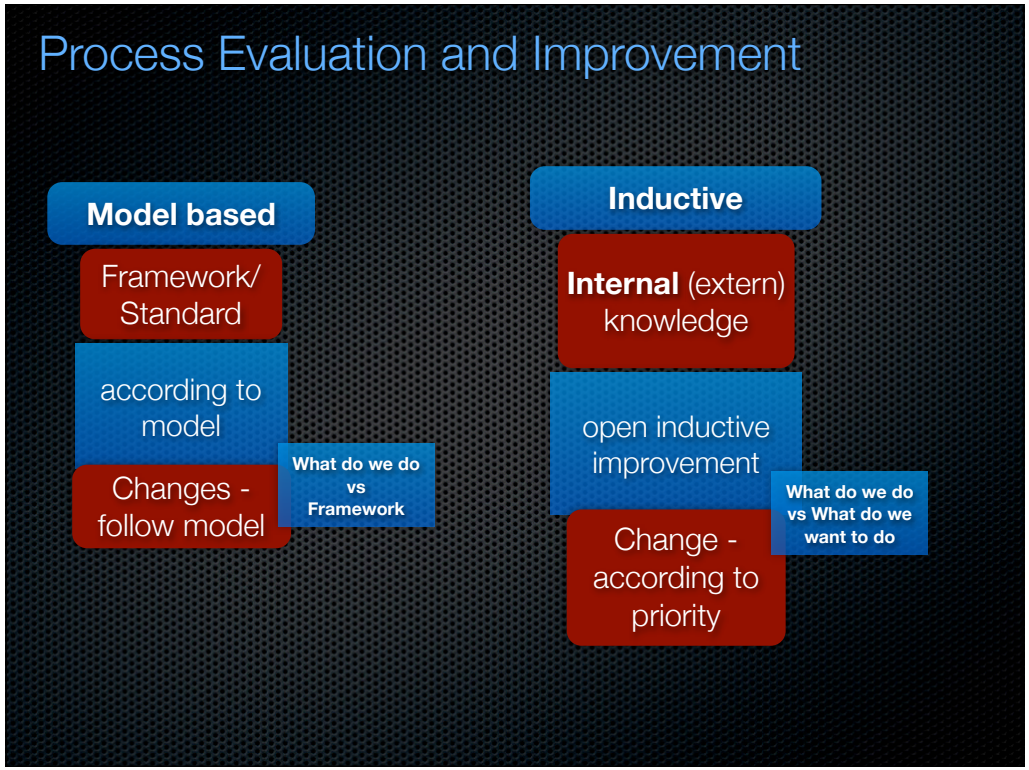
- Etc……Ok then, but how do we achieve this? ->

Process Evaluation and Improvement

Find out what the problems are!

- State-of-practice (official and **unofficial**)
  (if it a'int broke, don't fix it…)

- Use the knowledge and views of the organizations constituents to est. base-line and to identify improvement issues


Process Evaluation and Improvement
Model based
Framework/ Standard
according to model
Changes - follow model
What do we do vs Framework
Inductive
Internal (extern) knowledge
open inductive improvement
Change - according to priority
What do we do vs What do we want to do

Process Evaluation and Improvement 2

Model based

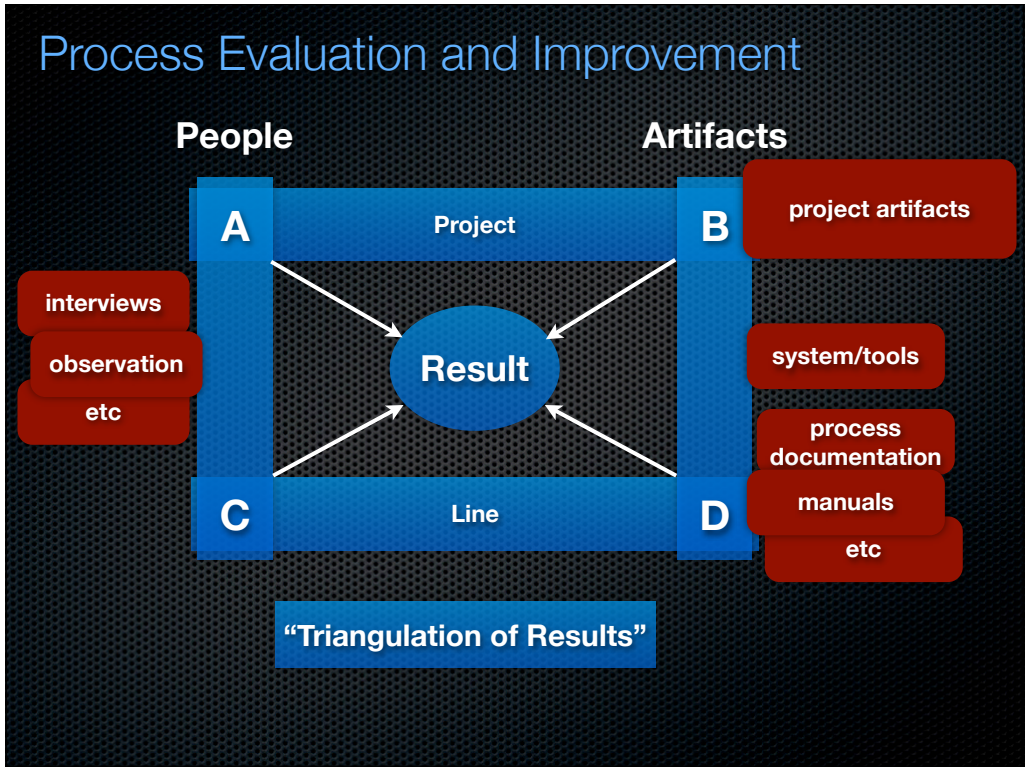
+ external knowledge
+ pre-packaged
+ best practices
- top down
- fit (generic)
- superfluous parts
- priority set

CMM/CMMI
SPICE
ISO

Inductive

+ adapted to the organization
+ only what is needed
+ org. priority
+/- learning process
+ up-down, down-up
- internal knowledge
- larger demands on internal commitment

QIP
PDCA
iFLAP


Process Evaluation and Improvement
People
Artifacts
A
Project
B
project artifacts
interviews
observation
etc
Result
system/tools
process documentation
manuals
etc
C
Line
D
“Triangulation of Results”

Process Evaluation and Improvement

OBSERVE!

- *Techniques are the same as for RE (e.g. reading documentation, interviews, brainstorming etc)*
- *You can use basically the same method for ELICITATION (est. knowledge about the domain, processes etc that the a system being developed is to support)*

Elicitation techniques

- Interviews
  + Getting to know the present (domain, problems) and ideas for future system
  - Hard to see the goals and critical issues, subjective
- Group interviews
  + Stimulate each other, complete each other
  - Censorship, domination (some people may not get attention)
- Observation (Look at how people actually perform a task (or a combination of tasks) – record and review…)
  + Map current work, practices, processes
  - Critical issues seldom captured (e.g. you have to be observing when something goes wrong), usability issues seldom captured, time consuming
- Task demonstrations (Ask a user to perform a task and observe and study what is done, ask questions during)
  + Clarify what is done and how, current work
  - Your presence and questions may influence the user, critical issues seldom captured, usability problems hard to capture

Elicitation techniques 2

- Questionnaires
  + Gather information from many users (statistical indications, views, opinions)
  - Difficult to construct good questionnaires, questions often interpreted differently, hard to classify answers in open questions and closed questions may be to narrow…
- Use cases and Scenarios (Description of a particular interaction between the (proposed) system and one or more users (or other terminators, e.g. another system). A user is walked through the selected operations and the way in which they would like to interact with the system is recorded)
  + Concentration on the specific (rather than the general) which can give greater accuracy
  - Solution oriented (rather than problem oriented), can result in a premature design of the interface between the problem domain and the solution
- Study present systems/processes
- Study tools/techniques
- Ask for complementary material during sessions... and follow up!

Process Evaluation and Improvement

Stakeholders

- Stakeholder identification
- Stakeholder selection (access, representative?)

Artifacts

- Identify artifacts (project, line)
- Select (access, representative?)

Family Evaluation Framework (FEF)

- Focuses on the evaluation of product lines (focus on aspects relevant to PLs)

BAPO view

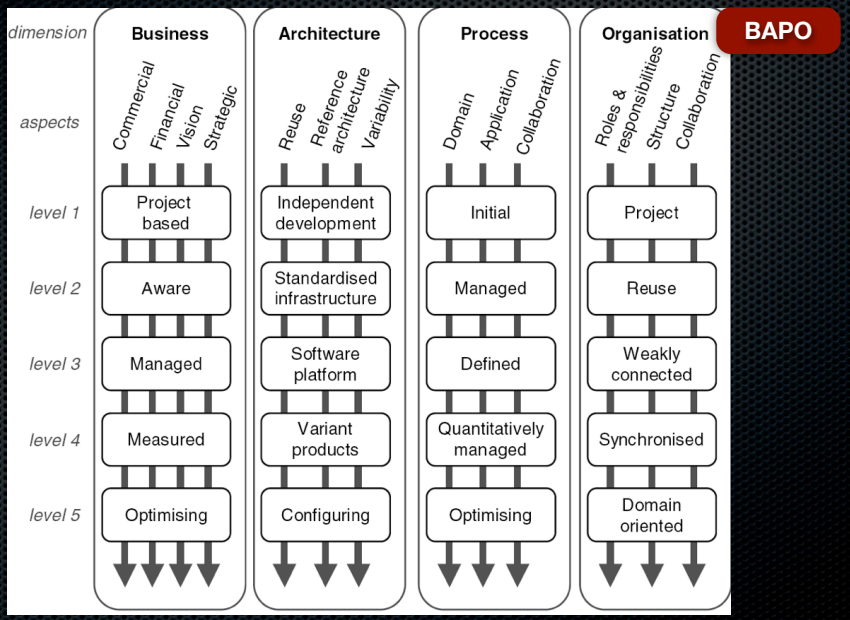
- FEF should be used to evaluate product line organizations (or product line “like” organizations...)

companies that have nothing like a product line = FEF might be a wrong fit

For the case study in this course, see FEF (available on course homepage!) - more detailed than the BAPO paper...

http://trind.dyndns.org/~feldt/cth/sple/papers/linden_2005_fef_intro_and_overview.pdf

Family Evaluation Framework (FEF) 2



Family Evaluation Framework (FEF) 3

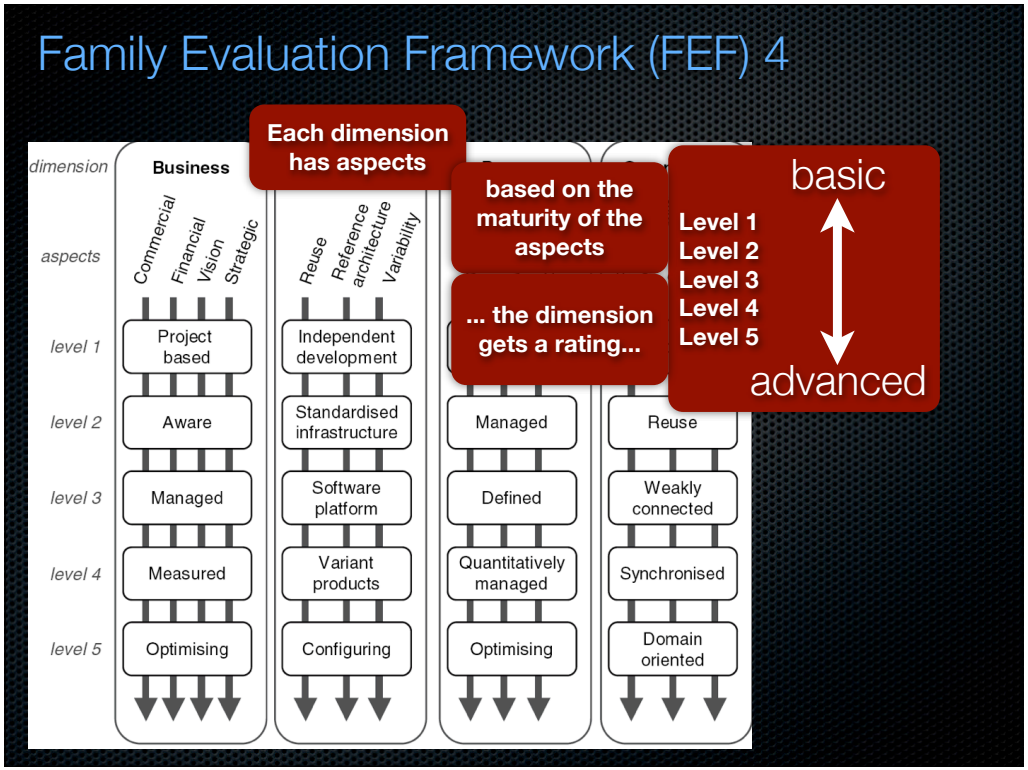
- Business: business involvement in the SPL engineering and variability management. Business relationships between domain and application engineering, and the cost, profits, market value, and planning of variability.

- Architecture: domain and application architecture relations and how they are related via variability.

- Process: process usage and process maturity (use e.g. CMMI)

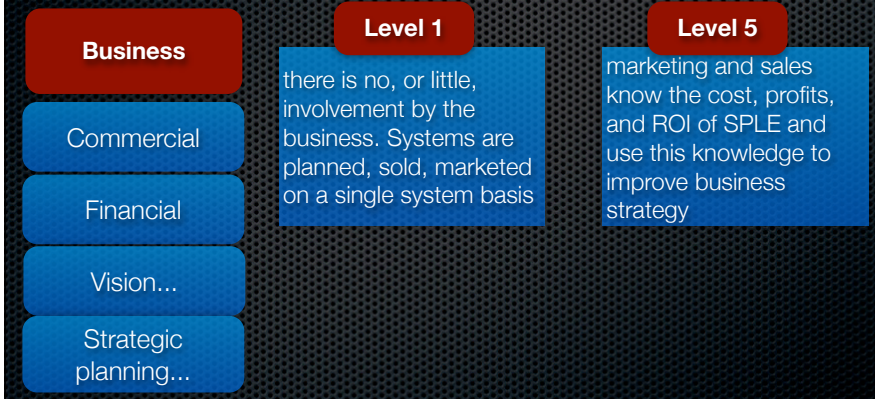
- Organization: effectiveness and distribution of domain and application engineering over the organization. Coordination, communication, how well is the organization suited to PL engineering and to the company

Family Evaluation Framework (FEF) 4

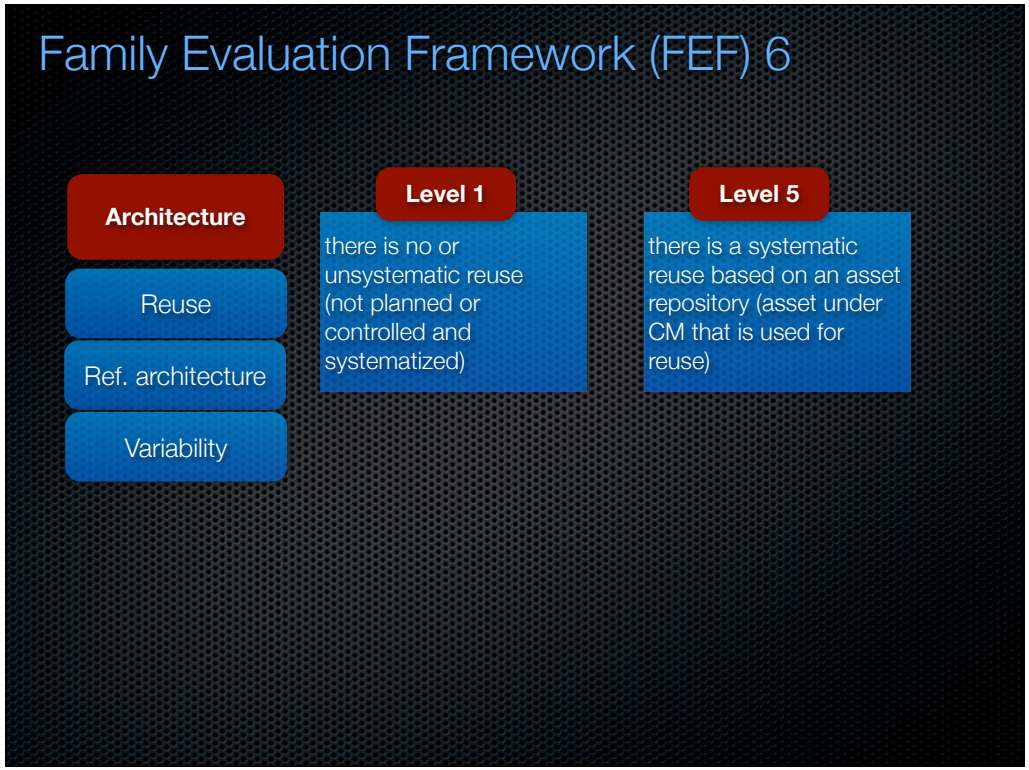


Family Evaluation Framework (FEF) 5

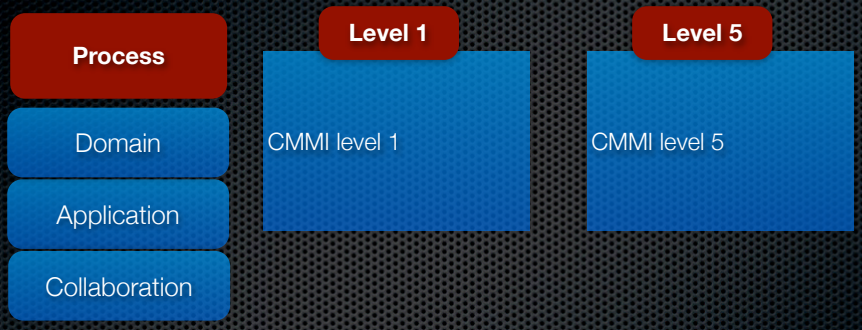
- For each level FEF gives a characterization of the maturity for each aspect.



Family Evaluation Framework (FEF) 6



Family Evaluation Framework (FEF) 7

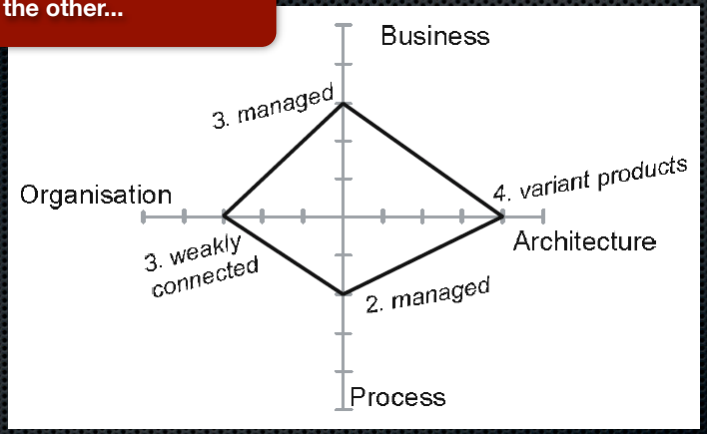


CMMI is used to evaluate the processes used, FEF uses parts of CMMI (and Level 1 in FEF does not always correspond to CMMI Level 1!)

http://www.sei.cmu.edu/cmmi/

Family Evaluation Framework (FEF) 8

balance, one dimension influences the other...



Case study

- Do the evaluation (or suitability analysis) according to relevant framework (see ass. desc.)
- The interview questions, design (e.g. selection of whom you talk to) and how these questions relate to the framework should be mapped.
- The subjects answers (raw data) should also be turned in (appendix).
- Your interpretations of the answers should be a part of the report, e.g. why you judge a certain level
- Some aspects are more suited to other data sources than interviews, but you may use interviews. Bonus if you use triangulation (e.g. confirm in other sources, e.g. two interviews or one interview and documentation)
  - E.g. ask about reuse, get an answer that indicated Level 5, then you look at their asset management and control that the opinion of the interview subject corresponds to reality.
  - E.g. 2: ask two different developers (separate interviews) about reuse, compare answers.
- The interviews you design should be semi-structured to reflect FEF, but do not be leading. Ask follow-up questions to be sure you understand enough to make judgement.

Case study

- ... so what is your status?
- ... practical tips...
  - first contact...
  - getting resources...
  - doing the work...
  - reporting (not only for the course...)

Case study

- ... so you got a lot if information about how the company works...
- ... and then what?
  - mapping/evaluation (to FEF/BAPO)
  - prioritize and order (prio and dependency)
  - create an improvement plan (stepwise)
  - report it...